Modeling Protocol:
2005 Basecase Technical Details

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1. INTRODUCTION

The purpose of this document is to provide technical details relating to photochemical modeling done to support State Implementation Plans for ozone, PM2.5, and regional haze using the 2005 base year. Information relevant for the 2005 basecase is presented in this document. Documents that relate to a conceptual description of ozone, PM2.5, and regional haze in the Upper Midwest are available on the organization website: www.ladco.org.

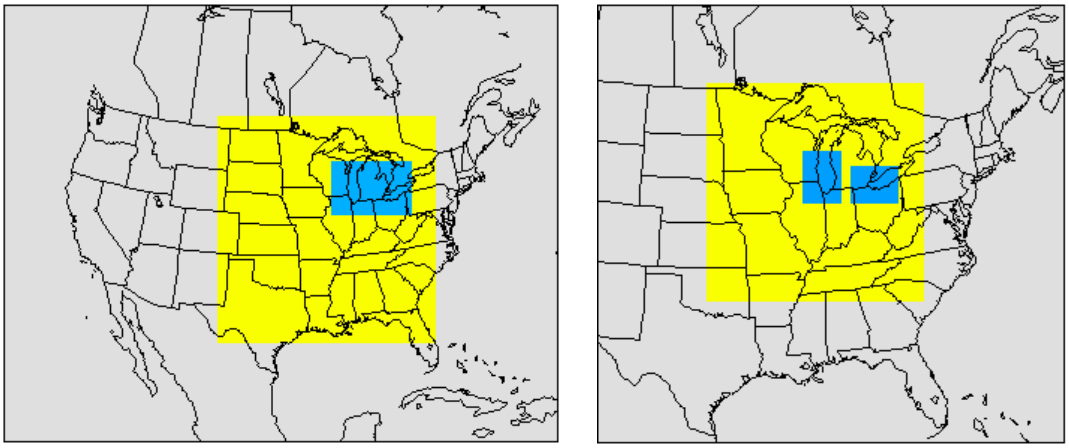
The computing platforms are Intel-based PCs running variations of the Linux operating system. The Portland Group (PGI) Fortran compiler is used to create all executables.

2. METHODOLOGY

Grid Projection and Domains (same as 2002 protocol)

All models are applied with a Lambert projection centered at (-97, 40) and true latitudes at 33 and 45. The 36 km photochemical modeling domain consists of 97 cells in the X direction and 90 cells in the Y direction covering the central and eastern United States with 36 km grid cells (Figure 2.1; Table 2.1). The 2-way nested 12 km photochemical domain covers most of the upper Midwest region. A 2-way nested 4 km photochemical domain is situated over the lower portion of Lake Michigan and over Detroit-Toledo-Cleveland.

Figure 2.1 Modeling Domains: Meteorological (left), photochemical (right)



The 36 km meteorological modeling domain covers the entire continental United States (Figure 2.1; Table 2.1). The 12 km meteorological domain covers most of the central and eastern United States and the 4 km domain covers the lower portion of the Great Lakes. CAMx4 is applied with the vertical atmosphere resolved with 16 layers up to approximately 15 kilometers above ground level.

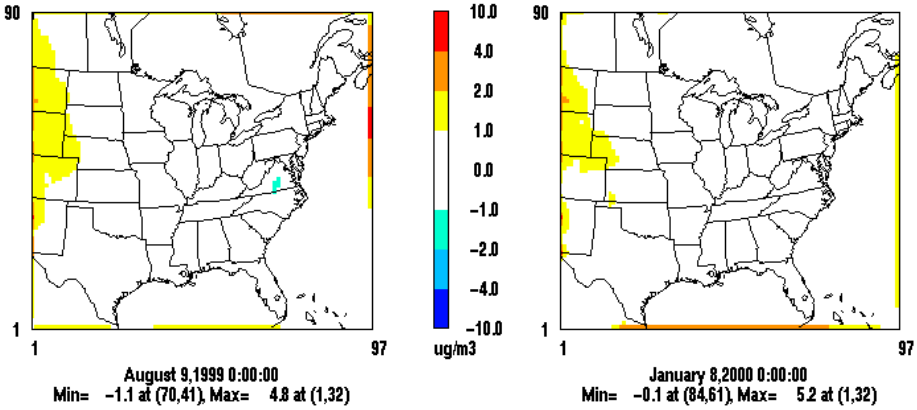
Table 2.1 Modeling Domains

Grid	Cell Size	XY Origin (km)	NX, NY
Emissions	36 km	(-2628., -1980.)	147, 111
Meteorological	4 km	(576., 108.)	214, 142
Meteorological	12 km	(-648., -1260.)	193, 199
Meteorological	36 km	(-2952., -2304.)	165, 129
Photochemical	36 km	(-900., -1620.)	97, 90
Photochemical (lm)	4 km	(608., 140.)	83, 128
Photochemical (detcle)	4 km	(1040., 176.)	74, 56
Photochemical/Emissions	12 km	(-48., -552.)	131,131

The photochemical model is not being applied to the entire 36 km Continental U.S. domain to maximize resources. A sensitivity study was conducted to compare winter and summer episode averaged PM2.5 concentrations between a Continental U.S. domain and Central/Eastern U.S. domain using clean boundary conditions released with the CMAQ model. The episode average differences in PM2.5 were less than 1 ug/m3 in the Midwest RPO States and neighboring States (Figure 2.2).

Figure 2.2 Continental Domain – Central/Eastern U.S. Domain Episode Average

PM2.5 Difference Plots for Summer (left) and Winter (right) episodes



Meteorological Inputs

The meteorological input data for 2005 modeling are developed with the National Center for Atmospheric Research (NCAR) 5th generation Mesoscale Model (MM5) version 3.6 (Dudhia, 1993; Grell et al, 1994) by Alpine Geophysics, LLC under contract from the Midwest Ozone Group. MM5 physics options and configurations for the 2005 simulations are the same as used for 2002 simulations (McNally and Schewe, 2006; Baker et al, 2007c). Important MM5 parameterizations and physics options include mixed phase (Reisner 1) microphysics, Kain-Fritsch 2 cumulus scheme, Rapid Radiative Transfer Model, Pleim-Chang planetary boundary layer (PBL), and the Pleim-Xiu land surface module. Analysis nudging for temperature and moisture is only applied above the boundary layer. Analysis nudging of the wind field is applied above and below the boundary layer.

MM5 performance for 2005 was evaluated by Alpine Geophysics for the Midwest Ozone Group and independently by Lake Michigan Air Directors Consortium. Performance for 2005 is considered comparable to 2002 performance and appropriate for regulatory modeling (Baker et al, 2007).

The meteorological fields output by MM5 are prepared for use by the photochemical model with processing utilities. These programs translate certain meteorological parameters from the MM5 grid to the photochemical grid. Additionally, these processors estimate parameters such as vertical diffusivity coefficients that are not explicitly output by MM5. The MM5CAMx version 4.4 utility is used to translate MM5 output to CAMx input. The vertical diffusivity coefficients are based on the O'Brien 1970 vertical diffusivity algorithm. This scheme takes the PBL height output by MM5 and creates a well-mixed atmosphere inside the PBL. The minimum vertical diffusivity coefficient is 0.1 m^2/s. A landuse-weighted vertical diffusivity coefficient (maximum of 1.0 m^2/s in a completely urban grid cell) is assigned to all grid cells up to approximately 150 meters above ground (model layer 3).

The vertical resolution used in MM5 consists of 34 sigma layers that represent the terrain following atmosphere up to 100 millibars. Figure 2.7 displays each vertical layer in terms of sigma level, pressure (millibars), height above ground level (meters) and layer thickness (meters). The relationship to the layer structure used in the photochemical models is also shown. The photochemical model layer structure avoids layer collapsing in the lower boundary layer to better resolve the mixing depth.

Figure 2.7 Vertical Layer Structure

k(MM5)	sigma	p(mb)	depth(m)	k(PCM)	depth(m)
34	0.000	100	1841	16	5597
33	0.050	145	1466		
32	0.100	190	1228		
31	0.150	235	1062		
30	0.200	280	939	15	2549
29	0.250	325	843		
28	0.300	370	767		
27	0.350	415	704	14	2533
26	0.400	460	652		
25	0.450	505	607		
24	0.500	550	569		
23	0.550	595	536	13	1522
22	0.600	640	506		
21	0.650	685	480		
20	0.700	730	367	12	634
19	0.740	766	266		
18	0.770	793	259	11	428
17	0.800	820	169		
16	0.820	838	166	10	329
15	0.840	856	163		
14	0.860	874	160	9	318
13	0.880	892	158		
12	0.900	910	78	8	155
11	0.910	919	77		
10	0.920	928	77	7	153
9	0.930	937	76		
8	0.940	946	76	6	151
7	0.950	955	75		
6	0.960	964	74	5	148
5	0.970	973	74		
4	0.980	982	37	4	37
3	0.985	987	37	3	37
2	0.990	991	36	2	36
1	0.995	996	36	1	36
--SURF--	1	1000	0	--SURF--	--SURF--

A compromise in the upper troposphere is met by employing layer collapsing to reduce computational effort and still maintain some upper troposphere resolution for long-range transport. The layer structure chosen for a modeling application should be capable of adequately resolving the diurnal variations in the boundary layer growth and mixing, long-range transport processes, wind shear, as well as transport to and from the free troposphere.

Emissions Inputs

Emissions developed for the 2005 basecase and future year inventories projected from 2005 are discussed in the "Base M/Round 5 Emissions Report" (LADCO, 2007). Anthropogenic emissions are developed for a weekday, Saturday, and Sunday for each month of 2005. On-road motor vehicle emissions were developed for a January and July weekday, Saturday, and Sunday. On-road motor vehicle emissions for other months are interpolated between the January and July estimates. On-road and biogenic volatile organic carbon (VOC) emissions are speciated for the CB05 chemical speciation profile (Environ CB05 report). All other sectors of the inventory are speciated for the CB-IV chemical speciation profile (Carter, 1996). CB-IV emissions are useable with CB05 chemistry (Environ CB05 report).

The Model of Emissions of Gases and Aerosols from Nature (MEGAN) was recently developed as the next generation emission model for biogenic emissions of gases and aerosols (Guenther and Wiedinmyer, 2006). MEGAN has been implemented into the CONsolidated Community Emissions Processing Tool (CONCEPT) emissions modeling framework (Wilkinson, 2006). Biogenic emissions are estimated for each day of the simulation using the MEGAN model as implemented in CONCEPT (Baker, 2007d). MEGAN explicitly outputs import biogenic secondary organic aerosol pre-cursor species including monoterpenes and sesquiterpenes that are used by the CAMx SOA chemistry module.

MEGAN groups plants and area coverages by plant functional type (PFT) rather than treating plant species explicitly as in the BIOME (and BEIS) models. Total emissions are the sum of emissions estimated for each PFT in a given grid cell. PFTs include broadleaf trees, fine leaf evergreen trees, fine leaf deciduous trees, shrubs, grass, and crops. Plant functional type data has been gridded to a scale of 30 seconds by 30 seconds and made available with the MEGAN model (Guenther et al, 2006). Soil wilting point data and leaf area index are also gridded to the same scale and used as input to MEGAN.

Volatile organic compounds are speciated to the Carbon Bond 2005 chemical speciation profile. Inputs to the biogenic model include hourly satellite photosynthetically activated radiation (PAR) and 15 m (above ground level) temperature data output from MM5 (Pinker and Laszlo, 1992). Other inputs to MEGAN include plant functional type (PFT) emission factors, PFT area coverage, soil wilting point data, leaf area index, and additional meteorological variables including soil moisture. Soil moisture estimated by MM5 for the 1 m soil depth is used as input to MEGAN because it represents the plant root layer.

Landuse (same as 2002 protocol)

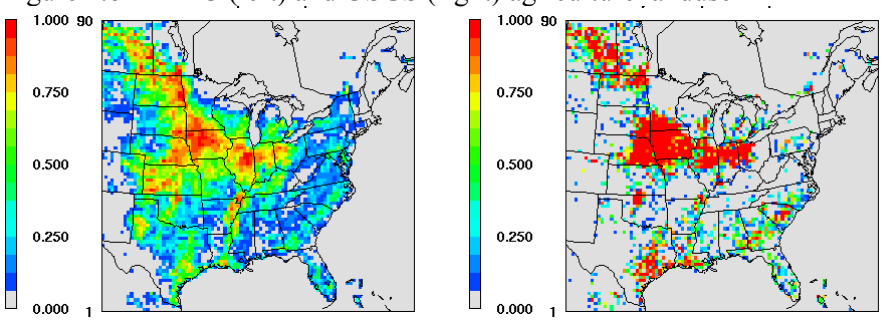
The photochemical model uses 11 land use categories to describe the surface. The land use file is based on BELD3 1 km data (US EPA, 2006; Kinnee et al. 1997; Kinnee et al. *in press*). The 1 km data was aggregated to the appropriate grid resolution for photochemical modeling. Surface roughness varies by season and land use category and are taken from EPA's AERMET User's Guide (EPA, 2004; ENVIRON, 2007).

Table 2.3 Landuse categories

Category	Landuse
1	Urban
2	Agricultural
3	Rangeland
4	Deciduous forest
5	Coniferous forest
6	Mixed forest
7	Water
8	Mixed agriculture/forest
9	Non-forested wetlands
10	Mixed agriculture/range
11	Rocky with low shrubs

USGS data was previously used for landuse information. The BELD3 was chosen because it incorporates the USGS data with other sources of information such as satellite data. A spatial comparison of the agriculture (category 2) landuse fractions are shown below.

Figure 2.8 BELD3 (left) and USGS (right) agriculture landuse



Drought Stress and Snow Cover (same as 2002 protocol)

The Palmer Drought Severity Index (PDSI) is an indicator of unusual excess or deficient moisture. The PDSI is calculated for 350 climatic divisions in the United States and Puerto Rico. PDSI data is available for each week of a calendar year and is obtained from the National Weather Service Climate Prediction Center (National Weather Service, 2005). The dry deposition calculations for non-water landuse categories are impacted by vegetative response to drought stress (ENVIRON, 2007).

Snow cover is also input to CAMx4 for the deposition scheme. Three-hourly snow cover data for each grid cell is extracted from MM5 output files. If snow exists in a grid cell, the deposition characteristics of the landuse are switched from “winter” to “winter with snow.” This switch has an impact on surface resistances for dry deposition, surface roughness, and chemistry due to the ultraviolet albedo being changed to the maximum class (ENVIRON, 2007).

Photolysis Rates (same as 2002 protocol)

Many chemical reactions in the atmosphere are started by the photolysis of certain trace gases. Photochemical models require these rates be input to accurately estimate these reactions. CAMx4 is applied with day specific photolysis rate look-up tables.

The Tropospheric Ultraviolet-Visible (TUV) radiation model is used to calculate photolysis rates based on solar zenith angle, height above ground, ultraviolet albedo of the ground, atmospheric turbidity, and total ozone column density. The TUV generates rates for each day as a function of 11 heights, 10 solar zenith angles, 5 ozone column values, 5 albedo values, and 3 turbidity values (ENVIRON, 2007; NCAR, 2006).

The ozone column data is derived from daily TOMS satellite observations (NASA, 2006). The albedo data varies by month and is based on over 10 years of TOMS satellite reflectivity observations. Actinic flux is estimated using the discrete ordinate algorithm. The two-stream delta-Eddington method is also available in the TUV model, but was not selected because the discrete ordinate approach is more accurate.

A sensitivity application with CMAQ using TOMS derived photolysis rates and rates based on seasonal average ozone column showed differences in ozone up to 3 ppb and differences in sulfate ion up to 1.5 ug/m^3. These differences suggest day specific ozone column data from satellites should be used rather than seasonal averages and that accurate photolysis rates are important for ozone and particulate matter applications.

For those days that do not have TOMS ozone column data, the data from the previous day is used instead. This option is more realistic than defaulting to a seasonal average, which may create a rather large discontinuity between the missing day and adjoining simulation days.

Initial and Boundary Conditions (same as 2002 protcol)

Boundary conditions represent pollution inflow into the model from the lateral edges of the grid and initial conditions provide an estimation of pollution that already exists. In the past a spin-up period of two to three days was used to eliminate initial condition effects for ozone modeling.

CAMx4 source apportionment runs show ozone attributed to initial concentrations does not exceed 5 ppb anywhere in the domain by the 7th day of the episode; ozone modeling episodes will be spun up with 11 days. The monitors used in model performance evaluation are far enough away from the boundaries that boundary influence is considered minimal.

CAMx4 particulate source apportionment (PSAT) runs show PM2.5 sulfate ion, nitrate ion, and ammonium ion contributions from initial concentrations fall below 0.05 µg/m^3 by the seventh day of the episode. PM2.5 elemental carbon, PM2.5 soil, and coarse mass have less than 1 ng/m^3 contribution from initial concentrations on the first day of the model episode everywhere in the modeling domain. Since gas phase chemistry is coupled with particulate formation, the annual simulations have two weeks of spin-up to minimize initial condition influence.

The initial and boundary conditions are based on monthly averaged species output from an annual (calendar year 2002) application of the GEOS-CHEM global chemical transport model (Jacob et al, 2005; Bey et al, 2001). Boundary conditions vary by month and in the horizontal and vertical direction. Where an initial or boundary concentration is not specified for a pollutant the model will default to a near-zero concentration.

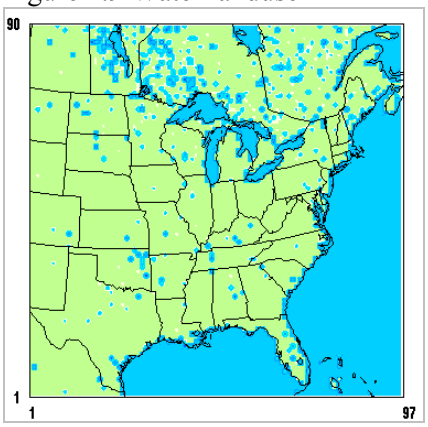
A study applying CMAQ with monthly averaged and 3-hr GEOS-CHEM initial and boundary conditions showed almost no change in model performance for any PM2.5 species. The error for total PM2.5 and each of the chemical species differed by less than 0.04 ug/m^3 at IMPROVE and EPA STN monitor sites (Morris et al, 2004b). Considering the need to model multiple annual simulations and potential issues related with inconsistencies between in-flows and out-flows between the GEOS-CHEM meteorology and the MM5 simulation used for regional modeling, the monthly averaged concentrations are used to support photochemical modeling applications.

Quality Assurance of Model Inputs (same as 2002 protocol)

The model input files are checked for reasonableness to ensure they accurately represent the underlying data used to create the files. The checks described in this document are steps that are in addition to the extensive QA done in the emission inventory compilation process, EMS emissions modeling, and MM5 modeling process.

The landuse files are converted to a CAMx4 output file format and directly viewed in PAVE over a political map. An example of the water landuse category is shown in the figure in this section.

Figure 2.9 Water landuse



The initial and boundary conditions processor outputs an ASCII file showing the specie concentration at each vertical layer. This is visualized in EXCEL to make sure the data is correctly mapped in the vertical direction. The initial and boundary concentration files themselves are also directly viewed in PAVE and the spatial representation is checked. The ozone column, albedo, and turbidity data are kept in ASCII files. Each file is checked to ensure the data looks spatially reasonable and that bad data did not get included in the file.

The emissions inputs are extensively checked for appropriateness. The steps taken in manipulating EMS-2003 output files to CAMx4 input files and the quality assurance of those files are detailed in “Emissions Processing and QA” (Baker, 2004b). Each emission file is checked for spatial and temporal agreement with EMS-2003 and for reasonableness. Additionally, the mass for each species is totaled by State and over the entire modeling domain and compared to EMS-2003 QA reports.

The MM5 output used to support the photochemical modeling is extensively evaluated from a meteorological perspective. An additional layer of quality assurance is done by evaluating model performance of the air quality model input meteorological data at several monitor locations. This is done for temperature, relative humidity, wind speed, and wind direction.

Photochemical model simulations also provide a level of quality assurance since deficiencies in emissions and meteorological inputs will be apparent in the photochemical model performance.

Photochemical Model Configuration

The Comprehensive Air Quality Model with Extensions (CAMx) version 4.50 uses state of the science routines to model particulate matter formation and removal processes over a large modeling domain (Nobel et al. 2002; Tanaka et al. 2003; Chen et al. 2003; Morris, Mansell, Tai, 2004). The model is applied with ISORROPIA inorganic chemistry, SOAP organic chemistry, regional acid deposition model (RADM) aqueous phase chemistry, and the carbon-bond 2005 (CB05) gas phase chemistry module (ENVIRON, 2007; Nenes et al, 1998; ENVIRON, 2007). CAMx4 is applied using the PPM horizontal transport scheme and an implicit vertical transport scheme with the fast CMC chemistry solver (ENVIRON, 2007). The chemical mechanism 6 is selected for the 2005 simulations, which includes additional PM2.5 secondary organic aerosol formation (ENVIRON, 2006; ENVIRON 2007). An updated dry deposition scheme that is based on AEROMOD is chosen for the 2005 simulations. This scheme uses gridded monthly leaf area index to adjust dry deposition velocities (Kemball-Cook et al, 2007).

CAMx4 models PM particles in the fine and coarse size fraction. There is no mechanism in the model to transfer mass between these 2 size sections. The particle density and diameter does not change from specie specific input values during a model simulation for either particle size bin.

The photochemical model is initiated at midnight Eastern Standard Time and run for 24 hours for each episode day. The summer 2005 simulation is initiated on June 2 and run through September 15. The annual simulation is run separately by calendar quarter and is initiated 2 weeks prior to each quarter: December 17 (2004), March 15, June 15, and September 15. The base and future year scenarios submitted as support for the annual PM2.5 standard will be using a horizontal grid resolution of 12 km. The modeling to support the 8-hr Ozone NAAQS will be at 12 km horizontal resolution over the entire upper Midwest with optional 2-way nested 4 km grids over the lower portion of Lake Michigan and over the Detroit-Toledo-Cleveland region.

Future year simulations will be applied with the same model configuration as for the base case simulation. All inputs except for emissions will be the same in the future year and base year simulations to assess changes in ozone, visibility, and PM2.5 due to control strategies and future growth. The terms base case and base line emissions inventories are one in the same, both referring to day specific biogenics and monthly weekday, Saturday, Sunday anthropogenic emissions.

Plume-in-Grid and Nesting

The GREASD sub-grid plume treatment option is being applied in CAMx4 for the summer season 12 km ozone simulations. This option is selected to improve the model treatment of large NOx plumes being released near Lake Michigan and Lake Erie. Sources included for the plume-in-grid treatment include any source near the Great Lakes with NOx emissions greater than 12 tons per day for any day of the summer in 2005 and 6 tons per day in future year scenarios.

At high grid resolutions of 4 km or finer, sub-grid scale treatment of plumes should not be applied since the fine grid appropriately captures the small scale physical and chemical processes.

Nested grids are useful to keep computational and data management resources acceptable while addressing important model application issues such as complex terrain, land-sea or land-lake breezes, and spatial emission gradients. They may also be useful to keep large point source plumes in smaller grid cells in lieu of having explicit sub-grid scale plume treatments.

CAMx4 allows for the inclusion of a fine grid within the coarse grid in a 2-way nesting mode. The 2-way nesting mode allows for interaction between the larger coarse grid with the smaller fine grid. This improves pollutant transport around the boundaries of the fine grid since a parcel of air may move from the fine grid, out to the coarse grid, and back into the fine grid depending on the shifting wind fields. This re-circulation is impossible in 1-way nesting applications.

Probing Tools

Probing tools are valuable from a scientific and regulatory perspective for one-atmosphere modeling. Use of source apportionment is more desirable for regulatory applications than the use of the "zero-out" approach to determine geographic and emissions sector culpability for long-term modeling simulations. Zeroing out emissions for large regions such as entire States fundamentally changes the atmospheric chemistry and makes interpretation of the results difficult.

An option in CAMx is employed to force elevated point sources into particular regions rather than placement based on coordinates and the 12 km geographic region map. This ensures that elevated emissions are placed in the appropriate geographic region and not incorrectly grouped with another region when a grid cell contains the boundary for more than one region. A good example of this is the Ohio River Valley where many large stationary point sources exist along State boundaries and could be grouped into the wrong region based on the 12 km grid cell source region map. This option improves the confidence in the source apportionment results for stationary point sources.

Ozone

CAMx is a state of the science photochemical model that contains a variety of ozone source apportionment tools, including the original ozone source apportionment tool (OSAT) and the anthropogenic pre-cursor culpability assessment (APCA) tool. The APCA tool assesses regional and emission sector contribution to ozone formation and provides information that is most policy relevant. When ozone is formed under VOC limited conditions due to biogenic VOC + anthropogenic NOx then OSAT attributes it to the biogenic VOC sources. When ozone is formed under NOx-limited conditions due to biogenic VOC + anthropogenic NOx then OSAT attributes it to the anthropogenic NOx sources. APCA is designed to provide more control strategy relevant information and recognizes that there are source categories such as biogenics that can not be controlled so the model only attributes ozone to biogenics when it is due to the interaction of biogenic VOC + biogenic NOx. In the case where ozone formed to biogenic VOC + anthropogenic NOx under VOC-limited conditions, OSAT attributes it to biogenic VOC, but APCA redirects the attribution to anthropogenic NOx. In NOx-limited conditions both OSAT and APCA attribute the ozone to anthropogenic NOx (ENVIRON, 2007). The APCA tool is chosen to track ozone contribution for this modeling study.

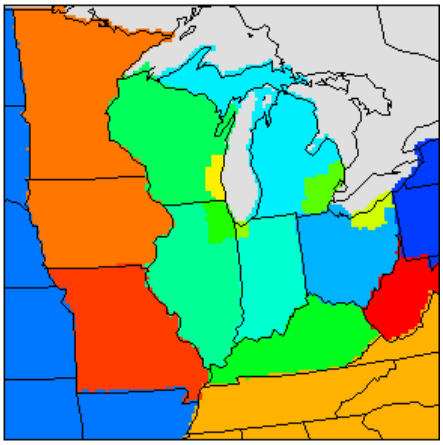
The source apportionment data is the average contribution over all modeled hours where predicted ozone at the monitor is greater than a threshold concentration value. Two different thresholds are used to examine different distributions of high modeled 8-hour ozone: 75 and 85 ppb (Baker, 2007). The geographic regions tracked for ozone contribution are listed in Table 2.4

and shown graphically in Figure 2.10 over the 12 km modeling domain. The contribution from the lateral and top boundaries of the model is also tracked for each receptor location.

Table 2.4 Complete list of source regions tracked for ozone contribution

Canada	Illinois Chicago non-attainment (NA) Counties
Northeast States (MANE-VU)	Detroit NA Counties
Central/Western States (CENRAP+ WRAP)	Indiana Chicago NA Counties
Ohio	Cleveland NA Counties
Michigan	Milwaukee NA Counties
Indiana	Southeast States (VISTAS)
Illinois	Minnesota+Iowa
Wisconsin	Missouri
Kentucky	West Virginia

Figure 2.10 Source regions tracked in the 12 km grid domain



Six emissions source sectors are tracked for contribution to ozone: onroad mobile, offroad mobile, area, electrical generating units, non-electrical generating units, and biogenics. Offroad mobile emissions include sources such as construction equipment, locomotives, commercial marine vessels, and airports. Two distinct groups of stationary point sources are tracked for contribution to ozone: electrical generating units and non-electrical generating units.

Particulate Matter and Visibility

The Particulate Source Apportionment Tool (PSAT) tracks contributions of PM2.5 sulfate ion, nitrate ion, ammonium ion, elemental carbon, and primary emissions of organic aerosol, soil, and coarse mass. Secondary organic aerosol tracking is also part of the tool but not employed for this study due to resource constraints. Secondary organic aerosol contributions from biogenic and anthropogenic sources are part of the standard CAMx output and included in the analysis.

Source apportionment results will be estimated on an annual average basis and on a daily 24-hr basis to be relevant to the annual and 24-hr PM2.5 NAAQS. The 24-hr average source apportionment results for the 20% worst and 20% best days at the Class I area receptors will be converted to light extinction then averaged together using the latest IMPROVE Steering Committee recommended equation (IMPROVE, 2006). Contributions from initial conditions are quantified to determine an optimal amount of spin-up time required to minimize the impacts from initial concentrations.

The geographic regions tracked for contribution are listed in Table 2.5 and shown graphically in Figure 2.11. The contribution from the lateral and top boundaries of the model is also tracked for each receptor location.

Figure 2.11 Model domain and source regions tracked with PSAT

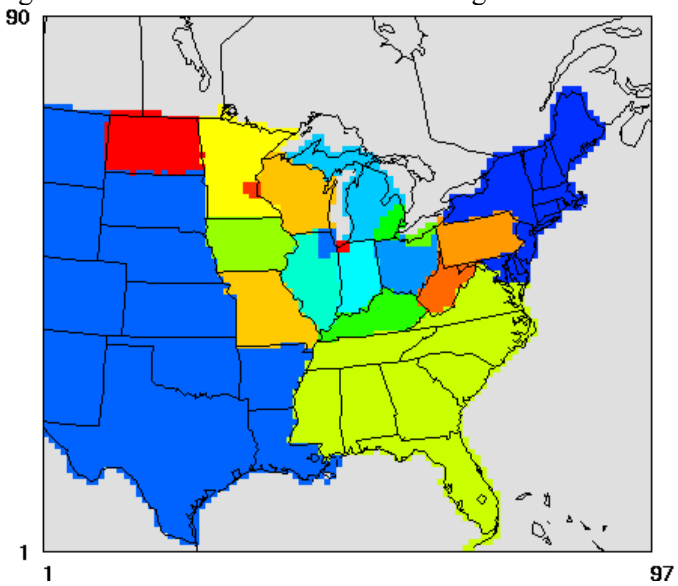


Table 2.5 Complete list of source regions tracked for contribution

Canada	Illinois Chicago non-attainment (NA) Counties
Northeast States (MANE-VU)	Detroit NA Counties
Central/Western States (CENRAP+ WRAP)	Indiana Chicago NA Counties
Ohio	Cleveland NA Counties
Michigan	Milwaukee NA Counties
Indiana	Southeast States (VISTAS)
Illinois	Minnesota
Wisconsin	Minneapolis-St. Paul
Kentucky	West Virginia
Iowa	North Dakota
Missouri	

Seven emissions source sectors are tracked for contribution to particulate matter: onroad mobile, offroad mobile, area, electrical generating units, non-electrical generating units, agricultural ammonia, and biogenics.

3. Model Performance Evaluation (same as 2002 protocol)

State Implementation Plans will include modeling the impacts of emission control scenarios with 3-D Eulerian photochemical transport models. Model performance is typically evaluated on an operational basis and rarely to support a diagnostic (dynamic) assessment. Operational evaluations for ozone modeling purposes include matching model estimates with observation data for ozone, nitrogen oxides (NO_X), and total volatile organic compounds (VOC). Operational evaluations for PM2.5 and visibility modeling purposes include matching model estimates with observation data for chemically speciated PM2.5 and important pre-cursor species including sulfur dioxide, nitric acid, and ammonia.

A diagnostic evaluation assesses how appropriately the modeling system responds to emissions adjustments. Since the modeled attainment demonstration includes modeling current and future year emissions it is important to have confidence that the model will predict concentrations appropriately when emissions change (US EPA, 2007). This type of evaluation includes modeling two different ozone episodes that are separated by enough years that large emissions differences exist. The diagnostic evaluation is an important assessment to make in addition to an operational evaluation because it is directly linked to the end use of the model, which is modeling the change in ozone concentrations after emissions adjustments.

A comparison between observed and estimated ozone for the summers of 2002 and 2005 is useful for a diagnostic assessment because high quality emission inventories were developed for each year and a large NO_X emissions reduction occurred between these years due in part to NO_X SIP Call compliance. Modeling two full summer seasons provides an opportunity to make another diagnostic evaluation which assesses model performance for high ozone by day of the week (Baker, 2007b). Emissions change substantially from weekday to weekend and having two full summers provides enough days with high ozone on each day of the week to make this type of evaluation useful.

The photochemical modeling applications are designed to support the development of regional control strategies for PM2.5 and Regional Haze. EPA guidance states that an attainment test for either standard will require the use of chemically speciated PM relative reduction factors (US EPA, 2007). Additionally, the model will be used to assess improvements in PM2.5 concentrations and visibility as a result of changes in emissions. These prominent end-uses of the modeling applications make comprehensive evaluations important. Clearly, reliance on model performance for PM2.5 total mass would be misleading since it is likely that the model and ambient data could estimate the same total mass but very different chemical composition. This scenario would compromise the development and interpretation of potential regulatory control strategies (Baker, 2004d).

The species to be compared to monitor concentrations include ozone, total VOC, NOX, SO2, NH3, HNO3, and speciated PM2.5 (see Table 3.1). Initially, scatter-plots of point-to-point relationships for all monitors in the domain for all episode days will be used for analysis for PM. This will allow for identification of gross model over or under-prediction by specie. Gas and aerosol data are taken from a variety of monitor networks for comparison to modeled estimates: IMPROVE, EPA Speciation Trends (STN), AIRS, and PAMS. The data is obtained directly from the VIEWS website and from the AFS database; a comparison of the monitor species to model species is shown below. PM2.5 ammonium ion is only measured at EPA Speciation Trends locations so the model performance for this chemical specie is dominated by, but not limited to, urban measurement locations.

Table 3.1 Species mapping between modeled and observed species (observed species from the VIEWS website)

	IMPROVE	STN	CAMx4 species
Sulfate aerosol	SO4f	SO4f	PSO4
Nitrate aerosol	NO3f	NO3f	PNO3
Ammonium aerosol		NH4f	PNH4
Organic aerosol	OCf*FACTOR FACTOR = 1.6 rural 2.1 urban	OCf*FACTOR FACTOR = 1.6 rural 2.1 urban	SOA1+SOA2+ SOA3+SOA4+ SOA5+POA
Elemental carbon	ECf	ECf	PEC
Soil/Crustal	SOILf	SOIL = 2.2*ALf + 2.49*SIf+1.63*CAf+ 2.42*FEf+1.94*TIf	FCRS
PM2.5 other	MF-RCFM	MF-(RCFM)	FPRM
Coarse mass	CM_calculated		CPRM+CCRS
PM2.5	MF	MF	PSO4+PNO3+PNH4+POA+ SOA1+SOA2+SOA3+SOA4+ SOA5+PEC+NA+PCL+ FPRM+FCRS
Re-constructed fine mass	RCFM	RCFM = SO4f+NO3f+ NH4f+OCf*FACTOR+ ECf+(SOIL)	1.375*PSO4+1.29*PNO3+ POA+SOA1+SOA2+SOA3+ SOA4+SOA5+PEC+NA+ PCL+FPRM+FCRS
Re-constructed bext	aerosol_bext		fRH*[4.125*PSO4+ 3.87*PNO3]+4*(SOA1+SOA2+ SOA3+SOA4+SOA5+POA)+ 10*PEC+NA+PCL+FPRM+FCRS+ 0.6*(CPRM+CCRS)

Model performance evaluation plots and metrics will be based on matching predictions and observations in time and space. There will not be any averaging over multiple-cell regions to match with an observation value. Qualitative evaluation will be done largely through graphical comparison of predictions and observations using spatial plots, time series plots, and scatter plots. The US EPA modeling guidance recommends against using any bright-line evaluation of performance metrics to determine whether the modeling is satisfactory (US EPA, 2007).

3.1 Particulate Matter and Regional Haze

The components of the visibility equation match up very closely to the prominent chemical forms of PM2.5: nitrate ion, sulfate ion, ammonium ion, organic carbon, elemental carbon, and soil (US EPA, 2007). Since these modeling applications will support PM2.5/Haze rules, model performance will be most rigorous for each of these PM2.5 species and coarse mass.

One of the problems related to PM model performance evaluation involves matching inconsistent monitor methodologies and model specie definition. Additionally, speciated measurements rarely add up to measurements of total fine mass. This unexplained fraction is usually attributed to the retention of water on the weighed samples (Timin, 2002). Other problems with comparing speciation samples and FRM measurements include volatilization of nitrate and positive and negative organic carbon artifacts (Timin, 2002).

Organic material is typically estimated from organic carbon using a 1.4 factor, which is based on the assumption that carbon accounts for 70% of the organic mass. Recent literature recommends a factor of 1.6 ± 0.2 for urban aerosol and 2.1 ± 0.2 for non-urban areas that would see more aged aerosol (Turpin and Lim, 2001; IMPROVE, 2006). These factors are applied to the observation data based on landuse type before being compared to model output. These factors may also be used to reduce modeled estimates of organic material to organic carbon.

Performance metrics used to describe model performance for PM2.5 species include mean bias, gross error, fractional bias, and fractional error (Table 3.2) (US EPA, 2007; Boylan et al, 2006). The bias and error metrics are used to describe performance in terms of the measured concentration units (μg/m^3). Even though the distribution of PM2.5 is log-normal, the data is not transformed for this analysis. The model attainment tests outlined by EPA for the PM2.5 NAAQS and Regional Haze rule require relative reduction factors to be applied to actual concentrations and not transformed concentrations. No minimum value is used to eliminate data points for the purposes of this analysis.

Table 3.2. Model Performance Metrics.

Mean Bias	$= \frac{1}{N \times M} \sum_{i=1}^{N} \sum_{j=1}^{M} (P_i^j - O_i^j)$
Gross Error	$= \frac{1}{N \times M} \sum_{i=1}^{N} \sum_{j=1}^{M} \lvert P_i^j - O_i^j \rvert$
Fractional Bias	$= \frac{1}{N \times M} \sum_{i=1}^{N} \sum_{j=1}^{M} \left(2 \times \frac{P_i^j - O_i^j}{P_i^j + O_i^j} \right)$
Fractional Gross Error	$= \frac{1}{N \times M} \sum_{i=1}^{N} \sum_{j=1}^{M} \left\lvert 2 \times \frac{P_i^j - O_i^j}{P_i^j + O_i^j} \right\rvert$

*P=model prediction; O=observation; N=number of days; M=number of monitors

Fractional bias and fractional error metrics are useful for comparison of model performance between species that tend to have large concentrations and those with small concentrations. It also helps compare performance of the same specie if concentrations are very large in some seasons and very small in others. The fractional metrics are best when close to 0 and worst when close to 2.

3.2 Ozone

Hourly running 8-hour averaged surface ozone observations from EPA's AIRS database are matched to hourly running 8-hour averaged layer 1 (30 m height) model estimates for evaluation. Only monitors in the 12 km modeling domain are included in the analysis. Model performance evaluation plots and metrics are based on matching predictions and observations in time and space. EPA has suggested several statistical metrics to describe model performance and include mean normalized bias error (MNBE) and mean normalized gross error (MNGE) (see Table 3.3) (US EPA, 2007).

This modeling system is used to support regulatory applications, so the model performance analysis reflects this end-use of the modeling results. It is well known that ozone data tends to follow a log-normal distribution and for the purposes of scientific evaluations the data is often log-transformed before evaluation (Hogrefe et al, 2003). Observations and predictions used in the

attainment test may not be transformed, so the data used for model performance evaluation will likewise not be transformed.

Table 3.3 Model Performance Metric Definitions.

Metric	Equation
Mean Normalized Bias Error (MNBE)	$=\frac{1}{N \times M}\sum_{i=1}^{N}\sum_{j=1}^{M}\left(\frac{P^j - O_i^j}{O_i^j}\right)$
Mean Normalized Gross Error (MNGE)	$=\frac{1}{N \times M}\sum_{i=1}^{N}\sum_{j=1}^{M}\left\lvert\frac{P_i^j - O_i^j}{O_i^j}\right\rvert$

**P=model prediction; O=observation; N=number of days; M=number of monitors*

These metrics have traditionally been calculated when the observation value exceeds a certain minimum value, often 60 ppb for 1-hour ozone evaluation (Hogrefe et al, 2003). The MNBE and MNGE will be estimated using 3 different minimum 8-hour ozone thresholds: 20, 40, and 60 ppb. The 60 ppb minimum threshold level excludes prediction-observation pairs that are not of direct regulatory importance since the 8-hour ozone attainment test only applies to days with high ambient concentrations (US EPA, 2007). The 20 and 40 ppb minimum thresholds are included in the evaluation to get a better idea about how well the model is performing at predicting diurnal formation and removal processes and for days between high ozone episodes.

The metrics are estimated for all stations in the 12 km modeling domain for each day of the summer episode. The episode average metrics are estimated from the daily metrics.

3.3 Deposition

Wet deposition is measured at several monitoring networks and is also output by the photochemical model. The National Trends Network (NTN) and the Atmospheric Integrated Research Monitoring Network (AIRMoN) make up the National Atmospheric Deposition Program (NADP). NTN sites collect weekly measurements of wet deposition fluxes of sulfate and nitrate anions and the ammonium cation. NADP network stations measure wet deposition as mass per volume (mg/L) and the model outputs mass per area (g/ha or mole/ha). CAMx4 wet deposition output is matched to NTN/NADP measurement data in units of kg/km^2 according to the details outlined below.

The calculations used to convert CAMx wet deposition output to compare to NTN/NADP network data:

SPECIE_WD (g/ha) * (1 ha / 2.5 acres) * (1 acre / 0.0040469 km^2) * (1 kg / 1000 g)

The calculations used to convert NTN/NADP data to compare with CAMx output data:

SPECIES (mg/L) * (1 L / 1,000,000 mm^3) * precipitation in mm * (1 mm^2 / 0.000000000001 km^2) * (1 g / 1000 mg) * (1 kg / 1000 g)

The table below outlines the matching of observed species to CAMx output species.

Table 3.4 Observed and Modeled Wet Deposition		
	NADP/NTN	CAMx4
Sulfate	SO4	PSO4_WD + SULF_WD
Nitrate	NO3	PNO3_WD + HNO3_WD
Ammonium	NH4	PNH4_WD + NH3_WD
Crustal	Ca + Cl + Mg +K + Na	FCRS_WD + FPRM_WD

4. Attainment Tests

Visibility

Visibility may be estimated by two similar methods that relate light extinction to ambient PM2.5 concentrations (FLAG, 2000; US EPA, 2007). Visibility will be estimated using the new equation recommended by the IMPROVE steering committee (IMPROVE, 2006). The new and old equations produce very similar estimates of light extinction in the upper Midwest. The new equation will be emphasized for the SIP modeling demonstration due to its more up to date science.

The equation shown below relates PM2.5 specie concentrations to light extinction. Additional factors of f(RH) are included that change the light scattering of sulfate and nitrate based on climatologically averaged relative humidity.

β_{ext} = 2.2*f_SRH*[small sulfate] + 2.4*f_S(RH)*[small nitrate] + 4.8*f_LRH*[large sulfate] + 5.1*f_L(RH)*[large nitrate]+ 2.8*[small OCM] + 6.1*[large OCM] + 10*EC + 1*SOIL + 0.6*CM + 1.7*f_{SS}(RH)*SS + $\beta_{rayleigh}$

Bext	Estimated extinction coefficient (Mm-1)
Sulfate	Sulfate associated with ammonium (SO4*1.375)
Nitrate	Nitrate associated with ammonium (NO3*1.29)
OCM	Organic carbon Mass
EC	Elemental carbon
SOIL	Inorganic primary PM2.5 (soil, crustal, other)
CM	Coarse fraction particulate matter
SS	Sea salt
$\beta_{rayleigh}$	Light scattering due to Rayleigh scattering (site specific)
fRH	Relative humidity adjustment factor

The apportionment of sulfate, nitrate, and organic carbon mass into small and large size fractions is shown below using 'X' as a placeholder for these species.

Large X = ([Total X] / [20 ug/m3]) * [Total X], where [Total X] < 20 ug/m3

Large X = [Total X], where [Total X] ≥ 20 ug/m3

Small X = [Total X] – [Large X]

The fRH values are long-term averages that are site and month specific (US EPA, 2003a; US EPA 2003b; FLAG, 2000). The light scattering due to Rayleigh is site specific (IMPROVE, 2006). The NO_2 component to the light extinction equation is not included since it is not measured at Class I areas in the upper Midwest. The visibility equation is expressed as an extinction coefficient (β_{ext}) and is converted to deciviews using the equation below.

$$\text{Deciview} = 10\ln(\beta_{ext}/\ \beta_{rayleigh})$$

The reasonable progress test to determine the relationship between current and future year visibility is expressed in deciview units. The changes in deciview between the current and future year strategy is the reasonable progress test and is shown below.

$$\text{Change in Deciview} = 10\ln[(\beta_{ext})_{future} / (\beta_{ext})_{base}]$$

- or -

$$\text{Change in Deciview} = \text{Deciview}_{base} - \text{Deciview}_{future}$$

Visibility will be estimated for key Class I area in the Midwest for the base year and various future year scenarios. The changes in visibility between the base line and future year will be assessed using procedures in U.S. EPA's modeling guidance document (US EPA, 2007).

1. The visibility in deciviews will be ranked from high to low at each Class I area for the calendar years 2000-2004 using the monthly and site specific fRH values and the more recent IMPROVE light extinction equation.
2. The mean deciviews for the 20% days with the best and the 20% days with the worst visibility is estimated for each Class I area for each year of the 2000-04 baseline period.
3. The mean observed extinction coefficient for the days during the modeling period (2005) with the 20% best and 20% worst visibility will be calculated.
4. The mean predicted extinction coefficient for the corresponding 20% best and 20% worst days of the modeling period of the base case and future year strategy will be calculated using monthly site specific fRH values.
5. The relative reduction factor for the 20% best and 20% worst group of days for each site for each of the particulate matter species in the light extinction equation are estimated.
6. The relative reduction factors are multiplied by daily measured PM data during the 2000-04 baseline to estimate future daily values of these species.
7. These future daily PM estimates are used to estimate light extinction for each of the previously identified 20% best and 20% worst days of monitored data. Light extinction is converted to deciviews and the mean value for the best and worst days for each year of the baseline period is estimated.
8. The 5 mean deciview values for the worst and best days (one from each of the 5 years) are averaged together for a mean value for the best and worst days.
9. The future year mean deciview values in step 8 are compared to the observed values from step 2. The differences are compared to established goals for reasonable progress to determine if reasonable progress is demonstrated.

Annual PM2.5 Standard

Progress in meeting the annual PM2.5 standard will be assessed by application of the procedures outlined by the U.S. EPA modeling guidance document (US EPA, 2007). The major steps of this attainment test are outlined below:

1. Chemically speciated IMPROVE and STN PM2.5 data from 2001-2005 is spatially interpolated to match the grid domain and resolution used for the photochemical modeling. Spatial fields are developed for each PM2.5 chemical species for each season using the SAS statistical software package PROC KRIG function (EPA, 2004b).
2. The estimated fractional composition of each species by quarter is multiplied by the 5 year weighted average 2001-2006 FRM quarterly mean concentrations at each FRM monitor, resulting in estimated quarterly mean ambient concentrations of PM2.5

components sulfate, nitrate, ammonium, elemental carbon, organic carbon, particle bound water, and crustal material.

3. Estimate the modeled quarterly mean concentration for each chemical component of PM2.5 in the base year and future scenarios.
4. Calculate quarterly relative reduction factors for sulfate, nitrate, elemental carbon, organic carbon, and crustal material. The RRF is the ratio of the future year to the base year.
5. Quarterly specific RRFs are multiplied by the quarterly average species concentration from step 2 to estimate future case quarterly average concentrations for each of the PM2.5 species.
6. Calculate the quarterly average future scenario concentrations for ammonium and particle bound water using estimated ambient concentrations of sulfate, nitrate, and degree of sulfate neutralization. Particle bound water is estimated with an empirical equation.
7. Sum the quarterly future species concentrations to estimate the future quarterly average PM2.5 concentration.
8. The annual average future scenario concentration is the average of the 4 future year quarterly average PM 2.5 concentrations.
9. Compare value to annual NAAQS standard of 15 ug/m^3. If value is ≤ 15 ug/m^3 then the test is passed.

Organic carbon mass is estimated using a mass balance approach (EPA, 2006). The organic carbon spatial fields are only used to supply a minimum value for OCM when OCM estimated by mass balance is less than OC*1.4*0.7. A spatial field of the degree of sulfate neutralization is developed to estimate PM2.5 ammonium. Particle bound water is estimated using an empirical equation with spatially interpolated PM2.5 sulfate ion, FRM equivalent PM2.5 nitrate ion, and FRM equivalent PM2.5 ammonium ion (EPA, 2006).

Ozone

Progress in meeting the 8-hour ozone standard will be assessed in part using the modeled attainment test outlined by the U.S. EPA's "Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone, PM2.5, and Regional Haze" (US EPA, 2007). The attainment test is only applicable to monitors with design values ≥ 75 ppb. The major steps of the attainment test are described below:

1. Calculate the 8-hour ozone design value at each monitor location; the design value used in the attainment test is the average of 3 consecutive 3 year averaged design values: 2003-2005, 2004-2006, and 2005-2007.
2. Apply the photochemical model to a current year and future year to estimate a monitor specific relative reduction factor.
3. Calculate the future year design value by multiplying the monitor-specific observed design value by the monitor-specific relative reduction factor.
4. If the future year design value is ≤ 84 ppb then the test is passed at that monitor location.

The highest 8 hour daily maximum predicted in the 3x3 (or 7x7 for 4 km modeling) group of cells surrounding and including the cell in which the monitor is located will be used in the attainment test. The attainment test will be applied to all days during the summer of 2005 that meet the meet the inclusion criteria for the relative reduction factor calculation (US EPA, 2007). An episode day must have a peak 8-hr ozone model prediction > 85 ppb at a specific monitor or near the monitor (definition of near mentioned above) to be included in the attainment test. If there are less than 10 days of estimated peak 8-hr ozone at a monitor then the threshold for inclusion to the relative

reduction factor is decreased until the number of days equals 10 or the threshold goes below 70 ppb (US EPA, 2007). If there are less than 4 days in the relative reduction factor calculation then the attainment test is not applied for that monitor.

Unmonitored Area Analysis

An un-monitored area analysis is an additional review to identify areas that might exceed the 8-hr ozone or annual PM2.5 NAAQS if monitors were present (US EPA, 2007). This analysis uses interpolated spatial fields of ambient concentrations and photochemical model estimated concentrations to develop "model adjusted spatial fields of observations" (US EPA, 2007). The model adjusted spatial fields are developed for the base year. Future year concentrations are estimated by applying RRFs to the base year model adjusted spatial field.

8-hr Ozone NAAQS

1. Ambient 8-hr ozone design values are interpolated to create the ambient spatial field. The design values are the 2003-2005 8-hr ozone design values.
2. The ambient spatial field is adjusted using gridded ozone seasonal average base year model output gradients.
3. Gridded RRFs are applied to the adjusted spatial field developed in step 2.
4. If any grid cell exceeds 84 ppb then that grid cell is predicted to exceed the 8-hr ozone NAAQS in the future scenario.

Annual PM2.5 NAAQS

1. Quarterly PM2.5 chemical species are interpolated to create the ambient spatial fields.
2. The ambient spatial field is adjusted using gridded ozone seasonal average base year model output gradients.
3. Quarterly gridded RRFs for each PM2.5 species are applied to the adjusted spatial field developed in step 2.
4. If any grid cell exceeds 15 ug/m3 then that grid cell is predicted to exceed the annual PM2.5 NAAQS in the future scenario.

US EPA intends to provide software that incorporates monitor observation data and CAMx output to generate the gridded future year 8-hr ozone and annual PM2.5 estimates (US EPA, 2007). This software will be used to apply the un-monitored area analysis.

24-hr PM2.5 Standard

Progress in meeting the new 24-hr PM2.5 standard will be assessed by application of the procedures outlined by the U.S. EPA document "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze" (US EPA, 2007). The major steps of this attainment test are outlined below:

1. Chemically speciated IMPROVE and STN PM2.5 data from 2001-2005 is spatially interpolated to match the grid domain and resolution used for the photochemical modeling. Spatial fields are developed for each PM2.5 chemical species for each season using the SAS statistical software package PROC KRIG function (EPA, 2004b). Rather than interpolating seasonal averages, the top 15% of reconstructed PM2.5 mass samples are used as the basis of the chemically speciated data used for seasonal spatial fields.

2. Estimate the observed 98th percentile value for each year of the 5 year baseline period. Additionally, the next highest concentration in each quarter is identified. This results in data for each year and site which contains one quarter that equals the 98th percentile and 3 quarters which are less than or equal to the 98th percentile.
3. The quarterly maximum daily concentration is multiplied by the fractional composition of PM2.5 species based on the spatial fields.
4. PM2.5 component specific relative reduction factors are estimated at each monitor for each quarter.
5. The component specific RRFs are multiplied by the observed values to estimate future year concentrations.
6. The quarterly components are summed to estimate the quarterly future year 98th percentile value.
7. The 3 consecutive future year 98th percentiles are averaged together to estimate 3 different future year design values. The 3 future year design values are averaged to estimate a single 5-year weighted average 24-hour design value.
8. If this 5 year weighted average 24-hour design value is less than 35 ug/m3 then the test is passed.

The relative reduction factor is only estimated for days with 24-hour average modeled PM2.5 greater than 35 ug/m3. If less than 10 days in a quarter meet this criteria, then the threshold is lowered until the number of days equals 10 or the threshold goes below 20 ug/m3. If there are less than 5 days in the RRF calculation then that quarter is not used for the estimation of the future year design value. If no quarter has more than 5 days included in the RRF calculation then the attainment test is not applied for that monitor.

5.0 Other Issues

Technology Transfer and Modeling Capacity Building

States that are part of the Midwest Regional Planning Organization and cooperating organizations have to opportunity to acquire a turn-key modeling system. This will include all the model inputs, scripts, and support documents to perform model simulations. States participate in an extensive sensitivity projects and preliminary strategy rounds which are designed in part to allow States to develop modeling expertise in-house.

The model input data will be available on an FTP site. The drawback is that transfer times will be long since the files are rather large, but the benefit is that as improvements and updates to input files, model code, and processing utilities become available they will immediately be available to everyone. This approach greatly reduces the resource burden involved with data distribution of media (i.e. hard drives or DLT tapes) via the mail system.

Where very large datasets need to be transferred USB/firewire drives will be sent via the mail system. A general figure where USB drives will be used for transfer instead of FTP would be 50+ gigabytes of data.

States and cooperating organizations will also participate in regular conference calls and face to face meetings to discuss problems, progress, and outline cooperative work objectives.

Ultimately, States that are inclined will be able to use the model inputs developed by the Midwest Regional Planning Organization as the basis for local emphasis modeling projects.

Data Management and Storage

The file storage requirements for annual modeling are large and data backup is an important consideration. Important files including raw emissions and meteorological files will be stored redundantly on multiple hard drives. Additionally, all the model inputs will have a redundant copy at each member State as they will be using them for model simulations as part of the technology transfer and capacity building.

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Appendix G

Attainment Test Results for All Louisville KY-IN Fine Particle Nonattainment Area $PM_{2.5}$ Monitors

Green Valley School - New Albany, IN (ID 18-043-1004)

Observed Quarterly Mean $PM_{2.5}$/Quarterly Mean Composition

Pollutant (percent of total mass)	Quarter 1	Quarter 2	Quarter 3	Quarter 4
SO_4	27.98	38.82	37.99	28.98
NO_3	21.3	0.4	0	10.55
OC	20.09	19.18	12.48	21.51
EC	4.19	04.16	2.9	5.64
Soil	02.43	03.48	3.34	3.8
NH_4	15.18	12.88	11.62	12.78
pbw	08.83	13.37	11.97	9.05

Quarterly Mean Composition for each Component of $PM_{2.5}$

Pollutant (µg/m3)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
SO_4	3.5059	5.5901	7.3701	3.6225	5.0
NO_3	2.6689	0.0576	0.0000	1.3188	1.0
OC	2.5173	2.7619	2.4211	2.6888	2.6
EC	0.5250	0.5990	0.5626	0.7050	0.6
Soil	0.3045	0.5011	0.6480	0.4750	0.5
NH_4	1.9021	1.8547	2.2543	1.5975	1.9
pbw	1.1064	1.9253	2.3222	1.1313	1.6
Quarterly FRM Mean (total mass)	12.53	14.4	19.4	12.5	

Relative Response Factors (RRFs) for each component

Pollutant	Quarter 1	Quarter 2	Quarter 3	Quarter 4
SO_4	0.8442	0.6592	0.608	0.7868
NO_3	1.022	0.8178	0.8161	0.9686
OC	0.9421	1.0007	1.0106	0.9882
EC	0.9142	0.8892	0.8847	0.8934
Soil	1.1841	1.1753	1.2751	1.1775
NH_4	0.8968	0.6897	0.6457	0.8453
pbw	0.8638	0.6682	0.6219	0.8189

Projected Future Quarterly Species Estimates

Pollutant (µg/m3)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	TOTAL
SO_4	2.9597	3.6850	4.4810	2.8502	3.5
NO_3	2.7276	0.0471	0.0000	1.2773	1.0
OC	2.3715	2.7639	2.4468	2.6570	2.6
EC	0.4800	0.5327	0.4977	0.6298	0.5
Soil	0.3605	0.5890	0.8262	0.5593	0.6
NH_4	1.7058	1.2792	1.4556	1.3504	1.4
Pbw	0.9557	1.2865	1.4442	0.9264	1.2
TOTAL	11.56	10.18	11.15	10.25	

Carpenter Street – Shepherdsville, KY (ID 21-029-0006)

Observed Quarterly Mean $PM_{2.5}$/Quarterly Mean Composition

Pollutant (percent of total mass)	Quarter 1	Quarter 2	Quarter 3	Quarter 4
SO_4	28.83	37.85	38.82	29.58
NO_3	20.09	0.5	0	10.82
OC	20.19	19.28	12.57	22.08
EC	4.2	4.28	3.01	5.69
Soil	2.56	3.52	2.97	3.88
NH_4	15.18	12.41	11.51	12.82
pbw	8.96	12.68	11.48	9.08

Quarterly Mean Composition for each Component of $PM_{2.5}$

Pollutant (µg/m3)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
SO_4	3.6124	5.6132	7.6592	3.5585	5.1
NO_3	2.5173	0.0742	0.0000	1.3016	1.0
OC	2.5298	2.8592	2.4801	2.6562	2.6
EC	0.5263	0.6347	0.5939	0.6845	0.6
Soil	0.3208	0.5220	0.5860	0.4668	0.5
NH_4	1.9021	1.8404	2.2709	1.5422	1.9
pbw	1.1227	1.8804	2.2650	1.0923	1.6
Quarterly FRM Mean (total mass)	12.53	14.83	19.73	12.03	

Relative Response Factors (RRFs) for each component

Pollutant	Quarter 1	Quarter 2	Quarter 3	Quarter 4
SO_4	0.8389	0.6618	0.5996	0.7877
NO_3	1.0484	0.8885	0.9015	0.9654
OC	0.9738	1.036	1.0387	1.0265
EC	0.924	0.9226	0.9273	0.9158
Soil	1.4091	1.3874	1.6155	1.3723
NH_4	0.8908	0.692	0.6298	0.8389
pbw	0.8479	0.6608	0.6041	0.8095

Projected Future Quarterly Species Estimates

Pollutant (µg/m3)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	TOTAL
SO_4	3.0304	3.7148	4.5924	2.8030	3.5
NO_3	2.6391	0.0659	0.0000	1.2566	1.0
OC	2.4635	2.9622	2.5760	2.7266	2.7
EC	0.4863	0.5856	0.5507	0.6269	0.6
Soil	0.4520	0.7242	0.9467	0.6405	0.7
NH_4	1.6943	1.2736	1.4302	1.2938	1.4
pbw	0.9519	1.2426	1.3683	0.8842	1.1
TOTAL	12.53	13.42	15.86	11.30	

Elizabethtown, KY (ID 21-093-0006)

Observed Quarterly Mean $PM_{2.5}$/Quarterly Mean Composition

Pollutant (percent of total mass)	Quarter 1	Quarter 2	Quarter 3	Quarter 4
SO_4	28.85	38.84	38.87	29.34
NO_3	20.25	0.41	0	10.91
OC	20.13	19.42	12.51	22.05
EC	4.11	4.3	3.0	5.68
Soil	2.47	3.59	2.99	3.93
NH_4	15.21	12.66	11.43	12.78
pbw	8.98	12.96	11.31	9.02

Quarterly Mean Composition for each Component of $PM_{2.5}$

Pollutant (µg/m3)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
SO_4	3.1648	5.4259	7.1521	3.0719	4.7
NO_3	2.2214	0.0573	0.0000	1.1423	0.9
OC	2.2083	2.7130	2.3018	2.3086	2.4
EC	0.4509	0.6007	0.5520	0.5947	0.5
Soil	0.2710	0.5015	0.5502	0.4115	0.4
NH_4	1.6685	1.7686	2.1031	1.3381	1.7
pbw	0.9851	1.8105	2.0810	0.9444	1.5
Quarterly FRM Mean (total mass)	10.97	13.97	18.4	10.47	

Relative Response Factors (RRFs) for each component

Pollutant	Quarter 1	Quarter 2	Quarter 3	Quarter 4
SO_4	0.837	0.6621	0.5984	0.7827
NO_3	1.0407	0.8368	0.8331	0.9356
OC	0.9787	1.0327	1.0345	1.0255
EC	0.9286	0.9267	0.9361	0.9199
Soil	1.3584	1.3409	1.5518	1.3242
NH_4	0.887	0.6889	0.6228	0.8278
pbw	0.8456	0.6652	0.6051	0.8055

Projected Future Quarterly Species Estimates

Pollutant (µg/m3)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	TOTAL
SO_4	2.6490	3.5925	4.2798	2.4044	3.2
NO_3	2.3118	0.0479	0.0000	1.0687	0.9
OC	2.1612	2.8017	2.3813	2.3675	2.4
EC	0.4187	0.5567	0.5167	0.5471	0.5
Soil	0.3681	0.6725	0.8537	0.5449	0.6
NH_4	1.4800	1.2184	1.3098	1.1077	1.3
pbw	0.8330	1.2044	1.2592	0.7607	1.0
TOTAL	10.22	10.09	10.60	8.80	

37th & Southern Ave. – Louisville, KY (ID 21-111-0043)

Observed Quarterly Mean $PM_{2.5}$/Quarterly Mean Composition

Pollutant(percent of total mass)	Quarter 1	Quarter 2	Quarter 3	Quarter 4
SO_4	27.98	38.82	37.99	28.98
NO_3	21.3	0.4	0	10.55
OC	20.09	19.18	12.48	21.51
EC	4.19	4.16	2.9	5.64
Soil	2.43	3.48	3.34	3.8
NH_4	15.18	12.88	11.62	12.78
Pbw	8.83	13.37	11.97	9.05

Quarterly Mean Composition for each Component of $PM_{2.5}$

Pollutant (µg/m3)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
SO_4	3.7018	5.9511	7.7614	3.7964	5.3
NO_3	2.8180	0.0613	0.0000	1.3821	1.1
OC	2.6579	2.9403	2.5497	2.8178	2.7
EC	0.5543	0.6377	0.5925	0.7388	0.6
Soil	0.3215	0.5335	0.6824	0.4978	0.5
NH_4	2.0083	1.9745	2.3740	1.6742	2.0
pbw	1.1682	2.0496	2.4455	1.1856	1.7
Quarterly FRM Mean (total mass)	13.23	15.33	20.43	13.1	

Relative Response Factors (RRFs) for each component

Pollutant	Quarter 1	Quarter 2	Quarter 3	Quarter 4
SO_4	0.8442	0.6592	0.608	0.7868
NO_3	1.022	0.8178	0.8161	0.9686
OC	0.9421	1.0007	1.0106	0.9882
EC	0.9142	0.8892	0.8847	0.8934
Soil	1.1841	1.1753	1.2751	1.1775
NH_4	0.8968	0.6897	0.6457	0.8453
pbw	0.8638	0.6682	0.6219	0.8189

Projected Future Quarterly Species Estimates

Pollutant (µg/m3)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	TOTAL
SO_4	3.1250	3.9230	4.7189	2.9870	3.7
NO_3	2.8800	0.0501	0.0000	1.3387	1.1
OC	2.5040	2.9424	2.5767	2.7846	2.7
EC	0.5068	0.5671	0.5242	0.6601	0.6
Soil	0.3807	0.6270	0.8701	0.5862	0.6
NH_4	1.8011	1.3618	1.5329	1.4152	1.5
pbw	1.0091	1.3696	1.5208	0.9708	1.2
TOTAL	12.21	10.84	11.74	10.74	

Wyandotte Park – Louisville, KY (ID 21-111-0044)

Observed Quarterly Mean $PM_{2.5}$/Quarterly Mean Composition

Pollutant(percent of total mass)	Quarter 1	Quarter 2	Quarter 3	Quarter 4
SO_4	28.65	37.33	37.83	28.51
NO_3	20.9	0.3	0	11.7
OC	19.57	18.92	12.07	19.89
EC	3.82	4.67	3.33	5.24
Soil	2.65	3.44	2.2	3.41
NH_4	15.44	12.36	11.41	13.15
pbw	8.97	12.81	11.58	8.96

Quarterly Mean Composition for each Component of $PM_{2.5}$

Pollutant (µg/m3)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
SO_4	3.7904	5.5136	7.6530	3.8004	5.2
NO_3	2.7651	0.0443	0.0000	1.5596	1.1
OC	2.5891	2.7945	2.4418	2.6513	2.6
EC	0.5054	0.6898	0.6737	0.6985	0.6
Soil	0.3506	0.5081	0.4451	0.4546	0.4
NH_4	2.0427	1.8256	2.3082	1.7529	2.0
pbw	1.1867	1.8920	2.3426	1.1944	1.7
Quarterly FRM Mean (total mass	13.23	14.77	20.23	13.33	

Relative Response Factors (RRFs) for each component

Pollutant	Quarter 1	Quarter 2	Quarter 3	Quarter 4
SO_4	0.8431	0.6562	0.601	0.7889
NO_3	1.0347	0.8576	0.8536	0.9583
OC	0.9567	1.0139	1.0216	1.0009
EC	0.9271	0.9102	0.9008	0.9106
Soil	1.3139	1.3042	1.4786	1.2928
NH_4	0.897	0.6902	0.6397	0.8406
pbw	0.8586	0.6601	0.6114	0.8141

Projected Future Quarterly Species Estimates

Pollutant (µg/m3)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	TOTAL
SO_4	3.1957	3.6181	4.5995	2.9981	3.6
NO_3	2.8610	0.0380	0.0000	1.4946	1.1
OC	2.4770	2.8333	2.4945	2.6537	2.6
EC	0.4685	0.6278	0.6068	0.6360	0.6
Soil	0.4606	0.6626	0.6581	0.5876	0.6
NH_4	1.8323	1.2600	1.4766	1.4735	1.5
pbw	1.0189	1.2489	1.4323	0.9723	1.2
TOTAL	12.31	10.29	11.27	10.82	

Barret Ave. – Louisville, KY (ID 21-111-0048)

Observed Quarterly Mean $PM_{2.5}$/Quarterly Mean Composition

Pollutant(percent of total mass)	Quarter 1	Quarter 2	Quarter 3	Quarter 4
SO_4	28.65	37.33	37.5	28.51
NO_3	20.9	0.3	0	11.7
OC	19.57	18.92	11.96	19.89
EC	3.82	4.67	3.3	5.24
Soil	2.65	3.44	2.18	3.41
NH_4	15.44	12.36	11.31	13.15
pbw	8.97	12.81	11.48	8.96

Quarterly Mean Composition for each Component of $PM_{2.5}$

Pollutant (µg/m3)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
SO_4	3.6471	5.3494	7.6613	3.6122	5.1
NO_3	2.6606	0.0430	0.0000	1.4824	1.0
OC	2.4913	2.7112	2.4434	2.5201	2.5
EC	0.4863	0.6692	0.6742	0.6639	0.6
Soil	0.3373	0.4930	0.4454	0.4320	0.4
NH_4	1.9655	1.7712	2.3106	1.6661	1.9
pbw	1.1419	1.8357	2.3454	1.1352	1.6
Quarterly FRM Mean (total mass)	12.73	14.33	20.43	12.67	

Relative Response Factors (RRFs) for each component

Pollutant	Quarter 1	Quarter 2	Quarter 3	Quarter 4
SO_4	0.8431	0.6562	0.601	0.7889
NO_3	1.0347	0.8576	0.8536	0.9583
OC	0.9567	1.0139	1.0216	1.0009
EC	0.9271	0.9102	0.9008	0.9106
Soil	1.3139	1.3042	1.4786	1.2928
NH_4	0.897	0.6902	0.6397	0.8406
pbw	0.8586	0.6601	0.6114	0.8141

Projected Future Quarterly Species Estimates

Pollutant (µg/m3)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	TOTAL
SO_4	3.0749	3.5103	4.6044	2.8497	3.5
NO_3	2.7529	0.0369	0.0000	1.4206	1.1
OC	2.3834	2.7489	2.4962	2.5223	2.5
EC	0.4508	0.6091	0.6073	0.6046	0.6
Soil	0.4432	0.6429	0.6585	0.5586	0.6
NH_4	1.7631	1.2225	1.4781	1.4005	1.5
pbw	0.9804	1.2117	1.4340	0.9242	1.1
TOTAL	11.85	9.98	11.28	10.28	

Watson Elementary School – Louisville, KY
(ID 21-111-0051)

Observed Quarterly Mean $PM_{2.5}$/Quarterly Mean Composition

Pollutant(percent of total mass)	Quarter 1	Quarter 2	Quarter 3	Quarter 4
SO_4	28.81	38.97	38.86	29.64
NO_3	20.25	0.51	0	11.1
OC	20.18	19.31	12.53	21.99
EC	4.12	4.22	2.93	5.54
Soil	2.47	3.49	2.94	3.68
NH_4	15.21	12.73	11.55	12.92
pbw	8.96	13.0	11.56	9.09

Quarterly Mean Composition for each Component of $PM_{2.5}$

Pollutant (µg/m3)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
SO_4	3.5926	5.6896	7.4495	3.4886	5.1
NO_3	2.5252	0.0745	0.0000	1.3065	1.0
OC	2.5164	2.8193	2.4020	2.5882	2.6
EC	0.5138	0.6161	0.5617	0.6521	0.6
Soil	0.3080	0.5095	0.5636	0.4331	0.5
NH_4	1.8967	1.8586	2.2141	1.5207	1.9
pbw	1.1173	1.8980	2.2161	1.0699	1.6
Quarterly FRM Mean (total mass)	12.47	14.6	19.17	11.77	

Relative Response Factors (RRFs) for each component

Pollutant	Quarter 1	Quarter 2	Quarter 3	Quarter 4
SO_4	0.8476	0.6721	0.6132	0.7926
NO_3	1.0426	0.8583	0.8683	0.9847
OC	0.9691	1.0237	1.0298	1.0163
EC	0.9356	0.903	0.8965	0.9126
Soil	1.2488	1.2449	1.3713	1.2324
NH_4	0.8994	0.7046	0.6488	0.8508
pbw	0.8598	0.6778	0.6231	0.8198

Projected Future Quarterly Species Estimates

Pollutant (µg/m3)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	TOTAL
SO_4	3.0451	3.8240	4.5680	2.7651	3.6
NO_3	2.6327	0.0639	0.0000	1.2865	1.0
OC	2.4387	2.8861	2.4736	2.6304	2.6
EC	0.4807	0.5564	0.5035	0.5951	0.5
Soil	0.3846	0.6343	0.7729	0.5338	0.6
NH_4	1.7059	1.3096	1.4365	1.2938	1.4
pbw	0.9607	1.2865	1.3808	0.8771	1.1
TOTAL	11.64	10.56	11.14	9.98	

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Appendix H

Example MOBILE Input/Output Files

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************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                           *
* Input file: RANA09JE.IN (file 1, run 1).                             *
************************************************************************

* # # # # # # # # # # # # # # # # # # # # # # # # # # #
*
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # # # #

                              Calendar Year:  2009
                                      Month:  July
               Gasoline Fuel Sulfur Content:   30. ppm
                 Diesel Fuel Sulfur Content:   43. ppm
                       Particle Size Cutoff:  2.50 Microns
                           Reformulated Gas:  No

       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV
LDDT      HDDV        MC   All Veh
               GVWR:                <6000     >6000     (All)
                         ------    ------    ------    ------    ------    ------
------    ------    ------    ------
   VMT Distribution:    0.5365    0.2988    0.0209              0.0408    0.0005
0.0003    0.0987    0.0035    1.0000
 ---------------------------------------------------------------------------------
----------------------------------------
 Composite Emission Factors (g/mi):
               Lead:    0.0000    0.0000    0.0000    0.0000    0.0000    ------
------    ------    0.0000    0.0000
              GASPM:    0.0038    0.0038    0.0038    0.0038    0.0370    ------
------    ------    0.0142    0.0048
            ECARBON:    ------    ------    ------    ------    ------    0.0549
0.0206    0.0824    ------    0.0082
            OCARBON:    ------    ------    ------    ------    ------    0.0155
0.0297    0.0421    ------    0.0042
                SO4:    0.0003    0.0005    0.0005    0.0005    0.0016    0.0004
0.0008    0.0026    0.0001    0.0006
   Total Exhaust PM:    0.0040    0.0042    0.0042    0.0042    0.0386    0.0708
0.0511    0.1272    0.0143    0.0178
              Brake:    0.0053    0.0053    0.0053    0.0053    0.0053    0.0053
0.0053    0.0053    0.0053    0.0053
               Tire:    0.0020    0.0020    0.0020    0.0020    0.0022    0.0020
0.0020    0.0065    0.0010    0.0024
           Total PM:    0.0114    0.0116    0.0116    0.0116    0.0461    0.0781
0.0585    0.1390    0.0206    0.0255
                SO2:    0.0068    0.0088    0.0115    0.0090    0.0165    0.0085
0.0159    0.0377    0.0033    0.0109
                NH3:    0.1017    0.1013    0.1012    0.1013    0.0451    0.0068
0.0068    0.0270    0.0113    0.0915
 ---------------------------------------------------------------------------------
----------------------------------------
```

```
*********************************************************************
****
* MOBILE6.2.03 (24-Sep-2003)
*
* Input file: RANA09JE.IN (file 1, run 1).
*
*********************************************************************
****

* Reading Registration Distributions from the following external
* data file: KYREGD09.D
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)

* Reading Hourly Roadway VMT distribution from the following external
* data file: JE09FVMT.D

  Reading User Supplied ROADWAY VMT Factors

* Reading Hourly, Roadway, and Speed VMT dist. from the following
external
* data file: JE09SVMT.D

* # # # # # # # # # # # # # # # # # # # # # # # # # # #
*
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # # # #
```

```
* Reading PM Gas Carbon ZML Levels
* from the external data file PMGZML.CSV

* Reading PM Gas Carbon DR1 Levels
* from the external data file PMGDR1.CSV

* Reading PM Gas Carbon DR2 Levels
* from the external data file PMGDR2.CSV

* Reading PM Diesel Zero Mile Levels
* from the external data file PMDZML.CSV

* Reading the First PM Deterioration Rates
* from the external data file PMDDR1.CSV

* Reading the Second PM Deterioration Rates
* from the external data file PMDDR2.CSV
  M616 Comment:
               User has supplied post-1999 sulfur levels.
  M615 Comment:
               User supplied VMT mix.
  M 48 Warning:
             there are no sales for vehicle class HDGV8b
 HDDV DEFEAT DEVICE EFFECTS ARE PRESENT. THE REBUILD FRACTION IS 0.10.

* Reading Ammonia (NH3) Basic Emissiion Rates

NOTICE
------
   Emission factors below were derived from MOBILE6 DATABASE OUTPUT
file
   RaNA09je.TB1 as converted by CVTM6EF.EXE (version 2.34 by Gary
Flispart 6/25/2004).

VMT FACILITY Distribution:

   All Facility Types   1.00000
   Freeway/Expressway   0.42130
   Arterial/Collector   0.43750
   Local                0.09780
   Ramp                 0.04340

ALL FACILITY TYPES ARE INCLUDED IN FACTORS BELOW

Emissions factors in grams/mile of total VMT for all MOBILE6 vehicle
types

ALL_VEH____LDGV___LDGT1___LDGT2___LDGT3___LDGT4__HDGV2B___HDGV3___HDGV4
___HDGV5___HDGV6___HDGV7__HDGV8A__HDGV8B____LDDV__LDDT12__HDDV2B___HDDV
3___HDDV4___HDDV5___HDDV6___HDDV7__HDDV8A__HDDV8B______MC____HDGB___HDD
BT___HDDBS__LDDT34__
```

VMT distribution:
1.00000 0.53653 0.06899 0.22975 0.01429 0.00660 0.03443 0.00119 0.00035
0.00116 0.00251 0.00103 0.00000 0.00000 0.00050 0.00001 0.01048 0.00321
0.00325 0.00154 0.00749 0.01077 0.01290 0.04590 0.00350 0.00012 0.00100
0.00218 0.00031

HC Total Emissions LESS Evap Refueling:
0.660 0.723 0.652 0.693 0.596 0.646 0.362 0.345 0.493
0.430 0.424 0.461 0.542 0.000 0.253 2.510 0.136 0.149
0.182 0.201 0.256 0.315 0.320 0.376 2.560 1.106 0.235
0.429 0.292
HC Total Emissions:
0.696 0.751 0.696 0.737 0.670 0.720 0.495 0.592 0.741
0.719 0.709 0.772 0.870 0.000 0.253 2.510 0.136 0.149
0.182 0.201 0.256 0.315 0.320 0.376 2.560 1.467 0.235
0.429 0.292
HC Exhaust:
0.196 0.170 0.173 0.193 0.202 0.227 0.196 0.200 0.225
0.229 0.226 0.251 0.280 0.000 0.145 0.719 0.136 0.149
0.182 0.201 0.256 0.315 0.320 0.376 1.375 0.538 0.235
0.429 0.199
HC Startup:
0.191 0.211 0.221 0.242 0.216 0.241 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.108 1.791 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000 0.711 0.000 0.000
0.000 0.093
HC Evap Hot Soak:
0.111 0.143 0.102 0.102 0.065 0.065 0.059 0.050 0.090
0.074 0.074 0.078 0.098 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000 0.021 0.166 0.000
0.000 0.000
HC Evap Diurnal:
0.011 0.013 0.011 0.011 0.008 0.008 0.007 0.007 0.019
0.011 0.011 0.012 0.015 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000 0.004 0.036 0.000
0.000 0.000
HC Evap Resting Loss:
0.071 0.085 0.072 0.072 0.047 0.047 0.037 0.032 0.089
0.054 0.052 0.056 0.076 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000 0.449 0.179 0.000
0.000 0.000
HC Evap Running Loss:
0.071 0.091 0.063 0.063 0.048 0.048 0.052 0.047 0.060
0.051 0.051 0.053 0.062 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.179 0.000
0.000 0.000
HC Evap Crankcase:
0.009 0.009 0.010 0.010 0.010 0.010 0.011 0.011 0.011
0.011 0.011 0.011 0.011 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.009 0.000
0.000 0.000

HC Evap Refueling:
0.036 0.028 0.044 0.044 0.074 0.074 0.133 0.247 0.248
0.289 0.285 0.311 0.328 0.000 0.000 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.361 0.000
0.000 0.000

CO Total Emissions:
10.583 11.546 11.739 12.568 11.196 11.404 6.313 6.786 7.041
7.671 7.565 8.420 9.115 0.000 1.015 4.487 0.630 0.698
0.866 0.934 0.942 1.168 1.574 1.886 12.368 13.122 2.362
1.493 0.531
CO Exhaust:
6.395 7.013 6.770 6.907 6.532 6.578 6.313 6.786 7.041
7.671 7.565 8.420 9.115 0.000 0.550 1.027 0.630 0.698
0.866 0.934 0.942 1.168 1.574 1.886 8.637 13.122 2.362
1.493 0.333
CO Startup:
4.188 4.533 4.969 5.661 4.665 4.826 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.465 3.460 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000 3.731 0.000 0.000
0.000 0.198

NOx Total Emissions:
1.546 0.705 0.648 0.883 0.838 1.140 2.628 2.731 2.753
3.060 3.034 3.368 3.692 0.000 0.701 3.029 3.070 3.336
4.173 4.489 5.633 6.992 8.537 10.005 1.657 5.721 13.387
9.853 0.686
NOx Exhaust:
1.423 0.573 0.519 0.712 0.701 0.955 2.628 2.731 2.753
3.060 3.034 3.368 3.692 0.000 0.673 2.656 3.070 3.336
4.173 4.489 5.633 6.992 8.537 10.005 1.103 5.721 13.387
9.853 0.669
NOx Startup:
0.124 0.131 0.129 0.170 0.137 0.184 0.000 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.028 0.373 0.000 0.000
0.000 0.000 0.000 0.000 0.000 0.000 0.554 0.000 0.000
0.000 0.018

CO2 Total Emissions:
530.6 368.3 477.4 477.4 622.6 622.6 876.9 945.7 952.5
1108.5 1091.9 1192.6 1258.2 0.0 317.0 425.7 786.7 873.6
998.5 1030.8 1169.0 1351.6 1545.6 1617.9 177.4 1384.6 2340.4
1645.6 598.2
CO2 Exhaust:
530.6 368.3 477.4 477.4 622.6 622.6 876.9 945.7 952.5
1108.5 1091.9 1192.6 1258.2 0.0 317.0 425.7 786.7 873.6
998.5 1030.8 1169.0 1351.6 1545.6 1617.9 177.4 1384.6 2340.4
1645.6 598.2

SO4 Total Emissions:
0.00061 0.00026 0.00046 0.00046 0.00046 0.00046 0.00164 0.00165 0.00147
0.00150 0.00150 0.00149 0.00147 0.00000 0.00044 0.00063 0.00147 0.00163
0.00187 0.00192 0.00219 0.00252 0.00289 0.00302 0.00009 0.00106 0.00437
0.00308 0.00084

```
SO4             Exhaust:
0.00061 0.00026 0.00046 0.00046 0.00046 0.00046 0.00164 0.00165 0.00147
0.00150 0.00150 0.00149 0.00147 0.00000 0.00044 0.00063 0.00147 0.00163
0.00187 0.00192 0.00219 0.00252 0.00289 0.00302 0.00009 0.00106 0.00437
0.00308 0.00084

Organic Carbon Total Emissions:
0.00418 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.01548 0.19027 0.03309 0.02942
0.03143 0.03055 0.05026 0.04957 0.06184 0.03482 0.00000 0.00000 0.07331
0.08682 0.02472
Organic Carbon Exhaust:
0.00418 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.01548 0.19027 0.03309 0.02942
0.03143 0.03055 0.05026 0.04957 0.06184 0.03482 0.00000 0.00000 0.07331
0.08682 0.02472

Elem Carbon    Total Emissions:
0.00817 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.05488 0.13223 0.03179 0.02827
0.03020 0.02935 0.06397 0.06309 0.07871 0.11026 0.00000 0.00000 0.09330
0.11049 0.01718
Elem Carbon    Exhaust:
0.00817 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.05488 0.13223 0.03179 0.02827
0.03020 0.02935 0.06397 0.06309 0.07871 0.11026 0.00000 0.00000 0.09330
0.11049 0.01718

GASPM          Total Emissions:
0.00479 0.00377 0.00378 0.00378 0.00377 0.00377 0.03714 0.03723 0.03632
0.03549 0.03537 0.03580 0.03637 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.01418 0.05105 0.00000
0.00000 0.00000
GASPM          Exhaust:
0.00479 0.00377 0.00378 0.00378 0.00377 0.00377 0.03714 0.03723 0.03632
0.03549 0.03537 0.03580 0.03637 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.01418 0.05105 0.00000
0.00000 0.00000

Lead           Total Emissions:
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00001 0.00002 0.00002
0.00002 0.00002 0.00002 0.00002 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00003 0.00000
0.00000 0.00000
Lead           Exhaust:
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00001 0.00002 0.00002
0.00002 0.00002 0.00002 0.00002 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00003 0.00000
0.00000 0.00000

Gaseous SO2    Total Emissions:
0.01093 0.00681 0.00879 0.00879 0.01150 0.01150 0.01591 0.01720 0.01737
0.02028 0.01997 0.02185 0.02309 0.00000 0.00851 0.01145 0.02101 0.02333
0.02667 0.02753 0.03123 0.03610 0.04129 0.04322 0.00330 0.02557 0.06252
0.04396 0.01606
```

Gaseous SO2 Exhaust:
0.01093 0.00681 0.00879 0.00879 0.01150 0.01150 0.01591 0.01720 0.01737
0.02028 0.01997 0.02185 0.02309 0.00000 0.00851 0.01145 0.02101 0.02333
0.02667 0.02753 0.03123 0.03610 0.04129 0.04322 0.00330 0.02557 0.06252
0.04396 0.01606

Ammonia Total Emissions:
0.09149 0.10170 0.10128 0.10128 0.10121 0.10121 0.04506 0.04506 0.04506
0.04506 0.04506 0.04506 0.04506 0.00000 0.00675 0.00672 0.02704 0.02704
0.02704 0.02704 0.02704 0.02704 0.02704 0.02704 0.01127 0.04506 0.02704
0.02703 0.00676
Ammonia Exhaust:
0.09149 0.10170 0.10128 0.10128 0.10121 0.10121 0.04506 0.04506 0.04506
0.04506 0.04506 0.04506 0.04506 0.00000 0.00675 0.00672 0.02704 0.02704
0.02704 0.02704 0.02704 0.02704 0.02704 0.02704 0.01127 0.04506 0.02704
0.02703 0.00676

Brake PM Total Emissions:
0.00533 0.00533 0.00533 0.00533 0.00533 0.00533 0.00533 0.00533 0.00533
0.00533 0.00533 0.00533 0.00533 0.00000 0.00534 0.00528 0.00533 0.00533
0.00533 0.00533 0.00533 0.00533 0.00533 0.00533 0.00533 0.00532 0.00533
0.00532 0.00533
Brake PM Brake Wear:
0.00533 0.00533 0.00533 0.00533 0.00533 0.00533 0.00533 0.00533 0.00533
0.00533 0.00533 0.00533 0.00533 0.00000 0.00534 0.00528 0.00533 0.00533
0.00533 0.00533 0.00533 0.00533 0.00533 0.00533 0.00533 0.00532 0.00533
0.00532 0.00533

Tire PM Total Emissions:
0.00244 0.00200 0.00200 0.00200 0.00200 0.00200 0.00200 0.00300 0.00300
0.00300 0.00300 0.00300 0.00900 0.00000 0.00200 0.00206 0.00200 0.00300
0.00300 0.00300 0.00300 0.00300 0.00900 0.00900 0.00100 0.00301 0.00300
0.00301 0.00200
Tire PM Tire Wear:
0.00244 0.00200 0.00200 0.00200 0.00200 0.00200 0.00200 0.00300 0.00300
0.00300 0.00300 0.00300 0.00900 0.00000 0.00200 0.00206 0.00200 0.00300
0.00300 0.00300 0.00300 0.00300 0.00900 0.00900 0.00100 0.00301 0.00300
0.00301 0.00200

Benzene Evap Hot Soak:
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000
Benzene Evap Diurnal:
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000

MTBE Evap Hot Soak:
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000

```
MTBE           Evap Diurnal:
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000


Emissions factors in grams/mile of total VMT for all MOBILE5 and NEI
vehicle types

___LDGV___LDGT1___LDGT2____HDGV____LDDV____LDDT____HDDV______MC____HD2B
___HD345____HD67___HD8AB___HDBUS__

VMT distribution:
0.53653 0.29874 0.02089 0.04081 0.00050 0.00032 0.09871 0.00350 0.01048
0.00799 0.01826 0.05879 0.00318

HC  Total Emissions LESS Evap Refueling:
  0.723   0.683   0.612   0.373   0.253   0.359   0.311   2.560   0.136
0.173   0.291   0.364   0.368
HC  Total Emissions:
  0.751   0.727   0.686   0.530   0.253   0.359   0.311   2.560   0.136
0.173   0.291   0.364   0.368
HC  Exhaust:
  0.170   0.188   0.209   0.201   0.145   0.215   0.311   1.375   0.136
0.173   0.291   0.364   0.368
HC  Startup:
  0.211   0.237   0.224   0.000   0.108   0.144   0.000   0.711   0.000
0.000   0.000   0.000   0.000
HC  Evap Hot Soak:
  0.143   0.102   0.065   0.061   0.000   0.000   0.000   0.021   0.000
0.000   0.000   0.000   0.000
HC  Evap Diurnal:
  0.013   0.011   0.008   0.008   0.000   0.000   0.000   0.004   0.000
0.000   0.000   0.000   0.000
HC  Evap Resting Loss:
  0.085   0.072   0.047   0.039   0.000   0.000   0.000   0.449   0.000
0.000   0.000   0.000   0.000
HC  Evap Running Loss:
  0.091   0.063   0.048   0.052   0.000   0.000   0.000   0.000   0.000
0.000   0.000   0.000   0.000
HC  Evap Crankcase:
  0.009   0.010   0.010   0.011   0.000   0.000   0.000   0.000   0.000
0.000   0.000   0.000   0.000
HC  Evap Refueling:
  0.028   0.044   0.074   0.157   0.000   0.000   0.000   0.000   0.000
0.000   0.000   0.000   0.000

CO  Total Emissions:
 11.546  12.377  11.262   6.523   1.015   0.649   1.471  12.368   0.630
0.812   1.075   1.818   1.767
CO  Exhaust:
  7.013   6.875   6.546   6.523   0.550   0.354   1.471   8.637   0.630
0.812   1.075   1.818   1.767
```

```
CO  Startup:
  4.533   5.502   4.716   0.000   0.465   0.296   0.000   3.731   0.000
0.000   0.000   0.000   0.000

NOx Total Emissions:
  0.705   0.828   0.934   2.698   0.701   0.757   7.952   1.657   3.070
3.898   6.435   9.683  10.964
NOx Exhaust:
  0.573   0.668   0.782   2.698   0.673   0.728   7.952   1.103   3.070
3.898   6.435   9.683  10.964
NOx Startup:
  0.131   0.161   0.152   0.000   0.028   0.028   0.000   0.554   0.000
0.000   0.000   0.000   0.000

CO2 Total Emissions:
  368.3   477.4   622.6   908.9   317.0   593.1  1411.3   177.4   786.7
954.6  1276.7  1602.0  1864.2
CO2 Exhaust:
  368.3   477.4   622.6   908.9   317.0   593.1  1411.3   177.4   786.7
954.6  1276.7  1602.0  1864.2

SO4            Total Emissions:
0.00026 0.00046 0.00046 0.00162 0.00044 0.00083 0.00264 0.00009 0.00147
0.00178 0.00239 0.00299 0.00349
SO4            Exhaust:
0.00026 0.00046 0.00046 0.00162 0.00044 0.00083 0.00264 0.00009 0.00147
0.00178 0.00239 0.00299 0.00349

Organic Carbon Total Emissions:
0.00000 0.00000 0.00000 0.00000 0.01548 0.02969 0.04213 0.00000 0.03309
0.03045 0.04986 0.04075 0.08257
Organic Carbon Exhaust:
0.00000 0.00000 0.00000 0.00000 0.01548 0.02969 0.04213 0.00000 0.03309
0.03045 0.04986 0.04075 0.08257

Elem Carbon    Total Emissions:
0.00000 0.00000 0.00000 0.00000 0.05488 0.02063 0.08242 0.00000 0.03179
0.02926 0.06345 0.10334 0.10508
Elem Carbon    Exhaust:
0.00000 0.00000 0.00000 0.00000 0.05488 0.02063 0.08242 0.00000 0.03179
0.02926 0.06345 0.10334 0.10508

GASPM          Total Emissions:
0.00377 0.00378 0.00377 0.03699 0.00000 0.00000 0.00000 0.01418 0.00000
0.00000 0.00000 0.00000 0.00000
GASPM          Exhaust:
0.00377 0.00378 0.00377 0.03699 0.00000 0.00000 0.00000 0.01418 0.00000
0.00000 0.00000 0.00000 0.00000

Lead           Total Emissions:
0.00000 0.00000 0.00000 0.00001 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000
Lead           Exhaust:
0.00000 0.00000 0.00000 0.00001 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000
```

Gaseous SO2 Total Emissions:
0.00681 0.00879 0.01150 0.01651 0.00851 0.01592 0.03770 0.00330 0.02101
0.02550 0.03410 0.04279 0.04980
Gaseous SO2 Exhaust:
0.00681 0.00879 0.01150 0.01651 0.00851 0.01592 0.03770 0.00330 0.02101
0.02550 0.03410 0.04279 0.04980

Ammonia Total Emissions:
0.10170 0.10128 0.10121 0.04506 0.00675 0.00676 0.02704 0.01127 0.02704
0.02704 0.02704 0.02704 0.02703
Ammonia Exhaust:
0.10170 0.10128 0.10121 0.04506 0.00675 0.00676 0.02704 0.01127 0.02704
0.02704 0.02704 0.02704 0.02703

Brake PM Total Emissions:
0.00533 0.00533 0.00533 0.00533 0.00534 0.00533 0.00533 0.00533 0.00533
0.00533 0.00533 0.00533 0.00533
Brake PM Brake Wear:
0.00533 0.00533 0.00533 0.00533 0.00534 0.00533 0.00533 0.00533 0.00533
0.00533 0.00533 0.00533 0.00533

Tire PM Total Emissions:
0.00200 0.00200 0.00200 0.00216 0.00200 0.00200 0.00647 0.00100 0.00200
0.00300 0.00300 0.00900 0.00301
Tire PM Tire Wear:
0.00200 0.00200 0.00200 0.00216 0.00200 0.00200 0.00647 0.00100 0.00200
0.00300 0.00300 0.00900 0.00301

Benzene Evap Hot Soak:
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000
Benzene Evap Diurnal:
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000

MTBE Evap Hot Soak:
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000
MTBE Evap Diurnal:
0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000
0.00000 0.00000 0.00000 0.00000

```
*********************************************************************
***
* MOBILE6.2.03 (24-Sep-2003)
*
* Input file: RANA09JE.IN (file 1, run 1).
*
*********************************************************************
****

* Reading Registration Distributions from the following external
* data file: KYREGD09.D
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)

* Reading Hourly Roadway VMT distribution from the following external
* data file: JE09FVMT.D

  Reading User Supplied ROADWAY VMT Factors

* Reading Hourly, Roadway, and Speed VMT dist. from the following
external
* data file: JE09SVMT.D
```

```
* # # # # # # # # # # # # # # # # # # # # # # # # # # #
*
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # # # #

* Reading PM Gas Carbon ZML Levels
* from the external data file PMGZML.CSV

* Reading PM Gas Carbon DR1 Levels
* from the external data file PMGDR1.CSV

* Reading PM Gas Carbon DR2 Levels
* from the external data file PMGDR2.CSV

* Reading PM Diesel Zero Mile Levels
* from the external data file PMDZML.CSV

* Reading the First PM Deterioration Rates
* from the external data file PMDDR1.CSV

* Reading the Second PM Deterioration Rates
* from the external data file PMDDR2.CSV
  M616 Comment:
               User has supplied post-1999 sulfur levels.
  M615 Comment:
               User supplied VMT mix.
  M 48 Warning:
             there are no sales for vehicle class HDGV8b
 HDDV DEFEAT DEVICE EFFECTS ARE PRESENT. THE REBUILD FRACTION IS 0.10.

* Reading Ammonia (NH3) Basic Emissiion Rates
* from the external data file PMNH3BER.D

* Reading Ammonia (NH3) Sulfur Deterioration Rates
* from the external data file PMNH3SDR.D
  M111 Warning:
               The input dIesel sulfur level of  43.0 ppm exceeds
               the 2007 HDD Rule diesel sulfur limit of 15 ppm.

                    Calendar Year:  2009
                            Month:  July
                         Altitude:  Low
              Minimum Temperature:  49.0 (F)
              Maximum Temperature:  66.0 (F)
                Absolute Humidity:   75. grains/lb
                 Nominal Fuel RVP:   6.9 psi
                    Weathered RVP:   6.9 psi
              Fuel Sulfur Content:   30. ppm

              Exhaust I/M Program:  No
                 Evap I/M Program:  No
                      ATP Program:  No
                 Reformulated Gas:  No
```

```
    Ether Blend Market Share: 0.000       Alcohol Blend Market Share:
                                   1.000
   Ether Blend Oxygen Content: 0.021     Alcohol Blend Oxygen Content:
0.036
                                          Alcohol Blend RVP Waiver: No

       Vehicle Type:      LDGV    LDGT12    LDGT34      LDGT      HDGV
LDDV      LDDT      HDDV        MC   All Veh
                GVWR:                <6000     >6000     (All)
                          ------    ------    ------    ------    ------
------    ------    ------    ------    ------
   VMT Distribution:    0.5365    0.2988    0.0209              0.0408
0.0005    0.0003    0.0987    0.0035    1.0000
 Fuel Economy (mpg):      24.1      18.6      14.2      18.2       9.8
32.1      17.2       7.2      50.0      17.3
  ---------------------------------------------------------------------
-------------------------------------------------
 Composite Emission Factors (g/mi):
     Composite VOC :      0.751     0.727     0.686     0.724     0.530
0.253     0.358     0.311      2.56     0.696
     Composite CO  :     11.55     12.38     11.26     12.30      6.52
1.015     0.649     1.472     12.37    10.584
     Composite NOX :      0.705     0.828     0.934     0.835     2.698
0.701     0.757     7.953      1.66     1.547
     Composite CO2 :    368.3     477.5     622.6     486.9     909.0
317.0     593.1    1411.4      177.4    530.64
   ---------------------------------------------------------------------
                        ----------------------------
```

```
MOBILE6 INPUT FILE :
POLLUTANTS         : HC CO NOX CO2
PARTICULATES       :
*AIR TOXICS         :
REPORT FILE        : RaNA09JE.OUT
SPREADSHEET        : RaNA09JE
DATABASE OUTPUT    :
WITH FIELDNAMES    :
DAILY OUTPUT       :
RUN DATA           :
EXPRESS HC AS VOC  :
REBUILD EFFECTS    : 0.10
* Assume Jefferson County, KY Registration Distribution based on 1997-
99 data
REG DIST           : KYREGD09.D
* Local VMT and speed distributions
VMT BY FACILITY    : JE09fvmt.d
SPEED VMT          : JE09svmt.d
* ------------------------------- Scenario   1 ------------------------
-------
SCENARIO RECORD    :
ALTITUDE           : 1
CALENDAR YEAR      : 2009
EVALUATION MONTH   : 7
* Humidity for PMConf_SIP, Jefferson County, KY
ABSOLUTE HUMIDITY  : 75.0
* PMConf_SIP Temperatures
MIN/MAX TEMP       :   49.0  66.0
* ------------------------ If PARTICULATES specified ----------------
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV
PMDDR1.CSV PMDDR2.CSV
* Only PM10 or PM2.5 (mutually exclusive) can be calculated in one run!
PARTICLE SIZE      : 00002.5
* Diesel Sulfur from EPA August 2004 guidance (hwydieselsulfur.pdf)
* sulfur content regulated to 500 ppm pre-2006, 15 ppm 2006+
DIESEL SULFUR      : 000043.0
* ------------------------ If *AIR TOXICS is specified --------------
*ADDITIONAL HAPS    : HAP_MTB2.CSV
* RFG PMConf NORTH FUEL (*AIR TOXICS VARIATION)
FUEL PROGRAM       : 4
 150.0  149.0  129.0  120.0  120.0   90.0   30.0   30.0
  30.0   30.0   30.0   30.0   30.0   30.0   30.0   30.0
1000.0 1000.0 1000.0 1000.0  303.0  303.0   87.0   87.0
  80.0   80.0   80.0   80.0   80.0   80.0   80.0   80.0
FUEL RVP           :   6.94
* The following RFG parameters are based on EPA RFG fuel survey for
Louisville
* for PMConf 2005 as published on EPA website
GAS AROMATIC%      : 16.13
GAS OLEFIN%        :  3.46
GAS BENZENE%       :  0.888
E200               : 46.5
E300               : 87.4
```

```
 * The following OXYGENATE and RVP OXY WAIVER parameters are equivalent
                                  to
* 100% Ethanol-based RFG assuming 3.5% by weight (M6.2 UG 2.8.10.7.f)
OXYGENATE          : MTBE    11.76  0.0001
                     ETBE    13.60  0.0000
                     ETOH    10.36  0.9999
                     TAME    12.70  0.0000
RVP OXY WAIVER     : 1
* ---------------------------------------------------------------------
------
*
*  MOBILE6 UG Chap 5 -- VMT MIX valid for calendar year:       2009
*
VMT FRACTIONS      :
0.5370 0.0690 0.2298 0.0145 0.0067 0.0449 0.0044 0.0036
0.0027 0.0100 0.0118 0.0129 0.0459 0.0023 0.0010 0.0035
*
*  Mix Sum  1.0000
*

* ------------------------------- Scenario   1 of 1 -------------------
------
* Evaluate ALL functional classes at once using local SPEED VMT
distribution
*
END OF RUN         :
```

Appendix I

Public Participation Documents

Annual 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

Summary/Response to Comments Received at Public Hearing

On May 7, 2008, the Indiana Department of Environmental Management (IDEM) conducted a public hearing concerning the draft attainment demonstration and technical support document of the annual fine particulate matter ($PM_{2.5}$) standard for the Indiana portion of the Louisville KY-IN Fine Particle Nonattainment Area, Jefferson County (Madison Township) and Clark and Floyd Counties, Indiana. There were no comments received during the public hearing.

Summary/Response to Comments Received During Comment Period

IDEM requested public comment on the draft attainment demonstration and technical support document for Indiana's portion of the Louisville KY-IN Fine Particle Nonattainment Area from April 4, 2008 through May 9, 2008. IDEM received comments from the following parties:

Randy Simon, Regional Planner, Kentuckiana Regional Planning and Development Agency (RS)
John S. Lyons, Director, Kentucky Department of Environmental Protection (JL)

Following is a summary of comments received and IDEM's responses thereto:

Comment: In the first paragraph in Section 8.1, the Metropolitan Planning Organization (MPO) counties of the Kentuckiana Regional Planning and Development Agency (KIPDA) are discussed. Although this is not designated as a nonattainment county for $PM_{2.5}$, Oldham County, Kentucky is a part of the KIPDA MPO. (RS)

Language has been added to Section 8.1 to list Oldham County, Kentucky as part of the KIPDA MPO and to clarify that it is not designated as part of the nonattainment area.

Comment: In the second paragraph of Section 8.1, it states "the agencies which jointly determine regional significance." (emphasis added) It would probably be more informative to list these agencies as the ones who consulted in determining the mobile source budgets. Also, the list of agencies should include the Kentucky Environmental and Public Protection Cabinet. (RS)

The second paragraph of Section 8.1 has been revised to state that the agencies that make up the interagency consultation group jointly determine the mobile source emissions budget. The Kentucky Environmental and Public Protection Cabinet has been added to the list of agencies that make up the interagency consultation group.

Comment: In the second paragraph in Section 8.1, the last sentence states that "Primary responsibility for modeling emissions falls under the purview of KIPDA." KIPDA provides input data for MOBILE 6 emissions (emissions factor) model, and KIPDA sometimes estimates emissions, but to say that KIPDA models emissions may lead to a misunderstanding. (RS)

Based on this information, IDEM believes KIPDA's responsibilities are adequately addressed in the third paragraph of Section 8.1 and this sentence has been deleted.

Comment: In the third paragraph of Section 8.1, MOBILE6 is introduced. It would be helpful to add a few words e.g. "(see Section 8.2)" to indicate where more detail about the MOBILE model can be found. (RS)

Language has been added to the third paragraph of Section 8.1 to indicate that additional information regarding the travel demand forecasting model can be found in Section 8.2.

Comment: In several places in Section 8, the model is referred to as the "travel demand forecast model" or the "travel demand model". The commenter suggests that the term, "travel demand forecasting model", be used for consistency. (RS)

For consistency, the term "travel demand forecasting model" has replaced all other references to the travel model in Section 8.

Comment: In the first paragraph in Section 8.2, it is stated that each year analyzed will likely have some additional links (among other data). The use of the word "links" may be confusing in this context. It is suggested that "roadway sections" be used instead. (RS)

To provide further clarity, the term "links" has been replaced with the term "roadway sections" in the first paragraph of Section 8.2.

Comment: Near the end of the paragraph of Section 8.2, there is a sentence which states, "This information derives from the travel demand model." Perhaps it would be clearer to state, "The VMT information is derived from the travel demand forecasting model." This would clarify that the subject information is VMT and not emissions or emissions factors. (RS)

To provide further clarity, the language in Section 8.2 has been modified as requested.

Comment: In the first paragraph in Section 8.3, the sentences after the first sentence do not apply to the KIPDA model. This material may have been copied from a description from another model, but it is incorrect to state that the KIPDA model has the attributes listed in that paragraph. (RS)

These sentences have been deleted since they are inaccurate.

Comment: Likewise in the listing of formulas near the end of Section 8.3, (The listing starts with "The BPR (Bureau of Public Roads) Formula is used as follows:".), the formulas provided for Amtime, Pmtime, and Optime do not apply to the KIPDA model or air quality post-processor. (RS)

This language has been deleted since it is inaccurate.

Comment: For the "Socioeconomic data" portion of Section 8.3, there are four comments. (RS)

(a) TAZs are "traffic analysis zones" rather than "travel analysis zones".

In Section 8.3 the term "travel analysis zone" has been replaced with the term "traffic analysis zone to provide further clarity.

(b) The TAZs have zone-specific information regarding population, households, and employment and not destinations and expected growth.

The references to "destinations" and expected growth" being included as traffic analysis zones in the travel demand forecasting models have deleted in Section 8.3 since this is inaccurate.

(c) The model was last updated in 2005 rather than 2003.

Section 8.3 has been modified to state that the "socioeconomic data" included in the most recent travel demand forecasting model was updated in "2005" not "2003" based on 2000 census.

(d) The last two sentences of the paragraph are difficult to understand at the best and could be misinterpreted. They should be removed.

The sentences have deleted as they are inaccurate.

Comment: In the paragraph concerning speeds in Section 8.3, there is a sentence concerning the "most accurate and through MOBILE6 input speed method." The sentence contains a note in ( )'s which states, "(one for each type.)" Perhaps it would be clearer to state, "(one for Arterials and one for Freeways)." Using the suggested language for the note would clarify which two facility types would need to have speed tables. (RS)

To provide further clarity, the language in Section 8.3 has been modified as requested.

Comment: For Section 8.4, there are three comments. (RS)

(a) It should be noted that each future year model scenario contains the road network based on KIPDA's long range transportation plan (and Transportation Improvement Program for the near term).

To provide further clarity, the language in Section 8.4 has been modified as requested.

(b) Each analysis year network contains the projects expected to exist by the end rather than the beginning of that year.

The language in Section 8.4 has been revised to clarify that each future year analysis scenario contains the road network KIPDA expects to exist by the end (as opposed to the beginning) of that year based on socioeconomic forecasts.

(c) Each analysis year uses the accompanying socioeconomic forecasts rather than growth projections. (Some TAZs may show decline rather than growth.)

The language in Section 8.4 has been revised to clarify that the travel demand forecasting model uses "the accompanying socioeconomic forecasts" rather than "growth projections" for each future analysis year.

Comment: In Section 8.5 in the last sentence before Table 8.1, the 2005 emissions estimates are described as being "interpolated values based on the travel demand model network for 2002 and 2009." The emissions estimates were based on all the inputs to the model-and not just the network-for 2002 and 2009. It would be better to state "the 2005 emission estimates are interpolated values based on the 2002 and 2009 emission estimates." (RS)

To provide further clarity, the language in Section 8.5 has been modified as requested.

Comment: In Table 1.3 on Page 6, the design values for the Kentucky monitor sites do not agree with the Kentucky data submitted to the U.S. Environmental Protection Agency's Air Quality System database. The units are in micrograms per cubic meters ($\mu g/m^3$). Below is a summary of the data discrepancies. (JL)

Comparison between Indiana's and Kentucky's 2003-2006 Design Values ($\mu g/m^3$)

Monitor Site	IDEM Design Value ($\mu g/m^3$)	Kentucky Department of Air Quality Design Value ($\mu g/m^3$)
Bullitt: Carpenter Street	14.9	14.6
Hardin: Elizabethtown	13.5	13.3
Jefferson: Southern Avenue	15.7	15.6
Jefferson: Wyandotte Park	15.4	15.3
Jefferson: Barret Avenue	15.2	15.0
Jefferson: Watson Elementary	14.7	14.5

The modeled attainment test was based on the three most current 3-year design values, centered around 2005 (2003-2005, 2004-2006, 2005-2007). The fine particle attainment test used 2005-2006 as the third design value because 2007 data was not available at the time of the modeling. 2007 data has since been made available and review of the 2007 annual values shows that the 2005-2006 average design value for Southern Indiana was higher than the 2005-2007 design value. Therefore, the more conservative numbers will be used to determine future year design values for Southern Indiana.

Comment: In Table 3.6 on Page 27, the 2003 and 2004 design values for the Southern Avenue monitoring site are slightly different from the Kentucky data submitted to the U.S. Environmental Protection Agency's Air Quality System database. Table 3.6 lists the design values for 2003 and 2004 for Southern Avenue as 16.4 and 14.6 $\mu g/m^3$, respectively. According to Kentucky's data, the 2003 and 2004 design values for the Southern Avenue monitoring site are 16.0 and 14.5 $\mu g/m^3$, respectively. (JL)

Table 3.6 has been revised to incorporate Kentucky's 2003 and 2004 monitoring data for the Southern Avenue monitoring site as requested.

LEGAL NOTICE OF PUBLIC HEARING

STATE IMPLEMENTATON PLAN SUBMITTAL

Fine Particle ($PM_{2.5}$) Attainment Demonstration and Technical Support Plan for Jefferson County (Madison Township) and Clark and Floyd Counties, Indiana

Notice is hereby given under 40 CFR 51.102 that the Indiana Department of Environmental Management (IDEM) will hold a public hearing on Wednesday, May 7, 2008. The purpose of this hearing is to receive public comment on the amendment to the State Implementation Plan (SIP) developed for the purpose of complying with the attainment demonstration requirement of Section 172 (c) of the Clean Air Act (CAA), as it applies to Jefferson County (Madison Township) and Clark and Floyd Counties, Indiana. Public comments will also be received on the 2005 emissions inventory included in the attainment demonstration. The meeting will convene at 6:00 p.m. (local time) at the Clarksville Branch Library, 1312 Eastern Boulevard, Clarksville, Indiana. All interested persons are invited and will be given opportunity to express their views concerning the draft documents.

Jefferson County (Madison Township) and Clark and Floyd Counties, Indiana are part of the Louisville KY-IN Fine Particle Nonattainment Area. This area was designated as nonattainment area for the annual fine particle standard and subject to the requirements of Section 172 of the CAA. One of the compliance requirements mandated by Section 172 (c) of the CAA, is the development of a plan demonstrating that the area will meet the annual fine particle air quality standard by the required attainment date. This Fine Particle Attainment Demonstration Plan is being drafted and submitted consistent with United States Environmental Protection Agency (U.S. EPA) guidance.

The demonstration plan includes an air quality modeling analysis, an emissions inventory, an air quality and emissions trend analysis, a summary of current and anticipated emission control measures and mobile source emission budgets for purposes of transportation conformity. Public comments will be received on all components of the attainment demonstration SIP submittal.

Copies of the draft documents will be available on or before April 7, 2008 to any person upon request and at the following locations:

- Indiana Department of Environmental Management, Office of Air Quality, Indiana Government Center North, 100 North Senate, Room N1003, Indianapolis, Indiana.
- Clarksville Branch Library, 1312 Eastern Boulevard, Clarksville, Indiana.
- Charlestown-Clark County Public Library, 51 Clark Road, Charlestown, Indiana
- New Albany-Floyd County Public Library, 180 West Spring Street, New Albany, Indiana.
- Jeffersonville Township Public Library, 211 East Court Avenue, Jeffersonville, Indiana
- Madison-Jefferson County Public Library, 420 West Main Street, Madison, Indiana.

Oral statements will be heard, but for the accuracy of the record, statements should be submitted in writing. Written statements may be submitted to the attendant designated to receive written comments at the public hearing.

IDEM will also accept written comments through May 9, 2008. Mailed comments should be addressed to:

Louisville KY-IN Fine Particle Standard Attainment Demonstration
Scott Deloney, Chief
Air Programs Branch, Office of Air Quality – Mail Code 61-50
100 North Senate Avenue
Indiana Department of Environmental Management
Indianapolis, IN 46206-2251

A transcript of the hearing and all written submissions provided at the public hearing shall be open to public inspection at IDEM and copies may be made available to any person upon payment of reproduction costs. Any person heard or represented at the hearing or requesting notice shall be given written notice of actions resulting from the hearing.

For additional information contact Mr. Gale Ferris, at the Indiana Department of Environmental Management, Office of Air Quality, Room 1001, Indiana Government Center North, 100 North Senate Avenue, Indianapolis or call (317) 234-3653 or (800) 451-6027 ext. 4-3653 (in Indiana).

****

Individuals requiring reasonable accommodations for participation in this hearing should contact the IDEM Americans with Disabilities Act (ADA) coordinator at:

Attn: ADA Coordinator
Indiana Department of Environmental Management – Mail Code 50-10
100 North Senate Avenue
Indianapolis, IN 46204-2251

Or call (317) 233-1785 (voice) or (317) 232-6565 (TDD). Please provide a minimum of 72 hours notification.

MEMORANDUM

TO: Gale Ferris
Indiana Department of Environmental Management

FROM: Randy Simon
KIPDA Transportation Planner

DATE: May 16, 2008

SUBJECT: Follow-up comments concerning the Fine Particle Attainment Demonstration and Technical Support Document for the Indiana Portion of the Louisville, KY-IN Fine Particle Nonattainment Area

As per the request in your e-mail of May13, KIPDA staff have reviewed the revised section 8 of the Fine Particle Attainment Demonstration and Technical Support Document for the Indiana Portion of the Louisville, KY-IN Fine Particle Nonattainment Area. For the most part, the review concerned how the previous comments of KIPDA staff were addressed. The previous comments are provided below in black. The follow-up comments are shown in red. In addition, there were a few places in the document where it appeared that wording changes would clarify the discussion. These suggested wording changes have been included in new comments at the end of this memo.

Appendix H, which is referenced in Chapter 8, was not available to KIPDA staff and therefore not reviewed. The applicability of present or previous KIPDA comments (concerning Chapter 8) to the material in Appendix H may need to be reviewed.

(1) In the first paragraph in section 8.1, the MPO counties of KIPDA are discussed. Although it is not designated as a nonattainment county for PM 2.5, Oldham County, KY is a part of the KIPDA MPO.

This comment has been addressed as it was originally stated. After reading the revised paragraph, it appears that the original comment of KIPDA staff should have stated that it would probably be helpful to indicate the difference between the MPO counties and the fine particle nonattainment area. An additional sentence could be added to the revised paragraph stating that all of the MPO counties except Oldham are in the fine particle nonattainment area as is the Madison Township of Jefferson County, IN.

(2) In the second paragraph of section 8.1, the agencies which jointly determine regional significance. (emphasis added) It would probably more informative to list these agencies as the ones who consulted in determining the mobile source budgets. Also, the list of agencies should include the Kentucky Environmental and Public Protection Cabinet.

The portion of this comment concerning consultation in determining mobile source budgets rather than consultation in determining regional significance has been addressed. However, the list of agencies still does not include the Kentucky Environmental and Public Protection Cabinet.

(3) In the second paragraph in section 8.1, the last sentence states that "Primary responsibility of modeling emissions falls under the purview of KIPDA." KIPDA provides input data for the MOBILE 6 emissions (emission factor) model, and KIPDA sometimes estimates emissions, but to say that KIPDA models emissions may lead to a misunderstanding.

It appears that this comment was addressed by removing the last sentence of the second paragraph in section 8.1. This addresses the comment of KIPDA staff but leaves only one sentence in the second paragraph in section 8.1. If having only one sentence in this paragraph is not a concern to IDEM, it is not a concern for KIPDA staff.

(4) In the first paragraph in section 8.2, it is stated that each year analyzed will likely have some additional links (among other data). The use of the word "links" may be confusing in this context. It is suggested that "roadway sections" be used instead.

This comment has been addressed.

(5) In the first paragraph in section 8.3, the sentences after the first sentence do not apply to the KIPDA model. This material may have been copied from a description from another model, but it is incorrect to state that the KIPDA model has the attributes listed in that paragraph.

It appears that this comment was addressed by removing all the sentences of the first paragraph in section 8.3 except for the first sentence. This addresses the comment of KIPDA staff but leaves only one sentence in the first paragraph in section 8.3. If having only one sentence in this paragraph is not a concern to IDEM, it is not a concern for KIPDA staff.

(6) Likewise in the listing of formulas near the end of section 8.3 (The listing starts with "The BPR (Bureau of Public Roads) Formula is used as follows:".), the formulas provided for Amtime, Pmtime, and Optime do not apply to the KIPDA model or air quality post-processor.

This comment has been addressed.

(7) For the "Socioeconomic data" portion of section 8.3, there are four comments.

(a) TAZs are traffic analysis zones rather than travel analysis zones.

(b) The TAZs have zone-specific information regarding population, households, and employment and not destinations and expected growth.
(c) The model was last updated in 2005 rather than 2003.
(d) The last two sentences of the paragraph are difficult to understand at best and could be misinterpreted. They should be removed.

These comments have been addressed.

(8) For section 8.4, there are three comments.
(a) It should be noted that each future year model scenario contains the road network based on KIPDA's long range transportation plan (and Transportation Improvement Program for the near term).
(b) Each analysis year network contains the projects expected to exist by the end rather than the beginning of that year.
(c) Each analysis year uses the accompanying socioeconomic forecasts rather than growth projections. (Some TAZs may show decline rather than growth.)

These comments have been addressed.

(9) In section 8.5 in the last sentence before Table 8.1, the 2005 emissions estimates are described as being "interpolated values based on the travel demand model network for 2002 and 2009." The emission estimates were based on all of the inputs to the model—and not just the network—for 2002 and 2009. It would probably be better to state the 2005 emission estimates are interpolated values based on the 2002 and 2009 emission estimates.

This comment has been addressed.

New Comments

(10) In the third paragraph of section 8.1, MOBILE6 is introduced. It would be helpful to add a few words—e.g. (see Section 8.2)—to indicate where more detail about the MOBILE model can be found.

(11) In several places in section 8, the model is referred to as the travel demand model forecast model or the travel demand model. KIPDA staff suggest that the term, travel demand forecasting model, be used for consistency.

(12) Near the end of the paragraph of section 8.2, there is a sentence which states, "This information derives from the travel demand model." Perhaps it would be clearer to state, "The VMT information is derived from the travel demand forecasting model." This would clarify that the subject information is VMT and not emissions or emission factors. Also, see comment 11.

(13) In the paragraph concerning speeds in section 8.3, there is a sentence concerning the "most accurate and thorough MOBILE6 speed input method." The sentence contains a note in ()'s which states, "(one for each facility type)." Perhaps it would be clearer to state, "(one for Arterials and one for

Freeways)." Using the suggested language for the note would clarify which 2 facility types would need to have speed tables.

(14) In the next-to-last paragraph in section 8.5, there are several occurrences where it is stated that a cushion was applied to the Budget. It would probably be clearer to state that a cushion was applied to the expected 2009 emission levels in establishing the $PM_{2.5}$ and NOx Budgets. In other words, the cushion is a part of each Budget rather than being added to them.

MEMORANDUM

TO: Gale Ferris
Indiana Department of Environmental Management

FROM: Randy Simon
KIPDA Transportation Planner

DATE: May 9, 2008

SUBJECT: Comments concerning the Fine Particle Attainment Demonstration and Technical Support Document for the Indiana Portion of the Louisville, KY-IN Fine Particle Nonattainment Area

KIPDA staff have reviewed the Fine Particle Attainment Demonstration and Technical Support Document for the Indiana Portion of the Louisville, KY-IN Fine Particle Nonattainment Area. Because of time considerations, the comments are limited to chapter 8 of the document. This is the chapter which concerns the mobile source budgets for fine particulate matter (PM 2.5) and its precursors. Therefore, chapter 8 is the one of greatest concern to KIPDA.

Chapter 8 references Appendix H as being the location of the detailed mobile input and output files. Since the appendices were not included in the electronic copy of the document, KIPDA staff have not reviewed Appendix H.

Below are the comments of KIPDA staff. The comments are presented in the same order as the portions of the document which they concern.

(1) In the first paragraph in section 8.1, the MPO counties of KIPDA are discussed. Although it is not designated as a nonattainment county for PM 2.5, Oldham County, KY is a part of the KIPDA MPO.

(2) In the second paragraph of section 8.1, the agencies which jointly determine <u>regional significance</u>. (emphasis added) It would probably more informative to list these agencies as the ones who consulted in determining the mobile source budgets. Also, the list of agencies should include the Kentucky Environmental and Public Protection Cabinet.

(3) In the second paragraph in section 8.1, the last sentence states that "Primary responsibility of modeling emissions falls under the purview of KIPDA." KIPDA provides input data for the MOBILE 6 emissions (emission factor) model, and KIPDA sometimes estimates emissions, but to say that KIPDA models emissions may lead to a misunderstanding.

(4) In the first paragraph in section 8.2, it is stated that each year analyzed will likely have some additional links (among other data). The use of the word "links" may be confusing in this context. It is suggested that "roadway sections" be used instead.

(5) In the first paragraph in section 8.3, the sentences after the first sentence do not apply to the KIPDA model. This material may have been copied from a description from another model, but it is incorrect to state that the KIPDA model has the attributes listed in that paragraph.

(6) Likewise in the listing of formulas near the end of section 8.3 (The listing starts with "The BPR (Bureau of Public Roads) Formula is used as follows:".), the formulas provided for Amtime, Pmtime, and Optime do not apply to the KIPDA model or air quality post-processor.

(7) For the "Socioeconomic data" portion of section 8.3, there are four comments.
   (a) TAZs are traffic analysis zones rather than travel analysis zones.
   (b) The TAZs have zone-specific information regarding population, households, and employment and not destinations and expected growth.
   (c) The model was last updated in 2005 rather than 2003.
   (d) The last two sentences of the paragraph are difficult to understand at best and could be misinterpreted. They should be removed.

(8) For section 8.4, there are three comments.
   (a) It should be noted that each future year model scenario contains the road network based on KIPDA's long range transportation plan (and Transportation Improvement Program for the near term).
   (b) Each analysis year network contains the projects expected to exist by the end rather than the beginning of that year.
   (c) Each analysis year uses the accompanying socioeconomic forecasts rather than growth projections. (Some TAZs may show decline rather than growth.)

(9) In section 8.5 in the last sentence before Table 8.1, the 2005 emissions estimates are described as being "interpolated values based on the travel demand model network for 2002 and 2009." The emission estimates were

based on all of the inputs to the model—and not just the network—for 2002 and 2009. It would probably be better to state the 2005 emission estimates are interpolated values based on the 2002 and 2009 emission estimates.

Steven L. Beshear
Governor

Robert D. Vance
Secretary

Commonwealth of Kentucky
Environmental and Public Protection Cabinet
Department for Environmental Protection
Division for Air Quality
803 Schenkel Lane
Frankfort, Kentucky 40601-1403
www.air.ky.gov

May 9, 2008

Ms. Amy Bukarica
Indiana Department of Environmental Management
Office of Air Quality
Indiana Government Center North
100 North Senate Avenue, Room N1001
Indianapolis, Indiana 46204

Dear Ms. Bukarica:

The Division for Air Quality has reviewed the Indiana Department of Environmental Management (IDEM) document titled, "Fine Particle Attainment Demonstration and Technical Support Document for the Indiana Portion of the Louisville KY-IN Fine Particle Nonattainment Area," for Jefferson County (Madison Township) and Clark and Floyd Counties, Indiana. Kentucky offers to make the following comments.

1) In Table 1.3 on page 6, the design values for the Kentucky monitor sites do not agree with the Kentucky data submitted to the U.S. Environmental Protection Agency's Air Quality System database. The units are in micrograms per cubic meters ($\mu g/m^3$). Below is a summary of the data discrepancies.

Comparison Between Indiana's and Kentucky's 2003-2006 Design Values ($\mu g/m^3$)

Monitor Site	IDEM Design Value ($\mu g/m^3$)	KDAQ Design Value ($\mu g/m^3$)
Bullitt: Carpenter Street	14.9	14.6
Hardin: Elizabethtown	13.5	13.3
Jefferson: Southern	15.7	15.6
Jefferson: Wyandotte	15.4	15.3
Jefferson: Barret	15.2	15.0
Jefferson: Watson	14.7	14.5

2) In Table 3.6 on page 27, the design values for the Southern Avenue site in 2003 and 2004 are slightly different from the Kentucky data submitted to the U.S. Environmental Protection Agency's Air Quality System database. The table lists the design values for these sites as 16.4 and 14.6 $\mu g/m^3$, respectively. According to Kentucky's data for these sites, the design values are 16.0 and 14.5 $\mu g/m^3$, respectively.

The Division appreciates the opportunity to review this submittal and looks forward to the continued cooperation with your staff in matters relating to transportation/air quality planning. If you have any questions regarding this matter, please contact Joe Forgacs of my staff at (502) 573-3382.

Sincerely,

John S. Lyons
Director

JSL/jmf

cc: Dianna Smith, U.S. EPA – Region 4
Harold Tull, KIPDA
Lynn Soporowski, KYTC

IND DEPT OF ENVIRONMENTAL MGMT

MARION COUNTY, INDIANA

To: INDIANAPOLIS NEWSPAPERS
307 N PENNSYLVANIA ST - PO BOX 145
INDIANAPOLIS, IN 46206-0145

PUBLISHER'S CLAIM

RECEIVED
STATE OF INDIANA
APR 7 2008
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OFFICE OF AIR QUALITY

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Display Matter - (Must not exceed two actual lines, neither of which shall total more than four solid lines of the type in which the body of the advertisement is set) Number of equivalent lines $_____

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COMPUTATION OF CHARGES

184.0 lines 1.0 columns wide equals 184.0 equivalent $ 72.31

lines at .393 cents per line

Additional charge for notices containing rule and figure work (50 per cent of above amount) $_____

Charges for extra proofs of publication ($1.00 for each proof in excess of two) $ .00 $ .00

TOTAL AMOUNT OF CLAIM $_____

DATA FOR COMPUTING COST $_____

Width of single column 7.83 ems Size of type 5.7 point $_____ $_____

Number of insertions 1.0 $ 72.31

Pursuant to the provisions and penalties of Chapter 155, Acts of 1953,
I hereby certify that the foregoing account is just and correct, that the amount claimed is legally due, after allowing all just credits, and that no part of the same has been paid.

DATE: 04/02/2008

Karen Mullins Clerk
Title

81956-5174149

PUBLISHER'S AFFIDAVIT

State of Indiana SS:
MARION County

Personally appeared before me, a notary public in and for said county and state, the undersigned **Karen Mullins** who, being duly sworn, says that SHE is clerk of the INDIANAPOLIS NEWSPAPERS a DAILY STAR newspaper of general circulation printed and published in the English language in the city of INDIANAPOLIS in state and county aforesaid, and that the printed matter attached hereto is a true copy, which was duly published in said paper for 1 time(s), between the dates of

04/02/2008 and **04/02/2008**

Karen Mullins Clerk
Title

Subscribed and sworn to before me on **04/02/2008**

Denise Hambrite
Notary Public

DENISE HAMBRITE
NOTARY PUBLIC
SEAL
STATE OF INDIANA
MY COMMISSION EXPIRES February 28, 2016

Form 65-REV 1-88

My commission expires: _____

STATE PRESCRIBED FORMULA

7.83 PICA COLUMN - 94 POINT
94 POINTS / 5.7 PT. TYPE - 16.49
16.49 EMS / 250 - .06596 SQUARES
.06596 SQUARES x $5.14 - .339 CENTS PER LINE

RATE PER LINE

PUBLISHED 1 TIME = .339
PUBLISHED 2 TIMES= .509
PUBLISHED 3 TIMES= .679
PUBLISHED 4 TIMES= .848

5 PUBLIC NOTICES

LEGAL NOTICE
OF PUBLIC HEARING
STATE IMPLEMENTATION
PLAN SUBMITTAL

Fine Particle (PM2.5) Attainment Demonstration and Technical Support Document for Jefferson County (Madison Township) and Clark and Floyd Counties, Indiana

Notice is hereby given under 40 CFR 51.102 that the Indiana Department of Environmental Management (IDEM) will hold a public hearing on Wednesday, May 7, 2008. The purpose of this hearing is to receive public comment on the amendment to the State Implementation Plan (SIP) developed for the purpose of complying with the attainment demonstration requirement of Section 172 (c) of the Clean Air Act (CAA), as it applies to Jefferson County (Madison Township) and Clark and Floyd Counties, Indiana. Public comments will also be received concerning the 2005 emissions inventory included in the attainment demonstration. The meeting will convene at 5:30 p.m. (local time) at the Clarksville Branch Library, 1312 Eastern Boulevard, Clarksville, Indiana. All interested persons are invited and will be given opportunity to express their views concerning the draft documents.

Jefferson County (Madison Township) and Clark and Floyd Counties, Indiana are part of the Louisville KY-IN Fine Particle Nonattainment Area. This area was designated as nonattainment for the annual fine particle standard and subject to the requirements of Section 172 of the CAA. One of the compliance requirements mandated by Section 172 (c) of the CAA, is the development of a plan demonstrating that the area will meet the annual fine particle air quality standard by the required attainment date. This Fine Particle Attainment Demonstration Plan is being drafted and submitted consistent with United States Environmental Protection Agency (U.S. EPA) guidance.

The attainment demonstration includes an air quality modeling analysis, an emissions inventory, an air quality and emissions trend analysis, a summary of current and anticipated emission control measures and mobile source emission budgets for purposes of transportation conformity. Public comments will be received on all components of the attainment demonstration SIP submittal.

Copies of the draft documents will be available on or before April 4, 2008 to any person upon request and at the following locations:

•Indiana Department of Environmental Management, Office of Air Quality, Indiana Government Center North, 100 North Senate, Room N1003, Indianapolis, Indiana.

•Clarksville Branch Library, 1312 Eastern Boulevard, Clarksville, Indiana

•Floyd County Public Library, 180 West Spring Street, New Albany, Indiana.

•Jeffersonville Township Public Library, 211 East Court Avenue, Jeffersonville, Indiana

•Madison-Jefferson County Public Library, 420 West Main Street, Madison, Indiana.

Oral statements will be heard, but for the accuracy of the record, statements should be submitted in writing. Written statements may be submitted to the attendant designated to receive written comments at the public hearing.

IDEM will also accept written comments through May 9, 2008. Mailed comments should be addressed to:

Louisville KY-IN Fine Particle Standard Attainment Demonstration
Scott Deloney, Chief
Air Programs Branch, Office of Air Quality-Mail Code 61-50
100 North Senate Avenue
Indiana Department of Environmental Management
Indianapolis, IN 46206-2251

A transcript of the hearing and all written submissions provided at the public hearing shall be open to public inspection at IDEM and copies may be made available to any person upon payment of reproduction costs. Any person heard or represented at the hearing or requesting notice shall be given written notice of actions resulting from the hearing.

For additional information contact Mr. Gale Ferris, at the Indiana Department of Environmental Management, Office of Air Quality, Room 1003, Indiana Government Center North, 100 North Senate Avenue, Indianapolis or call (317) 234-3653 or (800) 451-6027 ext. 4-3653 (in Indiana).

Individuals requiring reasonable accommodations for participation in this hearing should contact the IDEM Americans with Disabilities Act (ADA) coordinator at:

Attn: ADA Coordinator
Indiana Department of Environmental Management - Mail Code 50-10
100 North Senate Avenue
Indianapolis, IN 46204-2251
Or call (317) 233-1785 (voice) or (317) 232-6565 (TDD). Please provide a minimum of 72 hours notification.

(S - 4/2 - $174149)

88

STA FORMULA
7.83 - 94 POINT
94 P YPE - 16.49
16.49 596 SQUARES
.0659 5.14 - .339 CENTS PER LINE

State of Indiana SS:
MARION County

Personally appeared before me, a notary public in and for said county and state, the undersigned **Karen Mullins** who, being duly sworn, says that SHE is clerk of the INDIANAPOLIS NEWSPAPERS a DAILY STAR newspaper of general circulation printed and published in the English language in the city of INDIANAPOLIS in state and county aforesaid, and that the printed matter attached hereto is a true copy, which was duly published in said paper for 1 time(s), between the dates of: 04/02/2008 and 04/02/2008

Clerk
Title

Subscribed and sworn to before me on 04/02/2008

Denise Hambrite
Notary Public

My commission expires:

DENISE HAMBRITE
NOTARY PUBLIC
SEAL
STATE OF INDIANA
MY COMMISSION EXPIRES February 20, 2016

RATE PER LINE

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PUBLISHED 2 TIMES= .509
PUBLISHED 3 TIMES= .679
PUBLISHED 4 TIMES= .848

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

Mitchell E. Daniels Jr.
Governor

Thomas W. Easterly
Commissioner

100 North Senate Avenue
Indianapolis, Indiana 46204
(317) 232-8603
Toll Free (800) 451-6027
www.idem.IN.gov

April 1, 2008

Indianapolis Star/News
307 North Pennsylvania Street
PO Box 145
Indianapolis, Indiana 46206-0145

Phone: 317-444-4000
Fax: 317-444-8806

ATTENTION: PUBLIC NOTICES - LEGAL ADVERTISING SECTION

Enclosed, please find an Indiana Department of Environmental Management Public Hearing Legal Notice(s) concerning the Annual Fine Particle Attainment Demonstration and Technical Support Document for Jefferson County (Madison Township) and Clark and Floyd counties, Indiana.

Please print ONE TIME, on or before April 4, 2008, in order for us to satisfy our statutory requirements.

Please send a notarized form no. 99p and/or publisher's claim, together with the newspaper clipping, showing the date of publication and your Federal ID number to:

Attn: Sandra Robinson, Room N1003
Indiana Department of Environmental Management
Air Programs Branch, Office of Air Quality
Mail Code 61-50
Indianapolis, Indiana 46206-2251

If you have any questions, please call me at 317-233-0427. Thank you.

Sincerely,

Sandra Robinson
Air Programs Branch
Office of Air Quality

Enclosures

TO: ACCOUNTING
IGCN - Room 1345

FROM: KAROL T. CHUMA
IGCN - 1001
RULES SECTION
OFFICE OF AIR QUALITY

DATE: 4/8/08

Note: Please send a copy of the paid publication to Indianapolis Star/News

The attached invoice for publication of public notice is approved for payment.

ACCOUNT # 3610/140900

IDEM

Madison Courier Dr.

Jefferson County, Indiana

Madison, IN 47250

PUBLISHER'S CLAIM

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RECEIVED
STATE OF INDIANA
APR 22 2008
DEPT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR QUALITY

151 lines 1 columns wide equals 151 equivalent lines a .333 cents per line $ 50.28

Additional charge for notices containing rule or tabular work (50 percent of above amount)

Charges for extra proofs of pulication ($1.00 for each proof in excess of two)

TOTAL AMOUNT OF CLAIM $ 50.28

DATA FOR COMPUTING COST

Width of single column 9 ems

Fed ID # 35-8007 2

Number of Insertions 1

Size of type 7 point

Pursuant to the provisions and penalties of Chapter 155, Acts 1953,

I hereby cerifty that the forgoing account is just and correct, that the amount claimed is legally due, after allowing all just credits, and that no part of the same has been paid.

Jane W. Jacobs

Date: April 2, 2008 Title: Publisher

PUBLISHER'S AFFIDAVIT

State of Indiana
} SS:
Jefferson County

Personally appeared before me, a notary public in and for said country and state, the undersigned Jane W. Jacobs who, being duly sworn, says that she is Publisher of the Madison Courier newspaper of general circualtion printed and published in the English Language in the (city) (town) of Madison in state and county aforesaid, and that the printed matter attached hereto is a true copy, which was duly published in said paper for 1 time, the dates of publication being as follows:

April 2, 2008

ATTACHED COPY OF ADVERTISEMENT HERE

Jane W. Jacobs

Subscribed and sworn to before me this 2nd day of April, 2008.

My Commission expires: June 26, 2008

Ronnie J. Wehner

Notary Public: Ronnie J. Wehner

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

Mitchell E. Daniels Jr.
Governor

Thomas W. Easterly
Commissioner

100 North Senate Avenue
Indianapolis, Indiana 46204
(317) 232-8603
Toll Free (800) 451-6027
www.idem.IN.gov

April 1, 2008

The Madison Courier
310 Courier Square
Madison, Indiana 47250

Phone: 812-265-3641
Fax: 812-273-6903

ATTENTION: PUBLIC NOTICES - LEGAL ADVERTISING SECTION

Enclosed, please find an Indiana Department of Environmental Management Public Hearing Legal Notice(s) concerning the Annual Fine Particle Attainment Demonstration and Technical Support Document for Jefferson County (Madison Township) and Clark and Floyd counties, Indiana.

Please print ONE TIME, on or before April 4, 2008, in order for us to satisfy our statutory requirements.

Please send a notarized form no. 99p and/or publisher's claim, together with the newspaper clipping, showing the date of publication and your Federal ID number to:

Attn: Sandra Robinson, Room N1003
Indiana Department of Environmental Management
Air Programs Branch, Office of Air Quality
Mail Code 61-50
Indianapolis, Indiana 46206-2251

If you have any questions, please call me at 317-233-0427. Thank you.

Sincerely,

Sandra Robinson
Air Programs Branch
Office of Air Quality

Enclosures

60 Public Notice

LEGAL NOTICE OF PUBLIC HEARING
STATE IMPLEMENTATION PLAN SUBMITTAL

Fine Particle (PM2.5) Attainment Demonstration and Technical Support Document for Jefferson County (Madison Township) and Clark and Floyd Counties, Indiana

Notice is hereby given under 40 CFR 51.102 that the Indiana Department of Environmental Management (IDEM) will hold a public hearing on Wednesday, May 7, 2008. The purpose of this hearing is to receive public comment on the amendment to the State Implementation Plan (SIP) developed for the purpose of complying with the attainment demonstration requirement of Section 172 (c) of the Clean Air Act (CAA), as it applied to Jefferson County (Madison Township) and Clark and Floyd Counties, Indiana. Public comments will also be received concerning the 2005 emissions inventory included in the attainment demonstration. The meeting will convene at 5:30 p.m. (local time) at the Clarksville Branch Library, 1312 Eastern Boulevard, Clarksville, Indiana. All interested persons are invited and will be given opportunity to express their views concerning the draft documents.

Jefferson County (Madison Township) and Clark and Floyd Counties, Indiana are part of the Louisville, KY-IN Fine Particle Nonattainment Area. This area was designated as non attainment for the annual fine particle standard and subject to the requirements of Section 172 of the CAA. One of the compliance requirements mandated by Section 172 (c) of the CAA, is the development of a plan demonstrating that the area will meet the annual fine particle air quality standard by the required attainment date. This Fine Particle Attainment Demonstration Plan is being drafted and submitted consistent with United States Environmental Protection Agency (U.S. EPA) guidance.

The attainment demonstration includes an air quality modeling analysis, an emissions inventory, an air quality and emissions trend analysis, a summary of current and anticipated emission control measures and mobile source emission budgets for purposes of transportation conformity. Public comments will be received on all components of the attainment demonstration SIP submittal.

Copies of the draft documents will be available on or before April 4, 2008 to any person upon request and at the following locations

production costs. Any person heard or represented at the hearing or requesting notice shall be given written notice of actions resulting from the hearing.

For additional information contact Mr. Gale Ferris, at the Indiana Department of Environmental Management, Office of Air Quality, Room 1003, Indiana Government Center North, 100 North Senate Avenue, Indianapolis or call (317) 234-3653 or (800) 451-6027 ext. 4-3653 (in Indiana).

***

TO: ACCOUNTING
IGCN - Room 1345

FROM: KAROL T. CHUMA
IGCN - 1001
RULES SECTION
OFFICE OF AIR QUALITY

DATE: 4/23/08

Note: Please send a copy of the paid publication to The Madison Courier

The attached invoice for publication of public notice is approved for payment.

ACCOUNT # 3610/140900

Form Prescribed by State Board of Accounts

General Form No. 99p (Revised 1999)

To: IDEM
(Governmental Unit:)
Clark County, Indiana

From: The Evening News
221 Spring St. P.O. Box 867
Jeffersonville, IN 47130

PUBLISHER'S CLAIM

LINE COUNT

Display Matter (Must not exceed two actual lines, neither of which shall total more than four solid lines of type in which the body of the advertisement is set) -- number of equivalent lines . . . . . .

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Total number of lines in notice 154

COMPUTATION OF CHARGES

154 lines, 1 columns wide equals 154 equivalent lines at .333 cents per line . . . . . $ 51.28

Additional charge for notices containing rule or tabular work (50 percent of above amount) . . . . . .

Charge for extra proofs of publication ($4.00 for each proof in excess of two) . . . . . .

TOTAL AMOUNT OF CLAIM 51.28

DATA FOR COMPUTING COST

Width of single column 9.0 ems

Number of insertions 1

Size of type 7 point

FEDERAL ID#
55-0870768

Pursuant to the provisions and penalties of Chapter 155, acts 1953,

I hereby certify that the foregoing account is just and correct, that the amount claimed is legally due, after allowing all just credits, and that no part of the same has been paid.

Melissa Tolnay

Date: 5-12, 20 08 Title: Legal Bookkeeper

PUBLISHER'S AFFIDAVIT

State of Indiana)
) ss:
Clark County)

Personally appeared before me, a notary public in and for said county and state, the undersigned Melissa Tolnay who, being duly sworn, says that she is legal bookkeeper of The Evening News newspaper of general circulation printed and published in the English language in the (city) of Jeffersonville in state and county aforesaid, and that the printed matter attached hereto is a true copy, which was duly published in said paper for 1 time _____, the dates of publication being as follows:

April 4, 2008

ATTACH COPY OF ADVERTISEMENT HERE

Subscribed and sworn to before me this 12TH day of May, 20 08.

Joann Galligan Notary Public JOANN GALLIGAN

My commission expires: August 27, 2014

0517108

DATA FOR COMPUTING COST

Width of single column 9.0 ems

Number of insertions 1

Size of type 7 point

FEDERAL ID#
55-0870768

Pursuant to the provisions and penalties of Chapter 155, acts 1953,

I hereby certify that the foregoing account is just and correct, that the amount claimed is legally due, after allowing all just credits, and that no part of the same has been paid.

Melissa Dolnay

Date: 5-12, 20 08 Title: Legal Bookkeeper

PUBLISHER'S AFFIDAVIT

State of Indiana)
) ss:
Clark County)

and for said county
who, being duly
vening News
shed in the English
d county aforesaid,
ie copy, which was
, the
08
y of May, 2008

Notary Public JOANN GALLIGAN

My commission expires: August 27, 2014

LEGAL NOTICE OF PUBLIC HEARING

STATE IMPLEMENTATON PLAN SUBMITTAL Fine Particle (PM2.5) Attainment Demonstration and Technical Support Document for Jefferson County (Madison Township) and Clark and Floyd Counties, Indiana Notice is hereby given under 40 CFR 51.102 that the Indiana Department of Environmental Management (IDEM) will hold a public hearing on Wednesday, May 7, 2008. The purpose of this hearing is to receive public comment on the amendment to the State Implementation Plan (SIP) developed for the purpose of complying with the attainment demonstration requirement of Section 172 (c) of the Clean Air Act (CAA), as it applies to Jefferson County (Madison Township) and Clark and Floyd Counties, Indiana. Public comments will also be received concerning the 2005 emissions inventory included in the attainment demonstration. The meeting will convene at 5:30 p.m. (local time) at the Clarksville Branch Library, 1312 Eastern Boulevard, Clarksville, Indiana. All interested persons are invited and will be given opportunity to express their views concerning the draft documents. Jefferson County (Madison Township) and Clark and Floyd Counties, Indiana are part of the Louisville KY-IN Fine Particle Nonattainment Area. This area was designated as nonattainment for the annual fine particle standard and subject to the requirements of Section 172 of the CAA. One of the compliance requirements mandated by Section 172 (c) of the CAA, is the development of a plan demonstrating that the area will meet the annual fine particle air quality standard by the required attainment date. This Fine Particle Attainment Demonstration Plan is being drafted and submitted consistent with United States Environmental Protection Agency (U.S. EPA) guidance. The attainment demonstration includes an air quality modeling analysis, an emissions inventory, an air quality and emissions trend analysis, a summary of current and anticipated emission control measures and mobile source emission budgets for purposes of transportation conformity. Public comments will be received on all components of the attainment demonstration SIP submittal. Copies of the draft documents will be available on or before April 4, 2008 to any person upon request and at the following locations: Σ Indiana Department of Environmental Management, Office of Air Quality, Indiana Government Center North, 100 North Senate, Room N1003, Indianapolis, Indiana. Σ Clarksville Branch Library, 1312 Eastern Boulevard, Clarksville, Indiana Σ Floyd County Public Library, 180 West Spring Street, New Albany, Indiana. Σ Jeffersonville Township Public Library, 211 East Court Avenue, Jeffersonville, Indiana Σ Madison-Jefferson County Public Library, 420 West Main Street, Madison, Indiana. Oral statements will be heard, but for the accuracy of the record, statements should be submitted in writing. Written statements may be submitted to the attendant designated to receive written comments at the public hearing. IDEM will also accept written comments through May 9, 2008. Mailed comments should be addressed to: Louisville KY-IN Fine Particle Standard Attainment Demonstration Scott Deloney, Chief Air Programs Branch, Office of Air Quality – Mail Code 61-50 100 North Senate Avenue Indiana Department of Environmental Management Indianapolis, IN 46206-2251 A transcript of the hearing and all written submissions provided at the public hearing shall be open to public inspection at IDEM and copies may be made available to any person upon payment of reproduction costs. Any person heard or represented at the hearing or requesting notice shall be given written notice of actions resulting from the hearing. For additional information contact Mr. Gale Ferris, at the Indiana Department of Environmental Management, Office of Air Quality, Room 1003, Indiana Government Center North, 100 North Senate Avenue, Indianapolis or call (317) 234-3653 or (800) 451-6027 ext. 4-3653 (in Indiana).

.....

ndividuals requiring reasonable accommodations for participation in this hearing should contact the IDEM Americans with Disabilities Act (ADA) coordinator at: Attn: ADA Coordinator Indiana Department of Environmental Management – Mail Code 50-10 100 North Senate Avenue Indianapolis, IN 46204-2251 *Or call (317) 233-1785 (voice) or (317) 232-6565 (TDD). Please provide a minimum of 72 hours notification.*

0051712

IDEM

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

We Protect Hoosiers and Our Environment.

Mitchell E. Daniels Jr.
Governor

Thomas W. Easterly
Commissioner

100 North Senate Avenue
Indianapolis, Indiana 46204
(317) 232-8603
Toll Free (800) 451-6027
www.idem.IN.gov

Evening News
221 Spring Street
Jeffersonville, Indiana 47130

April 1, 2008

Phone: 812-283-6636
Fax: 812-284-7080

ATTENTION: PUBLIC NOTICES - LEGAL ADVERTISING SECTION

Enclosed please find an Indiana Department of Environmental Management Public Hearing Legal Notice(s) concerning the Attainment Demonstration and Technical Support Plan for Jefferson County (Madison Township) and Clark and Floyd counties, Indiana.

Please print ONE TIME, on or before April 4, 2008, in order for us to satisfy our statutory requirements.

Please send a notarized form no. 99p and/or publisher's claim, together with the newspaper clipping, showing the date of publication and your Federal ID number to:

Attn: Sandra Robinson, Room N1001
Indiana Department of Environmental Management
Air Programs Branch, Office of Air Quality
Mail Code 61-50
Indianapolis, Indiana 46206-2251

If you have any questions, please call me at 317-233-0427. Thank you.

Sincerely,

Sandra Robinson
Air Programs Branch
Office of Air Quality

Enclosures

TO: ACCOUNTING
IGCN - Room 1345

FROM: KAROL T. CHUMA
IGCN - 1001
RULES SECTION
OFFICE OF AIR QUALITY

DATE: 5/19/08

Note: Please send a copy of the paid publication to Evening News

The attached invoice for publication of public notice is approved for payment.

ACCOUNT # 3610/140900

Form Prescribed by State Board of Accounts

General Form No. 99p (Revised 199

To: DEM
(Governmental Unit)
Floyd County, Indiana

From: THE TRIBUNE
221 Spring St. P.O. Box 867
Jeffersonville, IN 47130

PUBLISHER'S CLAIM

LINE COUNT

Display Matter (Must not exceed two actual lines, neither of which shall total more than four solid lines of type in which the body of the advertisement is set) -- number of equivalent lines .....

Head -- number of lines 154

Body -- Number of lines .....

Tail -- number of lines .....

Total number of lines in notice 154

COMPUTATION OF CHARGES

154 lines, 1 columns wide equals 154 equivalent lines at .333 cents per line ..... $ 51.28

Additional charge for notices containing rule or tabular work (50 percent of above amount) .....

Charge for extra proofs of publication ($4.00 for each proof in excess of two) .....

TOTAL AMOUNT OF CLAIM 51.28

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Width of single column 9.0 ems

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55-0870768

Pursuant to the provisions and penalties of Chapter 155, acts 1953,

I hereby certify that the foregoing account is just and correct, that the amount claimed is legally due, after allowing all just credits, and that no part of the same has been paid.

Melissa Tolnay

Date: 5-12, 20 08 Title: Legal Bookkeeper

PUBLISHER'S AFFIDAVIT

State of Indiana)
) ss:
Floyd County)

Personally appeared before me, a notary public in and for said county and state, the undersigned Melissa Tolnay who, being duly sworn, says that she is legal bookkeeper of The Tribune newspaper of general circulation published in the English language in the (city) of New Albany in state and county aforesaid, and that the printed matter attached hereto is a true copy, which was duly published in said paper for 1 time _____, the dates of publication being as follows:

April 4, 2008

ATTACH COPY OF ADVERTISEMENT HERE

Subscribed and sworn to before me this 12TH day of May, 20 08

Joan Galligan Notary Public JOAN GALLIGAN

My commission expires: August 27, 2014

NC-10140

State of Indiana)
) ss:
)

peared before me, a notary public in and for said c
undersigned Melissa Tolnay who, be
hat she is legal bookkeeper of The Tribune
general circulation published in the English
he (city) of New Albany in state and county afores
printed matter attached hereto is a true copy, whicl
ed in said paper for 1 time _____, th
ication being as follows:
April 4, 2008

nd sworn to before me this 12TH day of May

Notary Public
JOANN

My commission expires: August 27, 2014

LEGAL NOTICE OF PUBLIC HEARING

STATE IMPLEMENTATON PLAN SUBMITTAL Fine Particle (PM2.5) Attainment Demonstration and Technical Support Document for

Jefferson County (Madison Township) and Clark and Floyd Counties, Indiana Notice is hereby given under 40 CFR 51.102 that the Indiana Department of Environmental Management (IDEM) will hold a public hearing on Wednesday, May 7, 2008. The purpose of this hearing is to receive public comment on the amendment to the State Implementation Plan (SIP) developed for the purpose of complying with the attainment demonstration requirement of Section 172 (c) of the Clean Air Act (CAA), as it applies to Jefferson County (Madison Township) and Clark and Floyd Counties, Indiana. Public comments will also be received concerning the 2005 emissions inventory included in the attainment demonstration. The meeting will convene at 5:30 p.m. (local time) at the Clarksville Branch Library, 1312 Eastern Boulevard, Clarksville, Indiana. All interested persons are invited and will be given opportunity to express their views concerning the draft documents. Jefferson County (Madison Township) and Clark and Floyd Counties, Indiana are part of the Louisville KY-IN Fine Particle Nonattainment Area. This area was designated as nonattainment for the annual fine particle standard and subject to the requirements of Section 172 of the CAA. One of the compliance requirements mandated by Section 172 (c) of the CAA, is the development of a plan demonstrating that the area will meet the annual fine particle air quality standard by the required attainment date. This Fine Particle Attainment Demonstration Plan is being drafted and submitted consistent with United States Environmental Protection Agency (U.S. EPA) guidance. The attainment demonstration includes an air quality modeling analysis, an emissions inventory, an air quality and emissions trend analysis, a summary of current and anticipated emission control measures and mobile source emission budgets for purposes of transportation conformity. Public comments will be received on all components of the attainment demonstration SIP submittal. Copies of the draft documents will be available on or before April 4, 2008 to any person upon request and at the following locations: Σ Indiana Department

hearing. For additional information contact Mr. Gale Ferris, at the Indiana Department of Environmental Management, Office of Air Quality, Room 1003, Indiana Government Center North, 100 North Senate Avenue, Indianapolis or call (317) 234-3653 or (800) 451-6027 ext. 4-3653 (in Indiana).

.....

Individuals requiring reasonable accommodations for participation in this hearing should contact the IDEM Americans with Disabilities Act (ADA) coordinator at: Attn: ADA Coordinator Indiana Department of Environmental Management – Mail Code 50-10 100 North Senate Avenue Indianapolis, IN 46204-2251 *Or call (317) 233-1785 (voice) or (317) 232-6565 (TDD). Please provide a minimum of 72 hours notification.*

065171

ment of Environmental Management, Office of Air Quality, Indiana Govemment Center North, 100 North Senate, Room N1003, Indianapolis, Indiana. Σ Clarksville Branch Library, 1312 Eastern Boulevard, Clarksville, Indiana Σ Floyd County Public Library, 180 West Spring Street, New Albany, Indiana. Σ Jeffersonville Township Public Library, 211 East Court Avenue, Jeffersonville, Indiana Σ Madison-Jefferson County Public Library, 420 West Main Street, Madison, Indiana. Oral statements will be heard, but for the accuracy of the record, statements should be submitted in writing. Written statements may be submitted to the attendant designated to receive written comments at the public hearing. IDEM will also accept written comments through May 9, 2008. Mailed comments should be addressed to: Louisville KY-IN Fine Particle Standard Attainment Demonstration Scott Deloney, Chief Air Programs Branch, Office of Air Quality – Mail Code 61-50 100 North Senate Avenue Indiana Department of Environmental Management Indianapolis, IN 46206-2251 A transcript of the hearing and all written submissions provided at the public hearing shall be open to public inspection at IDEM and copies may be made available to any person upon payment of reproduction costs. Any person heard or represented at the hearing or requesting notice shall be given written notice of actions resulting from the

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

Mitchell E. Daniels Jr.
Governor

Thomas W. Easterly
Commissioner

100 North Senate Avenue
Indianapolis, Indiana 46204
(317) 232-8603
Toll Free (800) 451-6027
www.idem.IN.gov

April 1, 2008

The Tribune
PO Box 867
Jeffersonville, Indiana 47130

Phone: 812-283-6636
Fax: 812-283-1150

ATTENTION: PUBLIC NOTICES - LEGAL ADVERTISING SECTION

Enclosed, please find an Indiana Department of Environmental Management Public Hearing Legal Notice(s) concerning the Annual Fine Particle Attainment Demonstration and Technical Support Document for Jefferson County (Madison Township) and Clark and Floyd counties, Indiana.

Please print ONE TIME, on or before April 4, 2008, in order for us to satisfy our statutory requirements.

Please send a notarized form no. 99p and/or publisher's claim, together with the newspaper clipping, showing the date of publication and your Federal ID number to:

Attn: Sandra Robinson, Room N1003
Indiana Department of Environmental Management
Air Programs Branch, Office of Air Quality
Mail Code 61-50
Indianapolis, Indiana 46206-2251

If you have any questions, please call me at 317-233-0427. Thank you.

Sincerely,

Sandra Robinson
Air Programs Branch
Office of Air Quality

Enclosures

TO: ACCOUNTING
IGCN - Room 1345

FROM: KAROL T. CHUMA
IGCN - 1001
RULES SECTION
OFFICE OF AIR QUALITY

DATE: 5-19-08

Note: Please send a copy of the paid publication to The Tribune, located Jeffersonville, IN

The attached invoice for publication of public notice is approved for payment.

ACCOUNT # 3610/140900

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR QUALITY

ORIGINAL

RECEIVED
STATE OF INDIANA
MAY 14 2008
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF AIR QUALITY

DATE: May 7, 2008

TIME: 5:30 P.M.

PLACE: Clarksville Public Library
1312 Eastern Boulevard
Multi-Purpose Meeting Room
Clarksville, IN 47129

PRESENT: Mr. Gale Ferris, Hearing Officer
Mr. Shawn Seals, Officer

Audience Members

Sharon Shields, Reporter

A public hearing regarding the draft Fine Particle Attainment Demonstration and Technical Support Document was held at the Clarksville Public Library, 1312 Eastern Boulevard, Multi-Purpose Meeting Room, Clarksville, Indiana at 5:30 P.M. on May 7, 2008.

OPENING STATEMENTS BY MR. GALE FERRIS:

This is a public hearing to solely provide interested persons an opportunity to provide comments to the State regarding the draft Fine Particle Attainment Demonstration and Technical Support Document for the Indiana Portion of the Louisville KY-IN Fine Particle Nonattainment Area; Madison Township (Jefferson County) and Clark and Floyd Counties, Indiana. Comments are also being accepted on the 2005 emissions inventory that is included as part of the attainment demonstration. This hearing is being held to conform to the provisions in 40 CFR Part 51 regarding public hearings for State Implementation Plan (SIP) submittals.

The area was designated as a nonattainment area for the annual fine particle standard and subject to the requirements of Section 172 of the Clean Air Act (CAA). One (1) of the compliance requirements mandated by Section 172c of the CAA is the development of a plan demonstrating that

the area will meet the annual fine particle national ambient air quality standard (NAAQS) by the required attainment date, April 5, 2010. The Indiana Department of Environmental Management (IDEM) will accept comments concerning this revision to the SIP for the purpose of complying with the attainment demonstration requirement, as it applies to Madison Township (Jefferson County) and Clark and Floyd Counties, Indiana. This Fine Particle Attainment Demonstration and Technical Support Document is being drafted and submitted consistent with United States Environmental Protection Agency (U.S.EPA) guidance.

My name is Gale Ferris. I am an Environmental Manager in the Planning Section of the Indiana Department of Environmental Management's Office of Air Quality. I have been appointed to act as hearing officer for this public hearing. Also, here with me is Shawn Seals, a Senior Environmental Manager, in the Planning Section of the Indiana Department of Environmental Management's office of Air Quality.

Notice of the time and place of the hearing was given as provided by law by publication in the following newspapers:

(1) The Indianapolis Star, Indianapolis, Indiana

(2) The New Albany Tribune, New Albany, Indiana

(3) The Evening News, Jeffersonville, Indiana

(4) The Madison Courier, Madison, Indiana

Appearance blanks have been distributed in the hearing room for all those desiring to be shown appearing on record in this cause. If you have not already filled out the form, please do so and indicate if you are appearing for yourself or on behalf of a group or organization and identify such group or organization. Also, note the capacity in which you appear, such as, attorney, officer or authorized spokesperson.

Any person who is heard or represented at this hearing or who requests notice may be given written notice of the final action taken on this State Implementation Plan submittal. Please indicate on the appearance card if you wish to receive this notification. When appearance cards have been completed, they should be handed to me and I will include them with the official record of this proceeding.

Oral statements will be heard, but written statements may be handed to me or mailed to the Office of Air Quality on or before close of business on May 9th, 2008. A

written transcript of this hearing is being made. The transcript will be open for public inspection and a copy of the transcript will be made available to any person upon payment of the copying cost.

After the conclusion of this public hearing, I will prepare a written report summarizing the comments received at this hearing and recommending changes which may need to be made to this document.

I would like to introduce the following documents into the record:

(1) The notice of public hearing.

(2) Draft Fine Particle Attainment Demonstration and Technical Support Document for the Indiana Portion of the Louisville KY-IN Fine Particle Nonattainment Area; Madison Township (Jefferson County) and Clark and Floyd Counties, Indiana.

(3) Supplement to Appendix A, 2007 Monitoring Data Technical Support Documentation.

(4) 2005 Clark, Floyd and Jefferson County, Indiana Emissions Inventory.

Finally, I would like to briefly go over the contents of the draft document.

In 1997, the United States Environmental Protection Agency set daily and annual ambient air quality standards for fine particles at 15.0 micrograms per cubic meter on an annual basis and at 65.0 micrograms per cubic meter on a 24-hour or daily basis.

Legal challenges to the new standards for fine particles resulted in delayed implementation of the standards until February 2001, when the Supreme Court upheld the standards and ruled that the U.S.EPA could proceed with implementation of the new standards. Indiana began monitoring for fine particles in 1999. The U.S.EPA originally designated counties under the fine particle standards based on 2001 through 2003 monitoring data in December 2004. The U.S.EPA designated areas throughout the country as attainment, nonattainment, or unclassifiable. Madison Township (Jefferson County) and Clark and Floyd Counties, Indiana were designated nonattainment as part of the Louisville KY-IN Fine Particle Nonattainment Area. The U.S.EPA withdrew a number of counties identified as nonattainment based on updated monitoring data for 2002 through 2004 prior to the effective date of designations,

which was April 5, 2005, based on the fact that those counties had met the standard at the close of 2004. However, this action did not affect the Louisville KY-IN nonattainment area. The area's controlling design value (16.9 micrograms per cubic meter) was monitored at the Wyandotte Park, Jefferson County, Kentucky air quality monitor. Monitors for ambient fine particle levels are located in all counties in the Louisville KY-IN nonattainment area except Madison Township in Jefferson County, Indiana. No monitors within Indiana's portion of the Louisville KY-IN fine Particle Nonattainment Area have violated the 1997 24-hour fine particle standard.

The Louisville KY-IN Fine Particle Nonattainment Area consists of Madison Township (Jefferson County) and Clark and Floyd Counties, Indiana; and Jefferson and Bullitt Counties, Kentucky.

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 planning issues.

Although Indiana and Kentucky have worked together on a comprehensive plan for 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 considered SIP submittals and U.S.EPA action on them is taken separately. This submittal only covers the Indiana portion of the nonattainment area, Madison Township (Jefferson County) and Clark and Floyd Counties, Indiana.

The Clean Air Act Amendments of 1990 (CAA) required areas designated nonattainment for the annual fine particle NAAQS to develop SIP revisions, to expeditiously attain and maintain the standard. Section 172 of the 1990

CAA stipulates the requirements nonattainment areas must meet, including the development of a plan to reduce direct $PM_{2.5}$, NO_x and SO_2 emissions and a demonstration that the area will meet the ambient air quality standard by April 5, 2010.

The CAA requires multi-state nonattainment areas to demonstrate attainment using photochemical computer 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. Computer 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 micrograms per cubic meter. According to the U.S.EPA guidance, areas with future year design values lower than 14.5 micrograms per cubic meter at each monitor site only need to provide a basic supplemental analysis that the area will attain the annual fine particle standard. Since the area's future year design value is predicted to be significantly below the fine particle standard, at 13.6 micrograms per cubic meter, a basic supplemental analysis is only 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 shows that NO_x and SO_2 emissions reductions since designation have had a positive effect on regional fine particle levels. It also shows that once the photochemical modeling results are considered along with additional national, regional and local control measures to be phased-in or implemented in 2008 and 2009, air quality in the area will achieve attainment of the annual NAAQS for fine particles by April 5, 2010, and provide for an ample margin of safety.

This plan satisfies Indiana's obligation under Section 172c of the CAA to demonstrate how the area will attain the annual standard for fine particles by the attainment date, and as a result, realize cleaner air. The development of this plan will bring this region into compliance with state and federal fine particle air quality standards, and provide real progress in the state's journey toward cleaner air.

In conclusion, monitors in Indiana's portion of the Louisville KY-IN Fine Particle Nonattainment Area have measured values above the 2006 daily standard. However, the U.S.EPA has not implemented the standard at this time. This

document solely applies to demonstrating attainment of the annual fine particle standard.

This concludes my comments regarding the draft Fine Particle Attainment Demonstration and Technical Support Document for Madison Township (Jefferson County) and Clark and Floyd Counties, the Indiana portion of the Louisville KY-IN Fine Particle Nonattainment Area. Before opening this hearing for public comments, may I once again remind you that this hearing pertains solely to this draft attainment demonstration and technical support document in association with the annual standard for fine particles for Indiana's portion of the Louisville KY-IN Fine Particle Nonattainment Area, and only comments germane to this matter will be considered as part of the public record.

Shawn and I will be available following this hearing to address any questions you may have that do not pertain to this specific matter.

This hearing is now open for public comment. Are there any public comments?

In the absence of any further comments, these proceedings are hereby concluded. This hearing is adjourned.

Thank you.

* * * * *

CONCLUSION OF HEARING

C E R T I F I C A T E

STATE OF INDIANA)
) SS:
COUNTY OF JEFFERSON)

I, Sharon Shields, do hereby certify that I am a Notary Public in and for the County of Jefferson, State of Indiana, duly authorized and qualified to administer oaths; That the foregoing public hearing was taken by me in shorthand and on a tape recorder on May 7, 2008 at the Clarksville Public Library, 1312 Eastern Boulevard, Multi-purpose Meeting room, Clarksville, IN; That this public hearing was taken on behalf of the Indiana Department of Environmental Management pursuant to agreement for taking at this time and place; That the testimony of the witnesses was reduced to typewriting by me and contains a complete and accurate transcript of the said testimony.

I further certify that pursuant to stipulation by and between the respective parties, this testimony has been transcribed and submitted to the Indiana Department of Environmental Management.

WITNESS my hand and notarial seal this 13th day of May, 2008.

Sharon Shields

Sharon Shields, Notary Public
Jefferson County, State of Indiana

My Commission Expires:

July 2, 2015

Appendix J

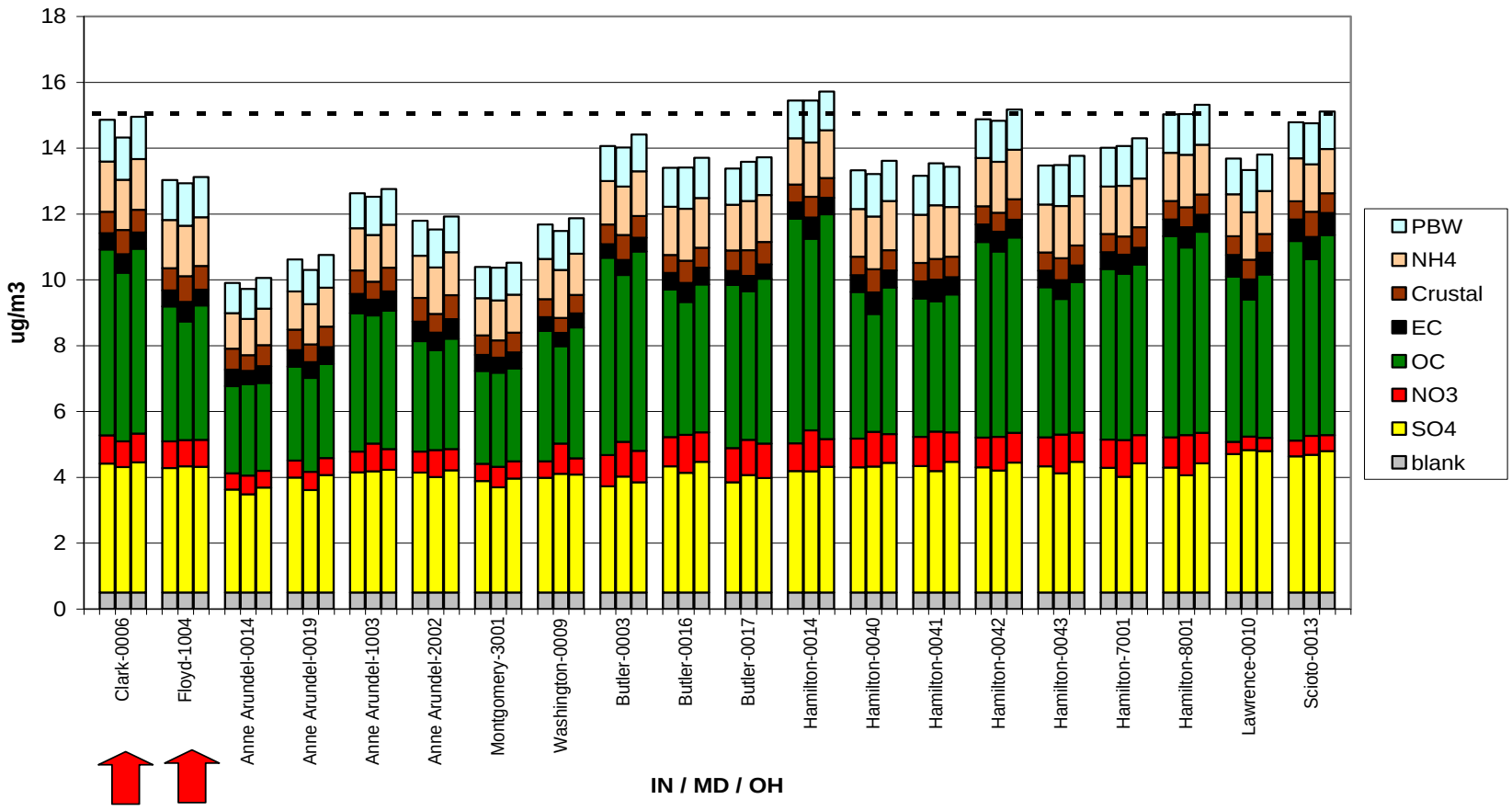
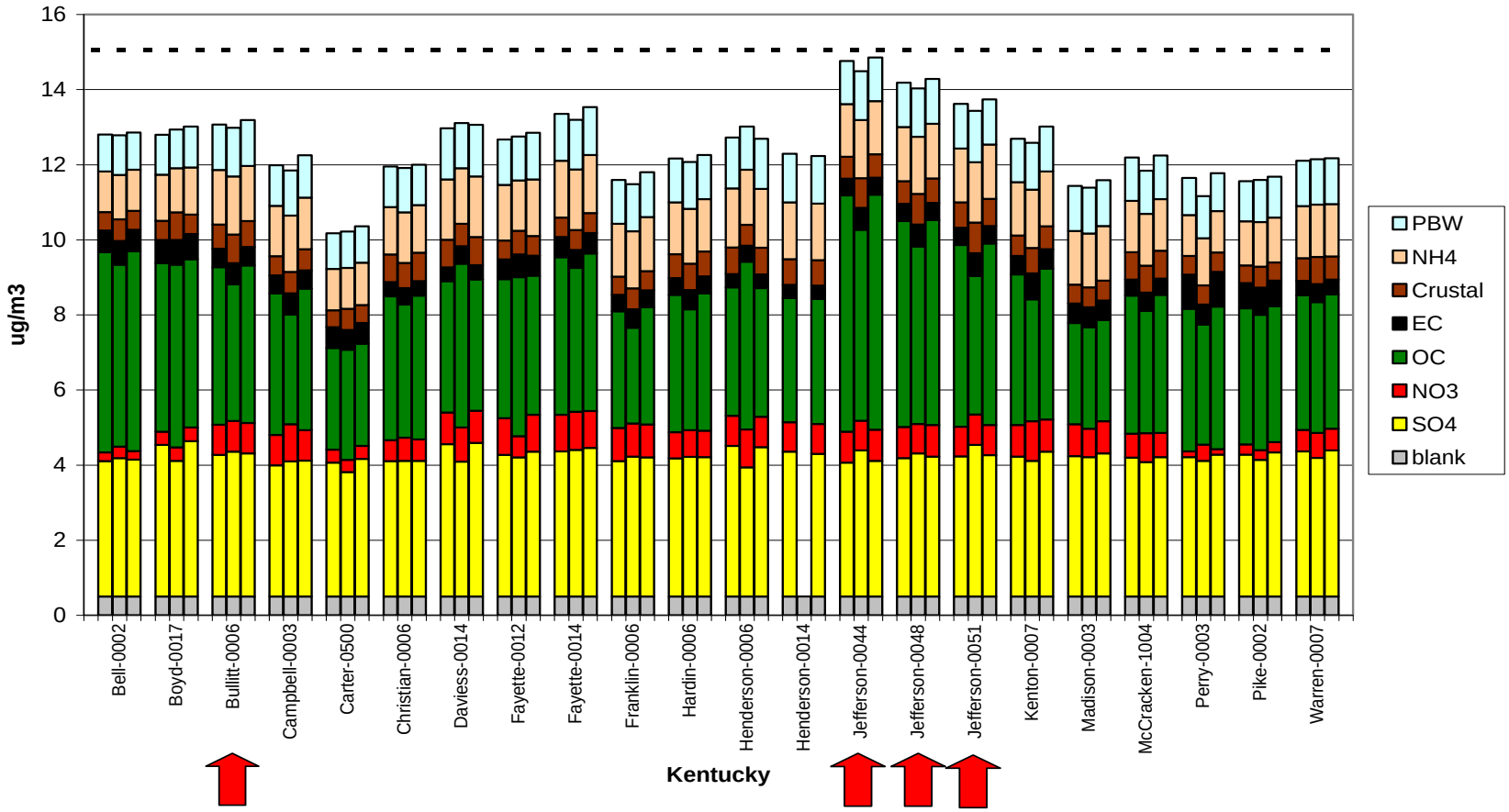
Association for Southeastern Integrated Planning Base G4 Annual $PM_{2.5}$ Modeling Results for all Louisville KY-IN Fine Particle Nonattainment Area $PM_{2.5}$ Monitors

ASIP's Base G2 Annual PM2.5 Modeling Results

Monitor ID	Monitor Name	County	Design Value 2000-2004	Future Year 2009 12 km
			(µg/m3)	(µg/m3)
18-019-0006	Pfau	Clark	16.84	14.86
18-043-1004	Green Valley School	Floyd	14.89	13.03
21-029-0006	Carpenter Street	Bullitt	14.88	13.06
21-093-0006	Elizabethtown	Hardin	13.97	12.16
21-111-0043	Southern Avenue	Jefferson	[a]	[a]
21-111-0044	Wyandotte Park	Jefferson	16.58	14.76
21-111-0048	Barret Ave.	Jefferson	16.06	14.18
21-111-0051	Watson Elementary	Jefferson	15.44	13.62

[a] No Speciated Modeled Attainment Test data available

IN / MD / OH 12km 2009 Projected DVF by G4a_EXCEL(Left) and G4a_MATS (Middle) andG2a_EXCEL (Right)



Kentucky 12km 2009 Projected DVF by G4a_EXCEL(Left) and G4a_MATS (Middle) andG2a_EXCEL (Right)