Technical Support Document for the Interstate Air Quality Rule Air Quality Modeling Analyses

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I. Introduction

This document was prepared to describe the air quality modeling performed by EPA in support of the proposed Interstate Air Quality Rule (IAQR). Included is information on (1) the air quality models and the development of model inputs, (2) the performance of the models as compared to measured data, (3) the procedures for projecting current air quality to future year emissions scenarios, (4) the evaluation of interstate contribution to ozone and PM2.5 in downwind nonattainment areas, (5) an analysis of the potential air quality improvements from locally applied controls, (6) an assessment of the expected air quality improvements from the regional SO2 and NOx emissions reductions, and (7) an analysis of the effects of SO2 emissions reductions on nitrate concentrations. The following is an outline of the main sections of this document:

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II. Emissions Inventories
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II. Emissions Inventories

A. Overview of Emissions Scenarios

In order to support the air quality modeling analyses for the proposed rule, emissions inventories were developed for the 48 contiguous States and the District of Columbia. Inventories were developed for a 2001 base year, for 2010 and 2015 future baseline scenarios, and for 2010 and 2015 future control scenarios. The 2001 base year and 2010 and 2015 future base case inventories were in large part derived from a 1996 base year inventory and projections of that 1996 inventory to 2007 and 2020 as developed for previous EPA rulemakings for Heavy Duty Diesel Engines (HDDE)(EPA, 2000a; www.epa.gov/otaq/models/hd2007/r00020.pdf) and Land-based Non-road Diesel Engines (LNDE)(EPA, 2003a; www.epa.gov/nonroad/454r03009.pdf).

The inventories were prepared at the county level for on-road vehicles, non-road engines, and area sources. Emissions for electric generating units (EGUs) and large industrial and commercial sources (non-EGUs) were prepared as individual point sources. The inventories contain both annual and typical summer season day emissions for the following pollutants: oxides of nitrogen (NOx); volatile organic compounds (VOC); carbon monoxide (CO); sulfur dioxide (SO2); direct particulate matter with an aerodynamic diameter less than 10 micrometers (PM10) and less than 2.5 micrometers (PM2.5); and ammonia (NH3).

B. 2001 Base Year Emissions Inventory

Emissions inventory inputs representing the year 2001 were developed to provide a base year for forecasting future air quality. Because the complete 2001 National Emissions Inventory (NEI) and future year emissions projections consistent with that NEI were not available in a form suitable for air quality modeling when needed for this analysis, the following approach was used to develop a reasonably representative "proxy" inventory for 2001 in model-ready form that retained the same consistency with the existing future year projected inventories as the 1996 model-ready inventory that was used as the basis for those projected inventories.

The EPA had available model-ready emissions input files for a 1996 Base Year and a projected 2010 Base Case from a previous analysis. In addition, robust NEI estimates were available for 2001 for three of the five anthropogenic emissions sectors: EGUs; on-road vehicles; and non-road engines. NEI estimates for the 2001 Base Year were not available on a basis consistent with the 1996 and 2010 modeling files for the remaining two emission sectors: non-EGU point sources and area sources. The 2001 Proxy modeling files were therefore developed in a slightly different manner for each sector, as described below.

For the EGU sector, State-level emissions totals from the NEI 2001 were divided by similar totals from the 1996 modeling inventory to create a set of 1996 to 2001 adjustment ratios. Ratios were developed for each State and pollutant. These ratios were applied to the model-ready 1996 EGU emissions file to produce the 2001 EGU emissions file. Adjustments were thus made in the modeling file to account for emissions reductions that had occurred between 1996 and 2001, but at an aggregated State-level, rather than for each individual source.

As previously stated, the NEI 2001 emissions estimates for the on-road vehicles and non-road engines sectors were available from the MOBILE6 and NONROAD2002 models, respectively. Because both of these models were updates of the versions used to produce the existing 1996 model-ready emissions files and their associated projection year files, an approach was developed to capture the relative 1996-to-2001 growth and control changes for these two sectors, rather than producing absolute tonnage values in the 2001 Proxy modeling files that would match the 2001 NEI.

The updated MOBILE6 and NONROAD2002 models were used to develop revised 1996 annual emissions estimates that were consistent with the 2001 NEI estimates. A set of 1996-to-2001 adjustment ratios were then created by dividing State-level total emissions for each pollutant for 2001 by the corresponding consistent 1996 emissions. These adjustment ratios were then multiplied by the older methodologies' existing gridded model-ready 1996 emissions for these two sectors to produce model-ready files for 2001. These model-ready 2001 files, therefore, maintain consistency with the future year projection files that were based on the older emission model versions but also capture the effects of the 1996 to 2001 emission changes as indicated by the latest versions of the two emissions models.

NEI estimates for the 2001 Base Year were not available on a basis consistent with the 1996 and 2010 modeling files for the non-EGU point source and area source sectors. Linear interpolations were performed between the gridded 1996 emissions and the gridded 2010 Base Case emissions to produce the 2001 gridded emissions files for these two sectors. These interpolations were done separately for each of the two sectors, for each grid cell, for each pollutant. As the 2010 Base Case inventory was itself a projection from the 1996 inventory, this approach maintained consistency of methods and assumptions between the 2001 and 2010 emissions files, and also attempted to capture likely changes in the inventory from 1996 to 2010. (Note that the gridded area source files had been split into livestock versus non-livestock categories. The grid cell by grid cell interpolations were therefore done separately for each of these two sub-sectors of the area source inventory).

Appendix A, Tables 1 through 3 show the adjustment ratios that were developed for EGUs, on-road vehicles and off-road engines. Tables 4 through 9 show the resulting State-level emissions totals for the 2001 Proxy modeling inventory for these three sectors, as well as for the non-egu and area source sectors which were developed from linear interpolation and a table for all sectors combined. Because the gridded 1996 modeling files contained pollutant PM-coarse (calculated from PM10 minus PM2.5), the three ratio tables include adjustment factors for PM-coarse rather than PM10.

C. 2010 and 2015 Base Case and IAQR Regional Control Case Emissions Inventories

The future Base Case scenarios represent predicted emissions in the absence of any further controls beyond those State, local, and Federal measures already promulgated plus other significant measures expected to be promulgated before the final IAQR is promulgated. Any additional local control programs which may be necessary for areas to attain the annual PM2.5 NAAQS and the ozone NAAQS are not included in the future base case projections. The future base case scenarios do reflect projected economic growth.

Specifically, the future base case scenarios include the effects of the LNDE as proposed, the HDDE standards, the Tier 2 tailpipe standards, the NOx SIP Call as remanded (excludes controls in Georgia and Missouri), and Reasonably Available Control Techniques (RACT) for NOx in 1-hour ozone nonattainment areas. Adjustments were also made to the non-road sector inventories to include the effects of the Large Spark Ignition and Recreational Vehicle rules; and to the non-EGU sector inventories to include the SO2 and particulate matter co-benefit effects of the proposed Maximum Achievable Control Technology (MACT) standard for Industrial Boilers and Process Heaters. The future base case scenarios do not include the NOx co-benefit effects of proposed MACT regulations for Gas Turbines or stationary Reciprocating Internal Combustion Engines, which we estimate to be small compared to the overall inventory; or the effects of NOx RACT in 8-hour ozone nonattainment areas, because these areas have not yet been designated.

The 2010 and 2015 Base Case inventories used for this proposal were derived from interpolations and adjustments to projection inventories developed for previous EPA rulemakings. In particular, the 2007 inventory used to represent the control case for the Heavy Duty Diesel Engines (HDDE) rule and the 2020 inventory used to represent the control case for the Land-based Non-road Diesel Engines (LNDE) rule were used with appropriate adjustments for this proposal. Full documentation of the procedures used to develop these earlier projection inventories is available at www.epa.gov/otaq/models/hd2007/r00020.pdf and www.epa.gov/nonroad/454r03009.pdf, respectively. A description of the adjustments that were made beyond what is documented in those earlier documents is described in subsections 1. through 4., below.

The control case inventories for 2010 and 2015 were developed by replacing the EGU emissions in the base case inventories with the projected EGU emissions under a proposed emissions cap scenario. Appendix A, Tables 10 thru 21 contain the State-level emissions summaries for each of the five sectors for the IAQR Base Case inventories for 2010 and 2015. Tables 22 thru 27 contain the Control Case summaries for the EGU sector, all sectors combined, and the differences from the Base Cases for the two years.

1. Development of Emissions Inventories for Electric Generating Units

Base and Control Case EGU emissions for 2010 and 2015 used for the air quality strategy modeling runs were obtained from version 2.1.6 of the Integrated Planning Model (IPM) (www.epa.gov/airmarkets/epa-ipm/index.html). However, results from this version of the IPM model were not available at the time that the air quality model runs used to determine interstate contributions ("zero-out runs") were started. Therefore, EGU emissions from a previous IPM version (v2.1.5) were used for the zero-out runs. Updates applied to the IPM model between versions 2.1.5 and 2.1.6 include the update of coal and natural gas supply curves and the incorporation of several State-mandated emission caps and New Source Review (NSR) settlements. In this document we refer to the 2010 Base Case used in the zero out runs as 2010 Base-1[1], and the 2010 Base Case used for the control strategy runs as 2010 Base-2. The 2010 Base-2 and 2015 Base Case were developed from the same IPM. The 2010 Base-2 emissions are also the same as the 2010 Base Case used for modeling in the 2003 Clear Skies analysis. Appendix A Tables 28 and 29 compare the State-level emissions totals of NOx and SO2 for 2010 Base-1 versus 2010 Base-2.

2. Development of Emissions Inventories for On-road Vehicles

The 2010 and 2015 Base Case emissions files used for this proposal were developed as straight-line interpolations between the 2007 on-road file used for the control case of the HDDE rule and the 2020 on-road file used for both the base and control cases of the LNDE rule. Note that the 2020 on-road vehicle emissions file developed for the LNDE rule includes the reductions expected from implementation of the earlier HDDE rule. No adjustments were made for on-road vehicles beyond the linear interpolations to produce the two intervening years.

As described in the referenced documents for the earlier rules, the 2007 and 2020 on-road vehicle files were developed using a version of the MOBILE5b model which had been adjusted to simulate the MOBILE6 model that was under development at that time. The 1996 on-road vehicle emission file (and therefore the derived 2001 Proxy modeling file) had been developed using the same adjusted version of MOBILE5b.

3. Development of Emissions Inventories for Non-road Engines

The 2010 and 2020 non-road emissions files developed for EPA's analysis of the preliminary controls of the LNDE rule (and as documented at www.epa.gov/nonroad/454r03009.pdf) were modified to reflect that rule as finally proposed (68 FR 28327, May 23, 2003) and to incorporate the effects of the Large Spark Ignition and Recreational Vehicle rules. These modifications were done using adjustment ratios developed from national-level estimates of the benefits of these two rules. A 2015 emissions file for this sector was then developed as a straight-line interpolation between the modified 2010 and 2020 files. Note that a 2010 emissions file for the non-road sector had been developed in a consistent manner as the 2020 and 2030 files that were actually modeled for the LNDE proposal. However,

[1]Revisions to PM2.5 emissions from EGU sources were made to the 2010 Base-1 for sources in Iowa, Louisiana, and North Dakota. These revisions were incorporated into an updated baseline referred to as 2010 Base-1a. The 2010 Base-1a was used as the baseline for the zero-out REMSAD modeling of Iowa, Louisiana, North Dakota combined with Vermont, Colorado, Montana, New Mexico, and Wyoming. Information on the zero-out modeling to assess interstate contributions to PM2.5 can be found in section VII.

2010 emissions files were not available from the LNDE analyses for the other emission sectors.

4. Development of Emissions Inventories for Non-EGU Point Sources and Area Sources

The 2010 and 2015 emissions files for these sectors that were used as part of the interpolation to 2001 were themselves developed as straight-line interpolations between the 2007 and 2020 inventories described above for the on-road vehicle sector. The interpolated 2010 and 2015 emissions were adjusted to reflect the SO2, PM10, and PM2.5 co-control benefits of the proposed Industrial Boiler and Process Heater MACT (68 FR 1660, January 13, 2003). The 2007 and 2020 projection inventories had been developed by applying State- and 2-digit SIC-specific economic growth ratios to the 1996 NEI, followed by application of any emissions control regulations.

5. Preparation of Emissions for Air Quality Modeling

The annual and summer day emissions inventory files were processed through the Sparse Matrix Operator Kernel Emissions (SMOKE) Modeling System (Houyoux, 2000) to produce 36-km gridded input files for annual PM2.5 air quality modeling and 12-km input files for episodic ozone air quality modeling. In addition to the U.S. anthropogenic emission sources described above, hourly biogenic emissions were estimated for individual modeling days using the BEIS model version 3.09 (ftp.epa.gov/amd/asmd/beis3v09/). Emissions inventories for Canada and for U.S. offshore oil platforms were merged in using SMOKE to provide a more complete modeling data set. The single set of biogenic, Canadian, and offshore U.S. emissions was used in all scenarios modeled. That is, the emissions for these sources were not varied from run to run.

III. Base Year Episodic Ozone Modeling

Air quality modeling analyses for ozone were conducted with the Comprehensive Air Quality Model with Extensions (CAMx). CAMx is a non-proprietary computer modeling tool that can be used to evaluate the impacts of proposed emissions reductions on future air quality levels. For more information on the CAMx model, please see the model user's guide (Environ, 2002). Version 3.10 of the CAMx model was employed for these analyses.

The modeling analyses were completed for an Eastern U.S. domain as shown in Figure III-1. The domain has nested horizontal grids of 36 and 12 km. The model was applied and evaluated over three episodes that occurred during the summer of 1995. Ozone model runs were performed for emissions in 1996 in order to evaluate the ability of the model to replicate measured concentrations. In addition, model runs were preformed for the 2001 Base Year and the 2010 and 2015 Base and control case scenarios for all episodes. The model outputs from the 2001 base year and 2010 and 2015 base and control cases, combined with current air quality data, were used to: 1) determine the degree and geographic extent of expected future nonattainment, 2) determine the potential impacts of local controls on future nonattainment, 3) assess the potential for transport of ozone and ozone precursors, and 4) determine the contribution from transport to future 8-hour ozone nonattainment.

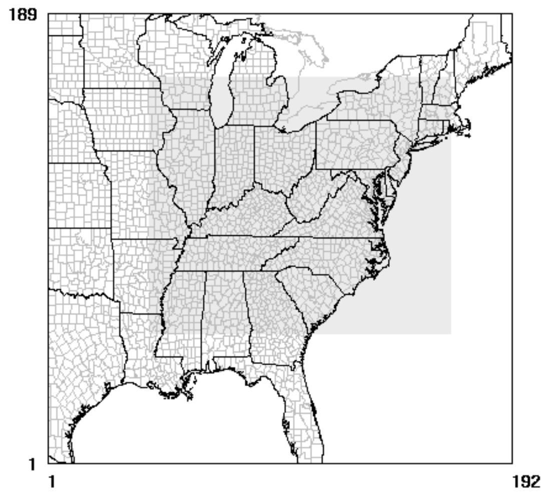

Figure III-1. Map of the Eastern U.S. modeling domain. The outer box denotes the entire modeling domain (36 km) and the inner box shaded indicates the fine grid location (12 km).

A. Modeling Episodes

There are several considerations involved in selecting episodes for an ozone modeling analysis (EPA, 1999a). In general, the goal is to model several differing sets of meteorological conditions leading to ambient ozone levels similar to an area's design value. Warm temperatures, light winds, cloud-free skies, and stable boundary layers are some of the typical characteristics of ozone episodes. On a synoptic scale, these conditions usually result from a combination of high pressure aloft (e.g., at the 500 millibar pressure level) and at the surface. On the local scale, the conditions that lead to ozone exceedances can vary from location to location based on factors such as wind direction, sea/lake breezes, etc. The ozone episodes modeled for the IAQR are listed in Table III-1. The meteorological and resultant ozone patterns for these episodes are discussed in more detail in previous technical support documents for the Tier-2/Low Sulfur rule (EPA, 1999b) and the Heavy-Duty Engine rule (EPA, 2000b). The first three days of each period are considered ramp-up days and the results from these days were not used in the analyses. In all, 30 episode days were modeled.

Table III-1. Dates of Ozone Episodes Modeled Including Ramp-Up Days.

	Ozone Episodes
Episode 1	June 12-24, 1995
Episode 2	July 5-15, 1995
Episode 3	August 7-21, 1995

In order to determine whether the modeling days correspond to commonly occurring and ozone-conducive meteorology, EPA has applied a multi variate statistical approach for characterizing daily meteorological patterns and investigating their relationship to 8-hour ozone concentrations in the Eastern U.S. (Battelle, 2004). The approach applies procedures presented in Eder, et al. (1994). These analyses were conducted using meteorological data from the most recent seven to ten years at 16 sites. In most locations, there were five to six distinct sets of meteorological conditions, called regimes, that occurred during the ozone seasons studied. An analysis of the 8-hour daily maximum ozone concentrations for each of the meteorological regimes determined the distribution of ozone concentrations for each regime and the frequency of regime occurrence. These two terms were combined to identify which regimes contribute the most to ozone concentrations in the locations under investigation. Using the data base in which each day in 1995 is assigned a meteorological regime, EPA determined that between 60 and 70 percent of the episode days modeled are associated with the most frequently occurring, high ozone potential, meteorological regimes. In general, these results provide support that the episodes modeled are representative of conditions present when elevated ozone is observed throughout the modeling domain.

B. Modeling Domain and Grid Configuration

As with episode selection, there are also several considerations involved in selecting the domain and grid configuration to be used in the ozone modeling analysis. The modeling domain should encompass the area of intended analysis with an additional buffer of grid cells to minimize the effects of, sometimes uncertain, boundary condition inputs. When possible, grid resolution should be equivalent to the resolution of the primary model inputs (emissions, winds, etc.) and equivalent to the scale of the air quality issue being addressed. The CAMx modeling was performed for the coarse and fine grid domains as defined below in Table III-2.

Table III-2. Configuration of Ozone Modeling Domain.

	Eastern US Domain	
	Coarse Grid	**Fine Grid**
Map Projection	latitude/longitude	latitude/longitude
Grid Resolution	1/2° longitude, 1/3° latitude (~ 36 km)	1/6° longitude, 1/9° latitude (~ 12 km)
East/West extent	-99 W to -67 W	-92 W to -69.5 W
North/South extent	26 N to 47 N	32 N to 44 N
Vertical extent	9 Layers: surface to 4 km	9 Layers: surface to 4 km
Dimensions	64 by 63 by 9	137 by 110 by 9

C. Meteorological and Other Model Inputs

In order to solve for the change in pollutant concentrations over time and space, the air quality model requires certain meteorological inputs that, in part, govern the formation, transport, and destruction of pollutant material. In particular, the CAMx model used in these analyses requires seven meteorological input files: wind (u- and v-vector wind components), temperature, water vapor mixing ratio, atmospheric air pressure, cloud cover, rainfall, and vertical diffusion coefficient. Fine grid values of wind, pressure, and vertical diffusivity are also used; the other fine grid meteorological inputs are interpolated from the coarse grid files.

The gridded meteorological data for the three historical 1995 episodes were developed using the Regional Atmospheric Modeling System (RAMS), version 3b. RAMS (Pielke *et. al.*, 1992) is a numerical meteorological model that solves the full set of physical and thermodynamic equations which govern atmospheric motions. The output data from RAMS, which is run in a polar stereographic projection and a sigma-p coordinate system, are then mapped to the CAMx grid. Two separate meteorological CAMx inputs, cloud fractions and rainfall rates, were developed based on observed data.

RAMS was run in a nested-grid mode with three levels of resolution: 108 km, 36 km, and 12 km with 28-34[2] vertical layers. The top of the surface layer was 16.7 m in the 36 and 12km grids. The two finer grids were at least as large as their CAMx counterparts. In order to keep the model results in line with reality, the simulated fields were nudged to an European Center for Medium-Range Weather Forecasting (ECMWF) analysis field every six hours. This assimilation

[2] The inner nests were modeled with 34 layers while the outer 108 km domain was modeled with 28 layers.

data set was bolstered by every four-hourly special soundings regularly collected as part of the North American Research Strategy on Tropospheric Ozone (NARSTO) field study in the northeast U.S.

A limited model performance evaluation (Lagouvardos et al., 2000) was completed for a portion of the 1995 meteorological modeling (July 12-15). Observed data not used in the assimilation procedure were compared against modeled data at the surface and aloft. In general, the model accurately reproduced the synoptic meteorological conditions of the episode days. Furthermore, the meteorological fields were compared before and after being processed into CAMx inputs. It was concluded that this preprocessing did not distort the meteorological fields.

In addition to the meteorological data, the photochemical grid model requires several other types of data. In general, most of these miscellaneous model files have been be taken from existing regional modeling applications. Clean conditions were used to initialize the model and were also used as lateral and top boundary conditions as in previous regional modeling applications. The model also requires information regarding land use type and surface albedo for all layer 1 grid cells in the domain. Existing regional data were used for these non-day-specific files. Photolysis rates were developed using the JCALC preprocessor. Turbidity values were set equal to a constant thought to be representative of regional conditions.

D. CAMx Model Performance Evaluation

The goal of the 1995 Base Year modeling was to reproduce the atmospheric processes resulting in high ozone concentrations over the eastern United States during the three 1995 episodes selected for modeling. Note that the base year of the emissions was 1996 while the eastern U.S. episodes are for 1995. The effects on model performance of using 1996 emissions for the 1995 episodes are not known, but are not expected to be major. The ozone model performance evaluation procedures and results are provided in Appendix B.

IV. Base Year PM2.5, Visibility, and Deposition Modeling

A. Introduction

This section describes the REgional Modeling System for Aerosols and Deposition (REMSAD) model which was used as the tool for simulating base year and future concentrations of PM, visibility, and deposition in support of the IAQR air quality assessments (ICF Kaiser, 2002) . Model runs were made for the 1996 and 2001 Base Years as well as for the 2010 and 2015 Base and control scenarios. As described below, each of these emissions scenarios was simulated using 1996 meteorological data in order to provide the PM2.5 concentrations needed for the projecting PM2.5, visibility and deposition for the future year baseline and control scenarios.

Two versions of REMSAD were used for the IAQR modeling. Version 7.03 was the most current version available when EPA began the IAQR model runs. During the course of the modeling process updates were made to REMSAD and incorporated into version 7.06. The updates made to REMSAD between version 7.03 and 7.06 are noted below in the section describing the scientific features of the model. Table IV-1 lists the IAQR emissions scenarios and the version of REMSAD used for modeling each scenario.

Table IV-1. Emissions Scenarios Modeled and REMSAD Model Version.

Model Version	2001 Proxy	2010 Base-1	2010 Base-2	2010 Zero-Out Runs	2010 Control Runs[a]	2015 Control Runs[a]
7.03	X	X	-	X	X	X
7.06	X	-	X	X[b]	-	-

a. The 2010 and 2015 Control runs include the IAQR regional strategy and a local control scenario for each of these projection years.
b. The zero-out model run for New Jersey was rerun using the 2010 Base-2 emissions because the emissions of SO2 in this State dropped by more than 10 percent compared to the emissions in the 2010 Base-1 scenario. Since the 2010 Base-2 scenario was modeled using version 7.06, the run of the New Jersey zero-out was also modeled with version 7.06.

B. REMSAD Model Description

The basis for REMSAD is the atmospheric diffusion equation (also called the species continuity or advection/diffusion equation). This equation represents a mass balance in which all of the relevant emissions, transport, diffusion, chemical reactions, and removal processes are expressed in mathematical terms. REMSAD employs finite-difference numerical techniques for the solution of the advection/diffusion equation.

REMSAD was run using a latitude/longitude horizontal grid structure in which the horizontal grids are generally divided into areas of equal latitude and longitude. The vertical layer structure of REMSAD is defined in terms of sigma-pressure coordinates. The top and bottom of the domain are defined as 0 and 1 respectively. The vertical layers are defined as a percent of the atmospheric pressure between the top and bottom of the domain. For example, a vertical layer of 0.50 sigma is exactly halfway between the top and bottom of the domain as defined by the local atmospheric pressure. The vertical layers were defined to match the vertical layer structure of the meteorological model used to generate the REMSAD meteorological inputs.

1. Gas Phase Chemistry

REMSAD simulates gas phase chemistry using a reduced-form version of Carbon Bond (CB4) chemical mechanism termed “micro-CB4” (mCB4) which treats fewer VOC species compared to the full CB4 mechanism. The inorganic and radical parts of the reduced mechanism are identical to CB4. In this version of mCB4 the organic portion is based on three primary species (VOC, ISOP, and TERP) and one primary and secondary carbonyl species (CARB). The VOC species was incorporated with kinetics representing an average anthropogenic hydrocarbon species. The other two primary VOC species represent biogenic emissions of isoprene and terpenes and are included with kinetic characteristics representing isoprene and terpenes respectively. The intent of the mCB4 mechanism is to (a) provide a physically faithful representation of the linkages between emissions of ozone precursor species and secondary PM precursors species, (b) treat the oxidizing capacity of the troposphere, represented primarily by the concentrations of radicals and hydrogen peroxide, and (c) simulate the rate of oxidation of the nitrogen oxide ($_{NOx}$) and sulfur dioxide (SO_2) PM precursors. Box model testing of mCB4 has found that it performs very closely to the full CB4 that is contained in UAM-V (Whitten, 1999).

REMSAD version 7 (7.03 and 7.06) includes several updates to the mCB4 mechanism relative to earlier versions of REMSAD. A new treatment for the NO_3 and N_2O_5 species has been implemented which results in improved agreement with rigorous solvers such as Gear and eliminates nitrogen mass inconsistencies. Also, several additional reactions have been added to the mCB4 mechanism which may be important for regional scale and annual applications where wide ranges in temperature, pressure, and concentrations may be encountered. The reactions are OH + H, OH + NO_3, and HO_2 + NO_3. For the same reason three reactions involving peroxy nitric acid (PNA), which were included in the original CB4 mechanism, were added to mCB4.

2. PM Chemistry

Primary PM emissions in REMSAD are treated as inert species. They are advected and deposited without any chemical interaction with other species. Secondary PM species, such as sulfate and nitrate are formed through chemical reactions within the model. SO_2 is the gas phase precursor for particulate sulfate, while nitric acid is the gas phase precursor for particulate nitrate. Several other gas phase species are also involved in the secondary reactions.

There are two pathways for sulfate formation; gas phase and aqueous phase. Aqueous phase reactions take place within clouds, rain, and/or fog. In-cloud processes can account for the majority of atmospheric sulfate formation in many areas. In REMSAD, aqueous SO_2 reacts with hydrogen peroxide (H_2O_2), ozone (O_3), and/or oxygen (O_2) to form aerosol sulfate. REMSAD version 7 reflects upgrades to include all three aqueous phase sulfate reactions. Previous versions only contained the hydrogen peroxide reaction. The rate of the aqueous phase reactions depends on the concentrations of the chemical reactants as well as cloud water content. SO_2 also reacts with OH radicals in the gas phase to form aerosol sulfate. The aqueous phase and gas phase sulfate is typically added together to get the total sulfate concentration.

An equilibrium algorithm is used to calculate particulate nitrate concentrations. REMSAD version 7 uses the MARS-A equilibrium algorithm (Saxena et al., 1986) and (Kim et al., 1993). In REMSAD, particulate nitrate is calculated in an equilibrium reaction between nitric acid, sulfate, and ammonia. Nitric acid is a product of gas phase chemistry and is formed through the mCB4 reactions. The acids are neutralized by ammonia with sulfate reacting more quickly than nitric acid. An equilibrium is established among ammonium sulfate and ammonium nitrate which strongly favors ammonium sulfate. If the available ammonia exceeds twice the available sulfate then particulate nitrate is allowed to form as ammonium nitrate. Nitrate is then partitioned between particulate nitrate and gas phase nitric acid. The partitioning of nitrate depends on the availability of ammonia as well meteorological factors such as temperature and relative humidity.

The updates to the REMSAD that were made between version 7.03 and 7.06 affect the dry deposition velocity of all gas phase species and in particular ammonia. Several assumptions contained in the REMSAD dry deposition code were removed. In previous versions of REMSAD, the surface resistance (Rc) for ammonia gas was set equal to 30 s/m at all times for the landuse categories of agriculture, range, and mixed agriculture and range. In addition, for the landuse types of deciduous forest, coniferous forest, and mixed forest, the ammonia surface resistance was set equal to the stomatal resistance only . Both of these assumptions were removed from the code. As a result, version 7.06 more closely follows the original work by Wesley (Wesley, 1989).

Organic aerosols can contribute a significant amount to the PM in the atmosphere. Primary organic aerosols (POA) are treated as a directly emitted species in REMSAD. In REMSAD version 7, a calculation of the production of secondary organic aerosols (SOA) due to atmospheric chemistry processes was added[3]. A peer review of the REMSAD model (Seigneur et al., 1999) recommended an SOA module based on the equilibrium approach of Pankow (Odum et al., 1997), (Griffin et al., 1999). The implementation of the SOA treatment in version 7 of REMSAD follows the recommendation of the peer review. This includes SOA formation from anthropogenic and biogenic organic precursors. For both anthropogenic and biogenic organics REMSAD includes gas phase secondary organic species and the corresponding aerosol phase species.

C. REMSAD Modeling Domain

The REMSAD domain used for the IAQR modeling is shown in Figure IV-1. The geographic characteristics of the domain are as follows:

120 (E-W) X 84 (N-S) grid cells
Cell size (~36 km)
    ½ degree longitude (0.5)
    1/3 degree latitude (0.3333)
E-W range: 66 degrees W - 126 degrees W

[3]An error was found in the SOA mechanism of REMSAD v7.01. This was corrected in version 7.03. The reference temperature from the literature to calculate the partitioning coefficient (K) was assumed to be 298K when it should have been ~308K.

N-S range: 24 degrees N - 52 degrees N
Vertical extent: Ground to 16,200 meters (100mb) with 12 layers

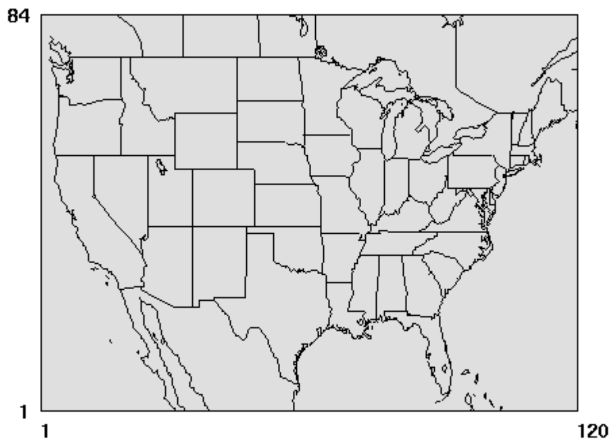

Figure IV-1. REMSAD Modeling Domain.

D. Meteorological and Other Model Inputs

REMSAD requires input of winds (u- and v-vector wind components), temperatures, surface pressure, specific humidity, vertical diffusion coefficients, and rainfall rates. The meteorological input files were developed from a 1996 annual MM5 model run that was developed for previous projects. MM5 is the Fifth-Generation NCAR / Penn State Mesoscale Model. MM5 (Grell et al., 1994) is a numerical meteorological model that solves the full set of physical and thermodynamic equations which govern atmospheric motions. MM5 was run in a nested-grid mode with 2 levels of resolution: 108 km, and 36km with 23 vertical layers sigma layers extending from the surface to the 100 mb pressure level. The model was simulated in five day segments with an eight hour ramp-up period. The MM5 runs were started at 00Z, which is 7:00 p.m. EST. The first eight hours of each five day period were removed before being input into REMSAD. Table IV-2 provides the vertical grid structures for the MM5 and REMSAD domains. Further detailed information concerning the development and evaluation of the 1996 MM5 datasets can be found in (Olerud, 2000).

Table IV-2. Vertical Grid Structure for 1996 MM5 and Clear Skies REMSAD Domains. Layer Heights Represent the Top of each Layer. The First Layer is from the Ground up to 38 meters.

REMSAD Layer	MM5 Layer	Sigma	Approximate Height (m)	Pressure (mb)
0	0	1.000	0.0	1000.0
1	1	0.995	38.0	995.5
2	2	0.988	91.5	989.2
	3	0.980	152.9	982.0
3	4	0.970	230.3	973.0
	5	0.956	339.5	960.4
4	6	0.938	481.6	944.2
	7	0.916	658.1	924.4
5	8	0.893	845.8	903.7
	9	0.868	1053.9	881.2
6	10	0.839	1300.7	855.1
	11	0.808	1571.4	827.2
7	12	0.777	1849.6	799.3
	13	0.744	2154.5	769.6
8	14	0.702	2556.6	731.8
	15	0.648	3099.0	683.2
9	16	0.582	3805.8	623.8
	17	0.500	4763.7	550.0
10	18	0.400	6082.5	460.0
	19	0.300	7627.9	370.0
11	20	0.200	9510.5	280.0
	21	0.120	11465.1	208.0
	22	0.052	13750.2	146.0
12	23	0.000	16262.4	100.0

The MM5 model output cannot be directly input into REMSAD due to differences in the grid coordinate systems and file formats. A postprocessor called MM5-REMSAD was developed to convert the MM5 data into REMSAD format. This postprocessor was used to develop hourly average meteorological input files from the MM5 output. Documentation of the MM5REMSAD code and further details on the development of the input files is contained in (Mansell, 2000).

Application of the REMSAD modeling system requires data files specifying the initial species concentration fields and lateral boundary species concentrations. Due to the extent of the proposed modeling domains and the large-scale modeling domain, these inputs were developed based on "clean" background concentration values. The IAQR modeling used temporally and spatially (horizontal) invariant data for both initial and boundary conditions. Species concentration values were allowed to decay vertically for most species.

Land use characteristics were perpared for input to the REMSAD simulations. These data provide the fraction in each grid cell of the 11 land specified in REMSAD. Land use characteristics are used in the model for the calculation of deposition parameters. For this task, land use data was obtained from the United States Geological Survey Global vegetation database which contains the same data used in the 1996 MM5 models runs. This dataset provides 24 landuse categories, including urban. For the REMSAD application the 24 vegetation categories were remapped to those required for application of REMSAD.

E. REMSAD Model Performance Evaluation

The goal of the 1996 Base Year REMSAD modeling was to reproduce the atmospheric processes resulting in formation and dispersion of fine particulate matter across the U.S. An operational model performance evaluation for PM2.5 and its related speciated components (e.g., sulfate, nitrate, elemental carbon etc.) for 1996 was performed in order to estimate the ability of the modeling system to replicate Base Year concentrations. A description of the evaluation procedures and the results are provided in Appendix C.

V. Procedures for Projecting Ozone and PM2.5 for Future Year Scenarios

A. Introduction

In this section we describe the procedures used to project current air quality concentrations to the future year baseline and control scenarios covered in this TSD. For this analysis we started with current ambient 8-hour ozone and annual average PM2.5 design values as calculated by EPA for individual monitoring sites. The development of these design values is described in the report Air Quality Data Analysis Technical Support Document for the Proposed Interstate Air Quality Rule (EPA, 2004)[4]. The procedures for projecting ozone concentrations is presented first followed by the procedures for projecting PM2.5 concentrations. In general, the

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[4]The ambient PM2.5 design values used for projecting future year concentrations were obtained for monitoring sites which meet the completeness criteria in 40CFR Part 50, Appendix N and do not reflect the application of any data substitution tests to fill in for incomplete data. However, the design values reported in the Air Quality Data Analysis TSD do reflect the data substitution. As a consequence of this difference, 2000-2002 design values reported in the Air Quality Data Analysis TSD may be higher than those used in the modeling analysis for the following counties: New Haven, CT, Richmond, GA, Lake, IN, Philadelphia, Hamilton, TN.

procedures for projecting ozone and PM2.5 follow the same general approach. This approach involves using the predictions from Base Year and future case air quality model runs in a relative sense to adjust current design value concentrations up or down, depending on the modeling results, to reflect expected future concentrations.

B. Projection of Future 8-Hour Ozone Concentrations

Ozone modeling for the 2001 Base Year was coupled with modeling for the future year scenarios in 2010 and 2015 to project which counties are expected to be nonattainment for the future year emissions scenarios. In general, the approach for projecting future 8-hour ozone concentrations involves using the model in a relative sense to estimate the change in ozone between 2001 and each future scenario. Concentrations of ozone in 2010 were estimated by applying the relative change in model predicted ozone from 2001 to 2010 with present-day 8-hour ozone design values (2000-2002). The procedures for calculating future case ozone design values are consistent with EPA's draft modeling guidance (EPA, 1999a) for 8-hour ozone attainment demonstrations, "Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS." The draft guidance specifies the use of the higher of the design values from (a) the period that straddles the emissions inventory Base Year or (b) the design value period which was used to designate the area under the ozone NAAQS. In this case, 2000-2002 is the design value period which straddles the 2001 Base Year inventory and is also the latest period which is available for determining designation compliance with the NAAQS. Therefore, 2000-2002 was the only period used as the basis for projections to the future years of 2010 and 2015.

The procedures in the guidance for projecting future 8-hour ozone nonattainment are as follows:

Step 1: Hourly model predictions are processed to determine daily maximum 8-hour concentrations for each episode day modeled. A relative reduction factor (RRF) is then determined for each monitoring site. First, the multi-day mean (excluding ramp-up days) of the 8-hour daily maximum predictions in the nine grid cells that include or surround the site is calculated using only those predictions greater than or equal to 70 ppb, as recommended in the guidance. This calculation is performed for the base year 2001 scenario and the future-year scenario. The RRF for a site is the ratio of the mean prediction in the future-year scenario (e.g., 2010) to the mean prediction in the 2001 base year scenario. The RRFs were calculated on a site-by-site basis.

Step 2: The RRF for each site is then multiplied by the 2000-2002 ambient design value for that site, yielding an estimate of the future design value at that particular monitoring location. In calculating the projected design values, any amount of the concentration less than 1 ppb (i.e., to the right of the decimal) were discarded (i.e., the concentrations were truncated to an integer ppb value).

Step 3: For counties with only one monitoring site, the value at that site was selected as the value for that county. For counties with more than one monitor, the highest value in the county was selected as the value for that county. Counties with projected 8-hour ozone design values of 85 ppb or more are projected to be nonattainment

.

As an example, consider Clay County, Alabama which has one ozone monitor. The 2000-2002 8-hour ambient ozone design value is 82 ppb. In the 2001 base year simulation, 24 of the 30 episode modeling days have CAMx values of 70 ppb or more in one of the nine grid cells that include or surround the monitor location. The average of these predicted ozone values is 88.62 ppb. In 2010, the average of the predicted values for these same grid cells was 70.32 ppb. Therefore, the RRF for this location is 0.79, and the projected 2010 design value is 82 multiplied by 0.79 equals 65.07. All projected future case design values are truncated to the nearest ppb (e.g., 65.07 becomes 65). Since there are no other monitoring locations in Clay County, Alabama, the projected 2010 8-hour design value for this county is 65 ppb.

The RRF approach described above was applied for the 2010 and 2015 Base Case scenarios. The 2010 Base and 2015 Base Case design values are provided in Appendix D. Of the 287 counties that were nonattainment based on 2000-2002 design values, 47 are forecast to be nonattainment in 2010 and 34 in 2015. None of the counties that were measuring attainment in the period 2000-2002 are forecast to become nonattainment in the future. Those counties projected to be nonattainment for the 2010 and 2015 Base Cases are listed in Table V-1. The counties projected to be nonattainment for the 2010 Base Case are the nonattainment receptors used for assessing the contribution of emissions in upwind States to downwind nonattainment and for analyzing the impacts of emissions control scenarios.

Table V-1. Counties Projected to be Nonattainment for the 8-Hour Ozone NAAQS in the 2010 and 2015 Base Cases.

State	2010 Base-2	2015 Base Case
AR	Crittenden	Crittenden
CT	Fairfield, Middlesex, New Haven	Fairfield, Middlesex, New Haven
DC	Washington, D.C.	Washington D.C.
DE	New Castle	None
GA	Fulton	None
IL	None	Cook
IN	Lake	Lake
MD	Anne Arundel, Baltimore, Cecil, Harford, Kent, Prince Georges	Anne Arundel, Cecil, Harford
MI	None	Macomb

NJ	Bergen, Camden, Cumberland, Gloucester, Hudson, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Ocean	Bergen, Camden, Gloucester, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Ocean
NY	Erie, Putnam, Richmond, Suffolk, Westchester	Erie, Richmond, Suffolk, Westchester
NC	Mecklenburg	None
OH	Geauga, Summit	Geauga
PA	Allegheny, Bucks, Delaware, Montgomery, Philadelphia	Bucks, Montgomery, Philadelphia
RI	Kent	Kent
TX	Denton, Harris, Tarrant	Harris
VA	Arlington, Fairfax	Arlington, Fairfax
WI	Kenosha, Racine, Sheboygan	Kenosha, Sheboygan

C. Projection of Future PM2.5 Concentrations

As with ozone, the approach for identifying areas expected to be nonattainment for PM2.5 in the future involves using the model predictions in a relative way to forecast current PM2.5 design values to 2010 and 2015. The modeling portion of this approach includes annual simulations for 2001 emissions and for the 2010 and 2015 Base Case emissions scenarios. As described below, the predictions from these runs were used to calculate RRFs which were then applied to current PM2.5 design values. The approach we followed is consistent with the procedures in the draft PM2.5 air quality modeling guidance (EPA, 2001) "Guidance for Demonstrating Attainment of Air Quality Goals for PM2.5 and Regional Haze." It should be noted that the approach for PM2.5 differs from the approach recommended for projecting future year 8-hour ozone design values in terms of the base period for design values. The approach for ozone uses the higher of the ambient design values for two 3-year periods, as described above. In contrast, the PM2.5 guidance recommends selecting the highest design value from among the three periods that straddle the base emissions year (i.e., 2001). The three periods that straddle this year are 1999-2001, 2000-2002, and 2001-2003. The data from the first two design value periods are readily available, but the data from the 2001-2003 period could not be used since the 2003 data were not yet available. Thus, we have relied on the data for the two periods 1999-2001 and 2000-2002. The design values from the period 2000-2002, which is the most recent period with available data, were used to identify which monitors are currently measuring nonattainment (i.e., annual average PM2.5 of 15.05 $\mu g/m^3$ or more). To be consistent with procedures in the modeling guideline, we selected the higher of the 1999-2001 or 2000-2002 design value from each nonattainment monitor for use in projecting future design values. The recommendation in the guidance for selecting the highest values from among 3 periods is applicable for nonattainment counties, but not necessarily for attainment counties. Thus, for monitors that are measuring attainment (i.e., PM2.5 less than 15.05 $\mu g/m^3$) using the most recent

3 years of data, we used the 2000-2002 design values as the starting point for projecting future year design values. Note that none of the counties that are attainment for the period 2000-2002 are forecast to become nonattainment in 2010 or 2015.

The modeling guidance recommends that model predictions be used in a relative sense to estimate changes expected to occur in each major PM2.5 species. These species are sulfate, nitrate, organic carbon, elemental carbon, crustal and un-attributed mass. Un-attributed mass is defined as the difference between FRM PM2.5 and the sum of the other five components. The procedure for calculating future year PM2.5 design values is called the Spectate Modeled Attainment Test (SMAT). Details on the SMAT procedure are provided in Appendix E.

We are using the FRM data for projecting future design values since these data will be used for nonattainment designations. In order to apply SMAT to the FRM data, information on PM2.5 speciation is needed for the location of each FRM monitoring site. Only a small number of the FRM sites have collocated species measurements. Therefore, spatial interpolation techniques were applied to the spectate component averages from the IMPROVE and Speciation Trends Network (STN) data to estimate concentrations of species mass at each FRM PM2.5 monitoring site.

The following is a brief summary of SMAT as applied to data for a given monitoring site:

<u>Step 1</u>: Calculate quarterly mean ambient concentrations (averaged over 3 years) for each of the six major components of PM2.5 using the species concentrations estimated for the FRM site. This is done by multiplying the monitored quarterly mean concentration of FRM-derived PM2.5 by the estimated fractional composition of PM2.5 species for each quarter in 3 consecutive years (e.g., 20 percent sulfate multiplied by 15 $\mu g/m^3$ PM2.5 equals 3 $\mu g/m^3$ sulfate).

<u>Step 2</u>: For each quarter, calculate the ratio of future (e.g., 2010) to current (i.e., 2001) model predictions for each component specie using the model output for the grid cell containing the monitoring site. The result is a component-specific RRF (e.g., assume that 2001 predicted sulfate for the grid cell containing the FRM site is 10 $\mu g/m^3$ and the 2010 Base concentration in this same grid cell is 8 $\mu g/m^3$, then the RRF for sulfate at this site is 0.8).

<u>Step 3</u>: For each quarter and each component specie, multiply the current quarterly mean component concentration (Step 1) by the component-specific RRF obtained in Step 2. This produces an estimated future quarterly mean concentration for each component (e.g., 3 $\mu g/m^3$ sulfate multiplied by 0.8 equals future sulfate of 2.4 $\mu g/m^3$).

<u>Step 4</u>: Average the four quarterly mean future concentrations to get an estimated future annual mean concentration for each component specie. Sum the annual mean concentrations of the 6 components to obtain an estimated future annual average concentration for PM2.5. In calculating the projected design values, any amount of the concentration less than 0.01 $\mu g/m^3$ (i.e., more than two places to the right of the decimal) were discarded (i.e., truncated).

The preceding procedures for determining future year PM2.5 concentrations were applied for each FRM site. For counties with only one FRM site, the forecast design value for that site was used to determine whether or not the county will be nonattainment in the future. For counties with multiple monitoring sites, the site with the highest future concentration was selected for that county. Those counties with future year concentrations of 15.05 $\mu g/m^3$ or more are predicted to be nonattainment.

The SMAT technique was used for estimating future year PM2.5 concentrations for all the scenarios modeled. For the 2010 Base-2 scenario there are 61 counties in the East that are forecast to be nonattainment. Of these, 41 are forecast to remain nonattainment for the 2015 Base Case. The PM2.5 nonattainment counties for the 2010 Base-2 and 2015 Base Case are listed in Table V-2. These nonattainment counties were used as receptors for quantifying the impacts of the local control strategies and regional control strategies described in sections IX and X, respectively.

Table V-2. Counties Projected to be Nonattainment for the PM2.5 NAAQS for the 2010 Base and 2015 Base Case.

State	2010 Base-2	2015 Base Case
AL	DeKalb, Jefferson, Montgomery, Russell, Talladaga	Jefferson, Montgomery, Russell, Talladaga
CT	New Haven	New Haven
DC	Washington, D.C.	None
DE	New Castle	None
GA	Clarke, Clayton, Cobb, DeKalb, Floyd, Fulton, Hall, Muscogee, Paulding, Richmond, Wilkinson	Clarke, Clayton, Cobb, DeKalb, Floyd, Fulton, Hall, Muscogee, Richmond, Wilkinson
IL	Cook, Madison, St. Clair, Will	Cook, Madison, St. Clair
IN	Clark, Marion	Clark, Marion
KY	Fayette, Jefferson	Jefferson
MD	Baltimore City	Baltimore City
MI	Wayne	Wayne
MO	St. Louis	None
NY	New York (Manhattan)	New York (Manhattan)
NC	Catawba, Davidson, Mecklenburg	None
OH	Butler, Cuyahoga, Franklin, Hamilton, Jefferson, Lawrence, Mahoning, Scioto, Stark, Summit, Trumbull	Butler, Cuyahoga, Franklin, Hamilton, Jefferson, Scioto, Stark, Summit
PA	Allegheny, Bucks, Lancaster, York	Allegheny, York

SC	Greenville	None
TN	Davidson, Hamilton, Knox, Roane, Sullivan	Hamilton, Knox
WV	Brooke, Cabell, Hancock, Kanawha, Marshal, Wood	Brooke, Cabell, Hancock, Kanawha, Wood

As noted above in section II, the 2010 Base Case used for the zero-out PM2.5 modeling included EGU emissions from an earlier simulation of the Integrated Planning Model. Of the 61 2010 Base-2 nonattainment counties listed in Table V-2, 4 counties (i.e., Catawba Co., NC, Trumbull Co., OH, Greenville Co., SC, and Marshall Co., WV) were projected to be in attainment in the 2010 Base-1 used for the zero-out modeling. Thus, 57 nonattainment counties (i.e., the 61 counties in Table V-2 less these 4 counties) were used as downwind receptors for the State-by-State zero-out modeling in the assessment of interstate PM2.5 contributions described in section VII. The 2010 Base-1, 2010 Base-2, and 2015 Base Case PM2.5 concentrations projected for each county that was nonattainment in the Base Year, are provided in Appendix F.

VI. Modeling to Assess Interstate Ozone Contributions

This section documents the procedures used by EPA to quantify the impact of ozone precursor emissions in specific upwind States on air quality concentrations in projected downwind 8-hour ozone nonattainment areas. These procedures are the first of the two-step process for determining significant contribution, in which the second step involves a control cost assessment to determine the amount of upwind emissions that should be reduced. In this section we use the phase "significant contribution" to refer to the ozone air quality step of the significance determination.

Included in this section are descriptions of: 1) the analytic approach for modeling the contribution of upwind States to ozone in potential downwind nonattainment areas, 2) the methodology for analyzing the modeling results, 3) the decision rules used to determine whether individual States make a significant contribution (before considering cost), and d) the results of the interstate ozone significant contribution analysis. As discussed in section III, the air quality modeling analyses for ozone were conducted for an Eastern U.S. domain with CAMx, version 3.10. The air quality modeling for the interstate ozone contribution analysis focuses on the 47 counties predicted to be nonattainment for 8-hour ozone in the 2010 Base Case. These counties are identified in section V. It should be noted that the approach used to identify the nonattainment receptors for this analysis differed from that used in the NOx SIP Call where we aggregated on a State-by-State basis all grid cells which were both (a) associated with counties that violated the 8-hour NAAQS (based on 1994-1996 data) and (b) had future base case predictions of 85 ppb or more. For the IAQR analysis of interstate ozone contributions, we have treated each individual county projected to be nonattainment in the future as a downwind nonattainment receptor.

A. Zero Out and Source Apportionment Techniques

The modeling approach used by EPA to quantify the impact of emissions in specific upwind States on projected downwind nonattainment areas for 8-hour ozone includes two different techniques, zero-out and source apportionment. The outputs of the two types of modeling were used to calculate certain measures of contribution, called "metrics". The metrics were evaluated in terms of three key contribution factors to determine which States make a significant contribution to downwind ozone nonattainment. The significant contribution analysis completed for the IAQR analysis uses the same modeling techniques, the same metrics, and the same three contribution factors as those used by EPA for the State-by-State determination in the NOx SIP Call.

The zero-out and source apportionment modeling techniques provide different technical approaches to quantifying the downwind impact of emissions in upwind States. The zero-out modeling provides an estimate of downwind impacts by calculating the difference between the model estimates from a base case run to the estimates from a simulation in which the base case man-made emissions of NOx and VOC are removed from a specific State. Because of the gridded nature of the modeling, State boundaries can only be approximated to the nearest grid. For grid cells that straddle State borders, assignments are made to the State in which the majority of the grid cell resides. Thus, for low-level sources (i.e., onroad, nonroad, area, and point sources with low plume rise) emissions were removed in the zero-out runs in grid cells which closely approximate the State. However, because elevated point source emissions are located in the model based on their actual latitude and longitude, only those sources within the State boundaries had emissions removed in the zero-out runs.

EPA also used the source apportionment technique as part of the modeling analysis to evaluate the downwind contributions of emissions in upwind States. The source apportionment technique in CAMx was developed to provide modelers with a means of estimating the contributions of many different source areas/categories to ozone formation in *one single model run*. This is achieved by using multiple tracer species to track the fate of ozone precursor emission (VOC and NOx) and the ozone formation caused by these emissions within a CAMx simulation. The methodology is designed so that all ozone and precursor concentrations are attributed to the selected source areas/categories at all times. Thus, for all receptor locations and times, the ozone, VOC, and NOx concentrations predicted by the CAMx are attributed to the source areas/categories selected for analysis. EPA used the Anthropogenic Precursor Culpability Assessment (APCA) option in the IAQR source apportionment modeling. The key feature of APCA is that it allocates the ozone production to the manmade precursor emissions, either through reactions among various manmade sources and/or through reactions between manmade emissions and biogenic emissions. Additional information on the source apportionment technique can be found in the CAMx User's Guide (Environ, 2002). In general, EPA found that the source apportionment modeling tends to show greater magnitude and frequency of contributions than the zero-out modeling for individual linkages. However, because there is no technical evidence showing that one technique is clearly superior to the other for evaluating contributions to ozone from various emission sources; both approaches were given equal consideration in the significance analysis.

The EPA performed State-by-State zero-out modeling and source apportionment modeling for 31 States in the Eastern U.S. These States are as follows: Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin. In both types of modeling, emissions from the District of Columbia were combined with those from Maryland.

B. Ozone Contribution Factors and Metrics

EPA selected several metrics to quantify the projected downwind contributions from emissions in upwind States. The metrics were designed to provide information on three fundamental factors for evaluating whether emissions in an upwind State make large and/or frequent contributions to downwind nonattainment. These factors are: a) the magnitude of the contribution, b) the frequency of the contribution, and c) the relative amount of the contribution.

The magnitude of contribution factor refers to the actual amount of ozone contributed by emissions in the upwind State to nonattainment in the downwind area. The frequency of the contribution refers to how often contributions above certain thresholds occur. The relative amount of the contribution is used to compare the total ozone contributed by the upwind State to the total amount of nonattainment ozone in the downwind area. These factors are the basis for eight separate metrics that can be used to assess a particular impact. These metrics are described below for the zero-out modeling and for the source apportionment modeling. Table VI-1 lists the four metrics for each factor.

Table VI-1. Ozone Contribution Factors and Metrics.

Factor:	Zero-out Metrics	Source Apportionment Metrics
Magnitude of Contribution	1) Maximum contribution	5) Maximum contribution; and 6) Highest daily average contribution (ppb and percent)
Frequency of Contribution	2) Number and percent of exceedances with contributions in various concentration ranges	7) Number and percent of exceedances with contributions in various concentration ranges
Relative Amount of Contribution	3) Total contribution relative to the total exceedance ozone in the downwind area 4) Population-weighted total contribution relative to the total population-weighted exceedance ozone in the downwind area	8) Total average contribution to exceedance ozone in the downwind area

The values for each metric were calculated using only those periods during which model-predicted 8-hour average ozone concentration were of 85 ppb or more in at least one of the model grid cells that are associated with the receptor county. That is, we only analyzed interstate ozone contributions for the nonattainment receptor counties when the model predicted an exceedance in the 2010 Base Case. Grid cells were linked to a specific nonattainment county if any part of the grid cell covered any portion of the projected 2010 nonattainment county. In cases where a grid cell covered two or more nonattainment counties, the grid was tied to the nonattainment county that contained the largest portion of the area of the grid cell. The exception to that rule involves cells that encompass a border of two adjacent States and more than two counties. In that case, grids are assigned to the county in the State with the largest area of the grid cell.

As in the NOx SIP Call, the ozone contribution metrics are calculated and evaluated for each upwind State to each downwind nonattainment receptor. These source-receptor pairs are referred to as "linkages".

1. Zero-out Metrics

A central component of several of the metrics is the number of predicted exceedances in the 2010 Base Case for each nonattainment receptor. The number of exceedances in a particular nonattainment receptor is determined by the total number of daily predicted peak 8-hour concentrations of 85 ppb or more across all the episode days in the model grid cells assigned to the receptor. For example, the Fairfield County, CT receptor area consists of 11 grid cells. There are 30 days in the modeling simulations. Thus, the maximum possible number of exceedances for this area is 330. The actual number of exceedances for this area was 27 grid-days.

The Maximum Contribution Metric (metric 1) for a particular upwind State to an individual downwind nonattainment receptor is determined by first calculating the concentration differences between the 2010 Base Case and the zero-out simulation for that upwind State. This calculation is performed for all 2010 Base Case exceedances predicted within the grid cells associated with the nonattainment county. The largest difference (i.e., contribution) for the linkage across all of the exceedances at the downwind receptor is identified as the maximum contribution.

The Frequency of Contribution Metric (metric 2) for a particular linkage is determined by first sorting the contributions by concentration range (e.g., >= 2 ppb, >= 5 ppb, etc.). The number of impacts in each range is used to assess the frequency of contribution. Frequency of Contribution is also expressed in terms of the percent of the 2010 Base exceedances that receive contributions in each range. For example, Ohio contributes 2 ppb or more to 9 of the 27 exceedances in Fairfield County, CT. Thus, Ohio contributes >= 2 ppb to 33% of the exceedances predicted in this county.

Determining the Total Ozone Contribution Relative to the Base Case Exceedance Metric

(metric 3) for a particular linkage involves first calculating the total ozone of 85 ppb or more in the 2010 Base Case and in the upwind State's zero-out run. The calculation is performed by summing the amount of ozone above the NAAQS for each predicted exceedance at the downwind receptor area. Second, the amount of ozone above the NAAQS from the zero-out run is subtracted from the amount of ozone above the NAAQS in the 2010 Base run. The difference in contribution (between the base and zero-out run) is then divided by the total ozone above the NAAQS in the base run to form this metric. For example in Fairfield County CT, the sum of the ozone above 85 ppb for the 2010 Base run in the 27 exceedances equals 319.5 ppb. When the emissions from Ohio are zeroed, the total ozone above the NAAQS equals 271.0 ppb. The difference between the base and zero-out amounts is 48.5 ppb. Thus, the total relative contribution from emissions in Ohio is 15 percent (48.5 divided by 319.5).

The Population-Weighted Relative Contribution Metric (metric 4) is similar to the total ozone contribution metric described in the preceding paragraph, except that during the calculation the amount of ozone above the NAAQS in both the base case and the zero-out simulation is weighted by (i.e., multiplied by) the 2000 population in the receptor grid cell. Note that this metric is used solely to provide an additional perspective. It is not considered as an independent metric and it did not provide the basis for any decisions.

2. Source Apportionment Metrics

Despite the fundamental differences between the zero out and source apportionment techniques, the definitions of the source apportionment metrics are generally similar to the zero out metrics. One exception is that all 8-hour periods with averages above or equal to 85 ppb are considered in the source apportionment metrics, as opposed to just the peak 8-hour average per day. Similar analyses completed as part of the NOx SIP call concluded that the differences resulting from considering only daily maximum 8-hour averages (zero out) versus considering all 8-hour periods (source apportionment) was very small and did not influence the significance determinations. Therefore, the number of "exceedance periods" are the total number of 8-hourly predicted concentrations greater than or equal to 85 ppb within the downwind area on a cell-by-cell basis. Again using the Fairfield County, CT receptor area as an example, the maximum possible number of exceedances for this area is 5,610 (11 cells * 30 days * 17 eight-hour averages per day). The actual number of exceedance periods for this area was 110.

For a given upwind State to downwind nonattainment receptor linkage, the Maximum Contribution Metric (metric 5) is the highest contribution from among the contributions to all exceedances at the downwind receptor.

The Highest Daily Average Contribution Metric (metric 6) is determined for each day with predicted exceedances at the downwind receptor. The metric is calculated by first summing the contributions for that linkage over all exceedances on a particular day, then dividing by the number of exceedances on that day to produce a daily average contribution to nonattainment. The daily average contribution values across all days with exceedances are examined to identify the highest value which is then selected for use in the determination of significance . We also express this metric as a percent by dividing the highest daily average contribution by the corresponding ozone exceedance concentration on the same day. As an example of how this metric is calculated, consider the following two modeling days in Fairfield County, CT.

7/13/95: There were 4 exceedance periods. The total contribution from Ohio was 11 ppb. Therefore, the daily average contribution from Ohio to Fairfield County, CT was 2.8 ppb on that day. The average exceedance ozone on that day was 87 ppb, so the percentage contribution from Ohio on that day was 3.1 percent.

7/14/95: There were 68 exceedance periods. The total contribution from Ohio was 503 ppb for those cell-hours. Therefore the daily average contribution from Ohio to Fairfield County, CT was 7.4 ppb on that day. The average exceedance ozone on that day was 103 ppb, so the percentage contribution from Ohio on that day was 7.2 percent. This day had the highest daily average contribution from Ohio to Fairfield County, CT (7.4 ppb) of any of the 30 modeling days, so the ppb and percent contributions on this day were used as the values for this metric.

The Frequency of Contribution Metric (metric 7) for the source apportionment technique is also determined in a similar way to which this metric is calculated for the zero-out modeling. Looking at the impact of Ohio man-made NOx and VOC emissions on Fairfield County, CT as an example, 77 of the 110 exceedance hours (70 percent) were reduced by at least 2 ppb.

The Total Average Contribution Metric is determined for each of the three episodes individually as well as for all 30 days (i.e., all three episodes) combined. There are three parts to the calculation of this metric. In step 1, the ozone values for each of the exceedance periods in a particular downwind area are summed over the episode(s). In step 2, the total ozone from the previous step that is due to anthropogenic sources is calculated based on the source apportionment results. In step 3, the contributions from a given source region to this downwind area are summed over the exceedance periods. The total contribution calculated in step 3 is then divided by the total ozone resulting from manmade sources in step 2 to determine the fraction of ozone that is due to emissions from the upwind source area. This fraction can be multiplied by 100 to express the result as a percentage. For example, for the 110 exceedance periods in Fairfield County, CT there is a total of 10,720 ppb of ozone. Of the total base ozone, the source apportionment results indicate that 8,613 ppb is due to anthropogenic sources. The sources in Ohio contribute a total of 535 ppb which is 6.2 percent of the base case total (i.e., 535 divided by 8,613).

C. Basis for Identifying which Linkages are Significant

EPA compiled the 8-hour metrics by downwind nonattainment receptor county (referred to below as "downwind area") in order to evaluate the contributions to downwind nonattainment in 2010. The contribution metrics were reviewed to determine how large of a contribution a particular upwind State makes to nonattainment in each downwind area in terms of the magnitude of the contribution, the frequency of the contributions, and the relative amount of the total contribution. Determining whether a particular linkage indicated a significant amount of transport from an upwind source State to a downwind county is a four step process.

The first step in evaluating the contribution factors was to screen out linkages for which the contributions were clearly small. This initial screening was based on: 1) a maximum contribution of less than 2 ppb from either of the two modeling techniques and/or, 2) a percent of total nonattainment of less than 1 percent. Any upwind State that contributed to a particular downwind area in amounts that were less than the screening criteria was considered not to make a significant contribution to that downwind area. As an example, Mississippi had a maximum contribution of 3 ppb on Fulton County, GA in both the source apportionment and the zero out modeling exercises, however, the percent of total nonattainment metric was less than 1 percent. Therefore, Mississippi was concluded not to have a significant impact on nonattainment in Fulton County, GA as a result of the initial screening. Virginia also had a maximum contribution of 3 ppb on Fulton County, GA in both the source apportionment and the zero out modeling, but the percent of total nonattainment metric for Virginia/Fulton was 1 percent. This linkage was carried on for further analysis.

Those linkages that had contributions which exceeded the screening criteria were evaluated further in steps 2 through 4. In step 2 we evaluated the contributions in each linkage based on the zero-out modeling and in step 3 we evaluated the contributions in each linkage based on the source apportionment modeling. In step 4 we considered the results of both step 2 and step 3 to determine which of the linkages are significant. For both techniques, EPA determined whether the linkage is significant by evaluating the magnitude, frequency, and relative amount of the contributions. Each upwind State that made relatively large and/or frequent contributions to nonattainment in the downwind area, based on these factors, is considered as contributing significantly to nonattainment in the downwind area. The EPA believes that each of the factors provides an independent legitimate measure of contribution. However, there had to be at least two different factors that indicate large and/or frequent contributions in order for the linkage to be found significant. In this regard, the finding of a significant contribution for an individual linkage was not based on any single factor.

As indicated above, in step 4 we considered the results of evaluating the contributions zero-out contributions from step 1 and source apportionment contributions from step 2. For many of the individual linkages the analyses of zero-out and source apportionment contributions yield a consistent result (i.e., either large and/or frequent contributions or small and infrequent contributions). Indeed, for each affected State, EPA's proposed determination that the State contributes significantly downwind is based on at least one linkage for which each of the factors indicates large and/or frequent contributions. For some of the linkages, however, not all of the factors are consistent. For upwind-downwind linkages in which some of the factors indicate high and/or frequent contributions while other factors do not, EPA considered the overall number and magnitude of those factors that indicate large and/or infrequent contributions compared to those factors that do not. As part of the process of evaluating these types of linkages, we required that two of the three factors had to indicate large and frequent contributions for one of the modeling techniques and large and/or frequent contributions for at least one factor in the other modeling technique in order to find that the linkage was significant. Thus, based on an assessment of all the factors in such cases, EPA determined that the upwind State contributes significantly to nonattainment in the downwind area if, on balance, the factors indicate large and frequent contributions from the upwind State to the downwind area. Table V-2, below, provides examples of the four step process to illustrate how the metrics were evaluated to determine whether individual linkages are significant. Contribution tables containing the values of the metrics for each linkage are provided in Appendix G.

D. Results of Interstate Ozone Contribution Analysis

Using the procedures described above, EPA determined which States contribute significantly to nonattainment in the 47 specific downwind counties. Of the 31 States included in the assessment of interstate ozone contributions, 25 States were found to have emissions which make a significant contribution to downwind 8-hour ozone nonattainment. These States are listed in Tables V-3 and V-4. The linkages which EPA found to be significant are listed in Tables V-3 (by upwind State) and V-4 (by downwind nonattainment county) for the 8-hour NAAQS. Each upwind State contributed to nonattainment problems in counties in at least two downwind States (except for Louisiana and Arkansas which contributed to nonattainment only in Texas counties). Of the 31 States included in the assessment of interstate ozone transport, the following six States are found to not make a significant contribution to downwind nonattainment: Florida, Maine, Minnesota, New Hampshire, Rhode Island, and Vermont.

Table VI-2a. Evaluation of the Contribution to Downwind Nonattainment in Middlesex Co., CT.

Receptor	Steps	Evaluation of Contributions
Middlesex Co. Connecticut	Step 1: Evaluation of Contributions Against Screening Criteria	- 23 upwind States had contributions that did not exceed either or both of the screening criteria. These linkages were not evaluated further. As an example, the contribution from WV did exceed the screening criteria for the Source Apportionment modeling but did not exceed the criteria for the zero-out modeling, so this linkage was deemed not significant. Of the 23 linkages that passed the screening criteria (i.e., were not significant), 16 were not significant in both modeling techniques. - 7 upwind States (MA, VA, MD, OH, NJ, PA, and NY) had contributions that exceeded both screening criteria and were carried forward for evaluation in Steps 2 - 4.
	Step 2: Evaluation of Contributions from Zero-Out Modeling	- Of the 7 States that exceeded the screening criteria, 6 (VA, MD, OH, NJ, PA, and NY) made contributions that were significant considering the metrics for all three factors. - Contributions from VA, MD, OH, NJ, PA, and NY: + Magnitude: values ranged from 4.0 ppb (VA) up to 15.2 ppb (NY) + Frequency: values ranged from VA which contributed 2 ppb or more to 19% of the exeedances up to both NJ and NY which contributed 2 ppb or more to all of the exceedances - Contributions from MA were large in terms of two of the three factors: + Magnitude: the maximum contribution was 7.0 ppb + Frequency: MA contributed 2.0 ppb or more to 6% of the exceedances
	Step 3: Evaluation of Contributions from Source Apportionment Modeling	- The findings from the source apportionment modeling were similar to that of the zero-out modeling in that 6 of the 7 States that exceeded the screening criteria (VA, MD, OH, NJ, PA, and NY) made contributions that were significant considering the metrics from all three factors: - Contributions from VA, MD, OH, NJ, PA, and NY: + Magnitude: values ranged from 7 ppb (VA) to 28 ppb (NJ and NY) + Frequency: values ranged from VA which contributed 2 ppb or more to 44% of the exeedances up to both NJ and NY which contributed 2 ppb or more to all of the exceedances - Contributions from MA were large in terms of two of the three factors: + Magnitude: the maximum contribution was 7 ppb + Frequency: MA contributed 2.0 ppb or more to 10% of the exceedances
	Step 4: Final Determination of Significance	- Since all 7 States had large and frequent contributions to Middlesex Co for at least two of the three contribution factors based on each modeling technique, we determined that each of these States makes a significant contribution to nonattainment in this county.

Table VI-2b. Evaluation of the Contribution to Downwind Nonattainment in Bergen Co., NJ.

Receptor	Steps	Evaluation of Contributions
Bergen Co. New Jersey	Step 1: Evaluation of Contributions Against Screening Criteria	- 25 upwind States had contributions that did not exceed either or both of the screening criteria. These linkages were not evaluated further. As an example, the contribution from DE did exceed the screening criteria for the Source Apportionment modeling but did not exceed the criteria for the Zero-Out modeling, so this linkage was deemed not significant. Of the 25 linkages that passed the screening criteria (i.e., were not significant), 17 were not significant in both modeling techniques. - 5 upwind States (PA, VA, MD, OH, and MI) had contributions that exceeded both screening criteria and were carried forward for evaluation in Steps 2 - 4.
	Step 2: Evaluation of Contributions from Zero-Out Modeling	- Of the 5 States that exceeded the screening criteria, 3 (PA, VA, and OH) made contributions that were significant considering the metrics for all three factors. - Contributions from PA, VA, and OH: + Magnitude: values ranged from 5.2 ppb (OH) up to 26.5 ppb (PA) + Frequency: values ranged from OH which contributed 2 ppb or more to 60% of the exeedances up to PA which contributed 2 ppb or more to all of the exceedances + Relative Amount: values ranges from 21% (VA) up to 92% (PA) - Contributions from MD were large in terms of two of the three factors: + Frequency: MD contributed 2.0 ppb or more to 30% of the exceedances + Relative Amount: the total contribution from MD is 12% of the total amount of nonattainment - Contributions from MI were large in terms of one of the three factors: + Relative Amount: the total contribution from MI is 5% of the total amount of nonattainment
	Step 3: Evaluation of Contributions from Source Apportionment Modeling	- In the source apportionment modeling 4 of the 5 States that exceeded the screening criteria (MD, OH, PA and VA) made contributions that were significant considering the metrics from all three factors: - Contributions from (MD, OH, PA and VA): + Magnitude: maximum contributions ranged from 9 ppb (MD, OH and VA) to 37 ppb (PA) + Frequency: values ranged from MD which contributed 2 ppb or more to 61% of the exeedances up to PA which contributed 2 ppb or more to all of the exceedances + Relative Amount: values ranged from 4% (MD and VA) up to 31% (PA) - Contributions from MI were large in terms of two of the three factors: + Magnitude: maximum contribution was 6 ppb + Frequency: MI contributed 2.0 ppb or more to 21% of the exceedances
	Step 4: Final Determination of Significance	- 4 of the States (MD, OH, PA and VA) had large and frequent contributions to Bergen Co. for at least two of the three contribution factors based on each modeling technique. Therefore, we determined that each of these States makes a significant contribution to nonattainment in this county. In addition, the contributions from MI were large and frequent for two factors based on the Source Apportionment modeling and large based on one factor in the Zero-Out modeling. Therefore, we determined that MI makes a significant contribution to Bergen Co.

Table VI-2c. Evaluation of the Contribution to Downwind Nonattainment in Suffolk Co., NY

Receptor	Steps	Evaluation of Contributions
Suffolk Co. New York	Step 1: Evaluation of Contributions Against Screening Criteria	- 19 upwind States had contributions that did not exceed either or both of the screening criteria. These linkages were not evaluated further. As an example, the contribution from IL did exceed the screening criteria for the Source Apportionment modeling but did not exceed the criteria for the Zero-Out modeling, so this linkage was deemed not significant. Of the 19 linkages that passed the screening criteria (i.e., were not significant), 17 were not significant in both modeling techniques. - 11 upwind States (NJ, PA, CT, VA, MD, DE, NC, OH, MA, WV, and MI) had contributions that exceeded both screening criteria and were carried forward for evaluation in Steps 2 - 4.
	Step 2: Evaluation of Contributions from Zero-Out Modeling	- Of the 11 States that exceeded the screening criteria, 8 States (NJ, PA, CT, VA, MD, NC, OH, and DE) made contributions that were significant considering the metrics for all three factors. - Contributions from NJ, PA, CT, VA, MD, NC, OH, and DE: + Magnitude: values ranged from 3.6 ppb (OH) up to 46.5 ppb (NJ) + Frequency: values ranged from NC which contributed 2 ppb or more to 8% of the exeedances up to NJ which contributed 2 ppb or more to all of the exceedances + Relative Amount: values ranges from 3% (NC) up to 69% (NJ) - Contributions from MI and WV were large in terms of two of the three factors: + Frequency: MI contributed 2.0 ppb or more to 3% of the exceedances; WV contributed 2.0 ppb or more to 5% of the exceedances + Relative Amount: the total contribution from MI is 3% of the total amount of nonattainment; the total contribution from WV is 3% of the total amount of nonattainment in Suffolk Co .- Contributions from MA exceeded the screening criteria in step 1, but the Zero-Out metrics were determined to be not significant: + Magnitude: the maximum contribution (2.8 ppb) was just above the value of the screening criteria + Frequency: MA contributed 2 ppb or more to only 1% of the exceedances + Relative Amount: the total contribution from MA was only 1% of the total amount of nonattainment in Suffolk Co.
	Step 3: Evaluation of Contributions from Source Apportionment Modeling	- In the source apportionment modeling 5 of the 11 States that exceeded the screening criteria (NJ, PA, VA, MD, and DE) made contributions that were significant considering the metrics from all three factors: - Contributions from NJ, PA, VA, MD, and DE: + Magnitude: maximum contributions ranged from 8 ppb (DE) to 64 ppb (NJ) + Frequency: values ranged from VA which contributed 2 ppb or more to 37% of the exeedances up to NJ which contributed 2 ppb or more to all of the exceedances + Relative Amount: values ranged from 3% (VA) up to 29% (NJ) - Contributions from CT, NC, OH, MA, WV, and MI were large in terms of two of the three factors: + Magnitude: the maximum contributions ranged from 3 ppb (WV) to 23 ppb (CT) + Frequency: values ranged from 6% (MA) to 25% (CT)
	Step 4: Final Determination of Significance	- 10 States (NJ, PA, CT, VA, MD, DE, NC, OH, WV, and MI) had large and frequent contributions to Suffolk Co. for at least two of the three contribution factors based on each modeling technique. Therefore, we determined that each of these States makes a significant contribution to nonattainment in this county. Although the contributions from MA based on the Source Apportionment modeling were found to be large and frequent for two of the factors, the metrics based on the Zero-Out modeling did not indicate large or frequent contributions for any factor. Therefore, we determined that MA does not make a significant contribution to Suffolk Co.

Table VI-2d. Evaluation of the Contribution to Downwind Nonattainment in Fulton Co, GA.

Receptor	Steps	Evaluation of Contributions
Fulton Co. Georgia	Step 1: Evaluation of Contributions Against Screening Criteria	- 23 upwind States had contributions that did not exceed either or both of the screening criteria. These linkages were not evaluated further. As an example, the contribution from FL did exceed the screening criteria for the Zero-Out modeling but did not exceed the criteria for the Source Apportionment modeling, so this linkage was deemed not significant. Of the 23 linkages that passed the screening criteria (i.e., were not significant), 18 were not significant based on both modeling techniques. - 7 upwind States (AL, SC, TN, NC, KY, VA, and WV) had contributions that exceeded both screening criteria and were carried forward for evaluation in Steps 2 - 4.
	Step 2: Evaluation of Contributions from Zero-Out Modeling	- Of the 7 States that exceeded the screening criteria 5 States (AL, SC, TN, NC, and KY) made contributions that were significant considering the metrics for all three factors. - Contributions from AL, SC, TN, NC, and KY: + Magnitude: values ranged from 3.6 ppb (KY) up to 22.2 ppb (AL) + Frequency: values ranged from KY which contributed 2 ppb or more to 12% of the exeedances up to TN which contributed 2 ppb or more to 40% of the exceedances + Relative Amount: values ranges from 4% (NC) up to 11% (TN) - Contributions from WV were large in terms of one of the three factors: + Frequency: WV contributed 2.0 ppb or more to 5% of the exceedances - - Contributions from VA exceeded the screening criteria in step 1, but the Zero-Out metrics were determined to be not significant: + Magnitude: the maximum contribution (2.9 ppb) was just above the value of the screening criteria + Frequency: VA contributed 2 ppb or more to only 2% of the exceedances + Relative Amount: the total contribution from VA was only 2% of the total amount of nonattainment in Fulton Co.
	Step 3: Evaluation of Contributions from Source Apportionment Modeling	- In the source apportionment modeling 3 of the 7 States that exceeded the screening criteria (AL, TN, and KY) made contributions that were significant considering the metrics from all three factors: - Contributions from AL, TN, and KY: + Magnitude: maximum contributions ranged from 7 ppb (KY) to 25 ppb (AL) + Frequency: values ranged from AL which contributed 2 ppb or more to 40% of the exeedances up to TN which contributed 2 ppb or more to 78% of the exceedances + Relative Amount: values ranged from 3% (KY) up to 5% (TN) - Contributions from NC, SC, VA, and WV were large in terms of two of the three factors: + Magnitude: the maximum contributions ranged from 3 ppb (VA and WV) to 9 ppb (SC) + Frequency: values ranged from 6% (VA) to 29% (SC)
	Step 4: Final Determination of Significance	- 5 States (AL, TN, KY, SC, and NC) had large and frequent contributions to Fulton Co. for at least two of the three contribution factors based each modeling technique. Therefore, we determined that each of these States makes a significant contribution to nonattainment in this county. In addition, the contributions from WV based on the Source Apportionment modeling were large and frequent for two of the three factors (magnitude and frequency) and the contributions based on the Zero-Out modeling were large for one of the factors (frequency). Therefore, we determined that WV makes a significant contribution to Fulton Co. Although the contributions from VA based on the Source Apportionment modeling were found to be large and frequent, this was not the case for any of the factors based on the Zero-Out modeling. Therefore, we determined that the contribution from VA was not significant.

Table VI-3. Projected Downwind Counties to Which Sources in Upwind States Contribute Significantly for the 8-Hour NAAQS.

Upwind State	Downwind 2010 Nonattainment Counties
AL	Crittenden AR, Fulton GA, Harris TX
AR	Harris TX, Tarrant TX
CT	Kent RI, Suffolk NY
DE	Bucks PA, Camden NJ, Cumberland NJ, Delaware PA, Gloucester NJ, Hunterdon NJ, Mercer NJ, Middlesex NJ, Monmouth NJ, Montgomery PA, Morris NJ, Ocean NJ, Philadelphia PA, Richmond NY, Suffolk NY
GA	Crittenden AR, Mecklenburg NC
IA	Kenosha WI, Lake IN, Racine WI
IL	Allegheny PA, Crittenden AR, Erie NY, Geauga OH, Kenosha WI, Lake IN, Racine WI, Sheboygan WI, Summit OH
IN	Allegheny PA, Crittenden AR, Geauga OH, Kenosha WI, Racine WI, Sheboygan WI, Summit OH
KY	Allegheny PA, Crittenden AR, Fulton GA, Geauga OH
LA	Harris TX, Tarrant TX
MA	Kent RI, Middlesex CT
MD	Arlington VA, Bergen NJ, Bucks PA, Camden NJ, Cumberland NJ, Delaware PA, Erie NY, Fairfax VA, Fairfield CT, Gloucester NJ, Hudson NJ, Hunterdon NJ, Mecklenburg NC, Mercer NJ, Middlesex CT, Middlesex NJ, Monmouth NJ, Montgomery PA, Morris NJ, New Haven CT, Newcastle DE, Ocean NJ, Philadelphia PA, Putnam NY, Richmond NY, Suffolk NY, Summit OH, Washington DC, Westchester NY
MI	Allegheny PA, Anne Arundel MD, Baltimore MD, Bergen NJ, Bucks PA, Camden NJ, Cecil MD, Cumberland NJ, Delaware PA, Erie NY, Geauga OH, Gloucester NJ, Harford MD, Hudson NJ, Hunterdon NJ, Kenosha WI, Kent MD, Lake IN, Mercer NJ, Middlesex NJ, Monmouth NJ, Montgomery PA, Morris NJ, Newcastle DE, Ocean NJ, Philadelphia PA, Prince Georges MD, Racine WI, Richmond NY, Suffolk NY, Summit OH
MO	Crittenden AR, Geauga OH, Kenosha WI, Lake IN, Racine WI, Sheboygan WI
MS	Crittenden AR, Harris TX
NC	Anne Arundel MD, Baltimore MD, Camden NJ, Cecil MD, Cumberland NJ, Fulton GA, Gloucester NJ, Harford MD, Kent MD, Newcastle DE, Ocean NJ, Philadelphia PA, Suffolk NY
NJ	Bucks PA, Delaware PA, Erie NY, Fairfax VA, Fairfield CT, Kent RI, Middlesex CT, Montgomery PA, New Haven CT, Philadelphia PA, Putnam NY, Richmond NY, Suffolk NY, Westchester NY
NY	Fairfield CT, Hudson NJ, Kent RI, Mercer NJ, Middlesex CT, Middlesex NJ, Monmouth NJ, Morris NJ, New Haven CT
OH	Allegheny PA, Anne Arundel MD, Arlington VA, Baltimore MD, Bergen NJ, Bucks PA, Camden NJ, Cecil MD, Cumberland NJ, Delaware PA, Fairfax VA, Fairfield CT,

	Gloucester NJ, Harford MD, Hudson NJ, Hunterdon NJ, Kenosha WI, Kent MD, Kent RI, Lake IN, Mercer NJ, Middlesex CT, Middlesex NJ, Monmouth NJ, Montgomery PA, Morris NJ, New Haven CT, Newcastle DE, Ocean NJ, Philadelphia PA, Prince Georges MD, Racine WI, Richmond NY, Suffolk NY, Washington DC, Westchester NY
PA	Anne Arundel MD, Arlington VA, Baltimore MD, Bergen NJ, Camden NJ, Cecil MD, Cumberland NJ, Erie NY, Fairfax VA, Fairfield CT, Gloucester NJ, Harford MD, Hudson NJ, Hunterdon NJ, Kenosha WI, Kent MD, Kent RI, Lake IN, Mecklenburg NC, Mercer NJ, Middlesex CT, Middlesex NJ, Monmouth NJ, Morris NJ, New Haven CT, Newcastle DE, Ocean NJ, Prince Georges MD, Putnam NY, Racine WI, Richmond NY, Suffolk NY, Summit OH, Washington DC, Westchester NY
SC	Fulton GA, Mecklenburg NC
TN	Crittenden AR, Fulton GA, Lake IN, Mecklenburg NC, Tarrant TX
VA	Anne Arundel MD, Baltimore MD, Bergen NJ, Bucks PA, Camden NJ, Cecil MD, Cumberland NJ, Delaware PA, Erie NY, Fairfield CT, Gloucester NJ, Harford MD, Hudson NJ, Hunterdon NJ, Kent MD, Kent RI, Lake IN, Mecklenburg NC, Mercer NJ, Middlesex CT, Middlesex NJ, Monmouth NJ, Montgomery PA, Morris NJ, New Haven CT, Newcastle DE, Ocean NJ, Philadelphia PA, Prince Georges MD, Putnam NY, Richmond NY, Suffolk NY, Summit OH, Washington DC, Westchester NY
WI	Erie NY, Lake IN
WV	Allegheny PA, Anne Arundel MD, Baltimore MD, Bucks PA, Camden NJ, Cecil MD, Cumberland NJ, Delaware PA, Fairfax VA, Fairfield CT, Fulton GA, Gloucester NJ, Harford MD, Hunterdon NJ, Kent MD, Mercer NJ, Middlesex NJ, Monmouth NJ, Montgomery PA, Morris NJ, New Haven CT, Newcastle DE, Ocean NJ, Philadelphia PA, Prince Georges MD, Suffolk NY, Summit OH, Washington DC, Westchester NY

Table VI-4. Upwind States that Contain Emissions Sources that Contribute Significantly to Projected 8-Hour Nonattainment in Downwind States.

Downwind Nonattainment Counties	Upwind States								
Crittenden AR	AL	GA	IL	IN	KY	MO	MS	TN	
Fairfield CT	MD	NJ	NY	OH	PA	VA	WV		
Middlesex CT	MA	MD	NJ	NY	OH	PA	VA		
New Haven CT	MD	NJ	NY	OH	PA	VA	WV		
Washington DC	MD	OH	PA	VA	WV				
Newcastle DE	MD	MI	NC	OH	PA	VA	WV		
Fulton GA	AL	KY	NC	SC	TN	WV			
Lake IN	IA	IL	MI	MO	OH	PA	TN	VA	WI
Anne Arundel MD	MI	NC	OH	PA	VA	WV			
Baltimore MD	MI	NC	OH	PA	VA	WV			
Cecil MD	MI	NC	OH	PA	VA				

Harford MD	MI	NC	OH	PA	VA	WV				
Kent MD	MI	NC	OH	PA	VA	WV				
Prince Georges MD	MI	OH	PA	VA	WV					
Mecklenburg NC	GA	MD	SC	TN	VA					
Bergen NJ	MD	MI	OH	PA	VA					
Camden NJ	DE	MD	MI	NC	OH	PA	VA	WV		
Cumberland NJ	DE	MD	MI	NC	OH	PA	VA	WV		
Gloucester NJ	DE	MD	MI	NC	OH	PA	VA	WV		
Hudson NJ	MD	MI	NY	OH	PA	VA				
Hunterdon NJ	DE	MD	MI	OH	PA	VA	WV			
Mercer NJ	DE	MD	MI	NY	OH	PA	VA	WV		
Middlesex NJ	DE	MD	MI	NY	OH	PA	VA	WV		
Monmouth NJ	DE	MD	MI	NY	OH	PA	VA	WV		
Morris NJ	DE	MD	MI	NY	OH	PA	VA	WV		
Ocean NJ	DE	MD	MI	NC	OH	PA	VA	WV		
Erie NY	IL	MD	MI	NJ	PA	VA	WI			
Putnam NY	MD	NJ	PA	VA						
Richmond NY	DE	MD	MI	NJ	OH	PA	VA			
Suffolk NY	CT	DE	MD	MI	NC	NJ	OH	PA	VA	WV
Westchester NY	MD	NJ	OH	PA	VA	WV				
Geauga OH	IL	IN	KY	MI	MO					
Summit OH	IL	IN	MD	MI	PA	VA	WV			
Allegheny PA	IL	IN	KY	MI	OH	WV				
Bucks PA	DE	MD	MI	NJ	OH	VA	WV			
Delaware PA	DE	MD	MI	NJ	OH	VA	WV			
Montgomery PA	DE	MD	MI	NJ	OH	VA	WV			
Philadelphia PA	DE	MD	MI	NC	NJ	OH	VA	WV		
Kent RI	CT	MA	NJ	NY	OH	PA	VA			
Denton TX	None of the upwind States examined in this analysis were found to make a significant contribution (before considering cost) to this nonattainment receptor									
Harris TX	AL	AR	LA	MS						
Tarrant TX	AR	LA	TN							
Arlington VA	MD	OH	PA							
Fairfax VA	MD	NJ	OH	PA	WV					
Kenosha WI	IA	IL	IN	MI	MO	OH	PA			
Racine WI	IA	IL	IN	MI	MO	OH	PA			
Sheboygan WI	IL	IN	MO							

As a refinement to the preceding procedures for evaluating the contributions for each linkage, EPA prepared the following criteria for the three contribution factors to distinguish between the values which comprise a significant contribution versus those that do not:

Magnitude Metrics: considered large enough to be significant if the contribution is >= 3 ppb.
Frequency Metrics: considered frequent enough to be significant if there is a 3 ppb or more contribution to at least 3 percent of the exceedances and, for linkages in which the maximum contribution was in the range of >= 2 to < 3 ppb, there has to be contributions in this range to at least two exceedances in the downwind area.
Relative Amount Metrics: considered large enough to be significant if the total contribution relative to the total amount of nonattainment is >= 3 percent.

Applying these criteria to the contribution metrics for each linkage in the evaluation steps 2 through 4 yields the same result in terms of which linkages are significant, as provided in Tables V-3 and V-4.

VII. Modeling to Assess Interstate PM2.5 Contributions

This section documents the procedures used by EPA to quantify the impact of emissions in specific States on projected downwind nonattainment for annual average PM2.5. The analytic approach for modeling the contribution of upwind States to PM2.5 in downwind nonattainment areas and the methodology for analyzing the modeling results are described in subsection A and the findings as to whether individual States meet the air quality component of the significant contribution test is provided in subsection B. These procedures are the first of the two-step process for determining significant contribution, in which the second step involves a control cost assessment to determine the amount of upwind emissions that should be reduced. In this section we use the phase "significant contribution" to refer to the PM2.5 air quality step of the significance determination.

A. Analytical Techniques for Modeling Interstate Contributions to Annual Average PM2.5 Nonattainment

1. State-by-State Zero-Out Modeling

The EPA performed State-by-State zero-out modeling to quantify the contribution from emissions in each State to future PM2.5 nonattainment in other States. As part of the zero-out modeling technique we removed the 2010 Base Case anthropogenic emissions of SO2 and NOx for 41 States on a State-by-State basis in different model runs. The States EPA analyzed using zero-out modeling are: Alabama, Arkansas, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, New Mexico, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, West

Virginia, Wisconsin, and Wyoming[5]. Emissions from the District of Columbia were combined with those from Maryland.

In processing emissions for zero-out modeling we removed the emissions of SO2 and NOx from all anthropogenic source sectors in the given State. For elevated point sources, the emissions were removed from individual sources located within the State. For low-level sources (i.e., onroad, nonroad, area, and low-level point sources) we removed emissions using data in the gridded emissions files. Thus, in order to zero-out emissions for these four source types we identified the set of grid cells that covered the State then removed the emissions from just these grid cells. In some cases a grid cell assigned to one State overlapped a portion of a neighboring State in which a nonattainment receptor was located. In these situations the receptor was not considered as a "downwind" receptor for that zero-out State.

The model predictions from the zero-out runs were used to calculate the contribution from each State to PM2.5 at nonattainment receptors in other States through the following procedures:

Step 1: The SMAT technique was applied for each zero-out run to calculate PM2.5 concentrations at each FRM site. That is, the outputs from each zero-out run was coupled with the outputs from the 2001 proxy run to create specie-specific RRFs which were then applied to ambient species concentrations estimated for the FRM sites in order to calculate PM2.5 concentrations at each site for each zero-out run.

Step 2: For the 57 receptor sites that were nonattainment in the 2010 Base-1, we calculated the difference between the 2010 Base-1 PM2.5 concentration at the receptor and the PM2.5 concentration for the zero-out run at that same receptor. This difference is the contribution from the zero-out State to the downwind nonattainment receptor. The contribution from each State to each downwind nonattainment receptor is provided in Appendix H.

2. Interstate PM2.5 Contribution Metrics

As described above in section VI, EPA used three fundamental factors for evaluating the contribution of upwind States to downwind nonattainment, i.e., the magnitude, frequency, and relative amount of contribution. One of these factors, the frequency of contribution, is not relevant for an annual average NAAQS and thus, frequency was not considered in the evaluation of interstate contributions to nonattainment of the PM2.5 NAAQS.

The EPA considered a number of metrics to quantify the magnitude and relative amount of the PM2.5 contributions. These metrics are listed in Table VII-1. The EPA is proposing to

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[5]For computational efficiency we performed zero-out modeling for six States as combination runs in which emissions from two very distant States were removed (i.e., zero-out) in the same model run. The States we combined in three separate runs are: Nebraska and Maine, South Dakota and New Hampshire, and North Dakota and Vermont.

use the maximum downwind contribution metric as the means for evaluating the significance of interstate PM2.5 transport. The maximum contribution from a given State is the highest contribution made by that State when considering all downwind receptors.

Table VII-1. PM2.5 Contribution Metrics Considered by EPA.

Metric	Description
Maximum Contribution	Highest contribution from a given State to any downwind nonattainment receptor
Sum of Contributions	Sum of the contributions from a given State to all downwind nonattainment receptors
Maximum Contribution per MM Tons of SO2+NOx	Divide Maximum contribution from a given upwind State by the total SO2+NOx emissions in that State
Sum of Contributions per MM Tons of SO2+NOx	Divide the Sum of contributions from a given upwind State by the total SO2+NOx emissions in that State
Sum Population-Weighted Contribution	Multiply the contributions from a give State to each downwind receptor by the population in the county in which the receptor is located; then sum these population weighted values
Maximum Percent of Downwind Nonattainment	For a given State, divide the contribution to each receptor by the exceedance amount at that receptor (i.e., the difference between the 2010 Base concentration and 15.05 $\mu g/m^3$); express this value as a percent; then select the highest value from among all downwind receptors for that State
Maximum Percent of Downwind PM2.5	For a given State, divide the contribution to each receptor by the 2010 Base Case concentration at that receptor; express this value as a percent; then select the highest value from among all downwind receptors for that State

The procedures for calculating the maximum contribution metric are as follows:

Step 1: Examine the contribution from each upwind State to PM2.5 at each downwind nonattainment receptor;

Step 2: Select the highest contribution from among those determined in Step 1. This is the maximum downwind contribution.

B. Evaluation of Upwind State Contributions to Downwind PM2.5 Nonattainment

The EPA is proposing to use a criterion of 0.15 $\mu g/m^3$ for determining whether emissions in a State make a significant contribution to PM2.5 nonattainment in another State. The rationale for choosing this criterion is described in the IAQR preamble. The maximum downwind contribution from each upwind State to a downwind nonattainment county is provided in Table VII-2. Of the States analyzed for this proposal, 28 States and the District of Columbia contribute 0.15 μg/m^3 or more to nonattainment in other States and therefore are found to make a significant contribution to PM2.5. Although we are proposing to use 0.15 μg/m^3 as the air quality criterion, we have also analyzed the impacts of using 0.10 μg/m^3 Based on our current modeling, two additional States, Oklahoma and North Dakota, would be included if we were to adopt 0.10 μg/m^3 as the air quality criterion. Table VII-3 provides a count of the number of downwind counties that received contributions of 0.15 μg/m^3 or more from each upwind State. This table also provides the number of downwind counties that received contributions of 0.10 μg/m^3 or more from each upwind State.

Table VII-2. Maximum Downwind PM2.5 Contribution (μg/m^3) for each of 41 Upwind States.

Upwind State	Maximum Downwind Contribution	Downwind Nonattainment County of Maximum Contribution
Alabama	1.17	Floyd, GA
Arkansas	0.29	St. Clair, IL
Connecticut	0.07	New York, NY
Colorado	0.04	Madison, IL
Delaware	0.17	Berks, PA
Florida	0.52	Russell, AL
Georgia	1.52	Russell, AL
Illinois	1.50	St. Louis, MO
Indiana	1.06	Hamilton, OH
Iowa	0.43	Madison, IL
Kansas	0.15	Madison, IL
Kentucky	1.10	Clark, IN
Louisiana	0.25	Jefferson, AL
Maryland/District of Columbia	0.85	York, PA
Maine	0.03	New Haven, CT
Massachusetts	0.21	New Haven, CT
Michigan	0.88	Cuyahoga, OH
Minnesota	0.39	Cook, IL
Mississippi	0.30	Jefferson, AL
Missouri	0.89	Madison, IL
Montana	0.03	Cook, IL
Nebraska	0.08	Madison, IL

New Hampshire	0.06	New Haven, CT
New Jersey	0.45	New York, NY
New Mexico	0.03	Knox, TN
New York	0.85	New Haven, CT
North Carolina	0.41	Sullivan, TN
North Dakota	0.12	Cook, IL
Ohio	1.90	Hancock, WV
Oklahoma	0.14	Madison, IL
Pennsylvania	1.17	New Castle, DE
Rhode Island	0.01	New Haven, CT
South Carolina	0.72	Richmond, GA
South Dakota	0.04	Madison, IL
Tennessee	0.57	Floyd, GA
Texas	0.37	St. Clair, IL
Vermont	0.06	New Haven, CT
Virginia	0.67	Washington, DC
West Virginia	0.89	Allegheny, PA
Wisconsin	1.00	Cook, IL
Wyoming	0.05	Madison, IL

Table VII-3. Number of Downwind PM2.5 Nonattainment Counties that Receive Contributions 0.15 μg/m^3 or More and 0.10 μg/m^3 or More from each Upwind State.

Upwind State	Number of Downwind Nonattainment Counties with Contributions of 0.10 μg/m^3 or More	Number of Downwind Nonattainment Counties with Contributions of 0.15 μg/m^3 or More
Alabama	43	32
Arkansas	27	4
Delaware	4	1
Florida	23	19
Georgia	38	27
Illinois	53	53
Indiana	54	53
Iowa	30	13
Kansas	4	2
Kentucky	52	50

Louisiana	33	25
Maryland/District of Columbia	9	7
Massachusetts	2	1
Michigan	55	39
Minnesota	18	8
Mississippi	28	18
Missouri	47	31
New Jersey	8	7
New York	16	12
North Carolina	35	28
North Dakota	4	0
Ohio	47	47
Oklahoma	3	0
Pennsylvania	52	46
South Carolina	23	19
Tennessee	50	43
Texas	48	36
Virginia	35	17
West Virginia	46	32
Wisconsin	48	29

VIII. Ozone Sensitivity Modeling of Local Emission Reductions

As noted in the Preamble to the proposed rule, it is expected that reducing upwind precursor emissions will assist downwind 8-hour ozone nonattainment areas in achieving the National Ambient Air Quality Standards. Furthermore, it is expected that regional controls will result in a more certain, equitable, and cost effective approach to attainment than by only local emission reductions in the nonattainment areas. This section documents the procedures used in, and presents the results of, a sensitivity modeling analysis designed to quantify the impact of local ozone precursor emissions on projected residual nonattainment in 2010.

As discussed in more detail in section III, the air quality modeling analyses completed to assess the effect of local emission reductions on 8-hour ozone nonattainment were conducted for an Eastern U.S. domain using CAMx, version 3.10. Two sets of modeling analyses were completed focusing on nonattainment counties projected to be nonattainment in 2010. The first analysis used the CAMx source apportionment probing tool, as discussed in section VI. The total average contribution metric was used to determine the percentage of ozone that was formed due to in-State vs. out-of-State emissions. The results are shown in Table VIII-1.

Table VIII-1. Projected 8-Hour Ozone Design Values and the Percent of Total Average Contribution Resulting from Emissions in Upwind States[6]

2010 Nonattainment Counties	Projected 2010 Design Value	Percent of 8-Hour Ozone due to Out-of-State Transport
New Haven CT	91	96
Middlesex CT	97	90
Ocean NJ	99	86
Cumberland NJ	85	86
Kent RI	87	85
Sheboygan WI	86	81
Fairfield CT	94	78
Ozaukee WI	86	77
Monmouth NJ	87	74
Middlesex NJ	93	71
Morris NJ	87	69
Gloucester NJ	92	68
Camden NJ	93	66
Door WI	85	65
Delaware PA	86	60
Hudson NJ	91	59
Montgomery PA	93	55
Richmond NY	92	54
Lehigh PA	86	54
Westchester NY	88	52
Kent MD	86	47
Anne Arundel MD	91	44
Bucks PA	98	43
Erie NY	85	43
Mercer NJ	99	41
Baltimore MD	85	40
New Castle DE	86	39
Kenosha WI	89	37
Prince Georges MD	87	37
Lake IN	85	36
Lancaster PA	85	36
Arlington VA	85	36

[6] Table VIII-1 was completed early in the analysis process and used 1999-2001 ambient data to project the future design values. This results in a slightly different set of projected nonattainment counties (37 of the 47 using 2000-2002 data are the same). The differing ambient data base is not expected to impact the results.

Fairfax VA	85	36
Galveston TX	92	35
Washington DC	87	35
Cecil MD	92	34
Harris TX	104	31
Northhampton PA	87	30
Harford MD	93	29
Tarrant TX	87	29
Shelby TN	85	29
Hunterdon NJ	93	28
Fulton GA	93	25
DeKalb GA	89	23
Rockdale GA	87	23
Denton TX	89	22
Collin TX	88	22

As seen from Table VIII-1, ozone transport constitutes a sizable portion of the projected nonattainment problem in most eastern areas in 2010 (even after implementation of the NOx SIP call). In many cases, over 50 percent of the ozone nonattainment problem is due to emissions in other States. All of the future nonattainment areas show at least a 20 percent impact from transported ozone or ozone precursors.

The second analysis considered the effects of 10 percent, 25 percent, and 50 percent reductions in man-made NOx + VOC emissions in possible future nonattainment areas. Figure VII-1 shows the counties in which the sensitivity controls were applied. In all, there were 271 counties over 29 possible future nonattainment areas. These projections were made using the Clear Skies 2010 Base Case (EPA, 2003b) and 1999-2001 ambient data as a starting point. For areas that might possibly be classified as marginal under the new 8-hour ozone implementation rule, and therefore require a 2007 attainment date, the 2010 projections were interpolated to 2007 in order to assess future nonattainment. The sensitivity controls were applied to the 2010 Clear Skies control case (i.e., after the application of a regional NOx reduction strategy). Only the effects of the 25 percent controls were analyzed; this control level is indicative of substantial local control. The results of the sensitivity modeling are shown in Table VIII-2.

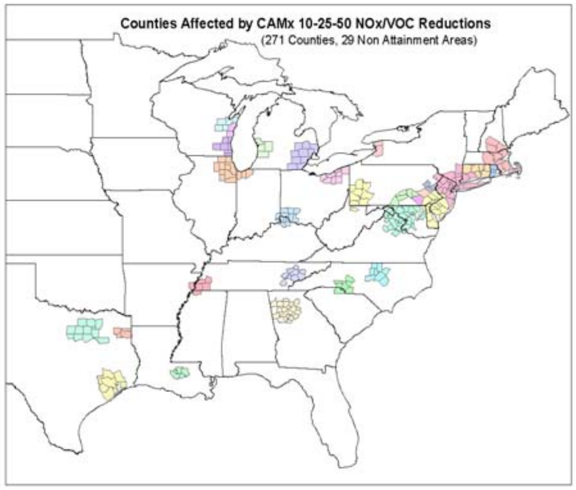

Figure VIII-1. Counties in which Sensitivity Controls were Applied.

Table VIII-2. Results of CAMx 25 percent Local NOx + VOC Control in Projected Future Nonattainment Areas.

CMSA-MSA	CSA 2007 Interpolated	CSA 2010 Base	CSA 2010 Control	CSA 2010 Control + Local
Allentown-Bethlehem-Easton PA-NJ		87	86	81
Atlanta GA		93	92	86
Baton Rouge, LA	85	83	83	79
Boston-Lawrence-Worcester (E. MA-NH)	88	84	84	77
Buffalo-Niagara Falls, NY		85	84	81
Charlotte-Gastonia-Rock Hill NC-SC	89	84	85	80
Chicago-Gary-Lake County, IL-IN (WI)		89	88	86
Cincinnati-Hamilton, OH-KY-IN	85	81	80	77
Cleveland-Akron, OH	86	83	82	78
Dallas-Fort Worth, TX		89	89	84
Detroit-Ann Arbor-Flint, MI	85	84	83	84
Grand Rapids-Muskegon-Holland, MI	86	83	82	78
Greater Connecticut, CT		93	93	88
Green Bay-Appleton-Oshkosh-Neenah-Door, WI		85	82	79
Harrisburg-Lebanon-Carlisle, PA	86	83	82	78
Houston-Galveston-Brazoria, TX		104	104	103
Knoxville, TN	85	79	79	76
Lancaster, PA		85	85	80
Longview-Marshall, TX	85	80	82	80

Memphis, TN-AR-MS		85	85	83
Milwaukee-Racine, WI		89	88	86
New York-New Jersey-Long Island NY-NJ-CT-		99	99	93
Philadelphia-Wilmington-Atlantic City, PA-NJ-		98	98	93
Pittsburgh, PA (WV)	86	84	83	80
Providence (All RI), RI		86	85	80
Raleigh-Durham-Chapel Hill, NC	85	81	80	76
Reading, PA	87	84	84	78
Sheboygan, WI		86	85	81
Washington-Baltimore, DC-MD-VA-WV		93	93	87

Table VIII-2 shows that eight metropolitan areas (Atlanta, Greater Connecticut, Chicago, Houston, Milwaukee, New York, Philadelphia, and Baltimore-Washington are projected to remain above the standard in 2010, despite the application of significant amounts of local control.

IX. PM2.5 Modeling of Locally Applied Control Measures

The purpose of this section is to discuss modeling studies aimed at a preliminary understanding of the effect of possible local control measures on PM2.5. We conducted two air quality modeling analyses to assess the impact on PM2.5 concentrations of applying measures only within the nonattainment areas. Both analyses were conducted :

- Identify a list of local control measures that could be applied in addition to those measures already in place or required to be in place in the near future;
- Determine the emissions inventory categories that would be affected by those measures, and the estimated percentage reduction;
- Apply those percentage reductions to sources within a selected geographic area; and
- Conduct regional air quality modeling using REMSAD to estimate the ambient impacts from these control measures and the degree to which the measures would reduce the expected number of nonattainment areas.

A. Control Measures and Percent Reductions

For the analysis of local controls, we developed a list of emission control measures as a surrogate for measures that State, local and tribal air quality agencies might include in their PM implementation plans. The list includes measures that such agencies might be able to carry out to reach attainment in 2009 or as soon thereafter as possible. The measures addressed a broad range of point, area, and mobile sources. In general, the measures represent what we consider to be a highly ambitious but achievable level of control. We identified measures for direct PM2.5 and also for the following PM2.5 precursors: SO2, NOx, and VOC. We did not attempt to address ammonia emissions, in part due to lower emissions of ammonia and the likelihood of fewer controllable sources within the urban areas targeted for the analysis.

The percent reduction in emissions associated with each control measure was developed in two ways. First, we developed percent reduction estimates for specific technologies to the extent that information was available. These estimates were based on both the percent control that might be achieved for sources applying that technology and the percent of the inventory the measures might be applicable to (i.e., rule penetration). For example, assume that a given technology is expected to reduce emissions of an individual source by 90 percent and it is reasonable to install this technology on only 30 percent of the sources in this category. In this case we applied a 27 percent reduction to all sources in this category (i.e., 90 percent control efficiency multiplied by 30 percent of the source covered yields an overall reduction of 27 percent.

Second, there were some groups of control measures where data and resources were not available to develop technology-specific estimates in this manner. For these, we felt it preferable to make broad judgments on the level of control that might be achieved rather than to leave these control measures out of the analysis entirely. For example, the analysis reflects a reduction of 3 percent from onroad mobile source emissions relative to a 2010 and 2015 baseline. We judged this 3 percent estimate to represent a reasonable upper bound on the degree to which transportation control measures and other measures for reducing mobile source emissions could reduce the overall inventory of mobile source emissions in a given area.

Additionally, we believe that it may be possible to improve the performance of emissions control devices such as baghouses and electrostatic precipitators for point sources, and in some cases to upgrade to a more effective control device. In our current emissions inventories, we have incomplete data on control equipment currently in use. As a result, data are not available to calculate for each source the degree to which the control effectiveness could be improved. Nonetheless, we believed it important to include assumptions concerning point source controls for direct PM. For this analysis, we assumed a 25 percent across-the-board that reduction in PM2.5 emissions at all point sources.

Table IX-1 shows the control measures selected for the analysis, the pollutants reduced and the percentage reduction estimates. Documentation and references for the local control measures are provided in Appendix I.

Table IX-1. Control Measures, Pollutants, and Percentage Reductions for the Local Measures Analysis

Source Description	Control Measure	SO2	NOx			PM2.5			Tol+Xyl (VOC)		
		Eff	Eff	App	% Red	Eff	App	% Red	Eff	App	% Red
Utility boilers	FGD scrubber for some or all unscrubbed units	See table IX-2									
Coal-fired industrial boilers > 250 MMBTU/hr	Coal switching	50									
Petroleum fluid catalytic cracking units	Wet gas scrubber	50									
Refinery process heaters - oil-fired	Switch to natural gas	50									
Sulfuric acid plants	Meet NSPS level	42-96									
Coal-fired industrial boilers	SNCR		50	20	10						
Gas-fired industrial boilers (large & medium)	SNCR		45	20	9						
Gas-fired industrial boilers (small)	Low NOx burner		50	20	10						
Gas-fired IC Engines (reciprocating)	NSCR		94	10	9.4						
Gas-fired turbine & cogeneration	SCR		90	10	9						
Asphalt Concrete, Lime Manufacture	Low NOx burner		27	50	14						
Cement Manufacturing	Tire derived fuel & mid-kiln firing		34	50	18						
Petroleum Refinery Gas-fired Process Heaters	Ultra-low NOx burner & SNCR		93	50	46.5						
All direct PM2.5 points sources	Improve existing controls (baghouses, ESPs)							25			
Wood fireplaces and woodstoves[2]	Natural gas inserts for fireplaces					80	30	24			
	Replace woostoves with certified noncatalytic wood stoves					71	30	21.4			
HDDV including buses[a]	Engine Modifications, Diesel oxidation catalyst		40	5	2						

Source Description	Control Measure	SO2	NOx			PM2.5			Tol+Xyl (VOC)		
		Eff	Eff	App	% Red	Eff	App	% Red	Eff	App	% Red
	Particulate filter					90	30	27			
	Idling reduction[4]				1.7			1.7			1.7
Off-highway diesel construction and mining equipment	Engine modifcations, diesel oxidation catalyst		40	73	29						
	particulate filter					25	73	18			
Diesel Marine Vessels	SCR		75	5	4						
	Particulate filter					90	30	27			
Diesel locomotives	SCR		72	5	4						
	Electrification of yard	2.5	2.5	6	0.2	2.5	6	0.2	2.5	6	0.2
Unpaved roads	Gravel covering					60	30	18			
Construction road	Watering					50	30	15			
Open burning	Ban		100	75	75	100	75	75	100	75	75
Agricultural tilling	Soil conservation measures, unspecified					20	30	6			
LDGV and LDGT1	Combination of unspecified measures to reduce highway vehicle miles and emissions				3			3			3

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[a] For the 1996 inventory woodstoves and fireplaces are combined into one SCC category. We assumed for purpose of this analysis that woodstoves and fireplaces each comprise half of the total wood burned for the category overall. Thus, the total percentage reduction is (24+21.4)/2 = 22.7 percent.

B. Development of Two Local Control Measure Studies

We conducted two studies for identifying the geographic area to which the control measures were applied. These two studies were intended to address two separate issues related to the effects of urban-based control measures.

The first study (3 City Study) was intended to illustrate the effect of the selected local control measures within the geographic area to which controls were applied. For this, we applied the control measures and associated emissions reductions to the inventories for three cities –- Birmingham, Chicago, and Philadelphia. We selected these three urban areas because each area was predicted to exceed the PM2.5 standard in 2010, albeit to varying degrees. Additionally, the three urban areas were selected because they are widely separated. Accordingly, we were able to conduct a single air quality analysis with less concerns for overlapping impacts due to transport than if less separated cities were selected.

The 3 City Study control measures were applied to the projected 2010 Base Case emission inventories for all counties within those Primary Metropolitan Statistical Areas (PMSAs)[7]. Thus, for Chicago, measures were applied to the 10 counties in Illinois, but were not applied in northwest Indiana or Wisconsin. For Philadelphia, measures were applied to the New Jersey and Pennsylvania counties within the Philadelphia urban area. For Birmingham, measures were applied to 4 Alabama counties.

The second Study (290 County Study) was intended to address the cumulative impact of local control measures applied within nonattainment areas. In this study we applied the control measures identified in IX-1 to all counties in Consolidated Metropolitan Statistical Areas (CMSAs) which contained at least one county that was projected to be nonattainment in the future baseline. A list of the counties included in this study is in Appendix J. The 290 County Study included the application of the local control package in model runs for 2010 and 2015.

Judgments evolved over the process of conducting these two scenarios which resulted in some differences in the measures that were applied. Table IX-2 outlines the differences in control assumptions between the two studies.

[7]For the three-city study we chose the PMSA counties rather than the larger list of counties in the consolidated metropolitan statistical area (CMSA). Both the PMSA and the CMSA classifications for metropolitan areas are created by the Office of Management and Budget (OMB). For this study, we used the classifications of counties in place as of spring 2003, rather than the revised classifications released by OMB on June 6, 2003.

Table IX-2. Differences Between the Two Local Control Studies.

Pollutant	Controls in 3 City Study, but not in 290 County Study	Controls in 290 County Study, but not in 3 City Study
SO2	50% reduction from switch to natural gas in oil-fired commercial and industrial boilers For unscrubbed utility coal-fired boilers, scrub to 0.15 lb/MMBTU	50% reduction from oil-fired refinery process heaters For unscrubbed utility coal-fired boilers, apply 50% reduction Sulfuric acid plants meet NSPS
NOx	[no differences]	
VOC	75% for solvent substitution for cold cleaning 70% reduction for area source coating use solvent substitution 75% reduction from metal pipe coating solvent substitution	
Direct PM	22.5% reduction from paved roads for street sweeping	No reductions for PM2.5 for street sweeping on advice from Tom Pace.
Measures that apply to all pollutants	Mobile source across the board assumption was 3% for Chicago and Philadelphia, 5% for Birmingham Open burning 100% control, 30% applicability No assumptions for idling	We assumed 3% across the board Open burning 100% control, 75% applicability Truck idling reductions Diesel locomotive switching yard reductions

C. Results of the Two Local Control Studies

Table IX-3 shows the results of applying the package of control measures in each of the three urban areas addressed in the 3 City Study. The emission reductions were estimated to achieve ambient PM2.5 reductions of about 0.5 to about 0.9 µg/m^3, less than needed to bring any of the cities into attainment in 2010.

Table IX-3. Impact on PM2.5 in 2010 of the Emissions Reductions in the 3 City Study.

Metro Area	2010 Base PM2.5 (µg/m^3)	PM2.5 Reduction (µg/m^3)	Final PM2.5 (µg/m^3))	Attainment Achieved?
Birmingham, AL	20.07	-0.84	19.23	No
Chicago, IL	18.01	-0.93	17.07	No
Philadelphia, PA	15.6	-.052	15.08	No

The results of the 290 County Study are summarized in Table IX-4. We were interested in what part of the PM2.5 improvement that was attributable to SO2 reductions due to local emissions reductions and due to emissions reductions in upwind States. Part B of Table IX-4 shows a re-analysis of the modeling results in which the observed sulfate reductions were not considered in calculating the PM2.5 effects of the control package. If, as we expect, the observation from the earlier described modeling of Birmingham and two other cities that local SO2 reductions have relatively small local effects on sulfate applies more generally, then the difference between Parts A and B of Table IV-7 would generally represent the effect of upwind reductions in SO2 from power plants and other sources in other urban areas.

Table IX-4. Impact on PM2.5 of the Emissions Reductions in 2010 for the 290 County Study.

	2010 Base-2	With Local Controls
Part A - Full Modeling Results Considering All Pollutants and Species		
Number of nonattainment counties	61	26
Average Reduction in PM2.5 Design Value	Not Applicable	1.26 µg/m^3
Part B - Results Not Counting Reductions in Sulfate Component of PM2.5		
Number of nonattainment counties	61	48
Average Reduction in PM2.5 Design Value	Not Applicable	0.37 µg/m^3

The results of the two scenarios show that much of the difference between the baseline case and the local control case is due to the sulfate component.

D. Analysis of the 290 County Study

The application of control measures to emissions in the 290 counties generally resulted in a somewhat modest percent reduction in emissions within an urban area in terms of the tons reduced and percent reduction. This occurs because a substantial part of the local emissions are attributable to mobile sources, small business, and household activities for which practical, large-reduction, and quick-acting emission reductions measures could not be identified at this time. Table IX-5 displays a ranking of measures by tons reduced for the various pollutants and where available along with the costs associated with those measures, in $/ton.

We also note that the baseline emissions inventory used for this analysis has some known gaps. For example, direct PM2.5 and VOC from commercial cooking (e.g., charbroiling) is not included because no robust estimates were available for the 1996 base year used for this analysis. Also, excess PM2.5 due to deterioration of engines in service, and emissions from open burning of refuse, may not be well represented.

Table IX-5. Emission Reductions and Costs of Local Measures for the Second Scenario.

Pollutant	Category/Measure	Total tons reduced in the 290 counties	$/ton, if available
SO2	Utility boilers achieve 50 % reduction overall	1,400,000	N/A
	Industrial boilers >250 MMBTU/hr / switch to lower sulfur coal to achieve 50% reduction	73,000	N/A
	Petroleum refinery catalytic cracking units/ Wet gas scrubber	36,000	N/A
	Sulfuric acid plant/ Meet NSPS	8,300	N/A
	Petroleum refinery oil-fired process heaters / Switch to natural gas	6,000	N/A

Pollutant	Category/Measure	Total tons reduced in the 290 counties	$/ton, if available
NOx	Off-highway diesel construction and mining equipment/particulate filter	45,000	N/A
	Heavy duty diesel vehicles including buses / engine modifications	20,000	N/A
	Petroleum refinery gas-fired process heaters / ultra-low NOx burner + SNCR	18,000	$800
	Combination of unspecified measures to reduce highway vehicle miles and emissions	15,000	N/A
	Coal-fired industrial boilers / SNCR	9,000	$1100
	Open burning / ban open burning	8,300	N/A
	Small Gas-fired industrial boilers / Low NOx burner	7,000	$10,000
	Diesel locomotives / SCR	5,900	
	Large and medium Gas-fired industrial boilers / SNCR	4,800	$5000-5300
	Diesel marine vessels / SCR	4,400	
	Cement manufacturing / mid-kiln firing	4,000	$150-680
	Gas-fired reciprocating IC engines / NSCR	2,800	$230
	Asphalt plants, lime manufacturing / Low NOx burner	2,400	$440 - $940
	Gas-fired turbines and cogeneration / SCR	<1000	$1500
Direct PM2.5	open burning / ban	42,000	N/A
	All point source SCCs / 25% reduction based upon improving existing controls	30,000	N/A
	Construction roads / watering	10,000	$2000

Pollutant	Category/Measure	Total tons reduced in the 290 counties	$/ton, if available
Direct PM2.5	Unpaved roads / gravel covering	4,600	$2100-5900
	Heavy duty diesel vehicles including buses / particulate filter	4,300	< $4000
	Fireplaces / natural gas inserts	3,600	$7500
	Woodstoves / replace with certified noncatalytic wood stove	3,200	$3800
	Diesel marine vessels / particulate filter	2,600	< $4000
	Off-highway diesel construction and mining equipment / particulate filter	2,100	< $4000
	Agricultural tilling / unspecified soil conservation measures	< 1000	$19
	Combination of unspecified measures to reduce highway vehicle miles and emissions	300	N/A

Appendix K contains a detailed listing of the tons of each pollutant for each of the urban areas included in the modeling. This Appendix contains nine individual tables, which show the emissions reductions from the local control measures for the years 2010 and 2015 for the following pollutants:

(1) SO2
(2) NOx
(3) VOC
(5) Total directly-emitted PM 2.5
(6 - 10), Individual primary PM2.5 species: elemental carbon (PEC), organic aerosol (POA), primary nitrate (PNO3), primary sulfate(GSO4), and "other" (PMFINE, generally crustal)

Each table compares emissions for a future year base case with a future year control case reflecting the collection of control measures described in Tables IX-1 and IX-2. These tables show varying degrees of control for the different pollutants. Because the patterns for 2010 and 2015 are very similar, this paragraph will focus on 2010 only. For 2010, total direct PM2.5 reductions ranged from 17 to 43 percent, and typically exceeded 25 percent. Reductions in primary organic carbon ranged from 16 to 24 percent and primary elemental carbon reductions ranged from 20-35 percent. NOx emissions in all areas were reduced by less than 10 percent. VOC emissions were typically less than 10 percent, except for a few areas which had reductions as high as15 percent. For SO2, emissions reductions were more variable across the area and are highly dependent on whether unscrubbed coal-fired utility boilers were located in the area. Some areas had SO2 emissions reductions approaching 50 percent, while other areas showed very little reduction in SO2. Overall, the greatest cumulative reductions over the entire 290 county area was for SO2. Emissions of SO2 in the 2010 Base Case 4.2 million tons, which were reduced to about 2.6 million tons in the control case. By comparison, total direct 2010 PM2.5 emissions for the 290 county area were reduced from about 380,000 tons to about 280,000 tons per year.

Appendix L contains tables (the year 2010 and the year 2015) summarizing REMSAD modeled air quality impacts from the control measures. In each table, the modeled impacts and the difference from the base case are noted for each of the geographic areas in which controls were applied:

- total PM2.5, and PM2.5 species:
    + crustal
    + elemental carbon
    + organic aerosol
    + ammonium sulfate
    + ammonium nitrate

Because most of the geographic areas consist of more than one county, each of these tables indicates a “maximum” impact (i.e., in county with the greatest reduction in concentrations), a “minimum” impact (i.e., in county with the smallest reduction in concentrations), and the average impact across all counties in the metropolitan area.

It is interesting to compare the year 2010 air quality impact to the emissions reductions described above. The largest impact in terms of modeled reductions was for ammonium sulfate, which is consistent with the sizeable emission reductions for SO2. As noted above, the overall average total PM2.5 reduction across all the metropolitan areas was 1.26 $\mu g/m^3$. The detailed tables in Appendix L show that in nearly all the areas, sulfate reductions were 2/3 or more of this amount. For organic aerosol, Appendix L shows modeled reductions less than 10 percent and typically 5-7 percent, which is significantly lower than the 16-24 percent reduction in primary organic carbon emissions in the 290 counties. Because crustal and elemental carbon concentrations are low, the overall reductions in emissions from these components do not have a significant effect on PM2.5 reductions. The ammonium nitrate concentrations showed slight increases for the control case, in all cases less than 0.1 $\mu g/m^3$. The increase in nitrate is likely to reflect “nitrate replacement” which is a phenomena whereby SO2 emissions reductions lead to an increase in nitrate concentrations. In the local control scenario, it is likely that the NOx controls included in the local control packet were insufficient to overcome the formation of additional nitrate as a result of the SO2 reductions. For more information on nitrate replacement please see section XI.

X. Modeling of Regional SO2 and NOx Emissions Reductions

A. Introduction

In this section, we describe the air quality modeling performed to determine the projected impacts on PM2.5 and 8-hour ozone of the proposed regional SO2 and NOx emissions reductions. The regional emissions reductions are associated with State emissions budgets in 2010 and 2015, as explained in the IAQR preamble. The impacts of the regional reductions in 2010 and 2015 are determined by comparing air quality modeling results for each of these regional control scenarios to the modeling results for the corresponding 2010 and 2015 Base Case scenarios. Descriptions of the 2010 Base-2 and 2015 Base Case are provided in section II. Note that neither the base cases nor the regional control strategy scenarios include any of the local control measures discussed in section IX. Also note that the 2015 Base Case does not include any 2010 emissions reductions from the regional strategy.

The 2010 and 2015 regional strategy budgets cover emissions from the power generation sector in 28 eastern States plus the District of Columbia that contribute significantly to both PM2.5 and ozone nonattainment in downwind States.[8] These annual SO2 and NOx budgets are provided in the IAQR preamble.

The EPA modeled a two-phase cap and trade strategy for SO2 and for NOx using the IPM to assess the impacts of the budgets on air quality. For the purposes of air quality modeling, we used a scenario that assumes a 48-State SO2 trading area and SO2 allowances. Most of the SO2 emissions reductions in this scenario occur in the 28-State and DC control region; there are only small changes in nearly all States.[9] We do not expect these latter changes to actually occur; but, because they are only small changes, the results of using this IPM scenario are expected to be very similar to the actual results of the IAQR proposal. For NOx, EPA modeled a NOx trading scenario covering 31 States, DC, and the eastern half of Texas. The 31 States include Arkansas, Iowa, Louisiana, Minnesota, Missouri, and all other States to the east of these five States. Thus, the modeled strategy does not match the NOx reductions required in the IAQR proposal for Kansas and western Texas. In addition, the modeled strategy includes NOx reductions in Maine, New Hampshire, Rhode Island, and Vermont which do not have any required reductions in the IAQR proposal.

Phase 1 of the regional strategy is forecast to reduce total EGU SO2 emissions in the 28-States plus DC by 40 percent in 2010. Phase 2 is forecast to provide a 44 percent reduction in

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[8] In addition, summer season only EGU NOx controls are proposed for Connecticut which significantly contributes to ozone, but not PM2.5 nonattainment in other States.

[9] The modeled scenario reduces EGU emissions in the five New England States not covered by the IAQR proposal by less than 3,000 tons per year. In the 15 States located to the west of the region covered by the IAQR proposal, total EGU SO2 emissions decline by 17 percent.

EGU SO2 emissions compared to the base case in 2015. The net effect of the strategy on total SO2 emissions in the 28-State plus DC States, considering all sectors of emissions, is a 27 percent reduction in 2010 and a 28 percent reduction in 2015. For NOx, Phase 1 of the strategy is forecast to reduce EGU emissions by 44 percent and total emissions by 10 percent in the 28-States plus DC in 2010. In Phase 2, EGU NOx emissions are projected to decline by 53 percent in 2015. Total NOx emissions are projected to be reduced by 14 percent in 2015. The percent change in emissions by State for SO2 and NOx in 2010 and 2015 for the regional strategy are provided in the Appendix A.

B. PM2.5 Modeling of the Proposed Regional SO2 and NOx Strategy

The PM modeling platform described in section IV was used by EPA to model the impacts of the proposed SO2 and NOx emissions reductions on annual average PM2.5 concentrations and visibility. In brief, we ran the REMSAD model for the meteorological conditions in the year of 1996 using our nationwide modeling domain. Modeling was performed for both 2010 and 2015 to assess the expected effects of the proposed regional strategy in each of these years on projected PM2.5 concentrations and nonattainment. The procedures used to project future PM2.5 design values and nonattainment are described in section V. The counties that are projected to be nonattainment for the PM2.5 NAAQS are listed in Table X-1 for the 2010 Base-2 and the 2010 regional strategy scenario and in Table X-2 for the 2015 Base Case and 2015 regional strategy scenario. The projected 2010 Base-2 and control scenario PM2.5 design values are provided in Table X-3. The projected 2015 Base Case and control PM2.5 design values are provided in Table X-4.

Table X-1. Projected PM2.5 Nonattainment Counties for 2010 Base Case and SO2+NOx Regional Strategy.

State	2010 Base-2	2010 Regional Strategy
AL	DeKalb, Jefferson, Montgomery, Russell, Talladaga	Jefferson, Russell, Talladaga
CT	New Haven	None
DC	Washington D.C.	None
DE	New Castle	None
GA	Clarke, Clayton, Cobb, DeKalb, Floyd, Fulton, Hall, Muscogee, Paulding, Richmond, Wilkinson	Clarke, Clayton, Cobb, DeKalb, Floyd, Fulton, Muscogee, Wilkinson
IL	Cook, Madison, St. Clair, Will	Cook, Madison, St. Clair
IN	Clark, Marion	None
KY	Fayette, Jefferson	None

MD	Baltimore City	None
MI	Wayne	Wayne
MO	St. Louis	None
NY	New York (Manhattan)	New York (Manhattan)
NC	Catawba, Davidson, Mecklenburg	None
OH	Butler, Cuyahoga, Franklin, Hamilton, Jefferson, Lawrence, Mahoning, Scioto, Stark, Summit, Trumbull	Cuyahoga, Hamilton, Jefferson, Scioto, Stark
PA	Allegheny, Berks, Lancaster, York	Allegheny
SC	Greenville	None
TN	Davidson, Hamilton, Knox, Roane, Sullivan	Knox
WV	Brooke, Cabell, Hancock, Kanawha, Marshal, Wood	None

Table X-2. Projected PM2.5 Nonattainment Counties for 2015 Base Case and SO2+NOx Regional Strategy.

State	2015 Base Case	2015 Regional Strategy
AL	Jefferson, Montgomery, Russell, Talladaga	Jefferson, Russell
CT	New Haven	None
GA	Clarke, Clayton, Cobb, DeKalb, Floyd, Fulton, Hall, Muscogee, Richmond, Wilkinson	Clayton, DeKalb, Fulton
IL	Cook, Madison, St. Clair	Cook
IN	Clark, Marion	None
KY	Jefferson	None
MD	Baltimore City	None
MI	Wayne	Wayne
NY	New York County (Manhattan)	None
OH	Butler, Cuyahoga, Franklin, Hamilton, Jefferson, Scioto, Stark, Summit	Cuyahoga, Hamilton, Jefferson, Scioto
PA	Allegheny, York	Allegheny
TN	Hamilton, Knox	Knox
WV	Brooke, Cabell, Hancock, Kanawha, Wood	None

Table X-3. Projected PM2.5 Design Values for the 2010 Base Case and SO2 + NOx Regional Strategy.

State	County	2010 Base-2	2010 Regional Strategy
Alabama	DeKalb	15.22	13.92
Alabama	Jefferson	20.03	18.85
Alabama	Montgomery	15.69	14.60
Alabama	Russell	17.07	15.77
Alabama	Talladega	16.44	15.26
Connecticut	New Haven	15.43	14.50
Delaware	New Castle	15.43	14.12
District of Columbia	District of Columbia	15.48	13.70
Georgia	Clarke	17.04	15.56
Georgia	Clayton	17.73	16.43
Georgia	Cobb	16.80	15.56
Georgia	DeKalb	18.26	16.92
Georgia	Floyd	16.99	15.65
Georgia	Fulton	19.79	18.37
Georgia	Hall	15.62	14.24
Georgia	Muscogee	16.68	15.41
Georgia	Paulding	15.40	14.17
Georgia	Richmond	15.99	14.65
Georgia	Wilkinson	16.68	15.51
Illinois	Cook	17.90	16.90
Illinois	Madison	16.41	15.33
Illinois	St. Clair	16.31	15.11
Illinois	Will	15.21	14.25
Indiana	Clark	15.86	14.34
Indiana	Marion	15.89	14.39
Kentucky	Fayette	15.21	13.55
Kentucky	Jefferson	15.79	14.23
Maryland	Baltimore City	16.58	14.82
Michigan	Wayne	18.78	17.65
Missouri	St. Louis City	15.25	14.14
New York	New York	16.30	15.25
North Carolina	Catawba	15.26	13.87
North Carolina	Davidson	15.52	14.22
North Carolina	Mecklenburg County	15.18	13.92
Ohio	Butler	16.01	14.53
Ohio	Cuyahoga	19.13	17.68
Ohio	Franklin	16.69	15.04
Ohio	Hamilton	17.75	15.96

Ohio	Jefferson	18.04	16.06
Ohio	Lawrence	15.48	13.67
Ohio	Mahoning	15.39	13.76
Ohio	Scioto	18.40	16.33
Ohio	Stark	17.09	15.19
Ohio	Summit	16.35	14.71
Ohio	Trumbull	15.13	13.56
Pennsylvania	Allegheny	19.52	16.92
Pennsylvania	Berks	15.39	13.84
Pennsylvania	Lancaster	15.46	13.71
Pennsylvania	York	15.68	13.93
South Carolina	Greenville	15.06	13.75
Tennessee	Davidson	15.36	13.92
Tennessee	Hamilton	16.14	14.74
Tennessee	Knox	18.36	16.60
Tennessee	Roane	15.18	13.69
Tennessee	Sullivan	15.24	13.77
West Virginia	Brooke	16.60	14.77
West Virginia	Cabell	16.39	14.41
West Virginia	Hancock	16.69	14.85
West Virginia	Kanawha	17.11	14.81
West Virginia	Marshall	15.53	13.25
West Virginia	Wood	16.30	14.15

Table X-4. Projected PM2.5 Design Values for the 2015 Base Case and SO2+NOx Regional Strategy.

State	County	2015 Base Case	2015 Regional Strategy
Alabama	Jefferson	19.57	18.11
Alabama	Montgomery	15.35	14.05
Alabama	Russell	16.68	15.05
Alabama	Talladega	15.97	14.57
Connecticut	New Haven	15.13	14.13
Georgia	Clarke	16.46	14.58
Georgia	Clayton	17.26	15.49
Georgia	Cobb	16.28	14.37
Georgia	DeKalb	17.93	16.22
Georgia	Floyd	16.51	14.71
Georgia	Fulton	19.44	17.62
Georgia	Hall	15.05	13.16
Georgia	Muscogee	16.31	14.71

Georgia	Richmond	15.51	13.82
Georgia	Wilkinson	16.40	14.88
Illinois	Cook	17.52	16.40
Illinois	Madison	16.03	14.88
Illinois	St. Clair	15.91	14.67
Indiana	Clark	15.40	13.69
Indiana	Marion	15.31	13.79
Kentucky	Jefferson	15.32	13.57
Maryland	Baltimore City	16.11	14.20
Michigan	Wayne	18.28	17.06
New York	New York (Manhattan)	15.82	14.69
Ohio	Butler	15.39	13.77
Ohio	Cuyahoga	18.58	17.05
Ohio	Franklin	16.18	14.46
Ohio	Hamilton	17.07	15.15
Ohio	Jefferson	17.49	15.51
Ohio	Scioto	17.62	15.49
Ohio	Stark	16.42	14.52
Ohio	Summit	15.78	14.14
Pennsylvania	Allegheny	18.64	16.09
Pennsylvania	York	15.13	13.26
Tennessee	Hamilton	15.63	13.91
Tennessee	Knox	17.73	15.59
West Virginia	Brooke	16.10	14.26
West Virginia	Cabell	15.70	13.71
West Virginia	Hancock	16.18	14.33
West Virginia	Kanawha	16.45	14.10
West Virginia	Wood	15.58	13.49

As described in section V, the air quality modeling results indicate that 61 counties in the East are expected to be nonattainment for PM2.5 in the 2010 Base-2. Of these 61 counties, 38 are projected to come into attainment in 2010 following the SO2 and NOx emissions reductions resulting from the regional control strategy. The 23 counties projected to remain nonattainment after the application of the regional strategy are expected to experience a sizeable reduction in PM2.5 from this strategy, which will bring them closer to attainment. Specifically, the average reduction in these 23 residual 2010 nonattainment counties is 1.50 $\mu g/m^3$ with a range of 0.93 to 2.60 $\mu g/m^3$.

In 2015, the SO2 and NOx reductions are expected to reduce the number of PM2.5 nonattainment counties in the East from 41 to 13. The regional strategy is predicted to provide large reductions in PM2.5 in those 13 residual nonattainment counties. Specifically, the average reduction in these 13 residual 2015 nonattainment counties is 1.70 $\mu g/m^3$ with a range of 1.00 to 2.54 $\mu g/m^3$.

Thus, the SO2 and NOx emissions reductions will greatly reduce the extent of PM2.5 nonattainment by 2010 and beyond. These emissions reductions are expected to substantially reduce the number of PM2.5 nonattainment counties in the East and make attainment easier for those counties that remain nonattainment by substantially lowering PM2.5 concentrations in these residual nonattainment counties.

C. Ozone Modeling of the Proposed Regional NOx Strategy

The EPA used the ozone modeling platform described in section III to model the impacts of the proposed EGU NOx controls on 8-hour ozone concentrations. In brief, we ran the CAMx model for the meteorological conditions in each of the three 1995 ozone episodes using the Eastern U.S. modeling domain. Ozone modeling was performed for both 2010 and 2015 to assess the projected effects of the regional strategy in each of these years on projected 8-hour ozone nonattainment.

The results of the regional strategy ozone modeling are expressed in terms of the expected reduction in projected 8-hour design value concentrations and the implications for future nonattainment. The procedures used to project future 8-hour ozone design values and nonattainment are described in section V. The counties that are projected to be nonattainment for the 8-hour ozone NAAQS are listed in Table X-5 for the 2010 Base-2 and the 2010 regional strategy scenario and in Table X-6 for the 2015 Base Case and 2015 regional strategy scenario. The projected 2010 Base Case and control scenario 8-hour ozone design values are provided in Table X-7. The projected 2015 Base and control 8-hour ozone design values are provided in Table X-8. Predicted exceedance counts for the 2010 Base-2 and control scenarios are provided in Tables X-9 for those counties that are projected to be nonattainment in the 2010 Base Case. The same information is provided in Table X-10 for the 2015 Base and control scenarios.

Table X-5. Projected 8-Hour Ozone Nonattainment Counties for 2010 Base and NOx Regional Strategy.

State	2010 Base-2	2010 Regional Strategy
AR	Crittenden	Crittenden
CT	Fairfield, Middlesex, New Haven	Fairfield, Middlesex, New Haven
DC	Washington D.C.	Washington D.C.
DE	New Castle	New Castle

GA	Fulton	Fulton
IL	None	None
IN	Lake	Lake
MD	Anne Arundel, Baltimore, Cecil, Harford, Kent, Prince Georges	Anne Arundel, Baltimore, Cecil, Harford, Kent, Prince Georges
MI	None	None
NJ	Bergen, Camden, Cumberland, Gloucester, Hudson, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Ocean	Bergen, Camden, Cumberland, Gloucester, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Ocean
NY	Erie, Putnam, Richmond, Suffolk, Westchester	Erie, Putnam, Richmond, Suffolk, Westchester
NC	Mecklenburg	Mecklenburg
OH	Geauga, Summit	Geauga
PA	Allegheny, Bucks, Delaware, Montgomery, Philadelphia	Bucks, Delaware, Montgomery, Philadelphia
RI	Kent	Kent
TX	Denton, Harris, Tarrant	Denton, Harris, Tarrant
VA	Arlington, Fairfax	Arlington, Fairfax
WI	Kenosha, Racine, Sheboygan	Kenosha, Racine, Sheboygan

Table X-6. Projected 8-Hour Ozone Nonattainment Counties for 2015 Base Case and NOx Regional Strategy.

State	2015 Base Case	2015 Regional Strategy
AR	Crittenden	None
CT	Fairfield, Middlesex, New Haven	Fairfield, Middlesex, New Haven
DC	Washington D.C.	Washington D.C.
DE	None	None
GA	None	None
IL	Cook	None
IN	Lake	Lake
MD	Anne Arundel, Cecil, Harford	Anne Arundel, Cecil, Harford
MI	Macomb	None
NJ	Bergen, Camden, Gloucester, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Ocean	Bergen, Camden, Gloucester, Hunterdon, Mercer, Middlesex, Monmouth, Ocean
NY	Erie, Richmond, Suffolk, Westchester	Erie, Richmond, Suffolk, Westchester

NC	None	None
OH	Geauga	None
PA	Bucks, Montgomery, Philadelphia	Bucks, Montgomery, Philadelphia
RI	Kent	None
TX	Harris	Harris
VA	Arlington, Fairfax	Arlington
WI	Kenosha, Sheboygan	Kenosha

Table X-7. Projected 8-Hour Ozone Design Values for the 2010 Base Case and NOx Regional Strategy.

State	County	2010 Base-2	2010 Regional Strategy
Arkansas	Crittenden	86	86
Connecticut	Fairfield	94	94
Connecticut	Middlesex	91	91
Connecticut	New Haven	92	92
District of Columbia	District of Columbia	88	88
Delaware	New Castle	87	86
Georgia	Fulton	86	85
Indiana	Lake	87	86
Maryland	Anne Arundel	91	91
Maryland	Baltimore	85	85
Maryland	Cecil	90	90
Maryland	Harford	93	93
Maryland	Kent	89	88
Maryland	Prince Georges	86	85
New Jersey	Bergen	88	87
New Jersey	Camden	93	92
New Jersey	Cumberland	86	85
New Jersey	Gloucester	95	95
New Jersey	Hudson	85	84
New Jersey	Hunterdon	89	89
New Jersey	Mercer	98	98
New Jersey	Middlesex	95	95
New Jersey	Monmouth	89	89
New Jersey	Morris	88	87
New Jersey	Ocean	105	104
New York	Erie	90	89
New York	Putnam	85	85

New York	Richmond	90	89
New York	Suffolk	90	90
New York	Westchester	86	85
North Carolina	Mecklenburg	85	86
Ohio	Geauga	88	88
Ohio	Summit	85	84
Pennsylvania	Allegheny	85	84
Pennsylvania	Bucks	97	97
Pennsylvania	Delaware	87	86
Pennsylvania	Montgomery	90	89
Pennsylvania	Philadelphia	92	92
Rhode Island	Kent	89	88
Texas	Denton	87	87
Texas	Harris	100	100
Texas	Tarrant	88	87
Virginia	Arlington	88	88
Virginia	Fairfax	87	87
Wisconsin	Kenosha	94	93
Wisconsin	Racine	86	85
Wisconsin	Sheboygan	90	89

Table X-8. Projected 8-Hour Ozone Design Values for the 2015 Base Case and NOx Regional Strategy.

State	County	2015 Base Case	2015 Regional Strategy
Arkansas	Crittenden	85	83
Connecticut	Fairfield	94	93
Connecticut	Middlesex	89	88
Connecticut	New Haven	90	89
District of Columbia	District of Columbia	86	85
Illinois	Cook	85	84
Indiana	Lake	87	86
Maryland	Anne Arundel	87	86
Maryland	Cecil	86	85
Maryland	Harford	89	88
Michigan	Macomb	86	84
New Jersey	Bergen	87	86
New Jersey	Camden	91	90
New Jersey	Gloucester	93	92
New Jersey	Hunterdon	87	86

New Jersey	Mercer	96	95
New Jersey	Middlesex	92	92
New Jersey	Monmouth	87	86
New Jersey	Morris	85	83
New Jersey	Ocean	102	101
New York	Erie	88	86
New York	Richmond	87	87
New York	Suffolk	89	89
New York	Westchester	86	85
Ohio	Geauga	85	83
Pennsylvania	Bucks	95	94
Pennsylvania	Montgomery	89	88
Pennsylvania	Philadelphia	91	90
Rhode Island	Kent	85	84
Texas	Harris	99	98
Virginia	Arlington	87	86
Virginia	Fairfax	85	84
Wisconsin	Kenosha	93	91
Wisconsin	Sheboygan	86	84

Table X-9. Count of Predicted 8-Hour Ozone Exceedances for the 2010 Base and NOx Regional Strategy.

State FIPs	County FIPs	State	County	2010 Base-2	2010 Regional Strategy
5	35	Arkansas	Crittenden	36	36
9	1	Connecticut	Fairfield	27	26
9	7	Connecticut	Middlesex	31	30
9	9	Connecticut	New Haven	35	34
10	3	Delaware	New Castle	25	22
11	1	D.C.	Washington	2	2
13	121	Georgia	Fulton	204	205
18	89	Indiana	Lake	36	32
24	3	Maryland	Anne Arundel	56	53
24	5	Maryland	Baltimore	71	68
24	15	Maryland	Cecil	31	31
24	25	Maryland	Harford	37	36
24	29	Maryland	Kent	30	29
24	33	Maryland	Prince Georges	56	52
34	3	New Jersey	Bergen	10	10
34	7	New Jersey	Camden	37	36

34	11	New Jersey	Cumberland	16	13
34	15	New Jersey	Gloucester	26	25
34	17	New Jersey	Hudson	5	5
34	19	New Jersey	Hunterdon	36	30
34	21	New Jersey	Mercer	17	17
34	23	New Jersey	Middlesex	37	34
34	25	New Jersey	Monmouth	63	60
34	27	New Jersey	Morris	45	41
34	29	New Jersey	Ocean	75	71
36	29	New York	Erie	13	13
36	79	New York	Putnam	14	14
36	85	New York	Richmond	8	8
36	103	New York	Suffolk	176	171
36	119	New York	Westchester	17	16
37	119	North Carolina	Mecklenburg	24	27
39	55	Ohio	Geauga	21	21
39	153	Ohio	Summit	45	42
42	3	Pennsylvania	Allegheny	118	112
42	17	Pennsylvania	Bucks	40	36
42	45	Pennsylvania	Delaware	11	11
42	91	Pennsylvania	Montgomery	22	16
42	101	Pennsylvania	Philadelphia	13	12
44	3	Rhode Island	Kent	22	22
48	121	Texas	Denton	6	6
48	201	Texas	Harris	324	320
48	439	Texas	Tarrant	3	3
51	13	Virginia	Arlington	3	2
51	59	Virginia	Fairfax	25	24
55	59	Wisconsin	Kenosha	17	17
55	101	Wisconsin	Racine	33	32
55	117	Wisconsin	Sheboygan	12	11

Table X-10. Count of Predicted 8-Hour Ozone Exceedances for the 2015 Base and NOx Regional Strategy.

State FIPs	County FIPs	State	County	2015 Base	2015 Regional Strategy
5	35	Arkansas	Crittenden	31	23
9	1	Connecticut	Fairfield	30	25
9	7	Connecticut	Middlesex	26	22
9	9	Connecticut	New Haven	30	28
11	1	D.C.	Washington	3	3
18	89	Indiana	Lake	29	24
24	3	Maryland	Anne Arundel	42	37
24	15	Maryland	Cecil	21	18
24	25	Maryland	Harford	30	27
34	3	New Jersey	Bergen	11	10
34	7	New Jersey	Camden	28	27
34	15	New Jersey	Gloucester	20	19
34	19	New Jersey	Hunterdon	22	16
34	21	New Jersey	Mercer	17	17
34	23	New Jersey	Middlesex	32	31
34	25	New Jersey	Monmouth	57	57
34	27	New Jersey	Morris	38	30
34	29	New Jersey	Ocean	59	56
36	29	New York	Erie	12	9
36	85	New York	Richmond	9	9
36	103	New York	Suffolk	169	161
36	119	New York	Westchester	20	20
39	55	Ohio	Geauga	9	8
42	17	Pennsylvania	Bucks	28	25
42	91	Pennsylvania	Montgomery	12	10
42	101	Pennsylvania	Philadelphia	12	12
44	3	Rhode Island	Kent	17	16
48	201	Texas	Harris	292	279
51	13	Virginia	Arlington	2	2
51	59	Virginia	Fairfax	18	16
55	59	Wisconsin	Kenosha	15	15
55	117	Wisconsin	Sheboygan	8	8

In the 2010 Base-2, 47 counties in the East are forecast to be nonattainment for ozone. With the implementation of the proposed regional NOx strategy, three of the 47 2010 Base Case nonattainment counties are forecast to come into attainment. Of the 44 counties that are projected to remain nonattainment in 2010 after the regional controls, 12 are projected to have design values within 2 ppb of attainment (i.e., counties that have design values of 85 or 86 ppb). In addition, the model predicted exceedances in nonattainment areas of the East show an overall decline of 4 percent between the 2010 Base Case and the control case[10]. Among the areas predicted to have the largest percent reduction in exceedances in 2010 are Montgomery Co., PA (27 percent reduction), Cumberland Co., NJ (19 percent reduction), and Hunterdon Co., NJ (17 percent reduction).

In 2015, the number of nonattainment counties is expected to decline from 34 counties in the Base Case to 26 counties after the NOx emissions reductions in the IAQR proposal. The proposed regional NOx strategy is projected to reduce nonattainment ozone design values in the East by 1 to 2 ppb in all but three of the 34 2015 Base Case nonattainment counties. Of the 26 counties that are forecast to remain nonattainment in the control case, ten are projected to be within 2 ppb of attainment. In addition, the overall number of model predicted exceedances in nonattainment areas of the East are projected to decline by 8 percent in 2015 with the regional strategy NOx reductions. Among the areas predicted to have the largest percent reduction in exceedances in 2015 are Morris Co., NJ (21 percent reduction), Fairfield Co., CT (17 percent reduction), and Anne Arundel Co., MD (12 percent reduction). Thus, our modeling indicates that by 2010 and 2015 the regional NOx controls will reduce ozone concentrations throughout the East and help bring areas into attainment with the 8-hour ozone NAAQS.

D. Visibility Modeling of the Proposed Regional SO2 and NOx Strategy

The impacts of the regional SO2 and NOx emissions reductions were examined in terms of the projected improvements in visibility on the 20 percent best and worst days from 1996 at each IMPROVE site with complete data. The future year base and control visibility was calculated using a methodology which applies modeling results in a relative sense similar to SMAT. The draft modeling guidance recommends the calculation of future year changes in

[10] In 2010, the modeling predicts an increase in the number of exceedances. This increase in ozone is caused by local predicted NOx increases in the IPM model from certain power plants. These power plants were predicted to be controlled under the NOxSIP call trading program (which is assumed in the 2010 IAQR Base Case). Under the IAQR regional control case, the plants trade under a new trading program which is year-round and expanded to additional states. The predicted emissions patterns from IPM are slightly different under the two trading programs. Therefore, some power plants that were predicted to put on controls under the NOxSIP call may not be predicted to do so under the IAQR (and vice versa). It is important to note that the overall summer utility NOx emissions in the States with NOxSIP call area are predicted to be lower under IAQR than under the NOxSIP call. So overall, the IAQR will provide regional ozone benefits in the NOxSIP call area.

visibility in a similar manner to the calculation of changes in PM2.5. The extinction coefficient and deciview values are made up of individual component species (sulfate, nitrate, organics, etc). The predicted change in visibility (on the 20 percent best and worst days) is calculated as the percent change in the extinction coefficient for each of the PM species (on a daily basis). The individual daily species extinction coefficients are summed to get a daily total extinction value. The daily extinction coefficients are then converted to deciviews and averaged across all 20 percent best and worst days (best and worst days separately). In this way, we can calculate an average change in deciviews from the base case to a future case at each IMPROVE site. Additionally, subtracting the future IAQR control case deciview values from the future base case deciview values gives an estimate of the visibility benefits in Class I areas from the SO2 + NOx regional strategy.

Appendix M contains an example calculation of the predicted improvement in visibility on the 20 percent worst days at an IMPROVE site. The predicted improvements in visibility at Class I areas on the 20 percent best visibility days and the 20 percent worst visibility days for the 2010 and 2015 base and regional control scenarios are also provided in Appendix M. There is a separate table in this appendix for the 20 percent best days and 20 percent worst days. The calculated reductions in deciviews is based on the model predicted changes in PM species between the 2001 proxy Base Year and the 2010 and/or 2015 model runs. The 1996 ambient data were used as a starting point to calculate the deciview reductions and thus, the visibility improvements are from a 1996 ambient baseline.[11] The visibility benefits solely from the regional strategy are also provided in Appendix M.

As an example, the expected improvement in visibility at the Great Smoky Mountain National Park (GRSM) from 2001 to the 2010 Base Case on the 20 percent worst visibility days is 1.38 deciviews. The expected improvement from 2001 to 2010 with the regional SO2+NOx controls (in addition to all other expected controls) is 3.55 deciviews. The improvement in visibility due only to the regional strategy in 2010 is 2.17 deciviews. The expected improvement in visibility in 2015 is even larger. The visibility improvement from 2001 to the 2015 Base is 1.94 deciviews. The improvement from 2001 from 2015 with the regional strategy emissions reductions is 4.52 deciviews. The improvement in 2015 between the base case and the regional strategy is 2.58 deciviews. The modeling predicts smaller improvements in visibility on the 20 percent best days forecast for both 2010 and 2015. Note that there are no cases in which visibility deteriorated due to the regional strategy.

[11] The 1996 data was used because it is coincident with the REMSAD meteorology. The changes in visibility are representative of emissions changes from 2001 into the future (not 1996). Due to the lack of complete IMPROVE baseline ambient data and due to the fact that 1996 meteorology was used, it was not possible to replicate the Regional Haze guidance (the modeling guidance and the procedures for calculating the baseline 20 percent best and worst days.) The resultant values are believed to be representative of the expected improvement in visibility.

XI. Modeling to Examine Nitrate Replacement

The chemical interactions involved in the formation of sulfates and nitrates have consequences for the effectiveness of SO2 emissions reductions in lowering regional and urban PM2.5 concentrations. The formation of ammonium nitrate is favored by availability of ammonia and nitric acid vapor, low temperatures, high relative humidity, and the absence of acid sulfate particles. At higher summer temperatures when photochemical processes and meteorological conditions in the East produce high sulfate levels, ammonia and nitric acid vapor tend to remain in the gas phase rather than forming ammonium nitrate particles. In winter months, with cooler temperatures and lower sulfur-related acidity, the presence of sufficient nitric acid and ammonia favors formation of nitrate particles. The air quality modeling , as described in section X, indicates that regional SO2 reductions are effective at reducing sulfates and PM2.5. When SO2 reductions reach a certain point in relation to other relevant reactants and conditions, however, the ammonia formerly associated with sulfate can react with excess nitric acid vapor to form nitrate particles, effectively replacing at least part of the PM2.5 reduction due to sulfate. This phenomenon is termed "nitrate replacement". The EPA performed several air quality modeling sensitivity simulations to provide information on the potential magnitude of nitrate replacement. The model simulations include zero-out runs with REMSAD for nine States in which emissions of SO2 from all source sectors were removed from an individual State. These nine States we modeled are: Alabama, Indiana, Michigan, Missouri, North Carolina, Pennsylvania, Tennessee, Texas, and West Virginia. These States were chosen to obtain information on nitrate replacement in various parts of the East that experience different meteorological conditions.

The results of the sensitivity runs were examined to determine the increase in nitrate concentrations in counties (i.e., receptors) projected to be nonattainment in the 2010 Base Case. Receptor specific impacts were calculated using the SMAT technique described in section V. Table XI-1 provides the mean and maximum annual average increase in nitrate particles calculated from these model runs. Mean and maximum values are given for both in-State impacts and impacts across all downwind nonattainment receptors and are expressed in terms of the concentration increase in $\mu g/m^3$ and as a percent of the 2010 Base nitrate concentration at the receptor location. The results indicate that the amount of nitrate replacement can be substantial for both in-State impacts and downwind impacts. The in-State maximum increase in nitrate ranges from 0.08 $\mu g/m^3$ (North Carolina and Tennessee) up to 0.59 $\mu g/m^3$ (West Virginia). Mean in-State increases range from 0.05 $\mu g/m^3$ (Missouri and North Carolina) up to 0.13 $\mu g/m^3$ (Alabama and Indiana). In terms the percent of base nitrate concentration, the amount of in-State nitrate replacement ranges from 2 percent (both mean and maximum) up to 10 percent, as a statewide mean value and 14 percent, as a statewide maximum value. Considering the amount of nitrate replacement in downwind States, the maximum amount ranges from less than 0.05 $\mu g/m^3$ (locations downwind of Alabama, Missouri, North Carolina, Tennessee, and Texas) up to more than 0.10 $\mu g/m^3$ (locations downwind of Indiana, Michigan, Pennsylvania, and West Virginia). The maximum downwind increases in nitrate represent amounts that are between 2 percent and 7 percent of the 2010 Base nitrate concentration at downwind locations.

Table XI-1. Results of Nitrate Replacement Sensitivity Modeling.

State	In-State Increase in Nitrates				Downwind Increase in Nitrates			
	Maximum		Mean		Maximum		Mean	
	μg/m^3	percent	μg/m^3	percent	μg/m^3	percent	μg/m^3	percent
AL	0.19	14%	0.13	10%	0.04	7%	0.02	1%
IN	0.17	5%	0.13	4%	0.10	4%	0.04	2%
MI	0.32	6%	0.32	6%	0.18	4%	0.03	1%
MO	0.05	2%	0.05	2%	0.04	2%	0.01	1%
NC	0.08	6%	0.05	4%	0.02	2%	<0.01	< 1%
PA	0.18	5%	0.11	4%	0.20	7%	0.03	1%
TN	0.08	7%	0.06	5%	0.04	3%	0.02	1%
TX	NA	NA	NA	NA	0.03	2%	0.01	1%
WV	0.59	25%	0.27	12%	0.11	4%	0.02	1%

The preceding information is useful for indicating the possible extent of nitrate replacement associated with all SO2 emissions in States in the East. Although not examined in this analysis, one would expect that the amount of nitrate replacement would be a function of the amount of SO2 emissions removed together with meteorological conditions and the amount of ammonia present in the State and in downwind areas. Also, these results are based single State model runs. One would expect that the amount of nitrate replacement would be larger for SO2 emissions reductions made across a multi-State region compared to the amount that would result from a single State.

XII. References

Battelle, 2004: Technical Report: Application of Automated Classification Scheme to Identify Meteorological Regimes and Their Relationship to Ozone Concentrations in the Eastern United States, Contract No. 68-D-02-061, Work Assignment 1-12, September 2003.

Battelle, 2004: Draft Paper: Identification of Meteorological Regimes and Their Relationship to Ozone Concentrations, in conjunction with US EPA and Sonoma Technology Inc., January 2004.

Eder, B.K., J.M. Davis, P. Bloomfield, (1994), "A Characterization of the Spatiotemporal Variability of Non-urban Ozone Concentrations over the Eastern United States", Atmospheric Environment, 30 (14), 2615-2625.

Environ, 2002: User's Guide: Comprehensive Air Quality Model with Extensions (CAMx), Novato, CA.

EPA, 1999a: Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS, Office of Air Quality Planning and Standards, Research Triangle Park, NC.

EPA, 1999b: Technical Support Document for the Tier 2/Gasoline Sulfur Ozone Modeling Analyses, EPA420-R-99-031, Research Triangle Park, NC.

EPA, 2000a: Procedures for Developing Base Year and Future Year Mass and Modeling Inventories for the Heavy Duty Engine and Vehicle Standards and Highway Diesel Fuel (HDD) Rulemaking: Air Quality Modeling Analyses, EPA420-R-00-0208, Research Triangle Park, NC.

EPA, 2000b: Technical Support Document for the Heavy Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements: Air Quality Modeling Analyses, EPA420-R-00-0208, Research Triangle Park, NC.

EPA, 2001: Guidance for Demonstrating Attainment of Air Quality Goals for $PM_{2.5}$ and Regional Haze; Draft 1.1, Office of Air Quality Planning and Standards, Research Triangle Park, NC.

EPA, 2003a: Procedures for Developing Base Year and Future Year Mass Emissions Inventories for the Nonroad Diesel Engine Rulemaking, Office of Air Quality Planning and Standards, Research Triangle Park, NC.

EPA, 2003b: Technical Support Document for the Clear Skies Act 2003: Air Quality Modeling Analyses, Office of Air Quality Planning and Standards, Research Triangle Park, NC. Available at http://www.epa.gov/clearskies/aq_modeling_tsd_csa2003.pdf

EPA, 2004: Air Quality Data Analysis Technical Support Document for the Proposed Interstate Air Quality Rule, Office of Air Quality Planning and Standards, Research Triangle Park, NC.

Grell, G., J. Dudhia, and D. Stauffer, 1994: A Description of the Fifth-Generation Penn State/NCAR Mesoscale Model (MM5), *NCAR/TN-398+STR*., 138 pp, National Center for Atmospheric Research, Boulder CO.

Griffin, R.J., D.R. Cocker III, R.C. Flagan, and J.H. Seinfeld, 1999: "Organic aerosol formation from the oxidation of biogenic hydrocarbons" *J. Geophysical Research*, Vol. 104, pp. 3555-3567.

Houyoux, M.; Vukovich, J.; Brandmeyer, J. *Sparse Matrix Operator Kernal Emissions Modeling System (SMOKE) User Manual*, Version 1.1.2 Draft, MCNC-North Carolina Supercomputing Center Environmental Programs, 2000. (Updates at http://www.cmascenter.org/modelclear.html#smoke)

IMPROVE, 2000. Spatial and Seasonal Patterns and Temporal Variability of Haze and its Constituents in the United States: Report III. Cooperative Institute for Research in the Atmosphere, ISSN: 0737-5352-47.

ICF Kaiser, 2002: User's Guide to the Regional Modeling System for Aerosols and Deposition (REMSAD) Version 7, San Rafael, CA.

Kim, Y.P., J.H. Seinfeld, and P. Saxena, 1993. "Atmospheric Gas-Aerosol Equilibrium I. Thermodynamic Model." *Aerosol Science and Technology*, Vol. 19, pp. 157-181.

Lagouvardos, K., G. Kallos, V. Kotroni, and S.T. Rao, 2000: "An Analysis of the Meteorological and Air Quality Conditions during an Extreme Ozone Episode over the Northeastern USA." *Int. J. Environment and Pollution*, Vol. 14, Nos. 1-6, pp. 581-587.

Mansell, G., 2000: User's Instructions for the Phase 2 REMSAD Preprocessors, Environ International, Novato, CA.

NCAR Fields Manual. Home page of the Geophysical Statistic Project. URL address located: http://www.cgd.ucar.edu/stats/Software/Fields/MAN.shtml.

Odum, J.R., T.P.W. Jungkamp, R.J. Griffin, R.C. Flagan, and J.H. Seinfeld, 1997: "The Atmospheric Aerosol-Forming Potential of Whole Gasoline Vapor." *Science*, Vol. 276, pp. 96-99.

Olerud, D., K. Alapaty, and N. Wheeler, 2000: Meteorological Modeling of 1996 for the United States with MM5. MCNC-Environmental Programs, Research Triangle Park, NC.

Pielke, R.A., W.R. Cotton, R.L. Walko, C.J. Tremback, W.A. Lyons, L.D. Grasso, M.E.

Nicholls, M.D. Moran, D.A. Wesley, T.J. Lee, and J.H. Copeland, 1992: A Comprehensive Meteorological Modeling System - RAMS, *Meteor. Atmos. Phys*., Vol. 49, pp. 69-91.

RTI, Analysis of Speciation Network Carbon Blank Data. Draft Report submitted to EPA, August 30, 2002 under Work Assignment 4-05 for contract 68-D-032, Research Triangle Institute.

SAIC, 2001: "Interpolating Relative Humidity Weighting Factors to Calculate Visibility Impairment and the Effects of Improve Monitor Outliers" EPA Contract No. 68-D-98-113. http://vista.cira.colostate.edu/improve/Publications/GuidanceDocs/DraftReportSept20.pdf

Saxena, P., A.B. Hudischewskyj, C. Seigneur, and J.H. Seinfeld, 1986: "A Comparative Study of Equilibrium Approaches to the Chemical Characterization of Secondary Aerosols." *Atmospheric Environment*, Vol. 20, pp. 1471-1483.

Seigneur, C., G. Hidy, I. Tombach, J. Vimont, P. Amar, 1999: "Scientific Peer-Review of the Regulatory Modeling System for Aerosols and Deposition (REMSAD)." The KEVRIC Company, Inc., Durham, NC.

Wesley, M.L., 1989: "Parameterization of Surface Resistances to Gaseous Dry Deposition in Regional-Scale Numerical Models" Atmospheric Environment, Vol. 23, No 6, pp. 1293-1304.

Whitten, Gary Z., 1999: Computer Efficient Photochemistry for Simultaneous Modeling of Smog and Secondary Particulate Precursors, Systems Application International, San Rafael, CA.

Technical Support Document for the Interstate Air Quality Rule Air Quality Modeling Analyses

Appendix A

Emissions Summary

Table 1. 1996 to 2001 Adjustment Ratios for EGU Sector

FIPS	State	VOC	NOX	CO	SO2	PM-coarse	PM2_5	NH3
01	Alabama	2.0945	0.7681	1.1934	0.7969	0.8595	0.9529	1.0436
04	Arizona	1.3613	1.3129	1.3961	0.6095	0.5264	0.6819	4.0316
05	Arkansas	0.7825	0.9404	0.5202	0.8248	0.8655	0.7512	0.8460
06	California	1.6865	1.3923	2.4643	1.0738	2.8898	1.7167	7.3337
08	Colorado	1.4226	0.9013	1.2024	1.0024	0.7279	0.6510	1.4924
09	Connecticut	1.1894	0.9765	1.6837	0.9366	4.0814	2.3472	0.9930
10	Delaware	0.9918	0.6944	1.0597	0.8404	0.8406	0.7182	0.9574
11	DC	1.1666	1.8784	1.2121	1.0117	1.2383	1.2122	1.2692
12	Florida	1.3012	1.0128	1.3290	0.8771	1.0521	0.9264	1.3229
13	Georgia	1.0956	0.9934	1.1147	1.0328	1.1189	1.1291	1.4102
16	Idaho	1.0000	4.4955	1.0000	4.3333	1.0000	1.0000	1.0000
17	Illinois	1.3303	0.6952	1.3984	0.5023	0.9420	0.9096	1.0347
18	Indiana	1.2160	0.8405	1.1252	0.8521	1.0061	1.0316	11.7019
19	Iowa	1.4793	1.0019	1.2398	0.8813	0.8670	0.9725	1.3102
20	Kansas	0.7806	0.9094	1.1991	1.0276	0.9523	1.0961	1.4990
21	Kentucky	1.1045	0.6294	1.0966	0.8337	0.6247	0.6187	1.0824
22	Louisiana	1.2568	1.0345	1.2482	1.1145	0.5666	1.5345	1.3203
23	Maine	14.2874	1.7712	32.0844	1.2063	1.3772	1.1463	1.7137
24	Maryland	1.1110	0.6790	0.9630	1.0031	0.8429	0.7690	1.7242
25	Massachusetts	0.9275	0.9876	0.7850	0.9846	1.0107	1.0057	1.1115
26	Michigan	1.0462	0.7862	1.0577	0.9271	0.9150	0.9218	2.2040
27	Minnesota	1.5712	0.9240	1.2561	1.0802	0.7451	0.9564	0.9518
28	Mississippi	3.4328	1.2552	2.3265	1.2550	1.2216	3.6208	1.8421
29	Missouri	1.2171	0.7866	1.2667	0.6590	0.9751	1.1990	1.1486
30	Montana	1.3587	1.5482	1.3393	1.4233	1.4576	1.4746	1.9565
31	Nebraska	1.3671	1.0020	1.5316	1.0726	1.4117	1.2847	1.6633
32	Nevada	1.3512	0.7309	1.2092	1.0276	0.4602	0.5897	1.4032
33	New Hampshire	1.2334	0.4080	3.2519	0.9537	1.2403	1.4975	0.5677
34	New Jersey	0.8673	0.9647	0.9575	1.1145	1.4005	1.1526	1.6309
35	New Mexico	1.0206	1.0315	0.9533	0.7943	0.9587	1.0431	1.1756
36	New York	1.2013	1.0838	1.1562	1.0434	1.0883	1.2421	2.3763
37	North Carolina	1.2398	0.5313	1.4623	0.9668	0.6209	0.6342	1.4202
38	North Dakota	1.0464	0.7430	0.7585	0.8744	1.1621	0.9900	0.8977
39	Ohio	0.9924	0.5990	1.0266	0.7610	1.0138	1.0206	2.4965
40	Oklahoma	1.0905	0.9463	1.1384	0.9517	1.0056	0.9837	0.9736
41	Oregon	2.7528	2.5515	2.4914	3.2359	3.2808	1.7384	3.4427
42	Pennsylvania	1.1263	0.7977	1.3806	0.9321	0.3768	0.4114	1.2189
44	Rhode Island	5.7597	0.7888	37.1047	0.5263	1.0000	1.0000	1.0000
45	South Carolina	1.2868	0.7422	2.3359	1.0050	0.7064	0.7648	1.8615
46	South Dakota	3.5138	1.0131	1.9764	0.9704	3.8807	2.1509	1.1248
47	Tennessee	1.0430	0.6030	1.0546	0.6968	0.1049	0.4203	1.0864
48	Texas	0.9678	0.7840	0.8039	0.8134	1.1211	0.8143	0.9183
49	Utah	1.2401	0.9868	1.2064	0.8844	0.5453	0.6310	3.2197
50	Vermont	0.8178	1.1201	5.6593	2.0400	0.6224	0.8198	12.7125
51	Virginia	1.6943	0.7934	2.1968	1.1288	0.7839	0.9162	5.1739
53	Washington	1.4558	0.8584	2.5344	0.8549	0.9737	1.0384	1.4307
54	West Virginia	0.9693	0.6890	0.9683	0.7566	0.9728	0.7952	1.0238
55	Wisconsin	1.1978	0.9573	1.2889	0.9176	0.8599	1.1143	1.3196
56	Wyoming	0.9763	0.8176	1.0194	0.8735	0.5601	0.7204	1.0506

Table 2. 1996 to 2001 Adjustment Ratios for On-road Sector								
FIPS	**State**	**VOC**	**NOX**	**CO**	**SO2**	**PM-coarse**	**PM2_5**	**NH3**
01	Alabama	0.7921	0.9455	0.9426	0.9799	0.9421	0.7064	1.1782
04	Arizona	0.8660	1.0318	1.0214	1.0388	1.0229	0.7686	1.2647
05	Arkansas	0.7667	0.8962	0.8963	0.8812	0.8830	0.6488	1.1260
06	California	0.7416	0.9204	1.0026	0.5488	0.9669	0.6912	1.1723
08	Colorado	0.8154	1.0213	0.9620	1.0486	0.9924	0.7418	1.2387
09	Connecticut	0.7150	0.8973	0.9489	0.6109	0.9550	0.6885	1.1697
10	Delaware	0.7211	0.8890	0.8945	0.5618	0.9307	0.6682	1.1505
11	DC	0.7098	0.8526	0.8479	0.5638	0.9389	0.6826	1.1255
12	Florida	0.8953	1.0240	1.0343	1.0738	1.0183	0.7710	1.2524
13	Georgia	0.8298	1.0239	1.0084	1.0723	1.0227	0.7773	1.2605
16	Idaho	0.7623	0.8834	0.9239	0.8737	0.8771	0.6426	1.1229
17	Illinois	0.7498	0.8955	0.9216	0.7417	0.9269	0.6825	1.1378
18	Indiana	0.7669	0.9042	0.9112	0.8881	0.9133	0.6756	1.1476
19	Iowa	0.7649	0.9227	0.8885	0.9143	0.9289	0.6875	1.1753
20	Kansas	0.7932	0.9219	0.9140	0.9807	0.9231	0.6875	1.1637
21	Kentucky	0.7819	0.9379	0.9388	0.8669	0.9399	0.6952	1.1782
22	Louisiana	0.7660	0.9250	0.9246	0.9267	0.9146	0.6800	1.1500
23	Maine	0.8104	0.9358	1.0091	0.9751	0.9328	0.6934	1.1890
24	Maryland	0.7257	0.9071	0.8797	0.6208	0.9487	0.6885	1.1618
25	Massachusetts	0.6854	0.8681	0.8712	0.5968	0.9283	0.6713	1.1301
26	Michigan	0.7759	0.9279	0.9063	0.9851	0.9360	0.7046	1.1607
27	Minnesota	0.8794	1.0129	1.0523	1.0043	1.0157	0.7561	1.2678
28	Mississippi	0.8498	0.9955	1.0044	0.9816	0.9853	0.7316	1.2477
29	Missouri	0.7758	0.9360	0.9442	0.8585	0.9460	0.7012	1.1750
30	Montana	0.7165	0.8800	0.8455	0.8827	0.8833	0.6557	1.1235
31	Nebraska	0.7840	0.9446	0.9189	0.9706	0.9480	0.7076	1.1942
32	Nevada	0.9011	1.0912	1.0166	1.0844	1.0667	0.7880	1.3366
33	New Hampshire	0.7663	0.9189	0.9491	0.8093	0.9324	0.6841	1.1733
34	New Jersey	0.7978	0.9189	1.0095	0.5730	0.9489	0.6836	1.1562
35	New Mexico	0.7579	0.9313	0.9130	0.9029	0.9015	0.6722	1.1351
36	New York	0.7352	0.9139	0.9565	0.7961	0.9502	0.7047	1.1627
37	North Carolina	0.8378	0.9672	0.9896	1.0177	0.9697	0.7247	1.2159
38	North Dakota	0.7138	0.8911	0.8432	0.8847	0.9014	0.6650	1.1503
39	Ohio	0.7173	0.8779	0.8560	0.8964	0.8893	0.6676	1.1000
40	Oklahoma	0.8252	0.9677	0.9687	0.9885	0.9588	0.7203	1.1936
41	Oregon	0.8475	0.9925	1.0541	0.9960	0.9941	0.7465	1.2366
42	Pennsylvania	0.7216	0.8973	0.8938	0.8358	0.9132	0.6778	1.1338
44	Rhode Island	0.8221	0.9877	1.0529	0.6615	1.0345	0.7502	1.2544
45	South Carolina	0.8351	0.9873	0.9816	1.0239	0.9750	0.7296	1.2287
46	South Dakota	0.7248	0.9033	0.8532	0.8917	0.9091	0.6698	1.1626
47	Tennessee	0.8238	0.9739	0.9773	1.0069	0.9688	0.7284	1.2051
48	Texas	0.8054	1.0203	0.9450	0.9160	1.0353	0.7720	1.2693
49	Utah	0.8311	1.0171	0.9663	1.0568	1.0006	0.7546	1.2393
50	Vermont	0.7473	0.8897	0.9354	0.8857	0.9016	0.6657	1.1473
51	Virginia	0.7885	0.8964	0.9465	0.8587	0.9006	0.6657	1.1249
53	Washington	0.7781	0.9445	1.0129	0.9335	0.9361	0.7003	1.1558
54	West Virginia	0.7935	0.9268	0.9375	0.9205	0.9185	0.6800	1.1682
55	Wisconsin	0.7455	0.9118	0.8969	0.8263	0.9281	0.6838	1.1628
56	Wyoming	0.7750	0.9345	0.9276	0.9550	0.9268	0.6874	1.1817

Table 3. 1996 to 2001 Adjustment Ratios for Non-road Sector								
FIPS	**State**	**VOC**	**NOX**	**CO**	**SO2**	**PM-coarse**	**PM2_5**	**NH3**
01	Alabama	0.9292	0.9691	1.0168	1.0317	0.9431	0.9293	1.1155
04	Arizona	0.8653	1.0032	1.0109	1.0871	0.9564	0.9495	1.1309
05	Arkansas	0.9601	0.9729	1.0126	1.0524	0.9001	0.9022	1.0235
06	California	0.8583	1.0381	1.0142	1.0299	0.9448	0.9443	1.1219
08	Colorado	0.8731	1.0020	1.0134	1.1052	0.9320	0.9200	1.0590
09	Connecticut	0.8701	1.0457	1.0121	1.1156	0.9540	0.9558	1.1423
10	Delaware	0.8935	0.9633	1.0054	1.0225	0.9382	0.9314	1.1113
11	DC	0.8376	1.0263	0.9958	1.1578	0.9232	0.9268	1.1369
12	Florida	0.8799	1.0358	1.0143	1.1087	0.9622	0.9620	1.1448
13	Georgia	0.8817	1.0058	1.0160	1.0885	0.9403	0.9363	1.1283
16	Idaho	0.9581	0.9747	1.0168	1.0729	0.9019	0.8993	0.9785
17	Illinois	0.8677	0.9941	1.0131	1.0628	0.9177	0.9117	1.0618
18	Indiana	0.8754	0.9709	1.0085	1.0427	0.9032	0.9003	1.0661
19	Iowa	0.8925	0.9857	1.0073	1.1038	0.8822	0.8793	0.9174
20	Kansas	0.8617	0.9784	1.0059	1.0911	0.8829	0.8783	0.9295
21	Kentucky	0.9247	0.9718	1.0125	1.0332	0.9334	0.9295	1.0800
22	Louisiana	0.9315	0.9369	1.0094	0.9908	0.9228	0.9213	1.0380
23	Maine	0.9669	0.9599	1.0148	1.0434	0.9323	0.9295	1.1165
24	Maryland	0.8708	1.0024	1.0110	1.0427	0.9400	0.9407	1.1242
25	Massachusetts	0.8655	1.0124	1.0073	1.1220	0.9429	0.9348	1.1470
26	Michigan	0.9333	0.9825	1.0124	1.0376	0.9396	0.9351	1.1092
27	Minnesota	0.9474	0.9792	1.0114	1.0629	0.9115	0.9103	1.0072
28	Mississippi	0.9559	0.9569	1.0132	1.0218	0.9171	0.9139	1.0578
29	Missouri	0.9001	0.9831	1.0137	1.0553	0.9199	0.9168	1.0464
30	Montana	0.9467	0.9588	1.0115	1.0258	0.8956	0.8899	0.8104
31	Nebraska	0.8837	0.9668	1.0062	1.0533	0.8863	0.8821	0.8616
32	Nevada	0.8676	0.9947	1.0056	1.1029	0.9385	0.9333	1.1374
33	New Hampshire	0.9382	1.0759	1.0154	1.1534	0.9582	0.9636	1.1422
34	New Jersey	0.8685	1.0525	1.0173	1.1165	0.9597	0.9604	1.1498
35	New Mexico	0.8963	0.9638	1.0119	1.0166	0.9371	0.9308	1.0637
36	New York	0.8909	1.0073	1.0214	1.0724	0.9427	0.9423	1.1413
37	North Carolina	0.8850	1.0076	1.0116	1.0917	0.9317	0.9264	1.1207
38	North Dakota	0.9015	0.9754	0.9979	1.1070	0.8647	0.8631	0.6901
39	Ohio	0.8785	0.9935	1.0110	1.0655	0.9361	0.9300	1.0997
40	Oklahoma	0.8934	0.9850	1.0118	1.0836	0.9034	0.8982	1.0116
41	Oregon	0.9125	1.0457	1.0159	1.1528	0.9537	0.9540	1.1035
42	Pennsylvania	0.8877	1.0295	1.0141	1.1004	0.9568	0.9541	1.1251
44	Rhode Island	0.8622	1.0748	1.0166	1.1242	0.9748	0.9707	1.1415
45	South Carolina	0.8945	1.0658	1.0114	1.1901	0.9770	0.9678	1.1215
46	South Dakota	0.9097	0.9904	1.0034	1.1430	0.8640	0.8615	0.7545
47	Tennessee	0.9116	0.9894	1.0136	1.0558	0.9378	0.9327	1.1084
48	Texas	0.8641	1.0222	1.0136	1.1053	0.9555	0.9504	1.0514
49	Utah	0.9300	0.9833	1.0063	1.1129	0.9241	0.9203	1.0980
50	Vermont	0.9513	1.0456	1.0151	1.1495	0.9398	0.9390	1.1075
51	Virginia	0.8715	0.9221	1.0086	0.9495	0.9179	0.9023	1.1177
53	Washington	0.8970	0.9501	1.0137	1.0128	0.9170	0.9105	1.1027
54	West Virginia	1.0198	1.2908	1.0381	1.4083	1.1704	1.1798	1.1019
55	Wisconsin	0.9376	1.0042	1.0122	1.0909	0.9275	0.9224	1.0743
56	Wyoming	0.9638	0.9543	1.0133	1.0050	0.9204	0.9137	0.9932

Table 4. 2001 Proxy Inventory for EGU Sector (Annual Tons)								
FIPS	**State**	**VOC**	**NOx**	**CO**	**SO2**	**PM-10**	**PM-2.5**	**NH3**
01	Alabama	2,084	168,221	9,629	466,155	8,385	4,161	16
04	Arizona	885	97,966	7,482	73,361	5,418	2,842	98
05	Arkansas	441	47,557	2,314	78,708	1,289	847	51
06	California	3,757	25,318	34,892	2,152	1,395	1,292	3,608
08	Colorado	888	75,288	9,431	92,963	1,530	844	24
09	Connecticut	404	11,196	2,176	34,147	1,270	756	152
10	Delaware	136	10,915	1,032	35,431	414	213	40
11	DC	9	348	31	934	45	43	5
12	Florida	3,672	299,320	27,833	569,980	9,119	5,739	1,197
13	Georgia	973	162,672	8,204	490,399	8,582	4,042	23
16	Idaho	0	0	0	0	0	0	0
17	Illinois	2,433	203,139	16,467	371,106	5,719	3,170	78
18	Indiana	2,144	310,458	15,759	802,556	11,765	6,431	325
19	Iowa	847	81,129	6,428	139,735	3,064	1,845	15
20	Kansas	907	87,177	7,034	120,358	2,349	1,550	60
21	Kentucky	1,420	231,062	13,427	536,744	11,207	5,053	16
22	Louisiana	1,709	80,365	14,625	112,806	3,550	2,882	794
23	Maine	491	2,105	3,821	6,818	84	73	32
24	Maryland	551	71,741	3,216	253,060	2,205	1,041	92
25	Massachusetts	721	34,945	3,785	103,451	1,534	963	267
26	Michigan	1,339	144,125	10,568	351,578	5,586	3,211	87
27	Minnesota	1,014	83,896	6,256	94,327	3,799	2,086	13
28	Mississippi	1,401	57,881	8,228	138,563	2,689	2,171	222
29	Missouri	1,577	147,125	10,896	240,199	3,526	2,460	19
30	Montana	349	39,553	2,743	24,402	6,030	3,023	6
31	Nebraska	468	48,868	4,110	70,541	1,424	958	9
32	Nevada	612	44,186	3,579	54,701	2,464	1,259	66
33	New Hampshire	152	6,831	2,049	48,137	331	244	15
34	New Jersey	3,597	66,513	18,767	68,210	7,493	7,213	32
35	New Mexico	578	83,864	4,332	62,355	8,874	4,186	59
36	New York	2,121	83,487	9,272	255,982	3,849	2,731	1,259
37	North Carolina	985	130,946	10,323	415,113	7,161	3,299	16
38	North Dakota	860	79,188	7,268	155,308	3,813	2,067	8
39	Ohio	1,657	336,761	14,008	1,145,322	15,143	6,950	61
40	Oklahoma	1,183	83,476	11,532	101,444	2,309	1,602	191
41	Oregon	137	24,683	1,641	28,316	395	283	1
42	Pennsylvania	1,556	203,131	14,968	945,019	10,911	5,330	119
44	Rhode Island	68	118	1,381	0	0	0	0
45	South Carolina	478	82,157	7,321	202,573	6,269	2,779	10
46	South Dakota	271	17,849	723	14,363	139	81	1
47	Tennessee	1,081	157,993	7,323	375,899	8,856	7,270	10
48	Texas	7,110	333,280	67,832	542,067	19,966	13,071	1,511
49	Utah	545	71,518	4,257	28,335	2,213	1,052	25
50	Vermont	44	1,125	987	109	45	43	1
51	Virginia	864	81,841	7,666	217,847	3,617	1,937	126
53	Washington	247	18,863	3,689	67,027	1,921	1,346	3
54	West Virginia	1,008	204,344	8,050	497,988	8,336	3,739	16
55	Wisconsin	928	102,564	8,070	190,060	3,316	2,212	15
56	Wyoming	784	87,879	6,506	87,906	4,643	2,979	9
	Total	**57,485**	**4,824,967**	**451,932**	**10,714,558**	**224,044**	**129,369**	**10,803**

Table 5. 2001 Proxy Inventory for non-EGU Sector (Annual Tons)								
FIPS	**State**	**VOC**	**NOx**	**CO**	**SO2**	**PM-10**	**PM-2.5**	**NH3**
01	Alabama	80,573	92,760	201,009	120,101	37,338	22,005	3,778
04	Arizona	18,674	92,129	21,293	104,999	29,821	16,264	5
05	Arkansas	13,492	22,446	104,432	16,953	30,709	18,147	15,767
06	California	73,353	131,142	84,548	42,289	30,602	17,268	15,218
08	Colorado	37,403	47,126	29,186	14,689	20,649	12,432	278
09	Connecticut	6,947	10,887	2,831	7,586	1,120	844	59
10	Delaware	7,058	10,317	15,271	40,499	1,178	839	668
11	DC	243	809	259	2,235	102	72	10
12	Florida	22,895	55,868	54,511	86,525	15,870	10,533	7,153
13	Georgia	40,220	65,153	171,012	85,644	29,481	20,604	15,114
16	Idaho	427	6,418	4,659	24,957	12,138	7,731	2
17	Illinois	149,255	133,197	119,543	261,252	87,262	45,692	12,158
18	Indiana	41,041	53,875	233,903	145,385	15,628	12,335	8,094
19	Iowa	8,897	25,759	6,957	84,608	8,095	4,483	8,481
20	Kansas	22,298	102,792	79,014	14,761	12,861	8,802	13,083
21	Kentucky	61,734	34,908	66,523	40,369	16,560	10,650	1,265
22	Louisiana	112,092	280,691	736,737	172,782	34,625	25,928	66,094
23	Maine	5,108	15,124	10,220	22,379	5,220	3,437	132
24	Maryland	7,493	21,665	44,471	22,879	4,000	2,349	311
25	Massachusetts	7,622	18,656	7,547	15,795	3,543	2,569	89
26	Michigan	82,758	159,031	125,560	130,191	22,522	12,818	502
27	Minnesota	35,312	78,404	86,078	40,256	82,519	36,493	1,114
28	Mississippi	55,415	68,081	109,202	69,182	14,095	10,101	26,768
29	Missouri	57,813	28,190	102,988	121,869	49,152	18,367	23,645
30	Montana	6,639	18,323	49,602	30,902	11,681	6,285	459
31	Nebraska	10,865	13,368	11,907	6,810	8,561	3,327	14
32	Nevada	1,438	5,064	11,898	2,924	13,020	4,556	8
33	New Hampshire	5,144	4,049	6,059	8,066	1,340	839	23
34	New Jersey	85,237	48,657	20,754	71,990	11,017	7,651	497
35	New Mexico	11,224	70,418	21,847	106,197	7,836	5,932	35
36	New York	54,443	41,428	30,814	188,988	49,686	34,209	225
37	North Carolina	78,423	66,906	77,927	90,282	21,250	14,930	113
38	North Dakota	261	7,499	3,614	62,497	1,418	1,263	13
39	Ohio	70,331	83,068	685,198	354,237	39,673	26,678	2,756
40	Oklahoma	48,837	120,822	221,112	36,790	10,161	6,246	17,616
41	Oregon	13,433	16,493	77,785	6,496	10,483	7,684	15
42	Pennsylvania	64,364	190,652	379,584	143,330	39,804	26,123	6,224
44	Rhode Island	4,909	871	1,716	2,578	1,240	912	8
45	South Carolina	40,208	45,743	65,518	58,738	8,134	5,937	55
46	South Dakota	1,516	4,518	0	1,308	857	448	1
47	Tennessee	108,302	88,697	102,384	135,863	18,367	10,738	80
48	Texas	243,265	505,461	404,608	303,841	37,478	25,726	1,318
49	Utah	18,849	28,769	117,815	27,835	21,530	17,629	1,218
50	Vermont	1,555	765	1,452	2,050	993	615	3
51	Virginia	55,898	70,598	65,376	111,065	16,083	10,187	746
53	Washington	18,682	41,059	177,380	46,629	10,818	7,308	5,049
54	West Virginia	23,097	52,440	110,439	64,213	11,661	7,339	409
55	Wisconsin	52,047	51,745	60,878	87,850	15,243	10,855	897
56	Wyoming	18,537	47,994	73,459	56,385	29,758	17,471	458
	Total	**1,985,624**	**3,180,835**	**5,196,881**	**3,696,048**	**963,181**	**581,654**	**258,025**

Table 6. 2001 Proxy Inventory for On-road Sector (Annual Tons)								
FIPS	**State**	**VOC**	**NOx**	**CO**	**SO2**	**PM-10**	**PM-2.5**	**NH3**
01	Alabama	90,967	191,356	1,255,115	6,311	4,936	3,631	5,568
04	Arizona	65,235	159,946	743,136	5,335	4,133	3,013	4,890
05	Arkansas	43,394	107,044	587,436	3,146	2,641	1,957	2,856
06	California	504,308	741,570	4,917,346	18,346	23,184	16,413	30,442
08	Colorado	57,530	142,904	782,750	4,702	3,545	2,595	4,134
09	Connecticut	40,483	98,070	503,158	2,081	2,382	1,697	3,065
10	Delaware	10,957	27,642	123,413	529	711	522	816
11	DC	4,485	8,390	54,361	214	244	170	352
12	Florida	267,721	481,541	3,330,519	16,935	12,349	8,951	15,153
13	Georgia	162,666	354,467	2,234,620	11,829	9,058	6,648	10,372
16	Idaho	20,979	49,766	304,092	1,451	1,219	901	1,325
17	Illinois	136,417	313,673	1,830,288	8,624	7,703	5,495	10,225
18	Indiana	111,679	244,554	1,617,597	7,375	6,121	4,491	6,978
19	Iowa	45,437	110,184	673,726	3,145	2,684	1,990	2,883
20	Kansas	41,203	100,675	619,475	3,210	2,485	1,834	2,768
21	Kentucky	67,842	168,246	903,618	4,665	4,138	3,048	4,598
22	Louisiana	68,422	149,575	905,798	4,445	3,694	2,742	4,017
23	Maine	20,295	53,403	311,775	1,615	1,321	984	1,383
24	Maryland	48,128	137,842	600,932	3,429	3,634	2,565	4,984
25	Massachusetts	56,206	135,741	722,639	3,465	3,489	2,427	5,279
26	Michigan	137,830	298,757	2,046,372	10,830	7,811	5,636	9,683
27	Minnesota	84,039	191,340	1,063,057	5,582	4,549	3,339	5,187
28	Mississippi	54,907	127,897	737,093	3,847	3,261	2,421	3,472
29	Missouri	76,380	210,112	1,131,261	6,430	5,330	3,866	6,622
30	Montana	14,409	39,793	213,828	1,086	947	708	962
31	Nebraska	27,481	66,437	416,446	2,006	1,643	1,218	1,772
32	Nevada	29,513	59,225	316,200	1,896	1,459	1,061	1,751
33	New Hampshire	17,581	43,974	246,304	1,129	1,065	785	1,180
34	New Jersey	81,796	181,198	938,311	4,203	4,581	3,183	6,730
35	New Mexico	37,571	84,822	523,730	2,480	2,083	1,545	2,230
36	New York	155,161	356,584	2,155,370	11,236	9,163	6,490	12,832
37	North Carolina	104,114	258,350	1,421,369	9,849	6,736	4,837	8,821
38	North Dakota	11,398	28,534	167,894	775	681	508	703
39	Ohio	157,237	351,592	2,226,531	11,390	8,908	6,502	10,486
40	Oklahoma	67,759	151,575	967,480	4,869	3,831	2,817	4,330
41	Oregon	47,206	126,382	615,341	3,799	3,114	2,299	3,445
42	Pennsylvania	148,739	345,513	1,982,662	9,888	8,730	6,433	10,106
44	Rhode Island	13,196	25,718	166,391	560	621	439	837
45	South Carolina	72,321	166,086	971,279	5,192	4,157	3,086	4,460
46	South Dakota	12,399	34,152	184,761	910	805	602	823
47	Tennessee	101,361	229,694	1,411,463	7,331	5,695	4,183	6,488
48	Texas	292,834	704,713	3,405,481	20,436	19,312	14,295	21,839
49	Utah	39,742	79,109	562,108	2,551	1,920	1,406	2,240
50	Vermont	10,829	26,182	164,165	728	628	467	665
51	Virginia	99,235	246,828	1,347,176	7,572	6,448	4,741	7,395
53	Washington	79,260	184,161	1,070,697	5,649	4,395	3,195	5,297
54	West Virginia	28,180	73,972	411,936	2,106	1,798	1,340	1,878
55	Wisconsin	69,708	191,803	1,015,476	5,429	5,085	3,753	5,630
56	Wyoming	12,049	32,946	187,636	913	767	573	790
	Total	**3,948,588**	**8,694,038**	**51,089,610**	**261,526**	**225,193**	**163,798**	**270,740**

Table 7. 2001 Proxy Inventory for Non-road Sector (Annual Tons)

FIPS	State	VOC	NOx	CO	SO2	PM-10	PM-2.5	NH3
01	Alabama	49,843	64,704	384,401	6,271	6,415	5,426	641
04	Arizona	49,263	51,488	516,299	4,207	8,060	5,038	497
05	Arkansas	30,576	41,132	235,198	3,940	4,174	3,776	426
06	California	253,515	438,815	2,747,237	13,734	26,413	23,456	4,532
08	Colorado	41,018	68,051	418,847	5,344	5,722	4,817	720
09	Connecticut	29,589	21,401	302,235	2,125	2,292	2,096	468
10	Delaware	10,349	17,079	82,028	1,372	1,345	1,210	96
11	DC	2,173	5,990	19,165	396	277	246	69
12	Florida	208,411	166,054	1,795,514	26,118	21,351	18,432	1,682
13	Georgia	70,317	79,983	728,751	9,392	8,031	7,091	1,196
16	Idaho	21,578	20,394	149,004	1,869	2,795	2,111	187
17	Illinois	102,314	176,679	1,053,290	13,858	13,599	12,380	1,970
18	Indiana	50,657	108,974	569,186	10,011	7,986	7,280	1,103
19	Iowa	35,447	69,050	329,620	7,523	7,788	7,129	591
20	Kansas	26,047	96,062	285,058	9,694	7,768	7,002	612
21	Kentucky	37,055	80,563	305,463	18,042	5,993	5,333	570
22	Louisiana	59,991	202,756	403,665	31,907	11,551	10,467	1,541
23	Maine	26,934	10,722	146,963	1,192	1,479	1,329	138
24	Maryland	49,250	43,271	481,748	12,020	4,666	4,147	494
25	Massachusetts	53,835	83,928	544,236	8,099	6,810	6,194	929
26	Michigan	141,309	75,516	1,016,464	6,835	9,160	8,337	1,535
27	Minnesota	99,352	75,615	578,010	7,845	9,473	8,678	891
28	Mississippi	33,202	49,193	226,986	5,452	4,810	4,192	395
29	Missouri	55,302	73,101	504,459	6,683	7,261	6,540	885
30	Montana	13,426	39,733	99,677	2,869	3,174	2,813	158
31	Nebraska	19,307	67,930	195,153	6,660	5,812	5,293	341
32	Nevada	19,029	29,938	178,300	2,592	3,213	2,421	172
33	New Hampshire	18,797	7,943	130,522	785	1,156	1,009	169
34	New Jersey	72,143	99,953	735,916	69,747	9,796	8,933	1,186
35	New Mexico	13,768	11,905	128,337	1,192	2,176	1,654	198
36	New York	135,077	107,083	1,287,956	11,061	11,727	10,556	2,084
37	North Carolina	74,100	74,746	744,771	7,285	9,049	7,784	1,334
38	North Dakota	14,378	49,288	111,394	5,433	5,586	5,059	196
39	Ohio	107,455	139,873	1,102,599	16,300	17,243	14,367	1,887
40	Oklahoma	33,152	47,907	305,507	4,872	5,170	4,554	823
41	Oregon	42,483	67,131	359,989	5,146	4,246	3,881	504
42	Pennsylvania	96,413	99,336	985,292	12,070	8,727	7,813	1,634
44	Rhode Island	6,994	6,864	80,475	3,779	698	638	120
45	South Carolina	41,617	39,206	379,582	4,630	4,064	3,630	546
46	South Dakota	12,046	29,095	96,483	3,424	3,843	3,484	170
47	Tennessee	55,168	149,755	477,648	17,540	8,229	7,510	894
48	Texas	163,338	491,346	1,831,200	56,608	30,521	26,142	5,006
49	Utah	25,881	38,389	201,705	3,912	3,593	3,124	322
50	Vermont	9,312	4,766	62,366	474	598	535	77
51	Virginia	61,874	82,788	611,529	9,959	9,383	7,942	739
53	Washington	61,445	85,804	543,499	14,625	7,787	6,782	836
54	West Virginia	17,107	77,029	129,518	49,287	5,575	5,096	231
55	Wisconsin	80,529	63,844	569,468	5,469	6,673	6,036	919
56	Wyoming	9,537	27,106	61,747	1,553	1,478	1,278	160
	Total	**2,741,704**	**4,059,278**	**25,234,462**	**531,203**	**354,734**	**311,039**	**42,879**

Table 8. 2001 Proxy Inventory for Area Sector (Annual Tons)

FIPS	State	VOC	NOx	CO	SO2	PM-10	PM-2.5	NH3
01	Alabama	156,928	66,927	547,935	52,248	194,840	80,885	80,092
04	Arizona	141,063	72,837	219,632	4,079	122,689	70,962	31,535
05	Arkansas	128,066	42,433	233,465	20,366	141,399	46,361	141,454
06	California	451,587	125,210	721,418	10,724	365,655	123,700	166,925
08	Colorado	123,489	55,752	79,398	4,552	144,770	35,401	97,929
09	Connecticut	85,850	10,601	129,781	531	37,799	7,030	5,357
10	Delaware	23,057	7,115	19,566	10,450	12,476	5,907	11,008
11	DC	9,477	2,033	870	6,029	1,573	611	983
12	Florida	351,830	52,481	501,295	43,645	235,571	89,998	69,625
13	Georgia	262,571	72,717	1,139,960	6,571	349,662	155,621	82,562
16	Idaho	71,583	27,822	455,387	8,324	185,906	66,120	62,242
17	Illinois	292,488	125,113	84,547	37,260	248,897	57,565	139,749
18	Indiana	224,455	36,584	81,933	2,079	159,995	32,724	94,342
19	Iowa	133,300	30,088	54,195	13,980	155,592	35,239	296,305
20	Kansas	120,974	70,489	81,998	3,384	217,109	47,697	213,171
21	Kentucky	140,706	73,687	164,588	56,501	102,479	38,138	88,425
22	Louisiana	123,698	101,234	151,815	93,687	139,903	58,872	66,540
23	Maine	49,242	5,556	58,526	12,387	26,470	12,555	6,064
24	Maryland	67,466	16,652	92,986	815	61,053	14,317	23,992
25	Massachusetts	139,347	26,696	48,451	65,893	71,517	20,102	8,128
26	Michigan	292,289	121,040	174,268	34,249	148,878	48,123	61,016
27	Minnesota	187,817	24,178	100,651	5,932	233,041	53,342	186,179
28	Mississippi	144,824	54,080	389,556	78,950	149,265	60,216	65,945
29	Missouri	156,821	14,252	160,545	31,955	332,368	72,527	180,671
30	Montana	56,138	18,172	239,130	1,415	150,392	45,230	88,533
31	Nebraska	77,465	14,811	23,181	9,962	160,061	30,602	227,271
32	Nevada	37,930	7,539	14,057	3,637	38,129	9,103	14,815
33	New Hampshire	36,337	13,649	38,526	89,896	19,396	8,567	2,170
34	New Jersey	158,069	84,626	52,949	46,291	76,027	24,380	8,677
35	New Mexico	57,522	28,830	99,253	8,462	265,621	50,899	45,681
36	New York	357,680	108,956	156,257	136,978	191,008	61,562	54,759
37	North Carolina	367,929	36,056	786,318	33,098	168,657	79,942	158,947
38	North Dakota	57,186	19,519	14,250	59,452	100,334	19,926	87,818
39	Ohio	302,230	83,225	136,451	62,840	176,768	54,446	79,446
40	Oklahoma	102,999	31,221	69,593	5,201	252,911	50,579	186,990
41	Oregon	148,786	39,443	897,808	19,715	278,811	132,568	59,039
42	Pennsylvania	273,343	121,781	228,637	92,518	153,451	55,278	79,834
44	Rhode Island	20,324	3,185	6,246	4,801	7,582	2,623	1,091
45	South Carolina	155,638	24,801	303,014	14,765	119,894	47,430	27,600
46	South Dakota	39,619	7,183	26,981	20,903	109,024	23,323	128,208
47	Tennessee	252,289	50,799	268,451	45,530	123,923	53,156	78,194
48	Texas	563,395	40,784	322,518	9,014	857,360	177,511	454,360
49	Utah	63,761	20,626	37,317	11,828	63,460	15,507	30,345
50	Vermont	24,406	13,383	31,272	13,462	22,136	7,788	8,845
51	Virginia	213,685	45,048	373,847	9,388	146,335	30,034	66,400
53	Washington	166,279	21,779	248,796	3,532	121,003	50,183	46,611
54	West Virginia	61,474	22,148	83,522	11,458	46,182	18,010	15,735
55	Wisconsin	193,368	60,381	151,495	44,669	115,160	38,924	119,948
56	Wyoming	19,796	67,208	44,209	16,403	177,504	30,896	47,944
	Total	**7,686,575**	**2,220,728**	**10,346,847**	**1,379,810**	**7,780,035**	**2,352,479**	**4,299,503**

Table 9. 2001 Proxy Inventory for All Sectors (Annual Tons)

FIPS	State	VOC	NOx	CO	SO2	PM-10	PM-2.5	NH3
01	Alabama	380,395	583,967	2,398,089	651,086	251,915	116,107	90,095
04	Arizona	275,120	474,366	1,507,841	191,981	170,120	98,120	37,023
05	Arkansas	215,970	260,611	1,162,845	123,114	180,213	71,089	160,555
06	California	1,286,520	1,462,055	8,505,442	87,245	447,250	182,129	220,725
08	Colorado	260,328	389,121	1,319,611	122,250	176,217	56,089	103,085
09	Connecticut	163,272	152,156	940,181	46,470	44,861	12,422	9,100
10	Delaware	51,556	73,068	241,310	88,282	16,124	8,691	12,628
11	DC	16,386	17,570	74,687	9,809	2,240	1,142	1,420
12	Florida	854,529	1,055,264	5,709,673	743,202	294,260	133,652	94,810
13	Georgia	536,746	734,992	4,282,547	603,836	404,814	194,007	109,267
16	Idaho	114,567	104,400	913,142	36,602	202,057	76,863	63,756
17	Illinois	682,907	951,800	3,104,135	692,100	363,180	124,302	164,179
18	Indiana	429,975	754,446	2,518,378	967,405	201,494	63,261	110,842
19	Iowa	223,929	316,211	1,070,926	248,992	177,223	50,687	308,274
20	Kansas	211,429	457,195	1,072,580	151,408	242,572	66,885	229,696
21	Kentucky	308,758	588,465	1,453,618	656,321	140,377	62,221	94,873
22	Louisiana	365,911	814,622	2,212,640	415,627	193,322	100,891	138,986
23	Maine	102,069	86,908	531,305	44,392	34,573	18,377	7,750
24	Maryland	172,888	291,171	1,223,353	292,204	75,558	24,419	29,873
25	Massachusetts	257,730	299,965	1,326,658	196,704	86,893	32,255	14,692
26	Michigan	655,525	798,470	3,373,233	533,683	193,956	78,124	72,823
27	Minnesota	407,534	453,434	1,834,051	153,942	333,380	103,938	193,385
28	Mississippi	289,749	357,132	1,471,065	295,994	174,121	79,102	96,802
29	Missouri	347,893	472,780	1,910,149	407,134	397,636	103,760	211,842
30	Montana	90,961	155,573	604,980	60,674	172,224	58,059	90,118
31	Nebraska	135,587	211,414	650,798	95,979	177,501	41,398	229,407
32	Nevada	88,522	145,952	524,033	65,750	58,286	18,400	16,811
33	New Hampshire	78,010	76,445	423,460	148,013	23,289	11,444	3,556
34	New Jersey	400,842	480,947	1,766,697	260,441	108,914	51,360	17,122
35	New Mexico	120,664	279,839	777,500	180,685	286,590	64,216	48,202
36	New York	704,481	697,539	3,639,669	604,245	265,433	115,547	71,159
37	North Carolina	625,552	567,003	3,040,707	555,627	212,852	110,791	169,232
38	North Dakota	84,083	184,028	304,421	283,465	111,832	28,824	88,738
39	Ohio	638,909	994,519	4,164,787	1,590,091	257,735	108,942	94,635
40	Oklahoma	253,931	435,001	1,575,225	153,176	274,383	65,798	209,951
41	Oregon	252,045	274,132	1,952,563	63,471	297,050	146,714	63,006
42	Pennsylvania	584,415	960,412	3,591,144	1,202,826	221,623	100,978	97,918
44	Rhode Island	45,490	36,756	256,208	11,718	10,141	4,612	2,056
45	South Carolina	310,262	357,994	1,726,715	285,898	142,518	62,861	32,671
46	South Dakota	65,850	92,796	308,948	40,908	114,669	27,939	129,203
47	Tennessee	518,201	676,938	2,267,269	582,163	165,069	82,857	85,667
48	Texas	1,269,942	2,075,584	6,031,639	931,966	964,637	256,744	484,034
49	Utah	148,777	238,410	923,202	74,462	92,716	38,718	34,151
50	Vermont	46,145	46,221	260,242	16,822	24,401	9,448	9,591
51	Virginia	431,556	527,102	2,405,594	355,830	181,866	54,841	75,407
53	Washington	325,914	351,666	2,044,061	137,462	145,924	68,814	57,795
54	West Virginia	130,866	429,934	743,465	625,052	73,552	35,524	18,269
55	Wisconsin	396,581	470,337	1,805,388	333,476	145,477	61,781	127,409
56	Wyoming	60,703	263,132	373,558	163,161	214,150	53,197	49,362
	Total	**16,419,976**	**22,979,846**	**92,319,732**	**16,583,144**	**9,547,186**	**3,538,339**	**4,881,950**

Table 10. IAQR 2010 Base EGU Annual Emissions (Tons)								
FIPS	**State**	**VOC**	**NOx**	**CO**	**SO2**	**PM-10**	**PM-2.5**	**NH3**
01	Alabama	1,073	134,134	21,015	473,043	8,322	4,323	9
04	Arizona	642	84,567	25,830	47,779	3,707	2,016	4
05	Arkansas	393	52,511	8,429	122,667	1,724	1,213	3
06	California	1,606	17,671	56,798	17,317	2,432	1,138	707
08	Colorado	446	82,714	7,924	73,089	1,594	888	4
09	Connecticut	99	5,168	5,984	6,284	829	282	0
10	Delaware	79	10,271	1,377	46,355	688	319	1
11	DC	0	42	41	0	1	1	0
12	Florida	1,224	161,846	44,976	233,241	9,414	4,225	62
13	Georgia	1,163	150,582	18,179	609,154	10,114	4,877	10
16	Idaho	21	1,197	2,273	0	38	38	0
17	Illinois	1,386	171,443	10,401	600,836	6,503	3,709	10
18	Indiana	1,704	239,713	14,292	670,365	12,150	6,408	37
19	Iowa	463	86,090	4,314	169,861	3,228	1,983	4
20	Kansas	538	100,942	4,234	63,532	2,800	1,734	4
21	Kentucky	1,352	195,883	13,849	363,145	8,874	4,092	11
22	Louisiana	459	49,767	11,683	112,534	3,378	1,384	3
23	Maine	48	2,103	4,592	3,210	349	148	0
24	Maryland	424	60,629	4,263	232,229	3,374	1,445	4
25	Massachusetts	239	10,392	10,920	15,650	1,237	646	23
26	Michigan	973	125,394	11,972	387,627	6,121	3,517	19
27	Minnesota	525	104,535	6,899	91,561	3,205	1,676	4
28	Mississippi	275	43,163	8,384	73,467	2,072	855	2
29	Missouri	1,150	137,009	9,132	293,093	3,950	2,685	9
30	Montana	220	38,465	2,021	17,923	2,874	1,378	2
31	Nebraska	299	57,826	2,452	97,630	1,285	881	3
32	Nevada	271	37,403	7,037	16,408	2,467	1,322	11
33	New Hampshire	113	3,647	4,437	7,289	363	252	0
34	New Jersey	196	29,322	5,790	41,255	2,037	796	1
35	New Mexico	359	76,400	3,233	48,577	1,939	919	3
36	New York	863	68,413	18,085	214,077	3,818	1,790	252
37	North Carolina	943	62,069	9,471	219,369	9,074	3,806	9
38	North Dakota	670	77,927	7,726	160,938	3,219	1,574	5
39	Ohio	1,664	266,798	15,149	1,258,684	15,245	6,907	16
40	Oklahoma	603	82,115	15,056	133,009	2,759	1,714	39
41	Oregon	132	13,346	9,654	15,187	381	310	0
42	Pennsylvania	1,483	209,760	16,238	853,431	15,288	6,453	14
44	Rhode Island	22	1,440	2,383	0	40	40	0
45	South Carolina	507	64,737	5,691	199,745	10,059	4,553	5
46	South Dakota	64	11,748	546	36,304	327	74	1
47	Tennessee	746	102,819	5,839	306,082	3,953	2,079	7
48	Texas	3,711	200,909	102,753	487,740	20,215	12,771	445
49	Utah	369	69,368	3,080	31,541	2,329	1,041	3
50	Vermont	0	1	2	0	0	0	0
51	Virginia	471	55,530	5,863	187,772	5,761	2,133	4
53	Washington	266	28,432	16,403	5,959	811	635	9
54	West Virginia	1,204	155,157	9,764	550,629	11,006	4,817	11
55	Wisconsin	697	111,540	8,011	214,063	3,124	2,046	6
56	Wyoming	506	90,500	4,241	47,276	3,145	2,090	5
	Total	**32,660**	**3,943,438**	**588,685**	**9,856,926**	**217,623**	**109,983**	**1,783**

Table 11. IAQR 2010 Base non-EGU Annual Emissions (Tons)

FIPS	State	VOC	NOx	CO	SO2	PM-10	PM-2.5	NH3
01	Alabama	59,099	83,403	217,668	121,267	38,080	22,112	4,054
04	Arizona	14,898	118,162	26,092	120,829	36,813	19,730	5
05	Arkansas	12,038	23,484	117,195	17,464	31,597	18,058	17,198
06	California	61,577	137,347	88,706	43,980	32,863	18,143	15,950
08	Colorado	37,311	44,879	28,358	15,909	24,074	14,406	351
09	Connecticut	5,811	11,252	3,160	7,567	1,151	869	59
10	Delaware	5,447	8,492	16,025	38,381	1,174	855	692
11	DC	239	812	273	2,123	97	71	8
12	Florida	21,531	59,032	57,372	90,435	15,931	10,385	6,816
13	Georgia	34,833	71,428	202,252	92,752	29,824	20,856	17,460
16	Idaho	327	6,645	4,906	26,758	10,629	7,184	2
17	Illinois	131,654	134,916	125,786	277,244	94,437	48,689	13,677
18	Indiana	38,674	45,385	250,845	152,198	16,468	12,993	8,996
19	Iowa	5,985	26,522	7,708	84,015	8,213	4,603	9,147
20	Kansas	16,738	108,813	84,638	16,013	13,728	9,370	14,038
21	Kentucky	61,947	34,826	76,182	42,912	18,374	11,864	1,469
22	Louisiana	87,220	297,110	822,849	193,555	35,295	26,138	73,111
23	Maine	4,940	15,551	10,688	22,206	4,877	3,173	132
24	Maryland	7,167	19,129	44,248	22,514	3,756	2,230	285
25	Massachusetts	7,064	18,221	8,024	15,337	3,491	2,561	89
26	Michigan	72,709	160,968	134,751	134,973	23,650	13,316	586
27	Minnesota	29,586	83,849	101,257	41,178	91,600	40,064	1,331
28	Mississippi	52,402	74,439	123,188	77,530	12,636	9,042	29,901
29	Missouri	55,860	29,745	111,022	128,569	54,393	20,189	26,844
30	Montana	5,225	20,759	55,176	34,720	14,252	7,546	562
31	Nebraska	10,840	14,459	13,092	7,302	9,751	3,699	14
32	Nevada	1,750	5,988	12,717	3,461	15,792	5,525	9
33	New Hampshire	4,866	4,231	6,268	7,948	1,341	816	23
34	New Jersey	76,222	51,016	21,876	70,783	10,870	7,590	472
35	New Mexico	9,044	68,718	21,539	115,204	7,556	5,504	37
36	New York	50,073	36,692	31,657	168,553	44,612	31,918	206
37	North Carolina	75,673	63,283	88,170	95,437	23,043	16,194	120
38	North Dakota	179	7,225	3,568	56,097	1,446	1,304	13
39	Ohio	56,202	77,462	724,782	337,560	37,671	25,030	2,962
40	Oklahoma	36,190	120,968	239,431	41,168	11,259	6,938	19,773
41	Oregon	8,578	16,785	82,183	6,558	9,217	6,617	16
42	Pennsylvania	48,210	172,998	350,381	141,002	39,014	25,787	6,842
44	Rhode Island	3,250	876	1,793	2,423	1,278	942	7
45	South Carolina	30,894	45,978	76,025	63,865	8,143	6,017	60
46	South Dakota	1,887	4,722	0	1,366	864	449	1
47	Tennessee	96,883	78,009	113,496	134,335	18,933	11,290	83
48	Texas	203,123	523,815	437,225	318,637	40,730	27,852	1,420
49	Utah	15,180	31,647	127,753	30,303	23,711	19,349	1,398
50	Vermont	1,413	780	1,540	2,024	975	575	3
51	Virginia	52,649	66,479	74,527	112,675	16,836	10,587	849
53	Washington	13,992	47,008	190,821	51,577	11,164	7,504	5,821
54	West Virginia	20,753	50,132	113,347	62,211	11,426	7,309	412
55	Wisconsin	45,276	54,295	66,172	88,506	16,203	11,496	986
56	Wyoming	13,652	49,464	82,803	59,741	35,812	20,952	533
	Total	**1,707,060**	**3,228,201**	**5,599,537**	**3,799,163**	**1,015,051**	**605,691**	**284,824**

Table 12. IAQR 2010 Base On-road Annual Emissions (Tons)								
FIPS	**State**	**VOC**	**NOx**	**CO**	**SO2**	**PM-10**	**PM-2.5**	**NH3**
01	Alabama	80,971	110,191	1,200,284	604	3,783	2,448	6,480
04	Arizona	48,868	91,317	600,172	555	3,302	2,102	5,990
05	Arkansas	40,377	64,910	578,870	335	2,216	1,459	3,561
06	California	255,609	401,906	2,528,853	3,446	20,857	13,333	38,090
08	Colorado	42,946	80,596	666,048	466	2,840	1,824	5,015
09	Connecticut	19,334	48,516	259,998	326	2,008	1,291	3,596
10	Delaware	8,754	17,423	137,544	92	606	399	1,008
11	DC	2,386	4,821	40,218	41	219	133	457
12	Florida	225,359	293,897	3,610,060	1,728	9,938	6,254	18,742
13	Georgia	102,256	189,194	1,570,358	1,137	6,898	4,419	12,257
16	Idaho	18,591	32,658	319,856	164	1,080	710	1,740
17	Illinois	91,971	177,741	1,489,301	1,121	6,471	4,054	12,296
18	Indiana	85,881	142,865	1,526,256	769	4,872	3,163	8,261
19	Iowa	35,789	61,607	641,840	308	2,032	1,338	3,282
20	Kansas	33,953	59,091	591,143	309	1,973	1,286	3,308
21	Kentucky	53,653	95,692	866,316	494	3,235	2,121	5,316
22	Louisiana	61,112	89,284	896,379	445	2,741	1,763	4,768
23	Maine	14,779	30,608	305,955	153	1,029	681	1,618
24	Maryland	29,581	73,126	451,132	552	3,143	1,955	6,073
25	Massachusetts	33,901	74,353	547,767	578	3,194	1,969	6,417
26	Michigan	104,326	171,375	2,049,577	1,014	5,852	3,676	10,959
27	Minnesota	56,188	103,429	927,184	535	3,334	2,156	5,747
28	Mississippi	46,140	68,761	644,765	357	2,368	1,559	3,800
29	Missouri	57,371	117,844	992,687	724	3,978	2,442	7,797
30	Montana	12,436	24,821	230,038	117	801	534	1,235
31	Nebraska	21,938	37,730	400,851	192	1,251	820	2,048
32	Nevada	20,414	36,277	305,382	202	1,207	770	2,178
33	New Hampshire	13,105	25,744	228,352	130	881	583	1,405
34	New Jersey	41,543	93,102	578,048	717	3,960	2,433	7,938
35	New Mexico	34,521	54,524	552,017	278	1,813	1,188	2,965
36	New York	87,991	181,546	1,617,694	1,296	7,191	4,440	14,218
37	North Carolina	87,854	150,027	1,482,472	988	5,496	3,384	10,631
38	North Dakota	9,126	16,449	164,300	77	528	351	818
39	Ohio	111,178	201,346	1,925,363	1,174	7,094	4,542	12,673
40	Oklahoma	56,863	86,790	931,020	468	2,918	1,886	5,034
41	Oregon	29,270	67,386	486,003	381	2,402	1,559	4,088
42	Pennsylvania	104,305	200,618	1,799,671	1,104	6,541	4,146	11,937
44	Rhode Island	6,979	12,265	91,584	81	480	304	902
45	South Carolina	64,158	94,175	921,836	491	3,202	2,098	5,230
46	South Dakota	10,037	20,183	184,474	96	659	439	1,013
47	Tennessee	85,533	132,898	1,422,081	715	4,416	2,848	7,683
48	Texas	220,557	399,631	3,025,769	2,288	12,974	8,085	24,981
49	Utah	30,313	48,995	542,229	263	1,584	1,013	2,839
50	Vermont	7,457	15,976	139,292	78	523	345	830
51	Virginia	74,439	147,032	1,162,361	859	5,221	3,337	9,326
53	Washington	65,982	114,579	1,249,051	638	3,770	2,396	6,907
54	West Virginia	22,222	40,379	359,078	200	1,357	900	2,125
55	Wisconsin	47,319	109,650	911,995	619	3,826	2,456	6,666
56	Wyoming	9,073	18,620	170,136	87	596	396	923
	Total	**2,824,708**	**4,931,947**	**44,323,659**	**29,790**	**178,660**	**113,788**	**323,171**

Table 13. IAQR 2010 Base Non-road Annual Emissions (Tons)								
FIPS	State	VOC	NOx	CO	SO2	PM-10	PM-2.5	NH3
01	Alabama	38,010	55,830	427,088	1,567	5,672	4,647	771
04	Arizona	35,574	43,609	587,042	716	9,058	4,605	608
05	Arkansas	24,641	35,395	263,509	475	3,100	2,774	483
06	California	162,983	276,098	3,104,650	12,967	21,719	19,082	5,369
08	Colorado	32,342	56,971	476,272	759	4,907	3,832	831
09	Connecticut	19,862	17,273	333,208	368	1,854	1,688	580
10	Delaware	6,850	16,801	89,348	310	1,218	1,092	115
11	DC	2,276	5,424	22,243	116	225	195	84
12	Florida	143,736	147,942	2,038,938	15,133	18,699	15,927	2,075
13	Georgia	50,978	66,365	814,963	2,636	6,582	5,727	1,465
16	Idaho	17,783	17,306	168,419	250	2,736	1,666	210
17	Illinois	76,333	150,172	1,159,501	1,724	10,260	9,281	2,318
18	Indiana	37,404	90,417	623,186	1,091	5,945	5,359	1,288
19	Iowa	25,895	57,564	353,199	624	5,245	4,773	605
20	Kansas	18,930	79,483	310,188	805	5,512	4,853	617
21	Kentucky	28,834	73,055	328,529	1,849	5,231	4,539	670
22	Louisiana	48,151	205,029	453,763	21,143	10,973	9,907	1,625
23	Maine	22,186	8,797	158,919	228	1,269	1,110	168
24	Maryland	35,791	38,923	549,345	8,132	4,084	3,576	576
25	Massachusetts	37,464	69,973	594,543	1,218	5,408	4,897	1,147
26	Michigan	107,260	63,196	1,083,795	1,316	7,399	6,682	1,861
27	Minnesota	78,587	64,800	611,775	1,082	6,963	6,359	1,006
28	Mississippi	26,628	44,790	255,001	2,007	4,158	3,542	456
29	Missouri	40,742	64,161	559,607	867	5,430	4,819	1,036
30	Montana	11,336	33,985	111,963	274	2,276	1,919	149
31	Nebraska	14,539	57,396	213,024	578	3,941	3,549	333
32	Nevada	14,473	25,367	203,541	357	3,155	2,039	208
33	New Hampshire	14,362	6,212	144,603	154	1,063	869	210
34	New Jersey	48,940	86,387	828,276	53,543	9,153	8,321	1,426
35	New Mexico	11,107	10,714	149,663	218	2,161	1,445	228
36	New York	97,406	90,922	1,450,391	2,226	9,414	8,372	2,588
37	North Carolina	52,331	60,101	814,384	1,237	7,734	6,502	1,629
38	North Dakota	11,115	41,798	115,381	405	3,737	3,320	136
39	Ohio	78,264	116,893	1,208,863	5,716	15,265	12,353	2,251
40	Oklahoma	24,505	40,022	340,543	608	3,974	3,411	870
41	Oregon	32,264	52,552	398,748	815	3,159	2,878	597
42	Pennsylvania	73,514	80,601	1,092,556	3,338	6,971	6,105	1,996
44	Rhode Island	4,714	5,633	90,238	2,883	617	563	148
45	South Carolina	28,816	29,879	417,852	1,193	3,197	2,821	664
46	South Dakota	9,170	24,422	100,351	248	2,570	2,284	134
47	Tennessee	42,874	138,923	518,158	2,771	7,251	6,600	1,075
48	Texas	114,781	432,118	2,046,992	33,434	26,184	21,664	5,489
49	Utah	20,821	31,535	223,250	395	2,899	2,369	382
50	Vermont	7,528	3,855	68,423	83	499	434	93
51	Virginia	44,498	76,591	683,777	4,592	8,656	7,211	888
53	Washington	45,488	78,757	609,995	9,459	6,901	5,814	996
54	West Virginia	14,605	57,047	148,138	33,597	4,491	4,100	265
55	Wisconsin	61,885	50,959	594,423	770	5,163	4,603	1,083
56	Wyoming	8,200	22,918	69,681	165	1,173	945	164
	Total	**2,006,777**	**3,404,962**	**28,010,246**	**236,446**	**295,253**	**251,423**	**49,964**

Table 14. IAQR 2010 Base Area Annual Emissions (Tons)								
FIPS	**State**	**VOC**	**NOx**	**CO**	**SO2**	**PM-10**	**PM-2.5**	**NH3**
01	Alabama	144,297	69,410	521,658	51,945	191,882	78,833	85,120
04	Arizona	139,902	78,053	213,271	4,333	122,253	70,998	31,614
05	Arkansas	118,428	44,794	198,105	21,156	135,966	42,502	149,698
06	California	472,160	129,306	638,780	10,684	347,785	117,527	165,486
08	Colorado	120,713	59,928	70,880	4,653	151,900	36,511	95,332
09	Connecticut	65,405	9,341	86,813	470	34,955	7,016	5,741
10	Delaware	22,724	6,872	19,292	10,223	13,424	6,238	12,672
11	DC	8,458	1,935	861	5,751	1,815	680	1,085
12	Florida	342,177	53,238	473,626	44,726	248,625	91,811	70,327
13	Georgia	257,398	74,729	1,117,469	6,661	350,201	155,686	89,400
16	Idaho	70,040	29,393	441,270	8,782	162,309	61,564	60,653
17	Illinois	263,817	115,848	69,185	36,367	244,904	56,227	144,138
18	Indiana	214,228	37,879	73,152	2,240	163,801	33,756	98,380
19	Iowa	128,567	31,091	44,865	14,630	150,839	33,704	306,177
20	Kansas	117,523	74,256	75,870	3,451	209,431	45,971	209,259
21	Kentucky	126,045	76,895	128,309	58,005	103,229	35,523	87,718
22	Louisiana	109,098	103,534	139,790	94,015	142,402	58,926	70,145
23	Maine	39,134	4,928	39,259	10,827	25,446	10,840	6,303
24	Maryland	63,097	15,936	91,552	898	64,349	13,901	26,160
25	Massachusetts	122,857	24,894	37,787	61,255	72,583	19,804	8,727
26	Michigan	254,186	115,555	127,662	32,688	150,240	44,957	62,070
27	Minnesota	180,126	24,850	77,015	5,692	229,854	51,182	190,979
28	Mississippi	133,143	56,688	366,353	82,727	144,645	57,758	69,378
29	Missouri	139,362	14,808	114,101	31,930	322,307	67,290	181,815
30	Montana	52,893	18,383	226,282	1,401	152,449	44,634	86,259
31	Nebraska	76,757	15,374	19,892	10,122	157,152	29,914	224,619
32	Nevada	38,369	8,455	12,709	3,913	38,023	9,386	14,545
33	New Hampshire	31,981	13,910	28,450	90,762	19,414	7,804	2,201
34	New Jersey	140,373	79,814	47,276	42,601	83,105	25,993	9,183
35	New Mexico	56,240	32,427	91,749	9,447	254,567	48,963	43,927
36	New York	319,026	88,071	106,257	122,071	188,701	57,721	54,593
37	North Carolina	353,839	36,969	727,973	33,810	175,321	77,486	170,679
38	North Dakota	57,618	21,197	13,578	64,078	98,021	19,417	87,088
39	Ohio	277,948	82,187	104,105	63,253	182,980	53,484	81,898
40	Oklahoma	92,653	33,165	52,658	5,528	243,098	47,946	186,307
41	Oregon	139,000	39,925	850,783	20,897	257,281	125,782	58,126
42	Pennsylvania	240,416	114,330	193,078	80,948	155,235	52,980	81,910
44	Rhode Island	18,047	2,766	4,454	4,108	7,957	2,578	1,205
45	South Carolina	151,220	26,093	279,698	15,619	118,616	45,755	29,031
46	South Dakota	40,456	7,880	24,025	23,819	110,488	23,431	125,939
47	Tennessee	235,564	52,303	214,772	47,789	125,280	49,494	78,243
48	Texas	558,052	43,065	304,178	9,570	857,424	178,493	444,795
49	Utah	64,449	23,536	34,962	13,107	67,559	16,411	29,630
50	Vermont	22,148	11,533	21,636	12,963	21,374	6,990	8,618
51	Virginia	202,313	45,680	302,317	9,471	147,719	33,371	67,726
53	Washington	152,211	22,999	203,537	3,732	117,415	46,448	46,814
54	West Virginia	53,461	21,321	59,801	11,332	45,549	15,976	15,950
55	Wisconsin	175,512	58,670	122,456	45,889	117,111	37,010	118,345
56	Wyoming	18,444	71,685	41,227	17,309	166,817	29,141	45,892
	Total	**7,221,877**	**2,225,898**	**9,254,775**	**1,367,643**	**7,693,802**	**2,285,814**	**4,341,905**

Table 15. IAQR 2010 Base All Sectors Annual Emissions (Tons)								
FIPS	State	VOC	NOx	CO	SO2	PM-10	PM-2.5	NH3
01	Alabama	323,451	452,969	2,387,712	648,426	247,738	112,362	96,434
04	Arizona	239,883	415,709	1,452,407	174,212	175,132	99,452	38,221
05	Arkansas	195,877	221,094	1,166,108	162,096	174,602	66,006	170,944
06	California	953,934	962,328	6,417,787	88,393	425,656	169,224	225,601
08	Colorado	233,758	325,088	1,249,482	94,875	185,315	57,461	101,533
09	Connecticut	110,510	91,552	689,163	15,014	40,796	11,146	9,978
10	Delaware	43,855	59,859	263,586	95,361	17,110	8,903	14,488
11	DC	13,359	13,033	63,635	8,031	2,357	1,080	1,635
12	Florida	734,026	715,956	6,224,972	385,263	302,607	128,602	98,023
13	Georgia	446,628	552,298	3,723,221	712,339	403,619	191,565	120,591
16	Idaho	106,763	87,199	936,723	35,953	176,792	71,161	62,605
17	Illinois	565,161	750,119	2,854,174	917,292	362,575	121,960	172,440
18	Indiana	377,892	556,258	2,487,732	826,664	203,237	61,680	116,962
19	Iowa	196,700	262,874	1,051,926	269,439	169,557	46,401	319,214
20	Kansas	187,682	422,586	1,066,073	84,111	233,444	63,213	227,226
21	Kentucky	271,831	476,351	1,413,185	466,405	138,942	58,140	95,184
22	Louisiana	306,041	744,724	2,324,464	421,691	194,790	98,118	149,653
23	Maine	81,087	61,986	519,413	36,624	32,969	15,951	8,220
24	Maryland	136,060	207,743	1,140,541	264,325	78,706	23,107	33,098
25	Massachusetts	201,524	197,833	1,199,042	94,038	85,913	29,878	16,403
26	Michigan	539,454	636,488	3,407,757	557,619	193,262	72,148	75,494
27	Minnesota	345,012	381,462	1,724,130	140,049	334,956	101,437	199,067
28	Mississippi	258,589	287,842	1,397,691	236,088	165,879	72,756	103,538
29	Missouri	294,485	363,568	1,786,549	455,182	390,058	97,425	217,502
30	Montana	82,111	136,413	625,481	54,434	172,654	56,011	88,208
31	Nebraska	124,374	182,786	649,310	115,823	173,379	38,863	227,016
32	Nevada	75,276	113,490	541,387	24,340	60,645	19,041	16,951
33	New Hampshire	64,426	53,744	412,110	106,284	23,063	10,324	3,838
34	New Jersey	307,274	339,640	1,481,267	208,899	109,126	45,133	19,021
35	New Mexico	111,272	242,782	818,201	173,724	268,036	58,018	47,160
36	New York	555,359	465,644	3,224,084	508,223	253,736	104,242	71,857
37	North Carolina	570,641	372,450	3,122,470	350,841	220,669	107,372	183,067
38	North Dakota	78,709	164,596	304,552	281,595	106,951	25,967	88,060
39	Ohio	525,256	744,686	3,978,263	1,666,387	258,255	102,317	99,799
40	Oklahoma	210,814	363,060	1,578,707	180,781	264,007	61,894	212,024
41	Oregon	209,243	189,993	1,827,370	43,838	272,440	137,146	62,828
42	Pennsylvania	467,928	778,307	3,451,925	1,079,823	223,050	95,471	102,699
44	Rhode Island	33,011	22,980	190,452	9,495	10,373	4,428	2,262
45	South Carolina	275,595	260,862	1,701,102	280,913	143,216	61,244	34,990
46	South Dakota	61,614	68,955	309,395	61,834	114,908	26,677	127,088
47	Tennessee	461,600	504,953	2,274,345	491,691	159,834	72,311	87,091
48	Texas	1,100,224	1,599,537	5,916,917	851,669	957,527	248,866	477,130
49	Utah	131,133	205,081	931,274	75,609	98,082	40,183	34,253
50	Vermont	38,545	32,147	230,893	15,148	23,371	8,344	9,544
51	Virginia	374,371	391,312	2,228,845	315,369	184,192	56,638	78,793
53	Washington	277,939	291,775	2,269,807	71,365	140,061	62,797	60,547
54	West Virginia	112,245	324,035	690,128	657,970	73,830	33,102	18,762
55	Wisconsin	330,688	385,113	1,703,056	349,847	145,427	57,610	127,086
56	Wyoming	49,875	253,187	368,088	124,577	207,543	53,524	47,518
	Total	**13,793,082**	**17,734,447**	**87,776,902**	**15,289,969**	**9,400,388**	**3,366,700**	**5,001,647**

Table 16. IAQR 2015 Base EGU Annual Emissions (Tons)								
FIPS	State	VOC	NOx	CO	SO2	PM-10	PM-2.5	NH3
01	Alabama	1,157	128,592	29,397	415,985	8,524	4,491	9
04	Arizona	673	85,975	29,226	47,779	3,764	2,073	4
05	Arkansas	408	52,786	10,022	122,667	1,751	1,240	3
06	California	1,440	19,597	71,879	17,317	2,760	1,466	503
08	Colorado	464	83,632	9,893	73,089	1,620	914	4
09	Connecticut	100	5,260	6,126	6,284	831	285	0
10	Delaware	84	10,843	1,658	48,275	717	335	1
11	DC	1	86	106	0	2	2	0
12	Florida	1,784	170,803	52,590	230,295	9,473	4,283	383
13	Georgia	1,228	153,295	25,136	600,315	10,236	4,996	10
16	Idaho	22	1,229	2,428	0	41	41	0
17	Illinois	1,509	179,581	12,281	539,206	6,854	3,910	11
18	Indiana	1,757	245,844	16,389	531,563	12,481	6,585	37
19	Iowa	491	90,805	4,729	178,041	3,376	2,084	4
20	Kansas	546	102,025	4,492	65,316	2,855	1,769	5
21	Kentucky	1,380	200,732	14,511	363,166	9,097	4,198	12
22	Louisiana	478	50,164	13,762	112,534	3,413	1,419	3
23	Maine	49	2,138	4,640	3,210	350	148	0
24	Maryland	436	62,037	5,165	229,578	3,444	1,476	4
25	Massachusetts	277	11,923	14,228	16,259	1,337	720	25
26	Michigan	1,028	131,114	15,432	390,753	6,324	3,656	19
27	Minnesota	546	108,222	7,567	92,830	3,368	1,767	5
28	Mississippi	358	44,939	17,374	73,467	2,223	1,007	2
29	Missouri	1,254	145,066	11,285	317,556	4,292	2,928	9
30	Montana	224	38,547	2,474	17,718	2,882	1,386	2
31	Nebraska	300	57,820	2,595	97,391	1,285	881	3
32	Nevada	298	41,284	8,606	17,314	2,616	1,403	11
33	New Hampshire	114	3,813	4,449	7,289	376	258	0
34	New Jersey	215	30,713	7,780	39,237	2,121	842	1
35	New Mexico	362	76,538	3,308	48,577	1,940	920	4
36	New York	801	70,461	24,469	214,077	3,932	1,904	176
37	North Carolina	1,025	63,472	12,048	144,369	9,673	4,087	9
38	North Dakota	689	80,541	7,857	171,995	3,330	1,622	6
39	Ohio	1,761	261,431	18,861	1,047,580	15,822	7,205	16
40	Oklahoma	692	86,711	17,434	133,009	2,782	1,737	84
41	Oregon	140	13,504	10,515	15,187	395	325	0
42	Pennsylvania	1,561	215,027	21,059	812,610	15,849	6,703	14
44	Rhode Island	29	1,989	3,211	0	54	54	0
45	South Carolina	529	66,243	7,797	195,541	10,122	4,601	5
46	South Dakota	74	13,552	639	42,118	379	85	1
47	Tennessee	756	102,714	6,114	309,626	3,994	2,102	7
48	Texas	3,737	201,284	110,660	487,068	20,355	12,911	416
49	Utah	369	69,402	3,110	31,541	2,330	1,042	3
50	Vermont	0	4	5	0	0	0	0
51	Virginia	496	57,948	8,307	186,498	5,851	2,191	4
53	Washington	255	26,336	15,235	5,959	791	615	9
54	West Virginia	1,211	148,246	9,974	485,118	11,097	4,852	11
55	Wisconsin	715	103,469	9,349	189,552	3,011	1,975	6
56	Wyoming	506	90,502	4,245	47,240	3,145	2,090	5
	Total	**34,332**	**4,008,241**	**700,418**	**9,222,097**	**223,265**	**113,584**	**1,850**

Table 17. IAQR 2015 Base non-EGU Annual Emissions (Tons)								
FIPS	**State**	**VOC**	**NOx**	**CO**	**SO2**	**PM-10**	**PM-2.5**	**NH3**
01	Alabama	62,259	86,324	227,779	123,496	39,909	23,175	4,233
04	Arizona	16,315	126,302	27,969	126,366	40,157	21,484	6
05	Arkansas	12,726	24,269	124,409	18,050	33,583	19,098	18,064
06	California	64,866	140,646	91,712	45,231	34,639	18,943	16,596
08	Colorado	39,457	44,303	28,096	16,572	25,629	15,303	373
09	Connecticut	6,057	11,769	3,319	7,765	1,187	896	61
10	Delaware	5,691	8,568	16,691	38,341	1,207	879	716
11	DC	243	840	282	2,164	100	73	8
12	Florida	22,873	61,083	59,391	93,694	16,716	10,876	6,829
13	Georgia	37,244	75,076	218,771	97,537	31,537	22,045	18,727
16	Idaho	334	6,833	5,068	27,825	10,996	7,463	2
17	Illinois	138,171	138,214	128,953	286,281	98,941	50,807	14,496
18	Indiana	40,812	46,176	258,837	157,305	17,034	13,404	9,468
19	Iowa	6,281	27,203	8,041	85,366	8,579	4,809	9,584
20	Kansas	17,474	111,768	88,084	16,668	14,372	9,758	14,659
21	Kentucky	65,902	35,997	81,025	44,661	19,486	12,595	1,558
22	Louisiana	91,246	305,063	869,350	204,181	36,848	27,270	76,805
23	Maine	5,154	16,078	11,084	22,731	5,068	3,292	136
24	Maryland	7,463	19,476	44,646	22,680	3,818	2,255	278
25	Massachusetts	7,304	18,925	8,296	15,561	3,562	2,611	91
26	Michigan	77,038	166,567	139,295	138,305	24,630	13,803	615
27	Minnesota	31,688	79,225	109,210	42,319	97,130	42,572	1,447
28	Mississippi	55,822	77,917	130,604	81,892	13,203	9,446	31,584
29	Missouri	59,087	30,766	115,122	133,606	57,424	21,287	28,608
30	Montana	5,472	21,792	58,055	36,510	15,623	8,254	598
31	Nebraska	11,424	15,062	13,626	7,637	10,342	3,899	14
32	Nevada	1,926	6,459	13,172	3,723	17,089	5,980	9
33	New Hampshire	5,087	4,362	6,442	8,092	1,390	842	23
34	New Jersey	79,765	52,739	22,676	71,653	11,025	7,694	465
35	New Mexico	9,095	68,196	21,555	119,341	7,821	5,668	38
36	New York	51,448	37,130	32,035	165,704	45,138	32,292	204
37	North Carolina	80,836	65,662	93,521	99,577	24,547	17,275	125
38	North Dakota	176	7,158	3,584	54,300	1,476	1,335	13
39	Ohio	59,521	79,281	745,465	334,133	38,902	25,813	3,090
40	Oklahoma	37,750	121,811	250,339	42,928	11,863	7,295	20,893
41	Oregon	8,946	17,175	85,362	6,714	9,389	6,714	16
42	Pennsylvania	50,102	173,185	340,856	141,871	39,699	26,160	7,183
44	Rhode Island	3,421	894	1,815	2,453	1,299	958	7
45	South Carolina	33,416	47,562	81,190	67,001	8,632	6,397	62
46	South Dakota	2,090	4,891	0	1,416	909	471	1
47	Tennessee	102,907	79,932	119,656	136,735	19,957	11,938	85
48	Texas	214,252	535,436	455,799	327,249	42,772	29,147	1,454
49	Utah	15,860	32,801	132,818	31,263	24,763	20,150	1,477
50	Vermont	1,486	803	1,595	2,064	1,007	590	3
51	Virginia	55,622	68,327	79,345	115,850	17,700	11,117	880
53	Washington	14,961	50,092	197,803	53,700	11,740	7,888	6,254
54	West Virginia	21,456	51,005	116,334	62,824	11,576	7,413	416
55	Wisconsin	48,251	56,094	69,181	91,386	16,971	12,034	1,041
56	Wyoming	14,202	50,184	84,785	61,094	38,814	22,666	569
	Total	**1,800,977**	**3,307,415**	**5,823,044**	**3,893,813**	**1,066,198**	**634,132**	**299,862**

Table 18. IAQR 2015 Base On-road Annual Emissions (Tons)								
FIPS	**State**	**VOC**	**NOx**	**CO**	**SO2**	**PM-10**	**PM-2.5**	**NH3**
01	Alabama	73,623	78,804	1,274,667	657	3,313	1,932	7,005
04	Arizona	42,794	64,120	617,336	618	2,983	1,712	6,619
05	Arkansas	36,663	46,228	614,446	365	1,920	1,137	3,862
06	California	210,076	275,210	2,385,266	3,786	19,093	11,182	41,530
08	Colorado	35,646	56,073	691,043	515	2,535	1,467	5,506
09	Connecticut	16,070	33,251	249,639	355	1,816	1,069	3,887
10	Delaware	7,062	11,830	147,363	101	538	322	1,095
11	DC	1,942	3,299	42,572	45	210	118	500
12	Florida	201,790	211,115	3,956,434	1,932	9,096	5,168	20,798
13	Georgia	90,406	133,254	1,606,409	1,256	6,162	3,558	13,438
16	Idaho	15,875	23,108	342,514	180	940	555	1,897
17	Illinois	76,888	123,878	1,491,270	1,216	5,925	3,400	13,234
18	Indiana	74,868	101,430	1,603,040	834	4,252	2,491	8,894
19	Iowa	31,147	43,585	674,725	332	1,743	1,033	3,517
20	Kansas	29,737	42,095	625,521	335	1,715	1,007	3,568
21	Kentucky	45,693	67,101	915,803	536	2,817	1,670	5,725
22	Louisiana	54,241	62,772	944,778	481	2,413	1,402	5,125
23	Maine	12,523	21,805	324,327	166	887	527	1,752
24	Maryland	25,508	50,672	465,492	603	2,950	1,693	6,584
25	Massachusetts	27,298	50,409	575,702	629	3,018	1,724	6,928
26	Michigan	90,077	122,230	2,161,156	1,091	5,227	2,980	11,703
27	Minnesota	46,835	72,259	983,535	581	2,919	1,703	6,206
28	Mississippi	41,812	48,738	680,140	387	2,037	1,207	4,089
29	Missouri	50,197	82,868	1,030,139	787	3,685	2,067	8,417
30	Montana	10,562	17,594	243,933	127	687	411	1,339
31	Nebraska	19,082	26,809	423,544	208	1,080	637	2,204
32	Nevada	17,171	25,719	335,181	228	1,102	633	2,441
33	New Hampshire	10,924	18,395	241,797	142	772	464	1,521
34	New Jersey	35,699	64,681	566,351	777	3,737	2,130	8,539
35	New Mexico	29,560	38,716	594,947	308	1,593	938	3,259
36	New York	72,821	127,098	1,638,456	1,382	6,579	3,736	15,054
37	North Carolina	77,471	106,425	1,597,593	1,090	5,132	2,880	11,629
38	North Dakota	7,687	11,569	172,264	83	448	268	875
39	Ohio	94,185	140,294	1,943,742	1,265	6,215	3,596	13,566
40	Oklahoma	50,700	62,063	987,603	509	2,557	1,490	5,437
41	Oregon	25,133	47,165	500,520	420	2,119	1,238	4,469
42	Pennsylvania	86,641	137,144	1,907,047	1,195	5,874	3,386	12,822
44	Rhode Island	5,401	8,360	83,640	88	439	255	974
45	South Carolina	58,895	67,410	984,012	538	2,793	1,646	5,697
46	South Dakota	8,711	14,353	196,221	105	566	338	1,100
47	Tennessee	74,531	93,790	1,517,880	781	3,891	2,262	8,336
48	Texas	197,443	277,366	3,157,126	2,506	12,029	6,862	27,155
49	Utah	25,041	34,523	589,164	294	1,429	824	3,142
50	Vermont	6,015	10,908	148,439	86	452	268	902
51	Virginia	64,957	103,491	1,230,113	941	4,743	2,762	10,143
53	Washington	55,723	80,559	1,349,970	707	3,398	1,950	7,592
54	West Virginia	19,629	28,484	376,185	216	1,158	691	2,277
55	Wisconsin	39,874	76,085	960,707	673	3,418	1,992	7,194
56	Wyoming	7,648	13,145	179,073	94	509	304	994
	Total	**2,440,276**	**3,458,279**	**46,328,823**	**32,551**	**160,910**	**93,083**	**350,542**

Table 19. IAQR 2015 Base Non-road Annual Emissions (Tons)								
FIPS	State	VOC	NOx	CO	SO2	PM-10	PM-2.5	NH3
01	Alabama	32,798	47,802	438,141	1,494	5,271	4,249	850
04	Arizona	32,630	36,972	612,706	619	9,124	4,275	673
05	Arkansas	20,093	28,970	267,038	365	2,576	2,289	532
06	California	149,152	235,899	3,232,631	13,249	19,931	17,437	5,888
08	Colorado	29,365	48,537	492,746	635	4,393	3,288	902
09	Connecticut	18,216	13,758	344,742	315	1,605	1,459	643
10	Delaware	6,039	14,822	91,633	295	1,136	1,017	127
11	DC	2,321	4,903	23,286	113	186	158	92
12	Florida	131,965	128,917	2,135,831	15,560	17,513	14,812	2,303
13	Georgia	46,179	55,313	847,928	2,514	5,798	5,000	1,622
16	Idaho	14,621	14,425	170,800	197	2,593	1,423	232
17	Illinois	69,021	127,051	1,190,122	1,380	8,585	7,728	2,563
18	Indiana	32,945	75,451	632,355	877	4,907	4,394	1,423
19	Iowa	21,912	46,265	354,808	367	4,062	3,680	671
20	Kansas	16,758	67,088	314,750	589	4,496	3,900	668
21	Kentucky	25,540	64,356	344,264	1,813	4,819	4,133	738
22	Louisiana	42,261	185,369	467,393	21,260	10,555	9,516	1,691
23	Maine	18,074	7,200	158,723	206	1,105	953	184
24	Maryland	33,924	33,441	574,791	8,033	3,769	3,274	633
25	Massachusetts	34,177	56,508	610,497	1,008	4,505	4,062	1,270
26	Michigan	88,876	51,442	1,099,629	1,140	6,303	5,663	2,059
27	Minnesota	63,307	53,064	602,546	847	5,651	5,151	1,114
28	Mississippi	22,382	38,257	258,017	1,943	3,756	3,168	502
29	Missouri	35,616	53,844	576,935	693	4,587	4,031	1,148
30	Montana	9,362	29,264	112,732	193	1,886	1,542	161
31	Nebraska	12,666	48,569	215,901	416	3,148	2,814	366
32	Nevada	13,251	21,225	211,624	290	2,999	1,794	230
33	New Hampshire	11,858	4,967	145,837	134	952	756	233
34	New Jersey	44,962	75,085	864,066	52,970	8,697	7,898	1,573
35	New Mexico	9,969	8,730	155,365	180	2,070	1,306	246
36	New York	85,796	73,472	1,505,260	1,895	7,983	7,045	2,879
37	North Carolina	46,044	47,811	834,169	1,049	6,883	5,707	1,804
38	North Dakota	9,195	34,383	111,990	226	2,908	2,549	149
39	Ohio	70,182	98,358	1,241,363	5,524	13,983	11,154	2,481
40	Oklahoma	21,373	33,257	350,407	487	3,406	2,881	919
41	Oregon	28,613	44,646	412,499	714	2,678	2,435	658
42	Pennsylvania	65,649	67,095	1,129,376	3,168	6,048	5,230	2,209
44	Rhode Island	4,383	4,713	93,192	2,901	570	520	163
45	South Carolina	25,445	24,160	428,653	1,130	2,807	2,460	734
46	South Dakota	7,495	19,450	98,197	116	1,973	1,729	149
47	Tennessee	38,116	123,363	536,210	2,720	6,674	6,066	1,186
48	Texas	104,746	380,897	2,124,134	33,591	24,085	19,607	5,818
49	Utah	17,269	24,644	225,855	268	2,413	1,888	418
50	Vermont	6,084	3,147	68,785	71	426	365	103
51	Virginia	40,859	65,601	710,236	4,552	8,029	6,630	980
53	Washington	40,593	67,516	631,226	9,535	6,282	5,202	1,100
54	West Virginia	12,171	51,505	154,504	34,261	4,417	4,031	286
55	Wisconsin	50,629	41,306	597,605	605	4,281	3,778	1,197
56	Wyoming	6,676	20,230	70,111	139	1,034	802	170
	Total	**1,771,559**	**2,903,048**	**28,871,613**	**232,644**	**263,857**	**221,249**	**54,742**

Table 20. IAQR 2015 Base Area Annual Emissions (Tons)								
FIPS	**State**	**VOC**	**NOx**	**CO**	**SO2**	**PM-10**	**PM-2.5**	**NH3**
01	Alabama	147,717	71,360	516,799	54,764	192,257	78,819	88,825
04	Arizona	147,153	80,293	212,314	4,443	124,052	71,502	32,022
05	Arkansas	121,987	46,195	190,819	21,833	135,645	41,884	154,846
06	California	491,456	132,987	620,067	10,897	350,983	117,982	167,727
08	Colorado	126,190	62,177	69,352	4,803	156,189	37,404	95,837
09	Connecticut	63,114	9,139	77,436	459	34,881	7,159	5,986
10	Delaware	23,804	6,946	19,656	10,428	13,956	6,461	13,608
11	DC	8,586	1,980	869	5,921	1,953	721	1,141
12	Florida	359,609	54,736	467,578	46,656	256,975	93,670	71,704
13	Georgia	268,166	76,381	1,114,791	6,898	352,511	156,723	93,851
16	Idaho	71,986	30,150	438,105	9,087	157,148	60,605	60,889
17	Illinois	273,244	116,003	66,517	37,232	246,317	56,584	145,952
18	Indiana	223,977	38,714	71,471	2,319	166,247	34,442	100,158
19	Iowa	132,804	31,811	43,276	14,996	150,631	33,646	310,204
20	Kansas	121,553	76,256	74,930	3,542	208,336	45,823	210,514
21	Kentucky	128,788	78,586	121,362	58,831	104,934	35,421	88,617
22	Louisiana	111,966	105,559	137,606	95,933	144,292	59,277	72,447
23	Maine	39,714	4,864	35,079	10,762	25,591	10,562	6,499
24	Maryland	65,591	15,960	93,687	933	66,161	13,988	27,484
25	Massachusetts	126,635	24,961	35,602	61,044	73,418	19,994	9,087
26	Michigan	260,658	116,735	117,357	32,875	151,877	44,719	62,904
27	Minnesota	186,991	25,540	72,193	5,695	229,766	50,999	193,373
28	Mississippi	137,505	58,172	361,720	85,352	143,913	57,404	71,865
29	Missouri	141,001	15,216	104,212	32,278	319,757	66,248	184,169
30	Montana	53,937	18,603	223,364	1,411	152,991	44,580	86,519
31	Nebraska	79,635	15,776	19,373	10,298	156,165	29,804	226,312
32	Nevada	41,269	8,967	12,548	4,107	39,156	9,732	14,720
33	New Hampshire	32,873	14,137	26,249	91,996	19,701	7,713	2,247
34	New Jersey	144,404	80,210	46,277	42,517	86,477	26,893	9,465
35	New Mexico	58,749	34,044	90,335	9,927	252,411	48,715	44,037
36	New York	325,497	82,286	95,010	118,216	189,190	57,251	55,389
37	North Carolina	367,073	37,921	717,184	34,478	180,595	78,175	175,663
38	North Dakota	59,430	21,882	13,516	65,873	97,732	19,396	87,433
39	Ohio	287,903	83,817	97,786	64,303	186,617	54,044	83,569
40	Oklahoma	94,792	34,141	49,281	5,690	242,364	47,764	188,583
41	Oregon	141,650	40,205	839,787	21,452	252,063	124,175	58,493
42	Pennsylvania	246,274	110,183	185,871	80,565	157,655	53,177	83,820
44	Rhode Island	18,741	2,701	4,072	3,996	8,222	2,620	1,260
45	South Carolina	157,237	26,841	275,218	16,186	118,876	45,672	30,006
46	South Dakota	42,288	8,246	23,544	25,135	112,100	23,760	126,624
47	Tennessee	243,272	53,973	204,066	49,292	127,498	49,253	79,402
48	Texas	579,751	44,600	300,113	9,885	863,796	180,445	448,202
49	Utah	68,759	24,951	34,634	13,897	69,389	16,898	29,783
50	Vermont	22,630	11,110	19,428	13,165	21,146	6,827	8,688
51	Virginia	210,021	46,708	290,029	9,742	150,838	35,101	69,379
53	Washington	157,056	23,927	193,592	3,845	118,429	46,061	47,621
54	West Virginia	53,973	21,489	55,088	11,484	45,472	15,624	16,348
55	Wisconsin	181,851	59,470	117,604	47,355	119,630	37,172	119,348
56	Wyoming	18,855	73,828	40,585	17,756	165,055	28,893	45,852
	Total	**7,468,115**	**2,260,738**	**9,037,352**	**1,390,552**	**7,741,355**	**2,291,781**	**4,408,472**

Table 21. IAQR 2015 Base All Sectors Annual Emissions (Tons)								
FIPS	**State**	**VOC**	**NOx**	**CO**	**SO2**	**PM-10**	**PM-2.5**	**NH3**
01	Alabama	317,555	412,881	2,486,784	596,395	249,274	112,667	100,922
04	Arizona	239,566	393,661	1,499,552	179,824	180,080	101,046	39,324
05	Arkansas	191,878	198,448	1,206,734	163,280	175,475	65,648	177,308
06	California	916,990	804,339	6,401,555	90,479	427,406	167,010	232,245
08	Colorado	231,122	294,722	1,291,130	95,613	190,366	58,377	102,622
09	Connecticut	103,557	73,176	681,262	15,178	40,319	10,867	10,578
10	Delaware	42,680	53,010	277,002	97,441	17,554	9,013	15,546
11	DC	13,093	11,107	67,115	8,243	2,450	1,072	1,741
12	Florida	718,021	626,654	6,671,824	388,137	309,773	128,808	102,018
13	Georgia	443,224	493,319	3,813,036	708,520	406,244	192,322	127,649
16	Idaho	102,839	75,745	958,915	37,289	171,718	70,088	63,021
17	Illinois	558,833	684,727	2,889,143	865,314	366,621	122,429	176,256
18	Indiana	374,359	507,615	2,582,093	692,897	204,921	61,316	119,981
19	Iowa	192,636	239,669	1,085,579	279,102	168,389	45,252	323,979
20	Kansas	186,068	399,231	1,107,777	86,450	231,775	62,258	229,413
21	Kentucky	267,303	446,772	1,476,965	469,007	141,152	58,017	96,650
22	Louisiana	300,192	708,927	2,432,889	434,391	197,521	98,884	156,071
23	Maine	75,514	52,084	533,854	37,076	33,000	15,482	8,571
24	Maryland	132,921	181,585	1,183,782	261,826	80,142	22,687	34,983
25	Massachusetts	195,691	162,726	1,244,325	94,500	85,840	29,111	17,401
26	Michigan	517,677	588,089	3,532,868	564,164	194,361	70,821	77,299
27	Minnesota	329,367	338,309	1,775,051	142,274	338,834	102,192	202,145
28	Mississippi	257,879	268,023	1,447,855	243,040	165,132	72,232	108,044
29	Missouri	287,156	327,759	1,837,693	484,920	389,745	96,560	222,351
30	Montana	79,557	125,799	640,558	55,959	174,069	56,174	88,620
31	Nebraska	123,107	164,036	675,039	115,949	172,019	38,036	228,898
32	Nevada	73,915	103,653	581,130	25,663	62,962	19,542	17,412
33	New Hampshire	60,856	45,674	424,775	107,652	23,191	10,034	4,024
34	New Jersey	305,045	303,427	1,507,150	207,154	112,056	45,457	20,044
35	New Mexico	107,734	226,223	865,510	178,332	265,836	57,546	47,584
36	New York	536,363	390,447	3,295,230	501,274	252,821	102,228	73,703
37	North Carolina	572,450	321,291	3,254,516	280,562	226,829	108,123	189,231
38	North Dakota	77,177	155,534	309,211	292,476	105,895	25,170	88,475
39	Ohio	513,552	663,181	4,047,217	1,452,804	261,539	101,813	102,721
40	Oklahoma	205,308	337,983	1,655,064	182,624	262,972	61,166	215,916
41	Oregon	204,482	162,695	1,848,682	44,487	266,643	134,886	63,637
42	Pennsylvania	450,228	702,633	3,584,209	1,039,410	225,125	94,656	106,048
44	Rhode Island	31,975	18,657	185,929	9,438	10,584	4,407	2,404
45	South Carolina	275,522	232,216	1,776,870	280,395	143,230	60,776	36,504
46	South Dakota	60,657	60,492	318,600	68,890	115,927	26,383	127,874
47	Tennessee	459,582	453,773	2,383,926	499,152	162,013	71,621	89,015
48	Texas	1,099,929	1,439,583	6,147,833	860,301	963,037	248,972	483,046
49	Utah	127,299	186,322	985,581	77,262	100,324	40,801	34,824
50	Vermont	36,215	25,972	238,251	15,386	23,032	8,051	9,695
51	Virginia	371,956	342,075	2,318,030	317,584	187,162	57,800	81,386
53	Washington	268,588	248,430	2,387,825	73,746	140,640	61,716	62,576
54	West Virginia	108,440	300,729	712,084	593,903	73,720	32,609	19,339
55	Wisconsin	321,319	336,423	1,754,446	329,571	147,311	56,951	128,787
56	Wyoming	47,887	247,890	378,800	126,323	208,557	54,755	47,589
	Total	**13,515,259**	**15,937,721**	**90,761,250**	**14,771,657**	**9,455,584**	**3,353,829**	**5,115,469**

Table 22. IAQR 2010 Control EGU Annual Emissions (Tons)								
FIPS	State	VOC	NOx	CO	SO2	PM-10	PM-2.5	NH3
01	Alabama	1,081	73,687	22,180	354,454	8,526	4,426	9
04	Arizona	641	84,483	25,711	47,779	3,705	2,014	4
05	Arkansas	378	38,169	6,782	77,934	2,039	1,421	3
06	California	1,605	17,855	56,973	17,317	2,438	1,144	706
08	Colorado	449	82,804	8,207	73,089	1,597	892	4
09	Connecticut	99	5,172	5,994	5,318	829	283	0
10	Delaware	83	8,545	1,842	34,020	685	322	1
11	DC	0	30	30	0	1	1	0
12	Florida	1,197	63,135	45,338	192,948	9,427	4,237	42
13	Georgia	1,153	65,104	19,234	407,671	10,752	5,272	10
16	Idaho	21	1,194	2,255	0	38	38	0
17	Illinois	1,478	113,864	11,313	246,121	6,593	3,805	11
18	Indiana	1,699	137,248	14,276	381,404	12,233	6,450	37
19	Iowa	424	38,307	3,917	156,234	2,979	1,835	4
20	Kansas	537	100,659	4,228	62,842	2,817	1,741	4
21	Kentucky	1,331	76,290	13,833	311,149	8,551	3,943	11
22	Louisiana	395	37,057	12,394	79,840	3,525	1,489	3
23	Maine	48	2,077	4,557	3,210	348	147	0
24	Maryland	412	22,904	4,140	67,079	3,384	1,441	4
25	Massachusetts	229	9,998	11,172	14,661	1,164	614	20
26	Michigan	995	94,310	13,069	376,726	6,086	3,504	32
27	Minnesota	482	42,698	4,191	77,332	3,001	1,555	4
28	Mississippi	301	19,633	11,215	73,467	2,119	903	2
29	Missouri	1,050	67,141	8,769	244,403	3,475	2,363	8
30	Montana	220	38,461	2,002	17,718	2,874	1,378	2
31	Nebraska	299	57,730	2,447	97,391	1,282	879	3
32	Nevada	273	37,789	7,089	16,535	2,486	1,331	11
33	New Hampshire	109	3,129	4,402	5,626	324	235	0
34	New Jersey	172	10,997	5,305	25,497	1,930	754	1
35	New Mexico	359	76,378	3,204	48,577	1,939	918	3
36	New York	814	60,728	19,082	113,726	3,838	1,810	216
37	North Carolina	995	62,004	10,042	219,369	9,585	4,021	9
38	North Dakota	717	84,889	8,259	68,024	3,464	1,656	6
39	Ohio	1,667	118,712	15,204	368,186	15,366	6,976	16
40	Oklahoma	624	83,133	15,930	133,009	2,770	1,725	47
41	Oregon	131	13,328	9,552	15,187	379	309	0
42	Pennsylvania	1,449	81,494	18,037	179,711	15,111	6,367	13
44	Rhode Island	23	1,504	2,489	0	42	42	0
45	South Carolina	496	33,570	5,586	162,980	9,778	4,435	5
46	South Dakota	97	17,608	835	2,865	500	111	1
47	Tennessee	747	50,199	5,919	258,130	3,957	2,082	7
48	Texas	3,782	198,229	102,008	401,700	20,228	12,760	455
49	Utah	369	69,368	3,080	31,541	2,329	1,041	3
50	Vermont	0	1	2	0	0	0	0
51	Virginia	456	33,536	5,615	160,665	5,618	2,070	4
53	Washington	263	28,321	16,109	5,959	806	630	9
54	West Virginia	1,179	41,356	9,654	221,065	10,836	4,740	11
55	Wisconsin	656	74,189	7,840	200,978	2,977	1,954	6
56	Wyoming	506	90,500	4,241	47,276	3,145	2,090	5
	Total	**32,488**	**2,569,519**	**595,553**	**6,106,708**	**217,876**	**110,155**	**1,753**

Table 23. IAQR 2010 Control All Sectors Annual Emissions (Tons)								
FIPS	State	VOC	NOx	CO	SO2	PM-10	PM-2.5	NH3
01	Alabama	323,460	392,522	2,388,878	529,837	247,942	112,466	96,434
04	Arizona	239,882	415,625	1,452,287	174,212	175,130	99,450	38,221
05	Arkansas	195,862	206,752	1,164,461	117,363	174,917	66,214	170,944
06	California	953,933	962,512	6,417,962	88,393	425,662	169,230	225,600
08	Colorado	233,760	325,177	1,249,765	94,875	185,319	57,465	101,533
09	Connecticut	110,510	91,556	689,172	14,048	40,796	11,146	9,978
10	Delaware	43,858	58,133	264,052	83,025	17,107	8,906	14,488
11	DC	13,359	13,022	63,624	8,031	2,356	1,080	1,635
12	Florida	734,000	617,245	6,225,334	344,970	302,619	128,614	98,003
13	Georgia	446,618	466,821	3,724,276	510,856	404,257	191,960	120,591
16	Idaho	106,763	87,196	936,705	35,953	176,791	71,161	62,605
17	Illinois	565,253	692,540	2,855,086	562,577	362,665	122,056	172,441
18	Indiana	377,887	453,794	2,487,715	537,702	203,319	61,722	116,962
19	Iowa	196,661	215,091	1,051,530	255,811	169,309	46,253	319,214
20	Kansas	187,681	422,303	1,066,068	83,420	233,460	63,221	227,226
21	Kentucky	271,809	356,759	1,413,169	414,409	138,620	57,991	95,184
22	Louisiana	305,977	732,014	2,325,175	388,997	194,937	98,223	149,652
23	Maine	81,087	61,960	519,377	36,624	32,969	15,950	8,220
24	Maryland	136,049	170,018	1,140,417	99,175	78,716	23,102	33,098
25	Massachusetts	201,514	197,438	1,199,294	93,049	85,840	29,847	16,400
26	Michigan	539,476	605,404	3,408,855	546,718	193,228	72,136	75,508
27	Minnesota	344,969	319,626	1,721,422	125,819	334,751	101,317	199,067
28	Mississippi	258,614	264,311	1,400,522	236,088	165,927	72,804	103,538
29	Missouri	294,385	293,700	1,786,185	406,492	389,583	97,102	217,501
30	Montana	82,110	136,409	625,461	54,229	172,653	56,010	88,208
31	Nebraska	124,373	182,690	649,306	115,585	173,376	38,861	227,016
32	Nevada	75,279	113,876	541,439	24,467	60,664	19,050	16,951
33	New Hampshire	64,422	53,226	412,076	104,621	23,024	10,306	3,838
34	New Jersey	307,250	321,315	1,480,781	193,141	109,018	45,092	19,020
35	New Mexico	111,272	242,760	818,172	173,724	268,036	58,018	47,160
36	New York	555,310	457,958	3,225,081	407,872	253,756	104,262	71,821
37	North Carolina	570,692	372,385	3,123,041	350,841	221,179	107,587	183,068
38	North Dakota	78,756	171,558	305,085	188,680	107,196	26,049	88,061
39	Ohio	525,259	596,601	3,978,318	775,888	258,376	102,386	99,799
40	Oklahoma	210,834	364,079	1,579,581	180,781	264,019	61,906	212,032
41	Oregon	209,242	189,974	1,827,268	43,838	272,438	137,145	62,828
42	Pennsylvania	467,893	650,041	3,453,723	406,103	222,872	95,385	102,698
44	Rhode Island	33,012	23,044	190,558	9,495	10,375	4,430	2,262
45	South Carolina	275,583	229,695	1,700,997	244,148	142,936	61,126	34,989
46	South Dakota	61,647	74,815	309,685	28,394	115,082	26,714	127,088
47	Tennessee	461,601	452,332	2,274,425	443,739	159,838	72,314	87,091
48	Texas	1,100,295	1,596,858	5,916,172	765,629	957,540	248,855	477,141
49	Utah	131,133	205,081	931,274	75,609	98,082	40,183	34,253
50	Vermont	38,545	32,147	230,893	15,148	23,371	8,344	9,544
51	Virginia	374,356	369,319	2,228,598	288,262	184,049	56,576	78,793
53	Washington	277,936	291,665	2,269,514	71,365	140,056	62,792	60,547
54	West Virginia	112,220	210,234	690,017	328,406	73,659	33,025	18,762
55	Wisconsin	330,647	347,762	1,702,885	336,762	145,280	57,518	127,085
56	Wyoming	49,875	253,187	368,088	124,577	207,543	53,524	47,518
	Total	**13,792,910**	**16,360,528**	**87,783,770**	**11,539,750**	**9,400,641**	**3,366,871**	**5,001,617**

Table 24. IAQR 2010 Control Minus Base All Sectors Annual Emissions

FIPS	State	NOx Tons Delta	SO2 Tons Delta	NOx % Delta	SO2 % Delta
01	Alabama	-60,446	-118,589	-13.3	-18.3
04	Arizona	-84	0	-0.0	0.0
05	Arkansas	-14,342	-44,733	-6.5	-27.6
06	California	184	0	0.0	0.0
08	Colorado	89	0	0.0	0.0
09	Connecticut	4	-966	0.0	-6.4
10	Delaware	-1,726	-12,336	-2.9	-12.9
11	DC	-12	0	-0.1	0.0
12	Florida	-98,711	-40,293	-13.8	-10.5
13	Georgia	-85,478	-201,483	-15.5	-28.3
16	Idaho	-3	0	-0.0	0.0
17	Illinois	-57,579	-354,715	-7.7	-38.7
18	Indiana	-102,464	-288,961	-18.4	-35.0
19	Iowa	-47,783	-13,628	-18.2	-5.1
20	Kansas	-283	-691	-0.1	-0.8
21	Kentucky	-119,593	-51,996	-25.1	-11.1
22	Louisiana	-12,710	-32,694	-1.7	-7.8
23	Maine	-26	0	-0.0	0.0
24	Maryland	-37,725	-165,150	-18.2	-62.5
25	Massachusetts	-395	-989	-0.2	-1.1
26	Michigan	-31,084	-10,901	-4.9	-2.0
27	Minnesota	-61,836	-14,229	-16.2	-10.2
28	Mississippi	-23,531	0	-8.2	0.0
29	Missouri	-69,868	-48,690	-19.2	-10.7
30	Montana	-4	-205	-0.0	-0.4
31	Nebraska	-95	-239	-0.1	-0.2
32	Nevada	386	127	0.3	0.5
33	New Hampshire	-519	-1,663	-1.0	-1.6
34	New Jersey	-18,325	-15,758	-5.4	-7.5
35	New Mexico	-21	0	-0.0	0.0
36	New York	-7,686	-100,351	-1.7	-19.7
37	North Carolina	-65	0	-0.0	0.0
38	North Dakota	6,962	-92,914	4.2	-33.0
39	Ohio	-148,085	-890,498	-19.9	-53.4
40	Oklahoma	1,018	0	0.3	0.0
41	Oregon	-19	0	-0.0	0.0
42	Pennsylvania	-128,267	-673,720	-16.5	-62.4
44	Rhode Island	64	0	0.3	0.0
45	South Carolina	-31,167	-36,765	-11.9	-13.1
46	South Dakota	5,860	-33,440	8.5	-54.1
47	Tennessee	-52,621	-47,952	-10.4	-9.8
48	Texas	-2,679	-86,040	-0.2	-10.1
49	Utah	0	0	0.0	0.0
50	Vermont	0	0	0.0	0.0
51	Virginia	-21,994	-27,107	-5.6	-8.6
53	Washington	-110	0	-0.0	0.0
54	West Virginia	-113,801	-329,564	-35.1	-50.1
55	Wisconsin	-37,351	-13,084	-9.7	-3.7
56	Wyoming	0	-0	0.0	-0.0
	Total	**-1,373,919**	**-3,750,219**	**-7.7**	**-24.5**

Table 25. IAQR 2015 Control EGU Annual Emissions (Tons)

FIPS	State	VOC	NOx	CO	SO2	PM-10	PM-2.5	NH3
01	Alabama	1,165	59,250	31,101	334,173	8,699	4,587	9
04	Arizona	677	85,861	29,738	47,779	3,773	2,082	4
05	Arkansas	405	8,587	9,736	77,935	2,089	1,471	3
06	California	1,389	19,586	72,692	17,317	2,789	1,495	465
08	Colorado	464	83,648	9,944	73,089	1,621	915	4
09	Connecticut	100	5,269	6,119	5,318	831	285	0
10	Delaware	92	9,088	2,707	34,574	710	342	1
11	DC	1	78	127	0	2	2	0
12	Florida	1,703	54,558	54,143	173,799	9,500	4,311	325
13	Georgia	1,203	51,838	25,151	196,833	10,647	5,274	10
16	Idaho	22	1,229	2,428	0	41	41	0
17	Illinois	1,569	96,049	13,039	262,563	6,918	3,987	11
18	Indiana	1,750	77,976	16,421	335,700	13,001	7,060	37
19	Iowa	454	39,694	4,268	164,217	3,132	1,937	4
20	Kansas	543	101,556	4,459	59,532	2,841	1,759	5
21	Kentucky	1,371	54,871	14,578	288,002	8,960	4,135	11
22	Louisiana	407	14,549	13,669	79,841	3,546	1,510	3
23	Maine	49	2,138	4,640	3,210	350	148	0
24	Maryland	432	24,707	5,402	39,592	3,490	1,492	4
25	Massachusetts	261	11,289	14,033	10,117	1,244	676	22
26	Michigan	1,045	99,367	16,329	385,221	6,267	3,624	33
27	Minnesota	500	44,813	4,530	79,335	3,118	1,622	4
28	Mississippi	380	14,583	19,887	43,279	2,265	1,049	2
29	Missouri	1,188	73,163	11,130	289,353	4,042	2,759	9
30	Montana	224	38,547	2,474	17,031	2,882	1,386	2
31	Nebraska	303	58,001	2,882	97,391	1,289	886	3
32	Nevada	300	41,649	8,520	17,506	2,641	1,414	11
33	New Hampshire	109	3,124	4,403	5,602	324	235	0
34	New Jersey	223	14,368	8,184	21,186	2,247	881	2
35	New Mexico	366	76,710	3,322	48,577	1,941	920	7
36	New York	663	57,818	26,997	117,490	3,986	1,959	75
37	North Carolina	1,052	54,849	12,909	144,369	9,910	4,192	10
38	North Dakota	717	84,890	8,259	68,024	3,464	1,656	6
39	Ohio	1,752	102,175	18,924	312,501	15,784	7,204	16
40	Oklahoma	703	87,241	18,259	131,902	2,795	1,750	86
41	Oregon	140	13,504	10,515	15,187	395	325	0
42	Pennsylvania	1,496	79,078	22,162	176,683	15,218	6,460	13
44	Rhode Island	29	1,985	3,204	0	54	54	0
45	South Carolina	521	30,780	7,809	145,254	9,852	4,489	5
46	South Dakota	97	17,613	841	2,865	501	111	1
47	Tennessee	757	31,580	6,267	192,419	3,996	2,104	7
48	Texas	3,716	160,282	111,554	365,440	19,983	12,630	415
49	Utah	369	69,400	3,108	31,541	2,330	1,042	3
50	Vermont	0	4	5	0	0	0	0
51	Virginia	487	33,794	8,384	117,255	5,756	2,149	4
53	Washington	254	26,234	15,112	5,959	789	613	9
54	West Virginia	1,199	35,873	9,942	138,781	10,964	4,796	11
55	Wisconsin	689	60,426	9,036	182,174	2,923	1,922	6
56	Wyoming	506	90,502	4,245	45,792	3,145	2,090	5
	Total	**33,846**	**2,304,175**	**713,590**	**5,401,704**	**223,046**	**113,828**	**1,663**

Table 26. IAQR 2015 Control All Sectors Annual Emissions (Tons)								
FIPS	**State**	**VOC**	**NOx**	**CO**	**SO2**	**PM-10**	**PM-2.5**	**NH3**
01	Alabama	317,563	343,540	2,488,487	514,583	249,448	112,762	100,922
04	Arizona	239,570	393,546	1,500,063	179,824	180,088	101,054	39,324
05	Arkansas	191,875	154,249	1,206,448	118,547	175,813	65,878	177,308
06	California	916,939	804,329	6,402,367	90,479	427,435	167,039	232,206
08	Colorado	231,122	294,738	1,291,182	95,613	190,367	58,377	102,622
09	Connecticut	103,557	73,185	681,255	14,211	40,319	10,867	10,578
10	Delaware	42,687	51,255	278,051	83,740	17,547	9,020	15,546
11	DC	13,093	11,099	67,137	8,243	2,451	1,073	1,741
12	Florida	717,941	510,410	6,673,377	331,641	309,801	128,836	101,959
13	Georgia	443,198	391,862	3,813,050	305,038	406,655	192,600	127,649
16	Idaho	102,839	75,745	958,915	37,289	171,718	70,088	63,021
17	Illinois	558,893	601,195	2,889,901	588,671	366,686	122,506	176,256
18	Indiana	374,353	339,747	2,582,125	497,034	205,441	61,791	119,981
19	Iowa	192,598	188,558	1,085,118	265,277	168,146	45,105	323,979
20	Kansas	186,065	398,762	1,107,743	80,667	231,760	62,247	229,413
21	Kentucky	267,294	300,911	1,477,033	393,843	141,016	57,954	96,650
22	Louisiana	300,121	673,312	2,432,795	401,697	197,654	98,975	156,071
23	Maine	75,514	52,084	533,854	37,076	33,000	15,482	8,571
24	Maryland	132,917	144,255	1,184,018	71,839	80,188	22,702	34,983
25	Massachusetts	195,675	162,092	1,244,130	88,359	85,747	29,067	17,397
26	Michigan	517,694	556,341	3,533,766	558,632	194,303	70,790	77,313
27	Minnesota	329,322	274,900	1,772,014	128,779	338,584	102,046	202,144
28	Mississippi	257,901	237,667	1,450,368	212,853	165,173	72,274	108,044
29	Missouri	287,089	255,856	1,837,538	456,717	389,494	96,391	222,350
30	Montana	79,557	125,799	640,558	55,273	174,069	56,174	88,620
31	Nebraska	123,110	164,217	675,326	115,949	172,024	38,041	228,898
32	Nevada	73,917	104,018	581,044	25,854	62,987	19,553	17,412
33	New Hampshire	60,850	44,986	424,728	105,965	23,139	10,010	4,024
34	New Jersey	305,053	287,082	1,507,554	189,103	112,182	45,495	20,045
35	New Mexico	107,739	226,396	865,525	178,332	265,836	57,546	47,587
36	New York	536,225	377,804	3,297,758	404,687	252,876	102,282	73,602
37	North Carolina	572,476	312,668	3,255,376	280,562	227,066	108,228	189,231
38	North Dakota	77,205	159,882	309,614	188,505	106,028	25,205	88,475
39	Ohio	513,543	503,925	4,047,280	717,725	261,500	101,811	102,721
40	Oklahoma	205,318	338,513	1,655,890	181,516	262,985	61,179	215,918
41	Oregon	204,482	162,695	1,848,682	44,487	266,643	134,886	63,637
42	Pennsylvania	450,163	566,685	3,585,311	403,482	224,494	94,413	106,047
44	Rhode Island	31,975	18,653	185,923	9,438	10,583	4,407	2,404
45	South Carolina	275,514	196,753	1,776,882	230,108	142,960	60,665	36,504
46	South Dakota	60,681	64,553	318,803	29,637	116,048	26,408	127,875
47	Tennessee	459,583	382,638	2,384,080	381,946	162,015	71,624	89,015
48	Texas	1,099,908	1,398,581	6,148,727	738,673	962,665	248,691	483,045
49	Utah	127,299	186,320	985,579	77,262	100,324	40,801	34,824
50	Vermont	36,215	25,972	238,251	15,386	23,032	8,051	9,695
51	Virginia	371,947	317,920	2,318,107	248,341	187,067	57,758	81,386
53	Washington	268,587	248,329	2,387,703	73,746	140,638	61,714	62,576
54	West Virginia	108,428	188,356	712,052	247,566	73,587	32,554	19,339
55	Wisconsin	321,293	293,381	1,754,133	322,193	147,223	56,898	128,786
56	Wyoming	47,887	247,890	378,800	124,875	208,557	54,755	47,589
	Total	**13,514,774**	**14,233,656**	**90,774,422**	**10,951,264**	**9,455,366**	**3,354,073**	**5,115,282**

Table 27. IAQR 2015 Control Minus Base All Sectors Annual Emissions

FIPS	State	NOx Tons Delta	SO2 Tons Delta	NOx % Delta	SO2 % Delta
01	Alabama	-69,341	-81,812	-16.8	-13.7
04	Arizona	-115	0	-0.0	0.0
05	Arkansas	-44,199	-44,732	-22.3	-27.4
06	California	-10	0	-0.0	0.0
08	Colorado	16	0	0.0	0.0
09	Connecticut	9	-966	0.0	-6.4
10	Delaware	-1,756	-13,701	-3.3	-14.1
11	DC	-8	0	-0.1	0.0
12	Florida	-116,245	-56,496	-18.6	-14.6
13	Georgia	-101,457	-403,482	-20.6	-56.9
16	Idaho	0	0	0.0	0.0
17	Illinois	-83,532	-276,643	-12.2	-32.0
18	Indiana	-167,868	-195,863	-33.1	-28.3
19	Iowa	-51,111	-13,824	-21.3	-5.0
20	Kansas	-469	-5,784	-0.1	-6.7
21	Kentucky	-145,860	-75,164	-32.6	-16.0
22	Louisiana	-35,615	-32,694	-5.0	-7.5
23	Maine	0	0	0.0	0.0
24	Maryland	-37,331	-189,987	-20.6	-72.6
25	Massachusetts	-634	-6,142	-0.4	-6.5
26	Michigan	-31,747	-5,531	-5.4	-1.0
27	Minnesota	-63,409	-13,495	-18.7	-9.5
28	Mississippi	-30,356	-30,187	-11.3	-12.4
29	Missouri	-71,903	-28,203	-21.9	-5.8
30	Montana	0	-686	0.0	-1.2
31	Nebraska	181	0	0.1	0.0
32	Nevada	365	191	0.4	0.7
33	New Hampshire	-689	-1,687	-1.5	-1.6
34	New Jersey	-16,345	-18,051	-5.4	-8.7
35	New Mexico	173	0	0.1	0.0
36	New York	-12,643	-96,587	-3.2	-19.3
37	North Carolina	-8,623	0	-2.7	0.0
38	North Dakota	4,348	-103,971	2.8	-35.5
39	Ohio	-159,256	-735,079	-24.0	-50.6
40	Oklahoma	530	-1,107	0.2	-0.6
41	Oregon	0	0	0.0	0.0
42	Pennsylvania	-135,949	-635,927	-19.3	-61.2
44	Rhode Island	-4	0	-0.0	0.0
45	South Carolina	-35,463	-50,287	-15.3	-17.9
46	South Dakota	4,060	-39,254	6.7	-57.0
47	Tennessee	-71,134	-117,207	-15.7	-23.5
48	Texas	-41,003	-121,628	-2.8	-14.1
49	Utah	-2	0	-0.0	0.0
50	Vermont	0	0	0.0	0.0
51	Virginia	-24,155	-69,243	-7.1	-21.8
53	Washington	-102	0	-0.0	0.0
54	West Virginia	-112,373	-346,336	-37.4	-58.3
55	Wisconsin	-43,043	-7,378	-12.8	-2.2
56	Wyoming	0	-1,448	0.0	-1.1
	Total	**-1,704,065**	**-3,820,393**	**-10.7**	**-25.9**

Table 28. NOx Comparison of 2010 Base-1 Versus 2010 Base-2						
FIPS	State	2010 Base-2 EGUs (tpy)	2010 Base-1 EGUs (tpy)	Base-2 Minus Base-1 (tpy)	2010 Base-1 All Sectors (tpy)	Base-2 Minus Base-1 (% of All)
01	Alabama	134,134	129,543	4,590	448,379	1.0
04	Arizona	84,567	88,190	-3,623	419,331	-0.9
05	Arkansas	52,511	52,570	-58	221,152	-0.0
06	California	17,671	18,221	-550	962,878	-0.1
08	Colorado	82,714	87,047	-4,333	329,420	-1.3
09	Connecticut	5,168	6,682	-1,514	93,065	-1.6
10	Delaware	10,271	11,503	-1,232	61,091	-2.0
11	DC	42	70	-28	13,062	-0.2
12	Florida	161,846	162,927	-1,082	717,038	-0.2
13	Georgia	150,582	152,535	-1,953	554,251	-0.4
16	Idaho	1,197	1,398	-201	87,400	-0.2
17	Illinois	171,443	194,241	-22,798	772,917	-2.9
18	Indiana	239,713	223,339	16,373	539,885	3.0
19	Iowa	86,090	95,351	-9,261	272,135	-3.4
20	Kansas	100,942	101,358	-416	423,001	-0.1
21	Kentucky	195,883	186,325	9,558	466,794	2.0
22	Louisiana	49,767	64,710	-14,943	759,667	-2.0
23	Maine	2,103	6,047	-3,944	65,930	-6.0
24	Maryland	60,629	60,515	114	207,629	0.1
25	Massachusetts	10,392	27,805	-17,412	215,245	-8.1
26	Michigan	125,394	126,212	-818	637,307	-0.1
27	Minnesota	104,535	109,707	-5,173	386,635	-1.3
28	Mississippi	43,163	49,726	-6,563	294,404	-2.2
29	Missouri	137,009	144,698	-7,689	371,257	-2.1
30	Montana	38,465	38,528	-64	136,477	-0.0
31	Nebraska	57,826	58,111	-285	183,071	-0.2
32	Nevada	37,403	44,778	-7,375	120,865	-6.1
33	New Hampshire	3,647	3,031	616	53,128	1.2
34	New Jersey	29,322	39,956	-10,634	350,274	-3.0
35	New Mexico	76,400	77,261	-861	243,643	-0.4
36	New York	68,413	58,665	9,749	455,895	2.1
37	North Carolina	62,069	64,705	-2,636	375,086	-0.7
38	North Dakota	77,927	81,093	-3,166	167,762	-1.9
39	Ohio	266,798	249,054	17,743	726,942	2.4
40	Oklahoma	82,115	97,721	-15,607	378,667	-4.1
41	Oregon	13,346	18,048	-4,701	194,694	-2.4
42	Pennsylvania	209,760	212,124	-2,364	780,671	-0.3
44	Rhode Island	1,440	1,343	97	22,884	0.4
45	South Carolina	64,737	67,477	-2,740	263,602	-1.0
46	South Dakota	11,748	13,846	-2,099	71,054	-3.0
47	Tennessee	102,819	106,702	-3,883	508,836	-0.8
48	Texas	200,909	246,216	-45,308	1,644,845	-2.8
49	Utah	69,368	68,411	957	204,124	0.5
50	Vermont	1	18	-17	32,163	-0.1
51	Virginia	55,530	55,794	-264	391,576	-0.1
53	Washington	28,432	26,567	1,865	289,910	0.6
54	West Virginia	155,157	142,549	12,608	311,427	4.0
55	Wisconsin	111,540	116,180	-4,640	389,753	-1.2
56	Wyoming	90,500	90,261	239	252,948	0.1
	Total	**3,943,438**	**4,079,159**	**-135,721**	**17,870,168**	**-0.8**

Table 29. SO2 Comparison of 2010 Base-1 Versus 2010 Base-2						
FIPS	State	2010 Base-2 EGUs (tpy)	2010 Base-1 EGUs (tpy)	Base-2 Minus Base-1 (tpy)	2010 Base-1 All Sectors (tpy)	Base-2 Minus Base-1 (% of All)
01	Alabama	473,043	494,704	-21,661	670,087	-3.2
04	Arizona	47,779	47,779	0	174,212	0.0
05	Arkansas	122,667	119,310	3,357	158,739	2.1
06	California	17,317	17,317	0	88,393	0.0
08	Colorado	73,089	90,389	-17,300	112,175	-15.4
09	Connecticut	6,284	6,579	-295	15,310	-1.9
10	Delaware	46,355	36,760	9,595	85,766	11.2
11	DC	0	0	0	8,031	0.0
12	Florida	233,241	230,295	2,946	382,317	0.8
13	Georgia	609,154	609,978	-825	713,164	-0.1
16	Idaho	0	0	0	35,953	0.0
17	Illinois	600,836	591,479	9,357	907,935	1.0
18	Indiana	670,365	599,035	71,330	755,333	9.4
19	Iowa	169,861	186,213	-16,351	285,790	-5.7
20	Kansas	63,532	71,466	-7,934	92,045	-8.6
21	Kentucky	363,145	393,296	-30,151	496,556	-6.1
22	Louisiana	112,534	96,341	16,194	405,498	4.0
23	Maine	3,210	4,707	-1,496	38,120	-3.9
24	Maryland	232,229	261,406	-29,177	293,502	-9.9
25	Massachusetts	15,650	17,723	-2,073	96,111	-2.2
26	Michigan	387,627	375,812	11,815	545,803	2.2
27	Minnesota	91,561	94,176	-2,615	142,663	-1.8
28	Mississippi	73,467	84,629	-11,163	247,251	-4.5
29	Missouri	293,093	261,017	32,076	423,106	7.6
30	Montana	17,923	17,718	205	54,229	0.4
31	Nebraska	97,630	97,151	478	115,345	0.4
32	Nevada	16,408	56,670	-40,262	64,602	-62.3
33	New Hampshire	7,289	7,289	-0	106,284	-0.0
34	New Jersey	41,255	85,348	-44,092	252,992	-17.4
35	New Mexico	48,577	48,274	302	173,421	0.2
36	New York	214,077	211,427	2,651	505,572	0.5
37	North Carolina	219,369	221,529	-2,161	353,001	-0.6
38	North Dakota	160,938	172,194	-11,256	292,851	-3.8
39	Ohio	1,258,684	979,332	279,352	1,387,034	20.1
40	Oklahoma	133,009	133,009	-0	180,781	-0.0
41	Oregon	15,187	15,187	0	43,838	0.0
42	Pennsylvania	853,431	670,161	183,270	896,553	20.4
44	Rhode Island	0	0	0	9,495	0.0
45	South Carolina	199,745	191,473	8,273	272,641	3.0
46	South Dakota	36,304	42,118	-5,814	67,647	-8.6
47	Tennessee	306,082	317,250	-11,168	502,859	-2.2
48	Texas	487,740	539,915	-52,175	903,844	-5.8
49	Utah	31,541	31,240	301	75,308	0.4
50	Vermont	0	0	0	15,148	0.0
51	Virginia	187,772	180,633	7,139	308,230	2.3
53	Washington	5,959	5,960	-0	71,365	-0.0
54	West Virginia	550,629	456,778	93,852	564,118	16.6
55	Wisconsin	214,063	217,221	-3,159	353,005	-0.9
56	Wyoming	47,276	47,120	156	124,422	0.1
	Total	**9,856,926**	**9,435,405**	**421,521**	**14,868,447**	**2.8**

Technical Support Document for the Interstate Air Quality Rule Air Quality Modeling Analyses

Appendix B

CAMx Model Performance Evaluation

Introduction

An operational model performance evaluation for surface ozone for the five episodes was performed in order to estimate the ability of the modeling system to replicate base year ozone concentrations. This evaluation is comprised principally of statistical assessments of model versus observed pairs. The robustness of an operational evaluation is directly proportional to the amount and quality of the ambient data available for comparison.

a. Statistical Definitions

Below are the definitions of those statistics used for the evaluation. The format of all the statistics is such that negative values indicate model ozone predictions that were less than their observed counterparts. Positively-valued statistics indicate model overestimation of surface ozone. Statistics were not generated for the first three days of an episode to avoid the initialization period. The statistics were calculated for (a) the entire HDE domain, (b) four quadrants (Midwest, Northeast, Southeast, Southwest), and (c) 51 local areas. The statistics that were calculated for each of these sets of areas are described below.

Domainwide unpaired peak prediction accuracy: This metric simply compares the peak concentration modeled anywhere in the selected area against the peak ambient concentration anywhere in the same area. The difference of the peaks (model - observed) is then normalized by the peak observed concentration.

Peak prediction accuracy: This metric averages the paired peak prediction accuracy calculated for each monitor in the subregion. It characterizes the capacity of the model to replicate peak (afternoon) ozone over a subregion. The daily peak model versus daily peak observed residuals are paired in space but not in time.

Mean normalized bias: This performance statistic averages the normalized (by observation) difference (model - observed) over all pairs in which the observed values were greater than 60 ppb. A value of zero would indicate that the model over predictions and model under predictions exactly cancel each other out.

Mean normalized gross error: The last metric used to assess the performance of the HDE base cases is similar to the above statistic, except in this case it is the absolute value of the residual which is normalized by the observation, and then averaged over all sites. A zero gross error value would indicate that all model concentrations (in which their observed counterpart was greater than 60 ppb) exactly matched the ambient values.

b. Domainwide Model Performance

As with previous regional photochemical modeling studies, the degree that model predictions replicate observed concentrations varies by day and location over the large eastern U.S. modeling domain. From a qualitative standpoint, there appears to be considerable similarity on most days between the observed and simulated ozone patterns. Additionally, where possible to discern, the model appears to follow the day-to-day variations in synoptic-scale ozone fairly closely. More quantitative comparisons of the model predictions and ambient data are provided below.

When all hourly observed ozone values (greater than 60 ppb) are compared to their model counterparts for the 30 episode modeling days in the eastern U.S. simulations, the mean normalized bias is -1.1 percent and the mean normalized gross error is 20.5 percent As shown in Table III-3, the model generally underestimates observed ozone values for the June and July episodes, but predicts higher than observed amounts for the August episode.

Table III-3. Performance statistics for hourly ozone in the Eastern U.S. CAMx simulations.

	Average Accuracy of the Peak	Mean Normalized Bias	Mean Normalized Gross Error
June 1995	-7.3	-8.8	19.6
July 1995	-3.3	-5.0	19.1
August 1995	9.6	8.6	23.3

Depending on the episode and region, the normalized biases can range from an underestimation of 18 percent to an overestimation of 16 percent. Gross errors tend to average between 17 and 25 percent. As shown in Table III-4, when the model domain is subdivided into four quadrants, it is found that most of the underestimations in the June and July episodes are driven by the Northeast and Midwest quadrants (i.e., the two northern ones). Conversely, most of the overestimated ozone in the August episode is due to the Midwest, Southeast and Southwest quadrants. Hourly ozone is consistently underestimated in the Northeast quadrant. The model does slightly better in replicating the peak values for each monitoring site than it does at replicating the mean values, especially in the Northeast where the underpredictions are not as large for the highest ozone observations.

Table III-4. Regional/Episodic performance statistics for IAQR hourly ozone predictions.

	Average Accuracy of the Peak			Mean Normalized Bias			Mean Normalized Gross Error		
	June	*July*	*August*	*June*	*July*	*August*	*June*	*July*	*August*
Whole Grid	-7.3	-3.3	9.6	-8.8	-5.0	8.6	19.6	19.1	23.3
Northeast	-14.7	-5.0	-4.3	-18.4	-7.2	-6.0	24.7	19.1	22.6
Midwest	-7.3	-6.2	15.5	-8.7	-7.2	15.5	18.0	19.4	23.7
Southeast	-2.9	1.9	15.1	-3.0	1.3	14.7	17.4	19.1	24.1
Southwest	-0.9	1.3	7.0	0.7	3.1	10.3	19.0	20.0	22.6

At present, there are no accepted criteria by which one can determine if a regional ozone modeling exercise is exhibiting adequate model performance. As a result, EPA compares the evaluation results of regional models against applicable previous analyses. For instance, the Heavy Duty Engine (HDE) base case simulations were determined to be appropriate for use based on comparisons to previously accepted modeling analyses (e.g., OTAG and Tier-2). Model performance in the base year IAQR simulations is generally similar or better than its predecessor regional ozone modeling efforts. In particular, the gross error metric is almost universally improved in the more recent IAQR modeling. In general, the IAQR CAMx modeling results are approximately 3-6 ppb higher on average than what was generated in the HDE/UAM-V modeling. In some previous regional modeling applications, there had been a tendency for the model to underestimate ozone in the early parts of an episode and then overestimate ozone at the end of an episode. The trend toward positive bias would increase throughout the episode, which may be a sign of an imbalance in the model chemistry which in turn could affect control strategy signal. In general, there does not appear to be an issue with bias creep in the base case IAQR modeling. Finally, as noted above, the IAQR base case CAMx modeling has been used before to support proposed emission control regulations (i.e., Clear Skies and the Non-Road rulemaking).

Table III-5 presents the results from the eight-hourly ozone evaluation. In general, the gross error is noticeably less for the eight-hour ambient versus observed ozone comparisons. However, the eight-hour ozone model predictions are large overestimates of the actual observed values for the August episode, especially outside of the Northeast quadrant.

Table III-5. Regional/Episodic performance statistics for IAQR 8-hourly ozone predictions.

	Average Accuracy of the Peak			**Mean Normalized Bias**			**Mean Normalized Gross Error**		
	June	*July*	*August*	*June*	*July*	*August*	*June*	*July*	*August*
Whole Grid	-3.9	0.9	13.9	-5.7	-2.1	11.0	17.5	16.4	22.6
Northeast	-13.5	-2.4	-1.6	-15.4	-4.9	-3.8	21.3	14.6	20.8
Midwest	-4.0	-0.9	20.6	-5.8	-4.4	17.6	16.0	16.7	23.7
Southeast	1.3	5.3	20.5	0.9	4.0	18.4	16.4	17.5	24.1
Southwest	5.0	8.2	16.2	3.9	3.6	12.4	17.8	18.1	21.1

c. Local-scale Model Performance

The CAMx modeling results were also evaluated at a "local" level. For this analysis, the modeling domain was broken up into 51 local subregions as shown in Figure III-2. The primary statistics for each of the 51 subregions is shown in Table III-6.

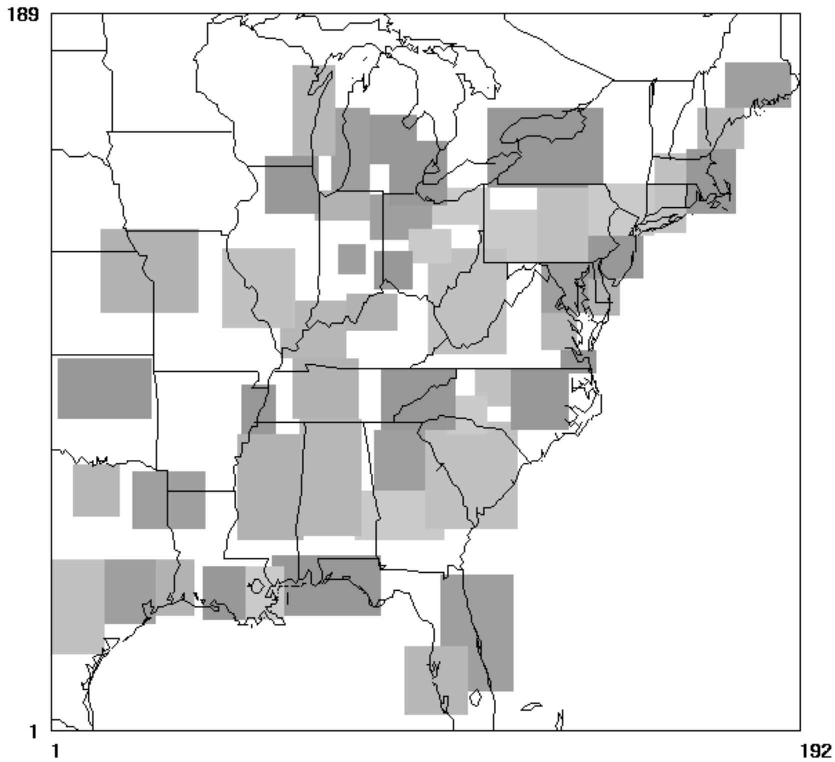
As noted above, there is no set of established statistical benchmarks to determine the adequacy of a regional modeling operation evaluation. If one were to evaluate the performance of the 1995 eastern base cases against existing EPA requirements for acceptable levels of accuracy, bias, and error in local attainment demonstration modeling, 69% of the regions would pass for the June episode, 80% of the regions would pass for the July episodes, and 61% of the regions would pass for the August episode. This is an improvement from the HDE base case analyses where the numbers were: 57%, 45%, and 55%, respectively. The local eight-hour metrics (not shown) generally do not greatly differ from their hourly counterparts. There is a slight tendency toward greater overprediction of the eight-hourly values.

Table III-6. Local performance statistics for IAQR hourly ozone predictions.

	Average Accuracy of the Peak			Mean Normalized Bias			Mean Normalized Gross Error		
	June	*July*	*August*	*June*	*July*	*August*	*June*	*July*	*August*
Dallas	-9.6	-12.3	2.2	-10.6	-11.5	3.2	16.6	18.7	15.7
Houston/Galveston	-3.0	-5.1	0.3	-3.5	-3.9	2.2	20.8	19.0	25.7
Beaumont/Port	14.0	16.7	8.8	16.0	19.3	12.9	20.4	24.5	24.6
Baton Rouge	15.6	24.7	31.4	22.6	26.6	37.4	26.1	31.0	40.5
New Orleans	15.6	29.1	42.1	15.9	28.9	48.9	21.9	32.0	50.2
St. Louis	-0.5	-4.0	8.4	-0.6	0.6	10.5	17.0	18.4	18.2
Memphis	-7.7	-4.9	13.7	-5.9	-0.3	13.6	15.5	19.3	22.0
Alabama	5.2	-1.7	16.0	6.5	6.7	23.1	14.4	16.6	25.2
Atlanta	-3.1	5.4	19.0	-3.4	6.8	26.1	16.7	20.1	31.0
Nashville	-2.9	7.8	31.5	-2.4	9.1	36.1	18.1	24.7	37.4
Eastern TN	-14.2	-16.0	-2.7	-21.0	-17.1	-5.9	22.7	20.7	18.3
Charlotte	8.3	-2.1	6.0	5.8	4.1	14.5	13.0	16.3	18.2
Greensboro	-1.7	-1.1	17.2	-4.2	1.2	18.2	14.1	15.3	21.7
Raleigh-Durham	-11.8	1.3	-2.3	-10.7	4.2	-1.9	14.6	13.9	16.9
Evansville/Owensbor	1.2	-0.9	28.3	4.5	5.4	32.8	15.1	21.2	33.9
Indianapolis	-8.3	-13.5	15.9	-3.6	-14.4	18.0	13.1	19.3	19.7
Louisville	2.8	4.2	36.6	4.8	6.1	42.1	14.7	17.9	42.5
Cincinnati/Dayton	-4.7	-8.5	29.0	0.1	-5.6	32.7	12.8	19.1	33.5
Columbus	-8.5	-14.5	9.2	-6.2	-11.0	14.2	14.6	17.3	18.7
West Virginia	-8.8	-5.7	12.7	-7.5	-3.2	13.7	15.7	16.6	24.5
Chicago	-9.9	-4.3	10.4	-17.1	-11.1	3.5	24.5	23.5	22.3
Milwaukee	-14.8	-12.9	21.5	-16.5	-16.9	12.3	19.1	23.3	18.2
Muskegon/Grand Rapids	-10.8	-12.3	3.1	-11.6	-12.9	1.7	17.7	20.4	16.4

Gary/South Bend	-13.0	-10.0	11.8	-15.0	-14.5	9.3	19.2	24.4	20.7
Detroit	-17.2	-5.8	3.9	-20.1	-13.2	-3.2	25.1	22.5	23.4
Pittsburgh	-10.0	-3.2	9.2	-9.2	-2.1	7.9	23.1	16.1	20.4
Central PA	-6.0	-7.6	1.0	-8.5	-6.0	1.1	21.9	15.5	18.6
Norfolk	-9.0	0.0	8.3	-13.4	-5.6	5.7	19.1	18.6	24.7
Richmond	-1.2	4.8	2.6	-1.3	10.7	4.5	8.4	18.3	20.3
Baltimore/Washingto	-4.7	-3.1	1.7	-6.8	-5.2	0.7	18.6	15.6	23.4
Delaware	-6.1	-5.2	2.3	-6.3	-0.2	7.5	12.9	11.6	16.2
Philadelphia	-14.1	-1.8	-8.7	-22.0	-10.5	-13.9	26.4	19.5	28.9
New York City	-16.2	-3.9	-12.2	-24.6	-14.1	-17.9	31.3	22.5	29.8
Hartford	-16.9	-5.0	-9.9	-18.5	-4.0	-7.7	23.6	18.2	20.1
Boston	-13.7	-4.7	-15.6	-19.6	-9.2	-19.6	25.9	20.9	26.5
Maine	-20.4	-4.7	-6.9	-25.0	-9.4	-6.9	25.3	19.0	15.5
Longview/Shreveport	-2.1	11.3	7.7	0.8	11.1	11.4	16.2	16.5	17.9
Kansas City	-8.5	-7.8	-4.3	-7.9	-1.5	-8.3	15.7	13.0	12.4
Western NY	-23.1	-20.6	-9.0	-25.6	-20.5	-12.1	28.1	23.8	19.0
Northeast OH	-4.0	-6.5	6.9	-6.6	-6.8	7.7	20.4	15.5	16.5
South Carolina	-2.5	1.3	11.4	-3.4	1.5	15.7	12.5	17.7	19.4
Gulf Coast	0.5	23.1	29.3	4.5	30.0	33.7	15.4	31.6	34.9
FL West Coast	-6.4	22.8	41.2	-7.3	11.9	42.8	11.3	22.7	43.7
FL East Coast	-15.9	16.2	23.3	-16.8	16.6	26.3	18.0	18.4	29.4
Jackson	0.6	10.9	21.0	1.8	10.0	24.0	16.0	16.0	24.9
Central MI	-6.9	-10.4	12.0	-9.6	-14.8	6.6	18.1	18.7	17.5
Macon/Columbus	-9.5	-11.1	21.6	-8.8	-5.7	26.4	10.9	13.0	26.9
Austin/San Antonio	-14.1	-19.6	-1.9	-11.0	-15.5	4.1	14.1	17.2	12.4
Oklahoma	-12.3	-5.6	-5.2	-12.9	-3.2	-2.8	17.2	14.6	12.6
Ft. Wayne/Lima	-9.1	-13.1	3.9	-8.3	-14.1	5.1	16.0	18.2	10.6
Bangor/Hancock Co.	-17.8	-6.9	-17.7	-24.4	-8.5	-19.9	25.2	15.3	21.0

Figure III-2. Map of the 51 local-scale evaluation zones.



Technical Support Document for the Interstate Air Quality Rule Air Quality Modeling Analyses

Appendix C

REMSAD Model Performance Evaluation

Introduction

This evaluation of REMSAD is comprised principally of statistical assessments of model versus observed pairs. The robustness of any evaluation is directly proportional to the amount and quality of the ambient data available for comparison. Unfortunately, there are few PM2.5 monitoring networks with available data for this evaluation. Critical limitations of the 1996 databases are a lack of urban monitoring sites with speciated measurements and poor geographic representation of ambient concentration in the East. PM2.5 monitoring networks were expanded in 1999 to include more than 1000 Federal Reference Method (FRM) monitoring sites. The purpose of this network is to monitor PM2.5 mass levels in urban areas. These monitors only measure total PM2.5 mass and do not measure PM species. In 2001 a new network of ~300 urban oriented speciation monitor sites began operation across the country. These monitors collect a full range of PM2.5 species that are necessary to evaluate models and to develop PM2.5 control strategies. Future modeling efforts will be able to take advantage of these newer speciated PM2.5 measurements.

The evaluation used data from the IMPROVE, CASTNet dry deposition, and NADP monitoring networks (IMPROVE, 2000), (EPA, 2002), (NADP, 2003). The IMPROVE and NADP networks were in full operation during 1996. The CASTNet dry deposition network was partially shutdown during the first half of the year. There were 65 CASTNet sites with at least one season of complete data. There were 16 sites which had complete annual data. The CASTNet visibility network was also partially operating in 1996. Data from the 7 visibility sites is only complete from September-December. This only provides a single season (fall) of complete data. Therefore, the limited data from these sites was not used in the evaluation. The mercury deposition network (MDN) was in its first year of operation in 1996. There was not adequate data to fully evaluate the wet deposition of total mercury.

The largest available ambient database for 1996 comes from the **I**nteragency **M**onitoring of **PRO**tected **V**isual **E**nvironments (IMPROVE) network. IMPROVE is a cooperative visibility monitoring effort between EPA, federal land management agencies, and state air agencies. Data is collected at Class I areas across the United States mostly at National Parks, National Wilderness Areas, and other protected pristine areas. There were approximately 60 IMPROVE sites that had complete annual PM2.5 mass and/or PM2.5 species data for 1996. Forty two sites were in the West[1] and 18 sites were in the East. Figure C-1 shows the locations of the IMPROVE monitoring sites used in this evaluation. IMPROVE data is collected twice weekly (Wednesday and Saturday). Thus, there is a total of 104 possible samples per year or 26 samples per season. For this analysis, a 50% completeness criteria was used[2]. That is, in order to be counted in the statistics a site had to have > 50% complete data in all 4 seasons. If any season was missing, an annual average was not calculated for the site. See Appendix D for a list of the

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[1]The dividing line between the West and East was defined as the 100th meridian.

[2]The same completeness criteria was used for all of the monitoring networks.

IMPROVE sites used in the evaluation. The observed IMPROVE data used for the performance evaluation was PM2.5 mass, sulfate ion, nitrate ion, elemental carbon, organic aerosols, and crustal material (soils). The REMSAD model output species were postprocessed in order to achieve compatibility with the observation species. The following is the translation of REMSAD output species into PM2.5 and related species:

Sulfate Ion:	TSO4 = ASO4 + GSO4
Nitrate Ion:	PNO3
Organic aerosols:	TOA = 1.167*POA + SOA1 + SOA2 + SOA3 + SOA4
Elemental Carbon:	PEC
Crustal Material (soils):	PMFINE
PM2.5:	PM2.5= PMFINE + ASO4 + GSO4 + NH4S + PNO3 + NH4N + 1.167*POA + PEC + SOA1 + SOA2 + SOA3 + SOA4

where, TSO4 is total sulfate ion, ASO4 is aqueous path sulfate, GSO4 is gaseous path sulfate, NH4S is ammonium associated with sulfate, PNO3 is nitrate ion, NH4N is ammonium associated with nitrate, TOA is total organic aerosols, POA is primary organic aerosol[3], SOA1 and SOA2 are anthropogenic secondary organic aerosol, SOA3 and SOA4 are biogenic secondary organic aerosol, PEC is primary elemental carbon, and PMFINE is primary fine particles (other unspeciated primary PM2.5). PM2.5 is defined as the sum of the individual species.

[3]For the performance evaluation and the calculation of PM2.5 mass, POA is multiplied by 1.167. The IMPROVE organic carbon mass is multiplied by a 1.4 factor to account for additional mass attached to the carbon (this follows standard IMPROVE procedures). In REMSAD, the "additional" mass is already accounted for in the SOA predictions (by using a molecular weight of 160 g/mole). The POA emissions have been multiplied by1.2 prior to processing by the emissions model (the 1.2 factor is applied to the organic carbon in the PM2.5 speciation profiles). The post-processed POA concentrations are then multiplied by 1.167 to simulate an equivalent 1.4 factor (1.2 * 1.167 = 1.4).

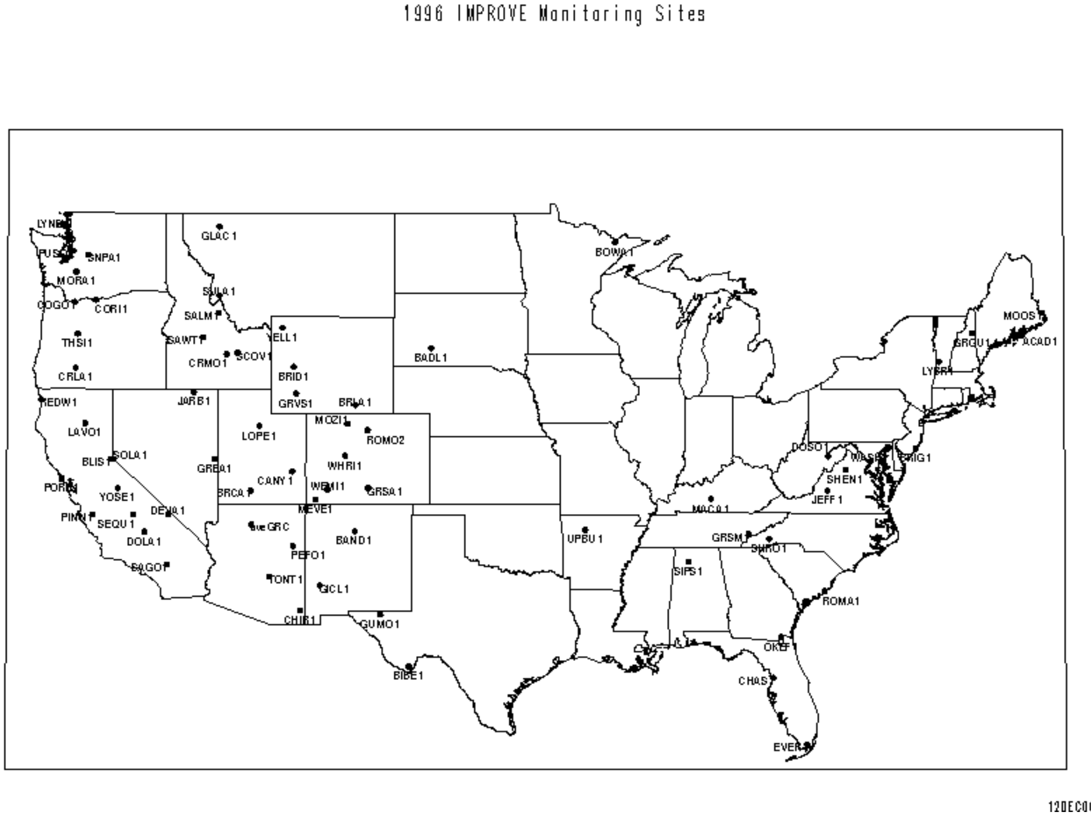

Figure C-1. Map of 1996 IMPROVE monitoring sites used in the REMSAD model performance evaluation.

Model performance was also calculated using data from the CASTNet dry deposition monitoring network. The sulfate and total nitrate data was used in the evaluation. CASTNet data is collected and reported as weekly average data. The data is collected in filter packs that sample the ambient air continuously during the week. The sulfate data is of high quality since sulfate is a very stable compound. But the particulate nitrate concentration data collected by CASTNet is subject to volatility due to the length of the sampling period. Therefore, we chose not to use the CASTNet particulate nitrate data in this evaluation. CASTNet also reports a total nitrate measurement. This is the combined total of particulate nitrate and nitric acid. Since the total nitrate measurement is not affected by the partitioning back and forth between particulate nitrate and nitric acid, it should be a fairly accurate measurement.

Wet deposition data from the National Acid Deposition Program (NADP) was also used in the model evaluation. There were a total of 160 NADP sites with complete annual data in 1996. Model results were compared to observed values of ammonium, sulfate, and nitrate wet deposition.

1. Statistical Definitions

Below are the definitions of statistics used for the evaluation. The format of all the statistics is such that negative values indicate model predictions that were less than their observed counterparts. Positive statistics indicate model overestimation of observed PM.. The statistics were calculated for the entire REMSAD domain and separated for the east and the west. The dividing line between East and West is the 100th meridian.

Mean Observation: The mean observed value (in µg/m^3) averaged over all monitored days in the year and then averaged over all sites in the region.

$$OBS = \frac{1}{N} \sum_{i=1}^{N} Obs_{x,t}^{i}$$

Mean REMSAD Prediction: The mean predicted value (in µg/m^3) paired in time and space with the observations and then averaged over all sites in the region.

$$PRED = \frac{1}{N} \sum_{i=1}^{N} Pred_{x,t}^{i}$$

Ratio of the Means: Ratio of the predicted over the observed values. A ratio of greater than 1 indicates on overprediction and a ratio of less than 1 indicates an underprediction.

$$RATIO = \frac{1}{N} \sum_{i=1}^{N} \frac{Pred_{x,t}^{i}}{Obs_{x,t}^{i}}$$

Mean Bias (µg/m^3): This performance statistic averages the difference (model - observed) over all pairs in which the observed values were greater than zero. A mean bias of zero indicates that the model over predictions and model under predictions exactly cancel each other out. Note that the model bias is defined such that it is a positive quantity when model prediction exceeds the observation, and vice versa. This model performance estimate is used to make statements about the absolute or unnormalized bias in the model simulation

$$BIAS = \frac{1}{N} \sum_{i=1}^{N} (Pred_{x,t}^{i} - Obs_{x,t}^{i})$$

Mean Fractional Bias (percent): Normalized bias can become very large when a minimum threshold is not used. Therefore fractional bias is used as a substitute. The fractional bias for cases with factors of 2 under- and over-prediction are -67 and + 67 percent, respectively (as opposed to -50 and +100 percent, when using normalized bias, which is not presented here). Fractional bias is a useful model performance indicator because it has the advantage of equally weighting positive and negative bias estimates. The single largest disadvantage in this estimate of model performance is that the estimated concentration (i.e., prediction, Pred) is found in both the numerator and denominator.

$$FBIAS = \frac{2}{N}\sum_{i=1}^{N}\frac{(Pred_{x,t}^{i} - Obs_{x,t}^{i})}{(Pred_{x,t}^{i} + Obs_{x,t}^{i})} * 100$$

Mean Error (µg/m³): This performance statistic averages the absolute value of the difference (model - observed) over all pairs in which the observed values were greater than zero. It is similar to mean bias except that the absolute value of the difference is used so that the error is always positive.

$$ERR = \frac{1}{N}\sum_{i=1}^{N}\left|Pred_{x,t}^{i} - Obs_{x,t}^{i}\right|$$

Mean Fractional Error (percent): Normalized error can become very large when a minimum threshold is not used. Therefore fractional error is used as a substitute. It is similar to the fractional bias except the absolute value of the difference is used so that the error is always positive.

$$FERROR = \frac{2}{N}\sum_{i=1}^{N}\frac{\left|Pred_{x,t}^{i} - Obs_{x,t}^{i}\right|}{Pred_{x,t}^{i} + Obs_{x,t}^{i}} * 100$$

Correlation Coefficient: This performance statistic measures the degree to which two variables are linearly related. A correlation coefficient of 1 indicates a perfect linear relationship, whereas a correlation coefficient of 0 means that there is no linear relationship between the variables.

$$CORRCOEFF = \frac{\sum_{i=1}^{N}(Pred_i - \overline{Pred})\,(Obs_i - \overline{Obs})}{\sqrt{\sum_{i=1}^{N}(Pred_i - \overline{Pred})^2 \;\sum_{i=1}^{N}(Obs_i - \overline{Obs})^2}}$$

2. Results of REMSAD Performance Evaluation

The statistics described above are presented for the entire domain, the Eastern sites, and the Western sites. The statistics were calculated in two different ways. The bias, error, and R^2 statistics in the tables below were calculated for all days and all sites. Observations and model predictions were paired in time and space on a daily basis. These statistics represent the ability of the model to replicate each day of year with measurements.

Following the statistical tables are scatterplots of seasonal and annual average predictions at each ambient data site. These scatterplots represent the ability of the model to represent a seasonal average or annual average measurement. The correlation coefficients for the scatterplots represent the correlation of the site average (seasonal and/or annual) predictions to the site average measurements.

a. IMPROVE Performance

a.1. PM2.5 Performance

Table C-1 lists the performance statistics for PM2.5 at the IMPROVE sites. For the full domain, PM2.5 is underpredicted by 18%. Overall, the performance of REMSAD (v7.06) has improved from underpredicting PM2.5 by 34% in version 7.01. The ratio of the means is 0.82 with a bias of -1.10 μg/m^3. It can be seen that most of this underprediction is due to the Western sites. The West is underpredicted by 33% while the East is underpredicted by 2%. The fractional bias is ~9% in the East, while the fractional error is 46%. The fractional bias and error in the West is ~30% and 63% respectively. The observed PM2.5 concentrations in the East are relatively high compared to the West. REMSAD displays an ability to differentiate between generally high and low PM2.5 areas.

Table C-1. Annual mean PM2.5 performance at IMPROVE sites.

	No. of Sites	Mean REMSAD Predictions (μg/m^3)	Mean Observations (μg/m^3)	Ratio of Means (pred/obs)	Bias (μg/m^3)	Fractional Bias (%)	Error (μg/m^3)	Fractional Error (%)	Correlation Coefficient
National	54	5.11	6.21	0.82	-1.10	-24.1	3.01	58.2	0.46
East	15	10.93	11.15	0.98	-0.22	-8.9	4.99	46.1	0.39
West	39	2.87	4.31	0.67	-1.44	-29.9	2.44	62.8	0.09

Figures C-2 and C-3 show the annual and seasonal average PM2.5 1996 IMPROVE observations versus REMSAD predictions respectively. The annual and seasonal scatterplots showed some scatter, but good agreement, with strong correlations (annual: $R^2 = 0.79$; summer: $R^2 = 0.69$; fall: $R^2 = 0.62$; spring: $R^2 = 0.60$; and winter: $R^2 = 0.78$).

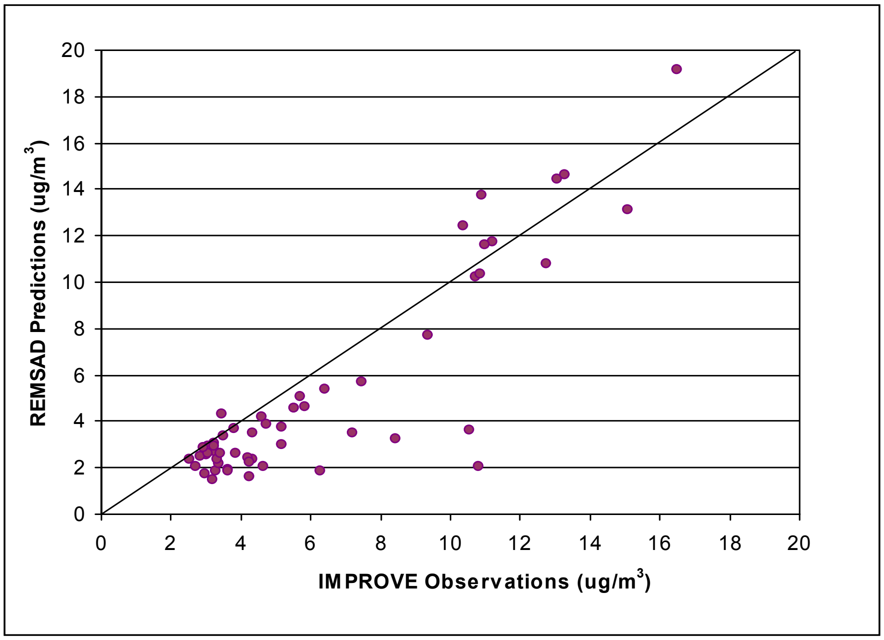

Figure C-2. Annual average PM2.5 1996 IMPROVE observations versus REMSAD predictions.

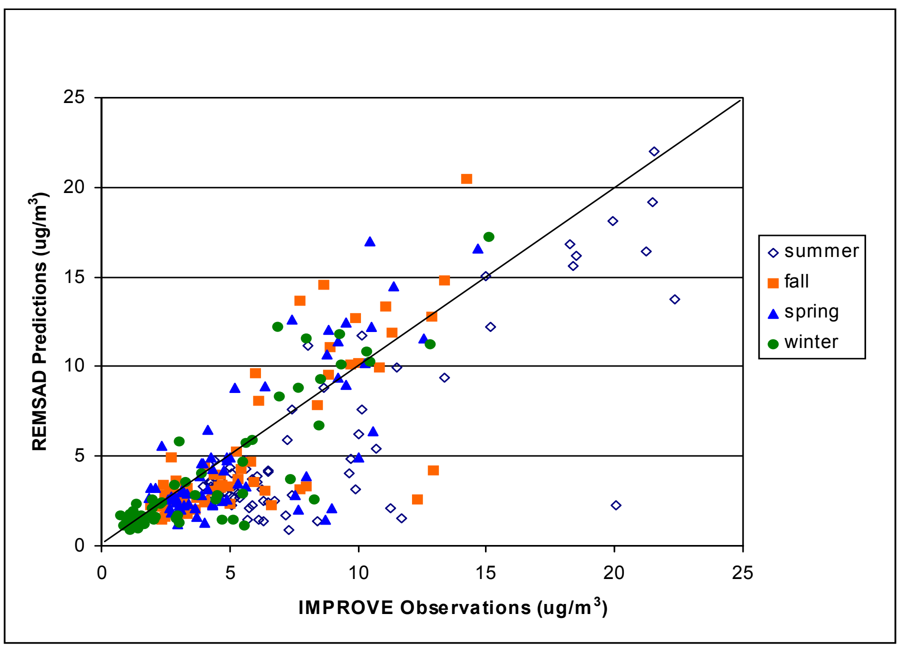

Figure C-3. Seasonal average PM2.5 1996 IMPROVE observations versus REMSAD predictions.

a.2. Sulfate Performance

Table C-2 lists the performance statistics for particulate sulfate at the IMPROVE sites. Domainwide, sulfate is underpredicted by 21%. The annual average sulfate underprediction in the east is 12% and 41% in the West. The sulfate performance (especially in the East) is better than most of the other PM2.5 species. The fractional error in the East is ~60% and the R^2 is 0.51.

Table C-2. Annual mean sulfate ion performance at IMPROVE sites.

	No. of Sites	Mean REMSAD Predictions (μg/m^3)	Mean Observations (μg/m^3)	Ratio of Means (pred/obs)	Bias (μg/m^3)	Fractional Bias (%)	Error (μg/m^3)	Fractional Error (%)	Correlation Coefficient
National	58	1.25	1.59	0.79	-0.34	-40.7	0.80	69.3	0.66
East	16	3.47	3.93	0.88	-0.46	-29.8	1.80	60.2	0.51
West	42	0.41	0.69	0.59	-0.29	-44.8	0.41	72.8	0.13

Figures C-4 and C-5 show the annual and seasonal average sulfate 1996 IMPROVE observations versus REMSAD predictions respectively. The scatterplots and linear regressions displayed strong correlations (annual: $R^2 = 0.96$; summer: $R^2 = 0.92$; fall: $R^2 = 0.91$; spring: $R^2 = 0.90$; and winter: $R^2 = 0.86$).

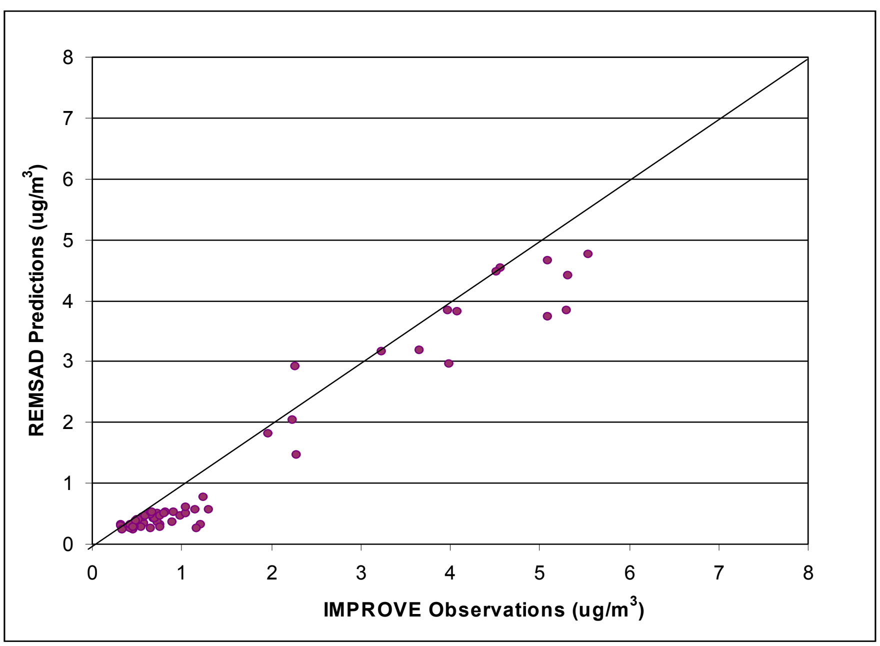

Figure C-4. Annual average sulfate 1996 IMPROVE observations versus REMSAD predictions.

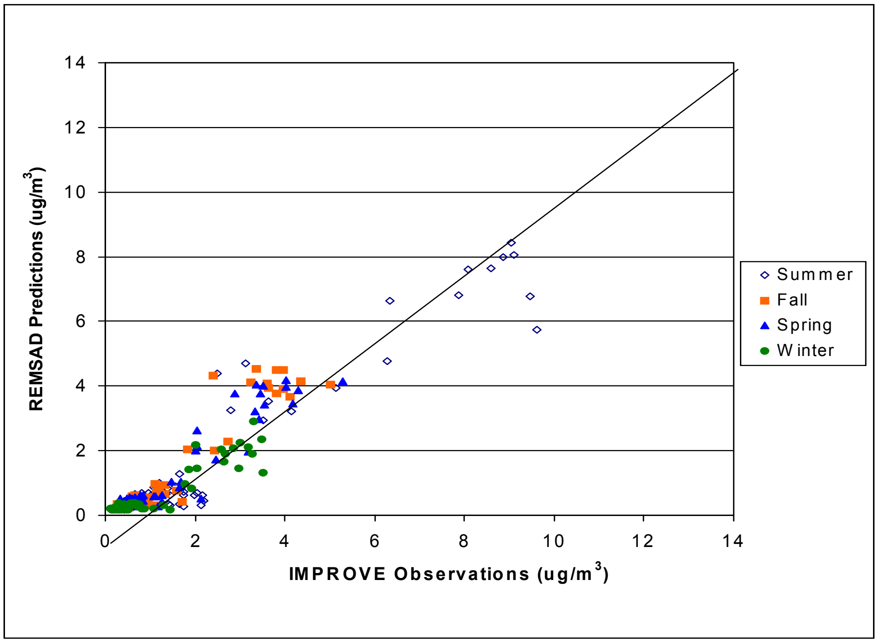

Figure C-5. Seasonal average sulfate 1996 IMPROVE observations versus REMSAD predictions.

Overall, the model shows an ability to replicate the annual and seasonal sulfate concentrations. This is particularly important for this application of REMSAD. The IAQR emissions controls mainly reduce SO_2 and lead to large predicted sulfate reductions. It is important to have good model performance for the species that is being reduced the most.

a.3. Elemental Carbon Performance

Table C-3 lists the performance statistics for primary elemental carbon at the IMPROVE sites. Elemental carbon concentrations at IMPROVE sites are relatively low, but performance is generally good. There is a domainwide underprediction of 14% and a western underprediction of 29%.

Table C-3. Annual mean elemental carbon performance at IMPROVE sites.

	No. of Sites	Mean REMSAD Predictions ($\mu g/m^3$)	Mean Observations ($\mu g/m^3$)	Ratio of Means (pred/obs)	Bias ($\mu g/m^3$)	Fractional Bias (%)	Error ($\mu g/m^3$)	Fractional Error (%)	Correlation Coefficient
National	47	0.27	0.32	0.86	-0.05	-13.6	0.17	58.7	0.33
East	15	0.49	0.48	1.01	0.01	1.78	0.20	41.7	0.47
West	32	0.17	0.24	0.71	-0.07	-20.9	0.16	66.7	0.07

Figures C-6 and C-7 show scatterplots of annual and seasonal average elemental carbon 1996 IMPROVE observations versus REMSAD predictions respectively. The annual scatterplot and linear regression displayed some scatter, however good agreement with a R^2 of 0.53. Overall, summer and fall linear regressions had relatively good agreement (summer: $R^2 = 0.63$; fall: $R^2 = 0.62$), whereas spring and winter had the weakest correlations (spring: $R^2 = 0.49$; and winter: $R^2 = 0.39$).

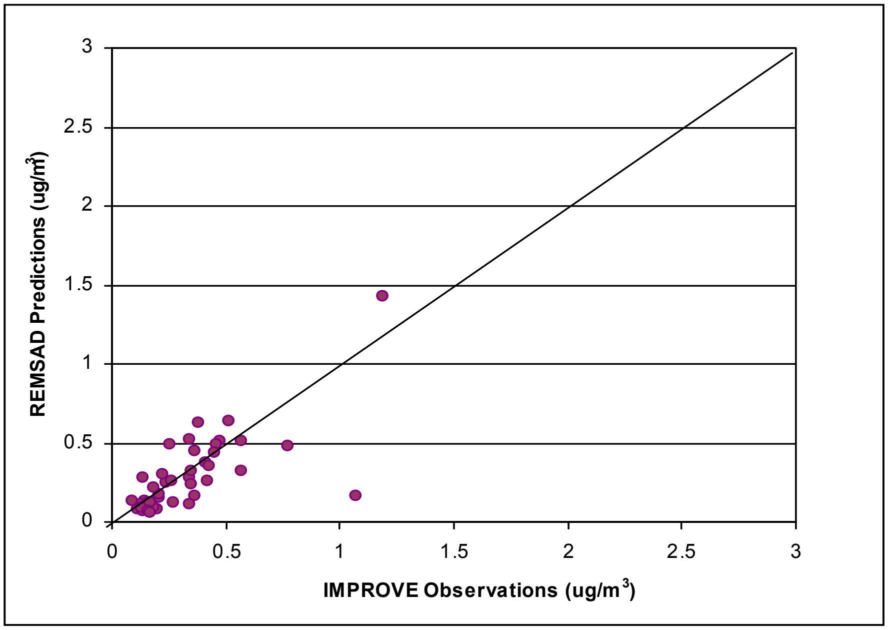

Figure C-6. Annual average elemental carbon 1996 IMPROVE observations versus REMSAD predictions.

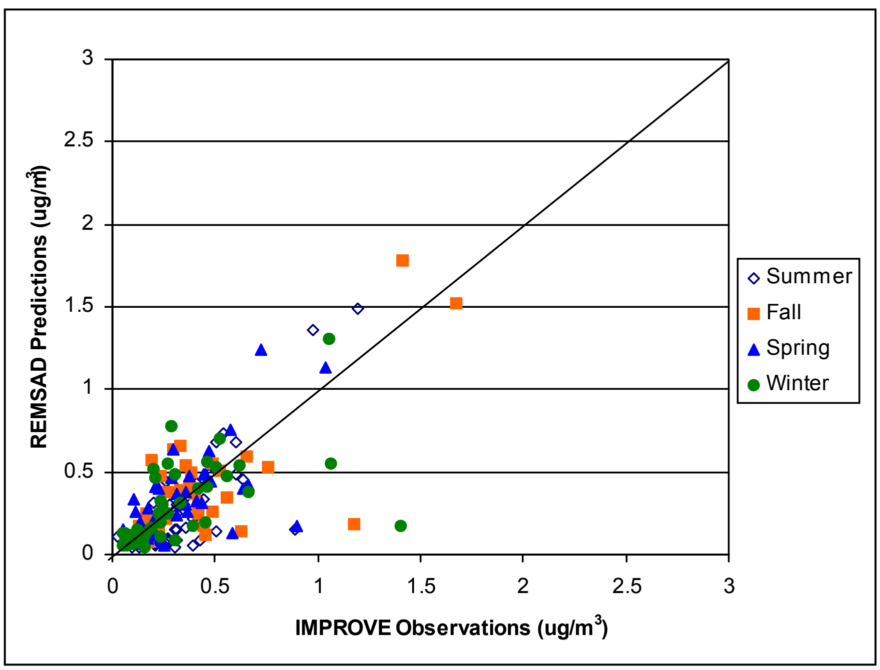

Figure C-7. Seasonal average elemental carbon 1996 IMPROVE observations versus REMSAD predictions.

a.4. Organic Aerosol Performance

Table C-4 lists the performance statistics for organic aerosols at the IMPROVE sites. Organic aerosols performance is generally good. The nationwide bias and errors are low. But the correlation coefficient is also low. There is much uncertainty in the predictions of organic carbon. There are several different forms of organic carbon predicted in the model. There is primary organic carbon, secondary biogenic organic carbon, and secondary anthropogenic organic carbon. Both the model and the ambient data contains a mix of these different types of organics which all originate from different sources. Unfortunately, given limitations in measurement techniques, it is currently not possible to quantify the different types of organic carbon in the ambient air.

This latest version of REMSAD (7.06) contains science updates and code fixes that result in predicted concentrations of secondary organic carbon that are much higher than in previous versions of REMSAD. The model predictions for organics are tempered by the fact that wildfires (a significant source of organic carbon) are not included in the current modeling inventory. The performance for organics should be viewed relative to the uncertainties in the measurements and the emissions inventories.

Table C-4. Annual mean organic aerosol performance at IMPROVE sites.

	No. of Sites	Mean REMSAD Predictions ($\mu g/m^3$)	Mean Observations ($\mu g/m^3$)	Ratio of Means (pred/obs)	Bias ($\mu g/m^3$)	Fractional Bias (%)	Error ($\mu g/m^3$)	Fractional Error (%)	Correlation Coefficient
National	47	1.76	1.76	1.00	0.004	-5.58	1.13	62.0	0.18
East	15	2.58	2.49	1.04	0.09	-11.83	1.42	54.7	0.21
West	32	1.38	1.42	0.97	-0.04	-2.64	1.00	65.4	0.10

Annual and seasonal scatterplots (Figures C-8 and C-9) of average organic aerosol for 1996 IMPROVE observations versus REMSAD predictions displayed some scatter, with an annual R^2 = 0.40 and seasonal correlations of: summer: R^2 = 0.43; fall: R^2 = 0.23; spring: R^2 = 0.45; and winter: R^2 = 0.45.

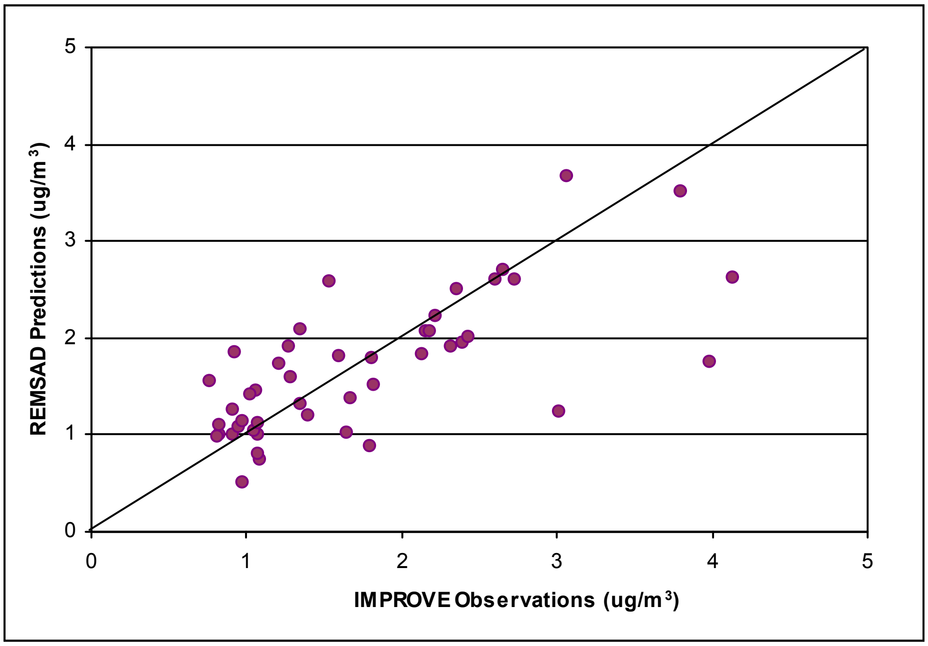

Figure C-8. Annual average organic aerosol 1996 IMPROVE observations versus REMSAD predictions.

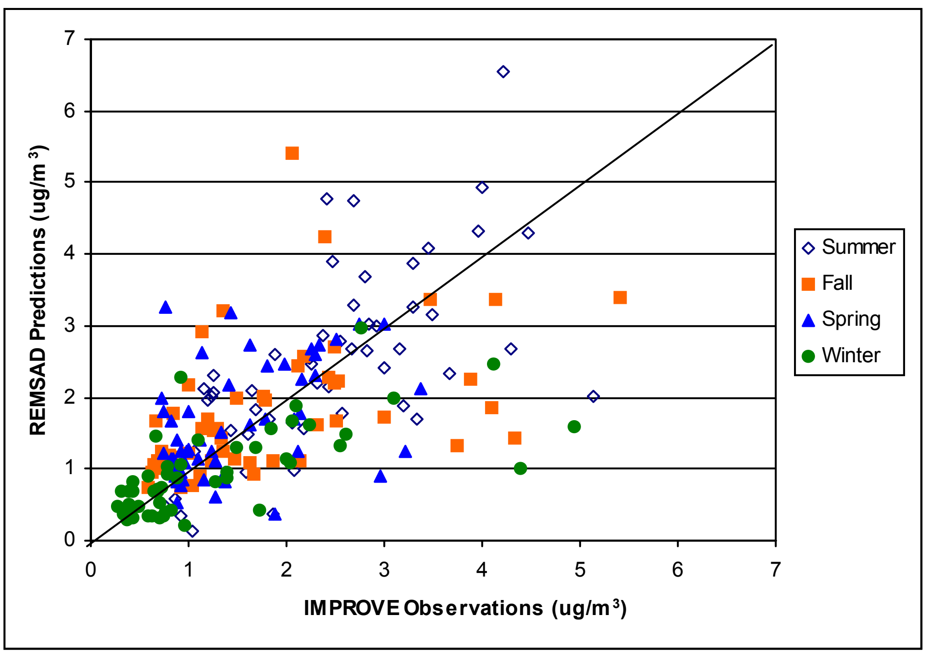

Figure C-9. Seasonal average organic aerosol 1996 IMPROVE observations versus REMSAD predictions.

a.5. Nitrate Performance

Table C-5 lists the performance statistics for nitrate ion at the IMPROVE sites. Nitrate is generally overpredicted in the East and underpredicted in the West. Nitrate is overpredicted by 166% in the east and underpredicted by 31% in the west. Domainwide there is an overprediction of 55%.

Table C-5. Annual mean nitrate ion performance at IMPROVE sites.

	No. of Sites	Mean REMSAD Predictions (μg/m^3)	Mean Observations (μg/m^3)	Ratio of Means (pred/obs)	Bias (μg/m^3)	Fractional Bias (%)	Error (μg/m^3)	Fractional Error (%)	Correlation Coefficient
National	48	0.61	0.39	1.55	0.21	-59.4	0.57	129.8	0.19
East	15	1.47	0.55	2.66	0.91	13.0	1.11	109.3	0.29
West	33	0.22	0.32	0.69	-0.10	-91.9	0.32	139.0	0.15

Likewise, this overprediction is depicted in Figures C-10 and C-11, which show the scatterplots of the annual (R^2= 0.37) and seasonal (summer: R^2= 0.24; fall: R^2= 0.17; spring: R^2= 0.36; winter: R^2= 0.52) average nitrate ion for 1996 IMPROVE observations verus REMSAD predictions.

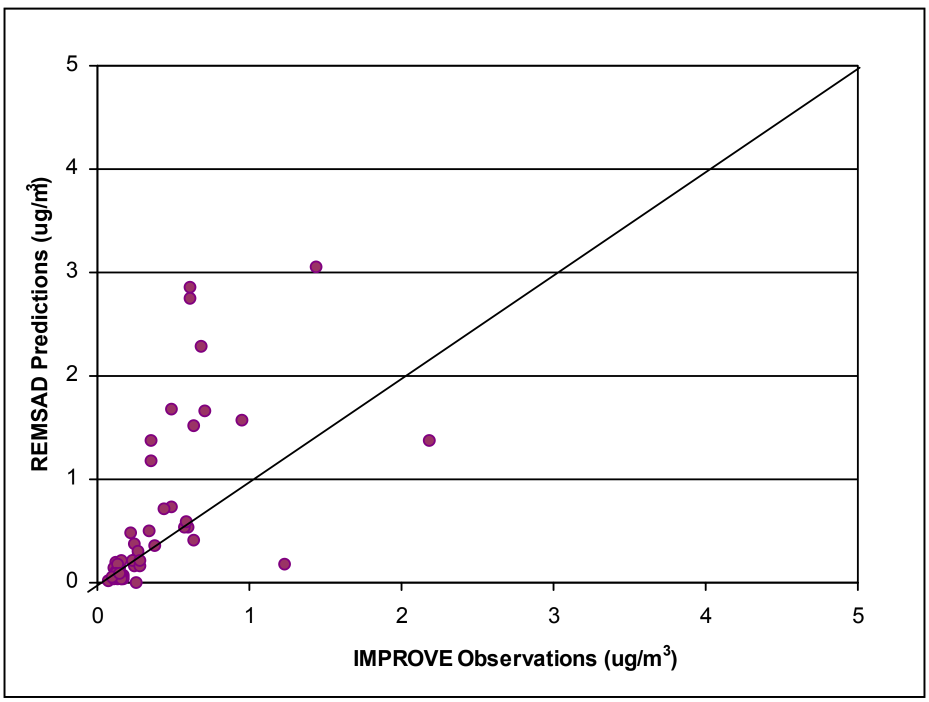

Figure C-10. Annual average nitrate ion 1996 IMPROVE observations versus REMSAD predictions.

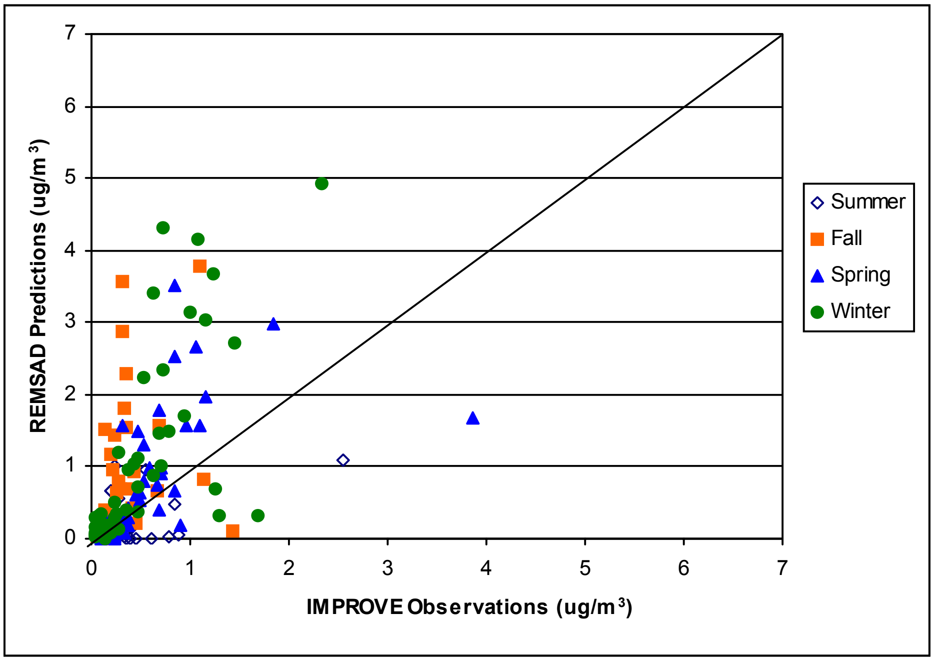

Figure C-11. Seasonal average nitrate ion 1996 IMPROVE observations versus REMSAD predictions.

It is important to consider these results in the context that the observed nitrate concentrations at the IMPROVE sites are very low. The mean nationwide observations are only 0.40 $\mu g/m^3$. It is often difficult for models to replicate very low concentrations of secondarily formed pollutants. Nitrate is generally a small percentage of the measured PM2.5 at almost all of the IMPROVE sites. Nonetheless, it has been recognized that the current generation of PM air quality models generally overpredict particulate nitrate. There are numerous ongoing efforts to improve particulate nitrate model performance through emissions inventory improvements (ammonia emissions and dry deposition of gaseous precursors) and improvements in the scientific formulations of the models.

More recent ambient data has shown that nitrate can be an important contributor to PM2.5 in some urban areas (particularly in California and the upper Midwest) but performance for those areas could not be assessed due to the lack of urban area speciated nitrate data for 1996.

a.6. PMFINE-Other (crustal) Performance

Table C-6 lists the performance statistics for PMFINE-other or primary crustal emissions. The observations show crustal PM2.5 to be generally higher in the West than in the East. However, REMSAD is predicting higher crustal concentrations in the East. Performance statistics show an underprediction of 19% in the west, with an overprediction nationally of ~33%. The largest categories of PMFINE-other are fugitive dust sources such as paved roads, unpaved roads, construction, and animal feed lots.

There is a large uncertainty as to how emissions for such sources should be treated in grid-based air quality models since a large fraction of the emissions either deposit or are removed by vegetation within a few meters of the source. Work is underway to develop improved methods for estimating emissions from these sources for the purpose of air quality modeling.

Table C-6. Annual mean PMFINE (crustal) performance at IMPROVE sites.

	No. of Sites	Mean REMSAD Predictions (µg/m^3)	Mean Observations (µg/m^3)	Ratio of Means (pred/obs)	Bias (µg/m^3)	Fractional Bias (%)	Error (µg/m^3)	Fractional Error (%)	Correlation Coefficient
National	57	0.86	0.64	1.33	0.22	38.8	0.80	93.9	0.003
East	16	1.64	0.53	3.08	1.10	103.8	1.36	116.1	0.002
West	41	0.56	0.69	0.81	-0.13	13.5	0.58	85.3	0.00

Figures C-12 and C-13 show the annual and seasonal average concentration scatterplots for PMFINE-other.

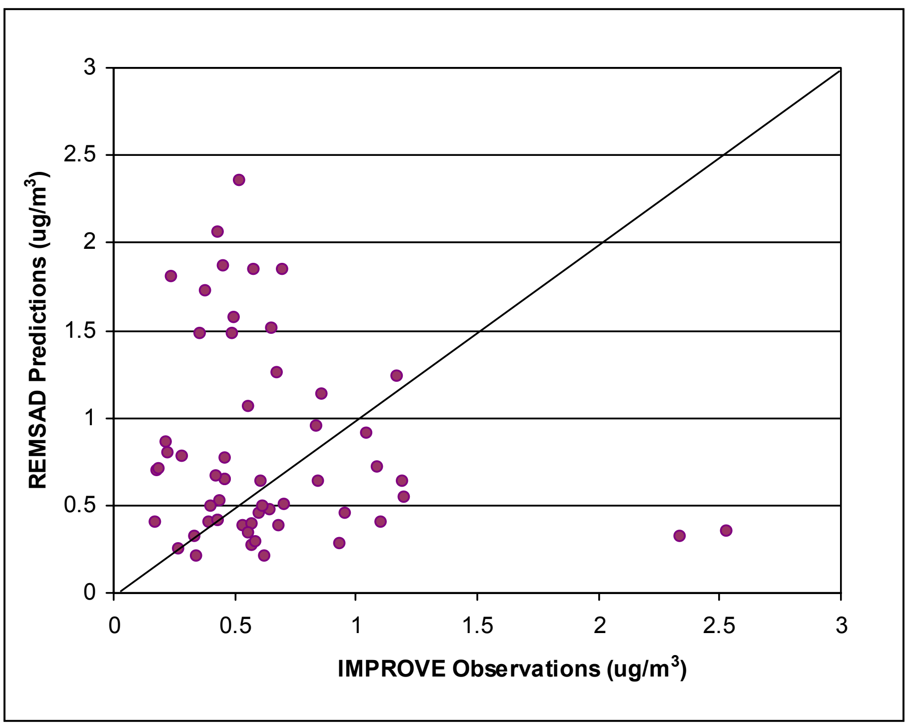

Figure C-12. Annual average PMFINE (crustal) 1996 IMPROVE observations versus REMSAD predictions

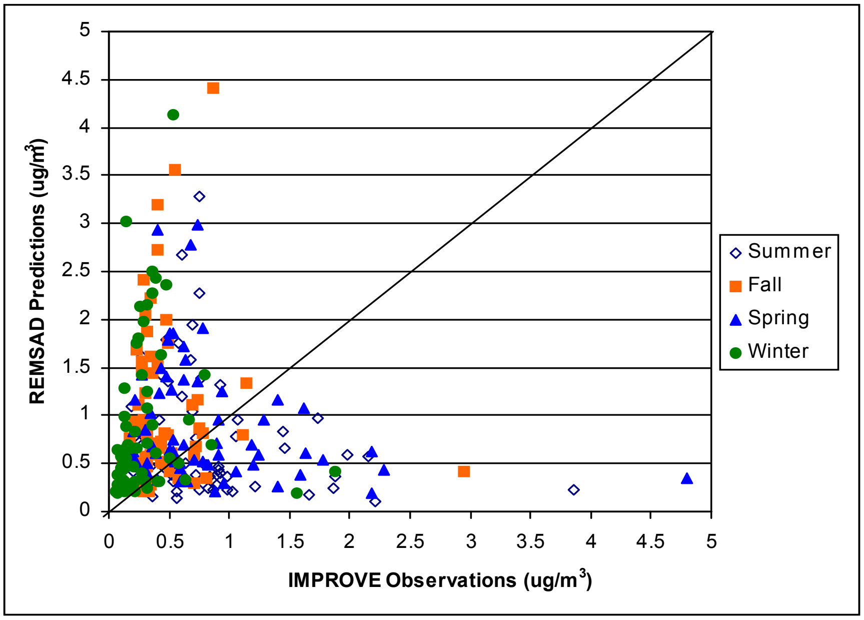

Figure C-13. Seasonal average PMFINE (crustal) 1996 IMPROVE observations versus REMSAD predictions

b. NADP Wet Deposition Performance

Figures C-14, C-15, and C-16 show the annual 1996 NADP observations versus REMSAD predictions for ammonium, nitrate, and sulfate wet deposition respectively. The scatterplots and linear regressions show some scatter (e.g. underprediction bias for nitrate and especially sulfate wet deposition), but good agreement, with strong correlations (NH_4: $R^2 = 0.65$; NO_3: $R^2 = 0.78$; SO_4: $R^2 = 0.78$).

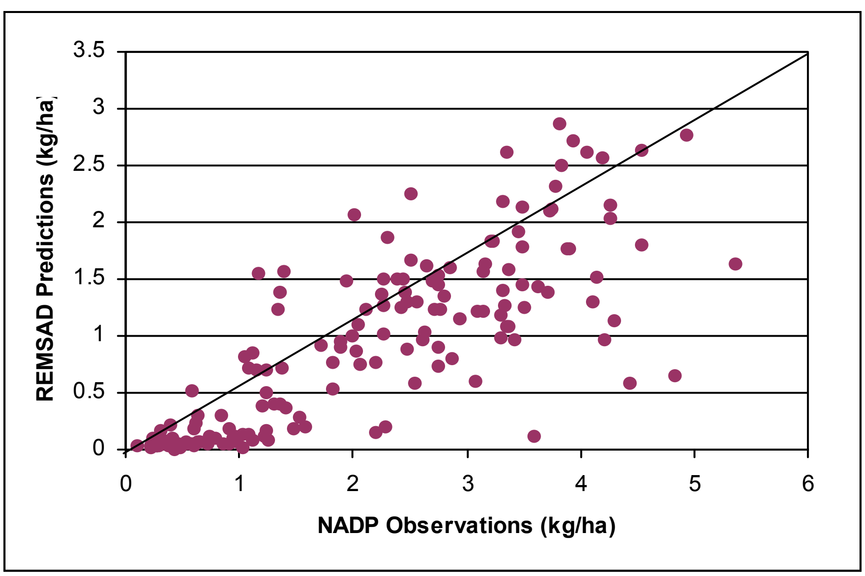

Figure C-14. Annual total ammonium (NH_4) wet deposition 1996 NADP observations versus REMSAD predictions.

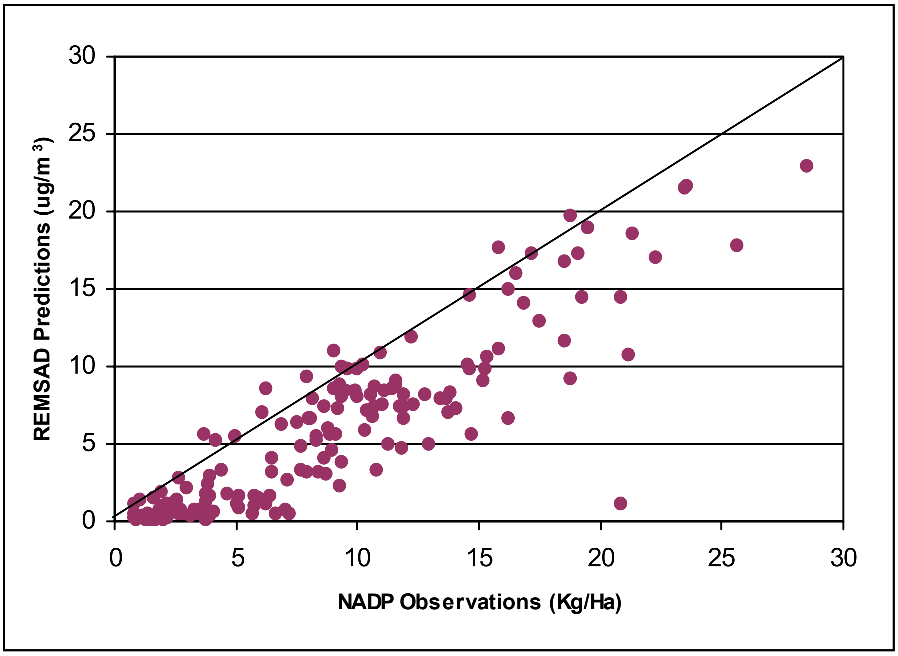

Figure C-15. Annual total nitrate (NO_3) wet deposition 1996 NADP observations versus REMSAD predictions

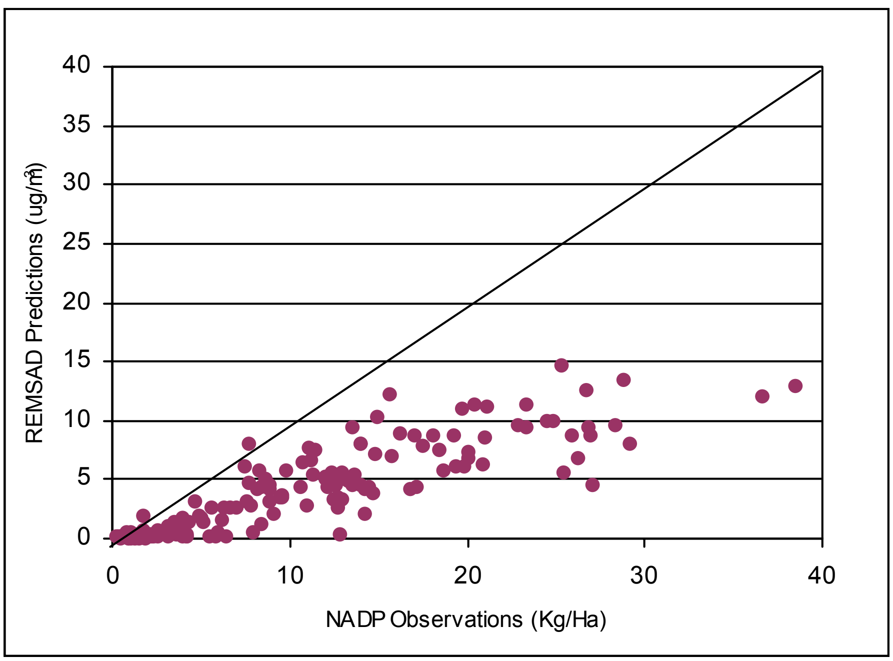

Figure C-16. Annual total sulfate (SO_4) wet deposition 1996 NADP observations versus REMSAD predictions.

c. CASTNet Performance

Figures C-17 and C-18 show the seasonal 1996 CASTNet observations versus REMSAD predictions for total sulfate and total nitrate, respectively. The scatterplot and linear regression of sulfate showed good agreement, with strong correlations among all seasons (summer: R^2 = 0.80; fall: R^2 = 0.92; spring: R^2 = 0.81; winter: R^2 = 0.78). The performance of sulfate at the CASTNet sites looks better than at the IMPROVE sites. The CASTNet sites measure data on a weekly average basis as opposed to the IMPROVE twice weekly sampling schedule. There are also more CASTNet sites in the high sulfate region of the East (e.g. the Ohio Valley). The CASTNet long term averaging of data seems particularly well suited for comparisons to seasonal average modeled concentrations.

The scatterplot and linear regression of total nitrate showed modest agreement, with weaker correlations within each season (summer: R^2 = 0.48; fall: R^2 = 0.67; spring: R^2 = 0.74; winter: R^2 = 0.51). There is an indication of an overprediction bias. This is not surprising given the overprediction bias of modeled particulate nitrate. The overprediction of total nitrate indicates that nitric acid concentrations may be overpredicted. This may be one of the reasons for the general overprediction of particulate nitrate. Model developers are continuing to examine the nitric acid production and destruction pathways. There are continuing improvements being made to the daytime and nighttime nitric acid formation reactions. Dry deposition of nitric acid is also being studied as a possible cause of overprediction.

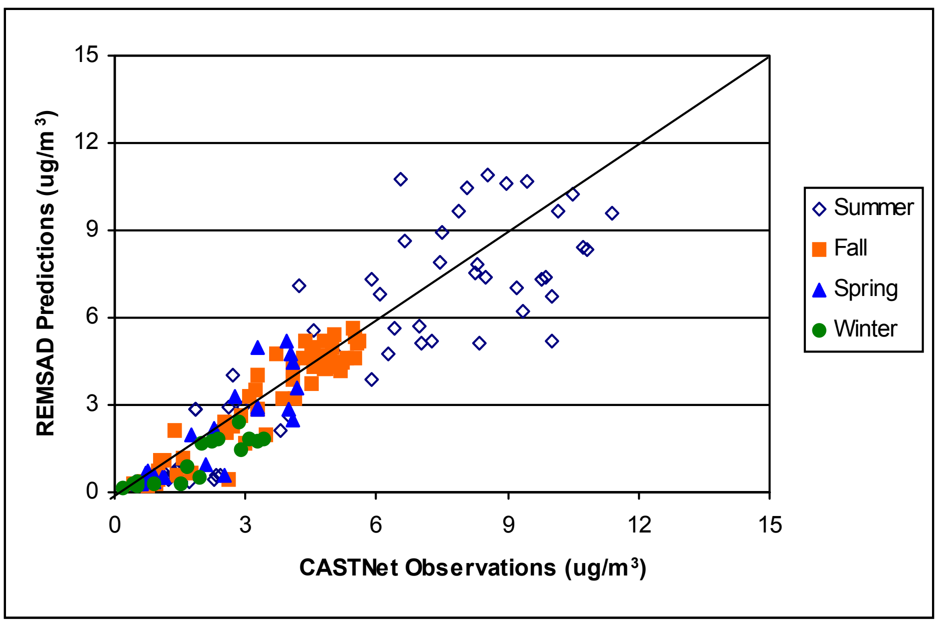

Figure C-17. Seasonal average sulfate (SO_4) 1996 CASTNet observations versus REMSAD predictions.

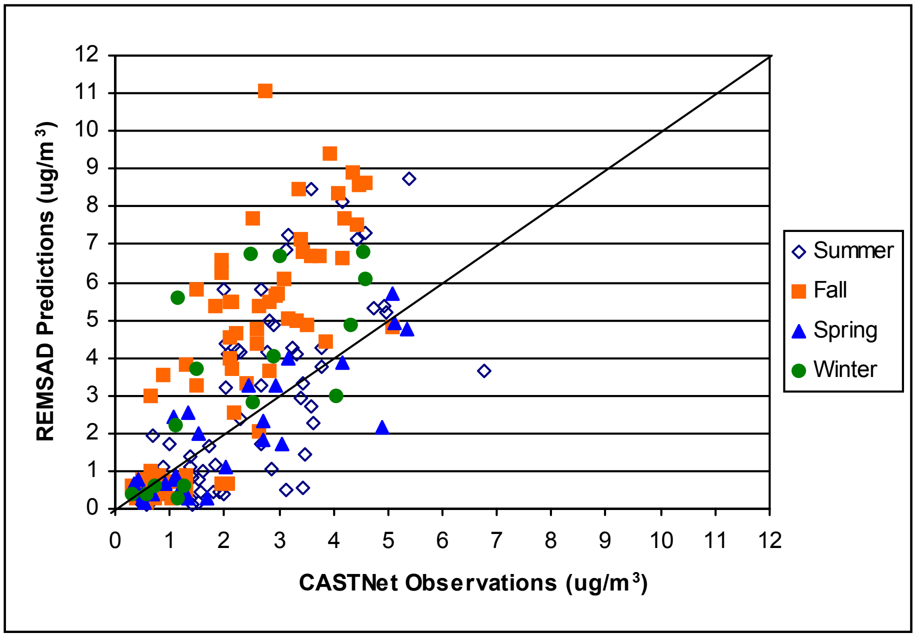

Figure C-18. Seasonal average total nitrate ($NO_3 + HNO_3$) 1996 CASTNet observations versus REMSAD predictions.

e. Visibility performance

For the purpose of model performance evaluation, visibility was calculated in a manner similar to recommendations for the Regional Haze rule. For the Regional Haze rule, states must look at the change in visibility on the 20% best days and the 20% worst days (in units of deciviews) at each Class I area. A certain improvement in visibility on the 20% worst days is needed in the future at each Class I area. Visibility on the 20% best days cannot degrade in the future.

EPA has released a draft version of guidance that details the calculation of base period visibility (EPA, 2001a). The 20% best and worst days for the "base period" are to be calculated from the 2000-2004 IMPROVE data at each Class I area. The daily average extinction coefficient (b_{ext}) values are calculated using the following formula:

$$b_{ext} = 10.0 + [3.0 * f(RH) * (1.375 * sulfate) + 3.0 * f(RH) * (1.29 * nitrate) + 4.0 * (organic\ aerosols) + 10.0 * (elemental\ carbon) + 1.0 * (crustal) + 0.6 * (coarse\ PM)]$$

B_{ext} is in units of inverse megameters (Mm^{-1}). The 10.0 initial value accounts for atmospheric background (i.e., Rayleigh) scattering. F(RH) refers to the relative humidity correction function as defined by IMPROVE (2000). The relative humidity correction factor was derived from historical climatological meteorological data. There is a published f(rh) value for each month of the year for each Class I area (SAIC, 2001). The climatological f(rh) values will be used to calculate bext for the Regional Haze rule.

The formula to calculate b_{ext} from REMSAD output species is as follows:

b_{ext} = 10.0 + [3.0 * f(RH) * (1.375 * (GSO4 + ASO4)) + 3.0 * f(RH) * (1.29 * PNO3)+ 4.0 * (TOA) + 10.0 * PEC + 1.0 * (PMFINE) + 0.6 * (PMCOARS)]

The daily average bext values are converted to deciview values using the following formula:

$$dv = 10.0 * \ln\left[\frac{(b_{ext})}{10.0\ Mm^{-1}}\right]$$

The 20% best and worst days are identified based on the daily average **observed** deciview values at each Class I areas. For the purpose of this model performance evaluation, we have calculated the 20% best and worst days from 1996 (the meteorological year we are using) at each IMPROVE site with complete data. The following scatter plots show the observed vs. predicted b_{ext} values at the IMPROVE sites on the 20% best and worst days.

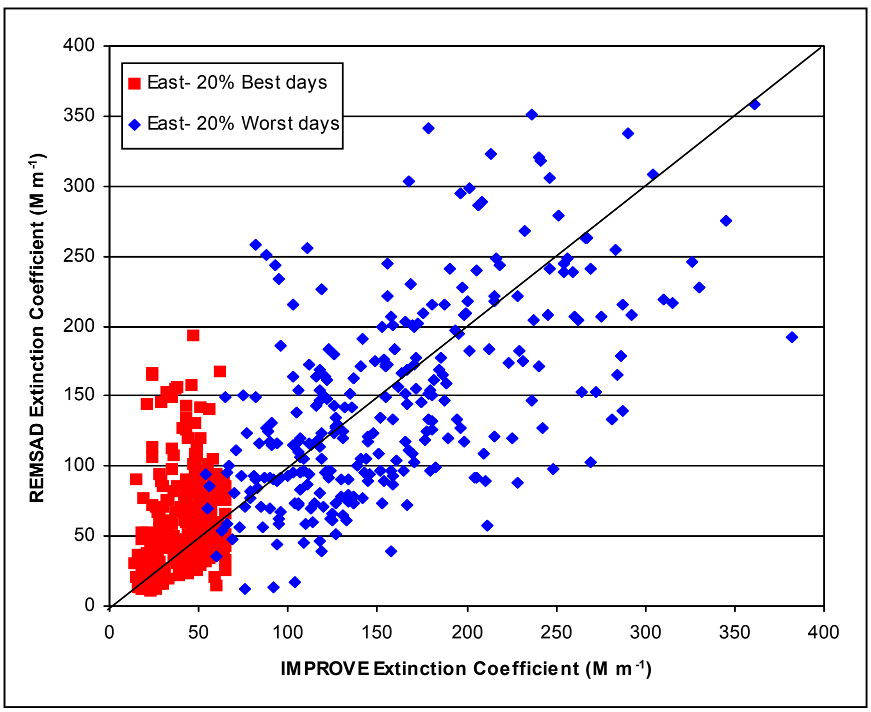

Figure C-19. IMPROVE observed versus REMSAD predicted light extinction coefficient values on the 20% best and worst days in the East.

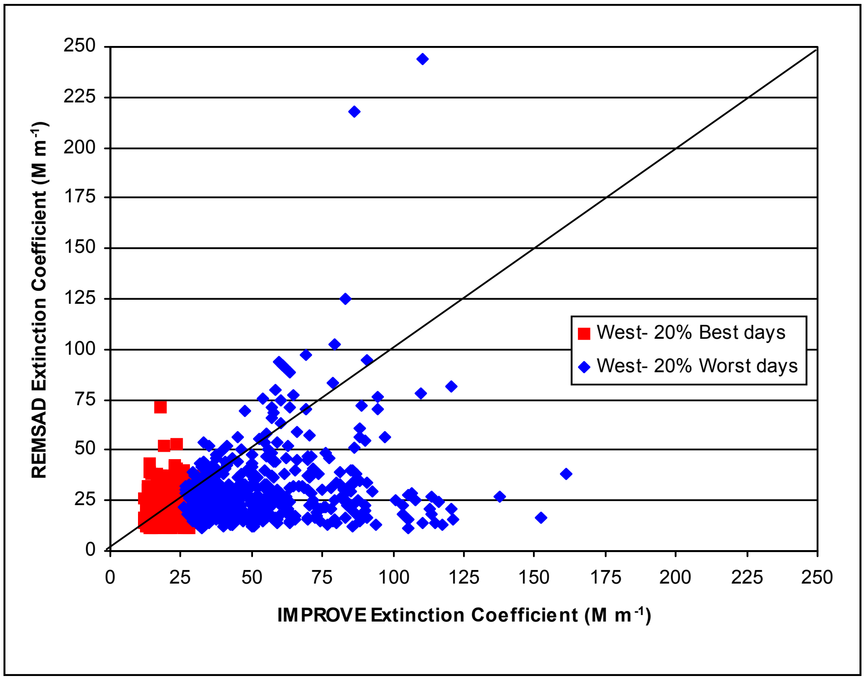

Figure C-20. IMPROVE observed versus REMSAD predicted light extinction coefficient values on the 20% best and worst days in the West.

REMSAD was generally able to predict the highest b_{ext} values on the observed worst days in the East. The 20% worst days in the East show little bias, but a large amount of scatter. The 20% best days in the East are generally overpredicted. The 20% worst days in the West are underpredicted. REMSAD rarely predicted high b_{ext} values in the West. The model predictions on the 20% best and worst days are similar.

3. Summary of Model Performance

The purpose of this model performance evaluation was to evaluate the capabilities of the REMSAD modeling system in reproducing annual average concentrations and deposition at all IMPROVE, CASTNet, and NADP sites in the contiguous U.S. for fine particulate mass, its associated speciated components, visibility, and wet deposition. When considering annual average statistics (e.g., predicted versus observed), which are computed and aggregated over all sites and all days, REMSAD underpredicted fine particulate mass (PM2.5), by 18%. PM2.5 in the Eastern U.S. was underpredicted by 2%, while PM2.5 in the West was underpredicted by 33%. All PM2.5 component species were underpredicted in the west. In the East, nitrate and crustal material are overestimated. Elemental carbon shows neither over or underprediction in the east with a bias near 0%. Eastern sulfate is slightly underpredicted with a bias of 12%. Organic aerosols show little or no bias in the East and West.

The comparisons to the CASTNet data show generally good model performance for particulate sulfate. Comparison of total nitrate indicate an overestimate, possible due to overpredictions of nitric acid in the model.

Performance at the NADP sites for wet deposition of ammonium, sulfate, and nitrate were reasonably good. There is a an underprediction bias of nitrate, and especially sulfate wet deposition. The model predictions of total mercury wet deposition at the MDN sites were also underpredicted.

Given the state of the science relative to PM modeling, it is inappropriate to judge PM model performance using criteria derived for other pollutants, like ozone. The overall model performance results may be limited by our current knowledge of PM science and chemistry, by the emissions inventories for direct PM and secondary PM precursor pollutants, by the relatively sparse ambient data available for comparisons to model output, and by uncertainties in monitoring techniques. The model performance for sulfate in the East is quite reasonable, which is key since sulfate compounds comprise a large portion of PM2.5 in the East.

Negative effects of relatively poor model performance for some of the smaller (i.e., lower concentration) components of PM2.5, such as crustal mass, are mitigated to some extent by the way we use the modeling results in projecting future year nonattainment and downwind contributions. As described in more detail below, each measured component of PM2.5 is adjusted upward or downward based on the percent change in that component, as determined by the ratio of future year to base year model predictions. Thus, we are using the model predictions in a relative way, rather than relying on the absolute model predictions for the future year scenarios. By using the modeling in this way, we are reducing the risk that large overprediction or underprediction will unduly affect our projection of future year concentrations. For example, REMSAD may overpredict the crustal component at a particular location by a factor of 2, but since measured crustal concentrations are generally a small fraction of ambient PM2.5, the future crustal concentration will remain as a small fraction of PM2.5.

A number of factors need to be considered when interpreting the results of this performance analysis. First, simulating the formation and fate of particles, especially secondary organic aerosols and nitrates is part of an evolving science. In this regard, the science in air quality models is continually being reviewed and updated as new research results become available. Also, there are a number of issues associated with the emissions and meteorological inputs, as well as ambient air quality measurements and how these should be paired to model predictions that are currently under investigation by EPA and others. The process of building consensus within the scientific community on ways for doing PM model performance evaluations has not yet progressed to the point of having a defined set of common approaches or criteria for judging model performance. Unlike ozone, there is a limited data base of past performance statistics against which to measure the performance of regional/national PM modeling. Thus, the approach used for this analysis may be modified or expanded in future evaluation analyses.

Technical Support Document for the Interstate Air Quality Rule Air Quality Modeling Analyses

Appendix D

8-Hour Ozone Concentrations at Nonattainment Counties for the 2010 Base Case and 2015 Base Case

The tables below provide 8-hour ozone concentration design values projected for the 2010 Base Case and 2015 Base Case. Concentrations for the two projection years are provided for each county in the East with ambient 2000-2002 8-hour design values >= 85 ppb (i.e., nonattainment). For counties with multiple monitoring sites, the data in the table below represent the highest concentration from among the monitors in the county. Note that in all but four counties the same site has the highest concentration in both the 2010 and 2015 Base Cases. The counties in which the highest concentration for the 2015 Base Case is at a different site than the 2010 Base Case are as follows:

County	2015 Base High Site
DeKalb Co, GA:	130893001
Mecklenburg Co, NC:	371190041
Alleghany Co, PA:	420030010
Knox Co, TN:	470930021

State FIPs	Cnty FIPs	State	County	AIRS Site ID	2000-2002 Ambient 8-Hr Ozone DV	2010 Base	2015 Base
1	73	Alabama	Jefferson	010732006	88	73	68
1	103	Alabama	Morgan	011030011	85	73	69
1	117	Alabama	Shelby	011170004	92	76	70
5	35	Arkansas	Crittenden	050350005	94	86	85
5	119	Arkansas	Pulaski	051191002	86	76	72
9	1	Connecticut	Fairfield	090011123	98	94	94
9	3	Connecticut	Hartford	090031003	90	82	78
9	7	Connecticut	Middlesex	090070007	97	91	89
9	9	Connecticut	New Haven	090093002	98	92	90
9	11	Connecticut	New London	090110008	89	82	79
9	13	Connecticut	Tolland	090131001	94	84	80
10	1	Delaware	Kent	100010002	92	79	75
10	3	Delaware	New Castle	100031010	96	87	84
10	5	Delaware	Sussex	100051002	94	81	77
11	1	D.C.	Washington	110010043	95	88	86
13	21	Georgia	Bibb	130210012	92	65	61
13	67	Georgia	Cobb	130670003	98	81	75
13	77	Georgia	Coweta	130770002	93	76	72
13	89	Georgia	De Kalb	130890002	95	82	79
13	97	Georgia	Douglas	130970004	95	79	74
13	113	Georgia	Fayette	131130001	90	75	70
13	121	Georgia	Fulton	131210055	99	86	81
13	135	Georgia	Gwinnett	131350002	89	74	68

13	151	Georgia	Henry	131510002	98	77	72
13	213	Georgia	Murray	132130003	87	68	63
13	223	Georgia	Paulding	132230003	90	70	65
13	245	Georgia	Richmond	132450091	87	74	70
13	247	Georgia	Rockdale	132470001	96	80	74
17	31	Illinois	Cook	170310032	88	84	85
17	83	Illinois	Jersey	170831001	89	78	74
17	163	Illinois	St Clair	171630010	85	77	75
18	3	Indiana	Allen	180030002	88	78	74
18	11	Indiana	Boone	180110001	88	79	76
18	19	Indiana	Clark	180190003	90	79	76
18	55	Indiana	Greene	180550001	89	77	74
18	57	Indiana	Hamilton	180571001	93	83	80
18	59	Indiana	Hancock	180590003	92	82	79
18	63	Indiana	Hendricks	180630004	88	79	76
18	69	Indiana	Huntington	180690002	86	76	72
18	71	Indiana	Jackson	180710001	85	72	69
18	81	Indiana	Johnson	180810002	87	75	72
18	89	Indiana	Lake	180892008	92	87	87
18	91	Indiana	La Porte	180910005	92	84	82
18	95	Indiana	Madison	180950010	91	80	76
18	97	Indiana	Marion	180970050	90	81	78
18	109	Indiana	Morgan	181090005	88	78	75
18	127	Indiana	Porter	181270024	90	84	83
18	129	Indiana	Posey	181290003	87	75	73
18	141	Indiana	St Joseph	181411007	90	78	75
18	145	Indiana	Shelby	181450001	93	83	79
21	13	Kentucky	Bell	210130002	86	69	65
21	15	Kentucky	Boone	210150003	86	71	68
21	19	Kentucky	Boyd	210190017	88	76	73
21	29	Kentucky	Bullitt	210290006	85	75	73
21	37	Kentucky	Campbell	210370003	94	83	80
21	47	Kentucky	Christian	210470006	85	65	62
21	111	Kentucky	Jefferson	211110027	85	76	74
21	117	Kentucky	Kenton	211170007	88	77	75
21	185	Kentucky	Oldham	211850004	87	73	71
21	227	Kentucky	Warren	212270008	86	70	67
22	33	Louisiana	East Baton Rou	220330003	86	79	77
22	47	Louisiana	Iberville	220470012	86	80	78
22	51	Louisiana	Jefferson	220511001	85	79	77
22	121	Louisiana	West Baton Rou	221210001	85	78	76

23	5	Maine	Cumberland	230052003	86	78	75
23	9	Maine	Hancock	230090102	93	81	76
23	31	Maine	York	230312002	90	82	80
24	3	Maryland	Anne Arundel	240030019	102	91	87
24	5	Maryland	Baltimore	240053001	93	85	83
24	13	Maryland	Carroll	240130001	92	82	78
24	15	Maryland	Cecil	240150003	104	90	86
24	17	Maryland	Charles	240170010	94	79	75
24	21	Maryland	Frederick	240210037	91	81	77
24	25	Maryland	Harford	240251001	104	93	89
24	29	Maryland	Kent	240290002	102	89	84
24	31	Maryland	Montgomery	240313001	89	82	79
24	33	Maryland	Prince Georges	240330002	95	86	82
24	43	Maryland	Washington	240430009	87	75	71
25	1	Massachusetts	Barnstable	250010002	93	81	77
25	5	Massachusetts	Bristol	250051002	90	80	76
25	9	Massachusetts	Essex	250092006	90	82	80
25	13	Massachusetts	Hampden	250130008	92	83	80
25	15	Massachusetts	Hampshire	250154002	88	80	78
25	17	Massachusetts	Middlesex	250171102	89	79	76
25	25	Massachusetts	Suffolk	250250041	89	79	75
25	27	Massachusetts	Worcester	250270015	85	76	73
26	5	Michigan	Allegan	260050003	92	82	79
26	19	Michigan	Benzie	260190003	86	78	75
26	21	Michigan	Berrien	260210014	87	77	74
26	27	Michigan	Cass	260270003	90	78	74
26	91	Michigan	Lenawee	260910007	85	76	74
26	99	Michigan	Macomb	260991003	88	84	86
26	105	Michigan	Mason	261050007	87	78	74
26	121	Michigan	Muskegon	261210039	89	80	77
26	125	Michigan	Oakland	261250001	86	81	82
26	139	Michigan	Ottawa	261390005	85	76	74
26	147	Michigan	St Clair	261470005	88	82	80
26	161	Michigan	Washtenaw	261610008	87	79	77
26	163	Michigan	Wayne	261630016	85	80	83
28	33	Mississippi	De Soto	280330002	86	75	72
29	47	Missouri	Clay	290470005	85	78	75
29	99	Missouri	Jefferson	290990012	86	75	72
29	183	Missouri	St Charles	291831002	90	81	78
29	189	Missouri	St Louis	291890004	89	81	78
29	510	Missouri	St Louis City	295100086	88	80	77

33	11	New Hampshire	Hillsborough	330111010	85	76	73
34	1	New Jersey	Atlantic	340010005	91	80	76
34	3	New Jersey	Bergen	340030005	91	88	87
34	7	New Jersey	Camden	340070003	103	93	91
34	11	New Jersey	Cumberland	340110007	98	86	81
34	15	New Jersey	Gloucester	340150002	104	95	93
34	17	New Jersey	Hudson	340170006	87	85	84
34	19	New Jersey	Hunterdon	340190001	96	89	87
34	21	New Jersey	Mercer	340210005	104	98	96
34	23	New Jersey	Middlesex	340230011	101	95	92
34	25	New Jersey	Monmouth	340250005	97	89	87
34	27	New Jersey	Morris	340273001	98	88	85
34	29	New Jersey	Ocean	340290006	115	105	102
34	31	New Jersey	Passaic	340315001	88	82	80
36	13	New York	Chautauqua	360130006	92	83	81
36	27	New York	Dutchess	360270007	93	83	80
36	29	New York	Erie	360290002	97	90	88
36	31	New York	Essex	360310002	86	80	78
36	45	New York	Jefferson	360450002	91	82	80
36	55	New York	Monroe	360551004	85	77	75
36	63	New York	Niagara	360631006	91	83	81
36	79	New York	Putnam	360790005	92	85	83
36	85	New York	Richmond	360850067	96	90	87
36	103	New York	Suffolk	361030009	97	90	89
36	119	New York	Westchester	361192004	90	86	86
37	3	North Carolina	Alexander	370030003	91	73	68
37	21	North Carolina	Buncombe	370210030	85	68	63
37	27	North Carolina	Caldwell	370270003	86	69	65
37	33	North Carolina	Caswell	370330001	91	75	71
37	51	North Carolina	Cumberland	370510008	87	73	68
37	59	North Carolina	Davie	370590002	95	78	73
37	63	North Carolina	Durham	370630013	91	77	72
37	65	North Carolina	Edgecombe	370650099	88	75	71
37	67	North Carolina	Forsyth	370670022	94	76	71
37	69	North Carolina	Franklin	370690001	91	77	72
37	77	North Carolina	Granville	370770001	94	79	75
37	81	North Carolina	Guilford	370810011	93	76	71
37	87	North Carolina	Haywood	370870036	87	69	65
37	99	North Carolina	Jackson	370990005	86	69	64
37	101	North Carolina	Johnston	371010002	85	72	67
37	109	North Carolina	Lincoln	371090004	94	77	72

37	119	North Carolina	Mecklenburg	371191009	102	85	79
37	145	North Carolina	Person	371450003	90	74	71
37	157	North Carolina	Rockingham	371570099	90	72	67
37	159	North Carolina	Rowan	371590022	101	82	77
37	179	North Carolina	Union	371790003	88	73	67
37	183	North Carolina	Wake	371830015	94	81	75
37	199	North Carolina	Yancey	371990003	87	70	66
39	3	Ohio	Allen	390030002	88	78	75
39	7	Ohio	Ashtabula	390071001	94	84	82
39	17	Ohio	Butler	390170004	89	77	74
39	23	Ohio	Clark	390230001	90	78	74
39	25	Ohio	Clermont	390250022	90	78	75
39	27	Ohio	Clinton	390271002	96	82	77
39	35	Ohio	Cuyahoga	390355002	86	78	75
39	41	Ohio	Delaware	390410002	89	79	75
39	55	Ohio	Geauga	390550004	99	88	85
39	57	Ohio	Greene	390570006	86	74	70
39	61	Ohio	Hamilton	390610006	89	79	76
39	81	Ohio	Jefferson	390810016	86	77	75
39	83	Ohio	Knox	390830002	90	80	77
39	85	Ohio	Lake	390850003	92	83	80
39	87	Ohio	Lawrence	390870006	86	74	71
39	89	Ohio	Licking	390890005	90	80	76
39	93	Ohio	Lorain	390930017	85	78	76
39	95	Ohio	Lucas	390950081	89	81	79
39	97	Ohio	Madison	390970007	89	78	75
39	99	Ohio	Mahoning	390990013	87	76	72
39	103	Ohio	Medina	391030003	87	77	73
39	109	Ohio	Miami	391090005	87	76	72
39	113	Ohio	Montgomery	391130019	86	75	71
39	133	Ohio	Portage	391331001	91	80	77
39	151	Ohio	Stark	391510021	89	79	75
39	153	Ohio	Summit	391530020	95	85	81
39	155	Ohio	Trumbull	391550011	90	79	75
39	165	Ohio	Warren	391650006	89	77	74
39	167	Ohio	Washington	391670004	87	74	67
39	173	Ohio	Wood	391730003	86	77	74
40	143	Oklahoma	Tulsa	401430137	85	76	74
42	3	Pennsylvania	Allegheny	420031005	95	85	82
42	5	Pennsylvania	Armstrong	420050001	91	79	76
42	7	Pennsylvania	Beaver	420070005	90	82	79

42	11	Pennsylvania	Berks	420110009	92	81	77
42	17	Pennsylvania	Bucks	420170012	104	97	95
42	21	Pennsylvania	Cambria	420210011	88	76	73
42	27	Pennsylvania	Centre	420270100	85	74	70
42	29	Pennsylvania	Chester	420290100	95	84	80
42	33	Pennsylvania	Clearfield	420334000	87	75	72
42	43	Pennsylvania	Dauphin	420431100	91	80	76
42	45	Pennsylvania	Delaware	420450002	95	87	84
42	49	Pennsylvania	Erie	420490003	88	79	77
42	55	Pennsylvania	Franklin	420550001	94	80	76
42	59	Pennsylvania	Greene	420590002	90	78	73
42	69	Pennsylvania	Lackawanna	420690101	85	74	69
42	71	Pennsylvania	Lancaster	420710007	94	83	80
42	77	Pennsylvania	Lehigh	420770004	93	83	80
42	85	Pennsylvania	Mercer	420850100	92	80	76
42	91	Pennsylvania	Montgomery	420910013	97	90	89
42	95	Pennsylvania	Northampton	420950025	92	82	79
42	101	Pennsylvania	Philadelphia	421010024	98	92	91
42	125	Pennsylvania	Washington	421255001	88	80	78
42	129	Pennsylvania	Westmoreland	421290008	86	76	73
42	133	Pennsylvania	York	421330008	92	81	78
44	3	Rhode Island	Kent	440030002	97	89	85
44	7	Rhode Island	Providence	440071010	91	82	78
44	9	Rhode Island	Washington	440090007	93	84	80
45	1	South Carolina	Abbeville	450010001	85	69	64
45	3	South Carolina	Aiken	450030003	88	75	71
45	7	South Carolina	Anderson	450070003	88	74	69
45	21	South Carolina	Cherokee	450210002	87	71	67
45	31	South Carolina	Darlington	450310003	86	73	69
45	77	South Carolina	Pickens	450770002	85	69	64
45	79	South Carolina	Richland	450791001	93	77	72
45	83	South Carolina	Spartanburg	450830009	90	74	69
47	1	Tennessee	Anderson	470010101	92	72	67
47	9	Tennessee	Blount	470090101	94	77	72
47	65	Tennessee	Hamilton	470650028	93	75	70
47	75	Tennessee	Haywood	470750003	86	74	71
47	89	Tennessee	Jefferson	470890002	95	78	73
47	93	Tennessee	Knox	470931020	96	77	72
47	121	Tennessee	Meigs	471210104	93	73	68
47	141	Tennessee	Putnam	471410004	86	72	68
47	155	Tennessee	Sevier	471550101	98	79	74

47	157	Tennessee	Shelby	471570021	90	80	78
47	163	Tennessee	Sullivan	471632003	92	74	70
47	165	Tennessee	Sumner	471650007	88	76	73
47	187	Tennessee	Williamson	471870106	87	72	69
47	189	Tennessee	Wilson	471890103	85	74	70
48	29	Texas	Bexar	480290059	86	72	69
48	39	Texas	Brazoria	480391003	86	80	78
48	85	Texas	Collin	480850005	93	83	79
48	113	Texas	Dallas	481130069	91	82	79
48	121	Texas	Denton	481210034	99	87	83
48	139	Texas	Ellis	481390015	86	75	71
48	167	Texas	Galveston	481670014	89	83	82
48	183	Texas	Gregg	481830001	88	74	71
48	201	Texas	Harris	482010024	107	100	99
48	251	Texas	Johnson	482510003	89	78	74
48	339	Texas	Montgomery	483390078	91	82	79
48	367	Texas	Parker	483670081	86	75	71
48	439	Texas	Tarrant	484392003	98	88	84
48	453	Texas	Travis	484530014	85	75	72
51	13	Virginia	Arlington	510130020	96	88	87
51	36	Virginia	Charles City	510360002	90	77	74
51	41	Virginia	Chesterfield	510410004	86	74	71
51	59	Virginia	Fairfax	510590018	97	87	85
51	69	Virginia	Frederick	510690010	85	73	70
51	87	Virginia	Henrico	510870014	90	77	74
51	107	Virginia	Loudoun	511071005	90	81	78
51	113	Virginia	Madison	511130003	85	71	67
51	153	Virginia	Prince William	511530009	85	75	72
51	161	Virginia	Roanoke	511611004	87	73	69
51	179	Virginia	Stafford	511790001	86	74	70
51	510	Virginia	Alexandria City	515100009	90	83	81
51	650	Virginia	Hampton City	516500004	89	80	77
51	800	Virginia	Suffolk City	518000004	88	79	77
54	11	West Virginia	Cabell	540110006	88	75	72
54	29	West Virginia	Hancock	540291004	85	76	74
54	39	West Virginia	Kanawha	540390010	85	69	66
54	69	West Virginia	Ohio	540690007	85	74	70
54	107	West Virginia	Wood	541071002	88	72	66
55	29	Wisconsin	Door	550290004	91	83	79
55	59	Wisconsin	Kenosha	550590019	100	94	93
55	61	Wisconsin	Kewaunee	550610002	88	80	77

55	71	Wisconsin	Manitowoc	550710007	88	80	77
55	79	Wisconsin	Milwaukee	550790085	91	83	81
55	89	Wisconsin	Ozaukee	550890009	93	84	81
55	101	Wisconsin	Racine	551010017	93	86	84
55	117	Wisconsin	Sheboygan	551170006	99	90	86

Technical Support Document for the Interstate Air Quality Rule Air Quality Modeling Analyses

Appendix E

Procedures for Estimating Future PM2.5 Values by Application of the Speciated Modeled Attainment Test (SMAT)

Introduction

EPA has issued draft guidance (EPA, 2001a) that describes a procedure for combining monitoring data with outputs from simulation models to estimate future concentrations of PM2.5 mass. The guidance recommends that model predictions be used in a relative sense to estimate changes expected to occur in each major PM2.5 species. PM2.5 species are sulfates, nitrates, organic carbon, elemental carbon, crustal and un-attributed mass which is defined as the difference between measured PM2.5and the sum of the five component species. EPA is using the "SMAT" procedure to estimate the ambient impact of national rules and legislation, including the Clear Skies Act and the Interstate Air Quality Rule (IAQR).

The draft guidance includes a sequence of key steps that are recommended for processing the data. The following is a brief summary of those steps:

(1) Derive current quarterly mean concentrations (averaged over three years) for each of the six major components of PM2.5. This is done by multiplying the monitored quarterly mean concentration of Federal Reference Method (FRM) derived PM2.5 by the monitored fractional composition of PM2.5 species (at speciation monitor sites) for each quarter in three consecutive years. (e.g., 20% sulfate x 15 $\mu g/m^3$ PM2.5 = 3 $\mu g/m^3$ sulfate).

(2) For each quarter, apply an air quality model to estimate current and future concentrations for each of the six components of PM2.5. Take the ratio of future to current predictions for each component. The result is a component-specific *relative reduction factor* (RRF). (e.g., given model predicted sulfate for base is 10 $\mu g/m^3$ and future is 8 $\mu g/m^3$ then RRF for sulfate is 0.8).

(3) For each quarter, multiply the current quarterly mean component concentration (step 1) times the component-specific RRF obtained in step 2. This leads to an estimated future quarterly mean concentration for each component. (e.g., 3 $\mu g/m^3$ sulfate x 0.8 = future sulfate of 2.4 $\mu g/m^3$).

(4) Average the four quarterly mean future concentrations to get an estimated future annual mean concentration for each component. Sum the annual mean concentrations of the six components to obtain an estimated future annual concentration for PM2.5.

EPA will use the Federal Reference Monitor (FRM) data for nonattainment designations. Therefore it is important that FRM data is used in the speciated modeled attainment test described above. As can be seen from the list of steps, the modeled attainment test is dependent on the availability of species component mass at FRM sites. Since roughly 80% of the FRM sites will not have collocated speciation monitors, a spatial interpolation methodology was developed to estimate component species mass at the FRM locations. This method was further utilized to estimate PM2.5 and component species mass at every grid cell in the study domain. Additional ambient data handling procedures were also developed. Below we describe an example application of the procedures, for a study domain that extends over a large portion of eastern US. The study domain is defined for grids of dimension 1/2 degree longitude by 1/3 degree latitude (~36 km X 36 km) covering the area enclosed within -100 to -67 longitude and 25 to 49 latitude. Base year and future year model predictions are available for each grid cell (72 rows by 66 columns) that make up the study domain.

Ambient Data preparation

PM2.5 quarterly averages at FRM sites for 1999-2001 were calculated using data from the Air Quality System (AQS). The resulting data set contained 325 sites that meet the completeness criteria needed to determine the PM2.5 NAAQS attainment status. Each of the PM2.5 sites was uniquely associated with one of the grid cells in the study domain.

Speciated PM2.5 data from both the Interagency Monitoring of Protected Visual Environments (IMPROVE) and EPA's speciation trends network[1] (STN) were used to derive mean concentrations of each of the six PM2.5 components. No attempt was made to resolve differences in measurement and analysis methodology between the two networks[2]. Since three years of urban speciation data were not available, the latest full year of data was used. Quarterly average concentrations between July 2001 through June 2002[3] were retained for sites that had at least 15 monitored values (50% completeness for 1 in 3 day sampling). The quarters were defined as follows: Q3 = July 2001 - September 2001; Q4 = October - December 2001; Q1 = January - March 2002; and Q2 = April - June 2001. Figure 1 shows the spatial distribution of IMPROVE and STN stations that met this completeness criteria for first quarter of 2002.

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[1]The network is referred to as the "STN", but all urban speciation sites were used, not just the trends sites.

[2]There are certain differences in sampling and analysis techniques which may affect the results of this application. The data from both networks were treated similarly whenever possible. Further comparison studies and analyses are needed to develop data sampling and handling procedures that may make the data from the two networks more similar.

[3] The 2nd quarter of 2002 was the most recent quarter of data available from both the IMPROVE and STN networks at the time of the analysis. The ambient speciation data will be updated as newer data and more sites become available.

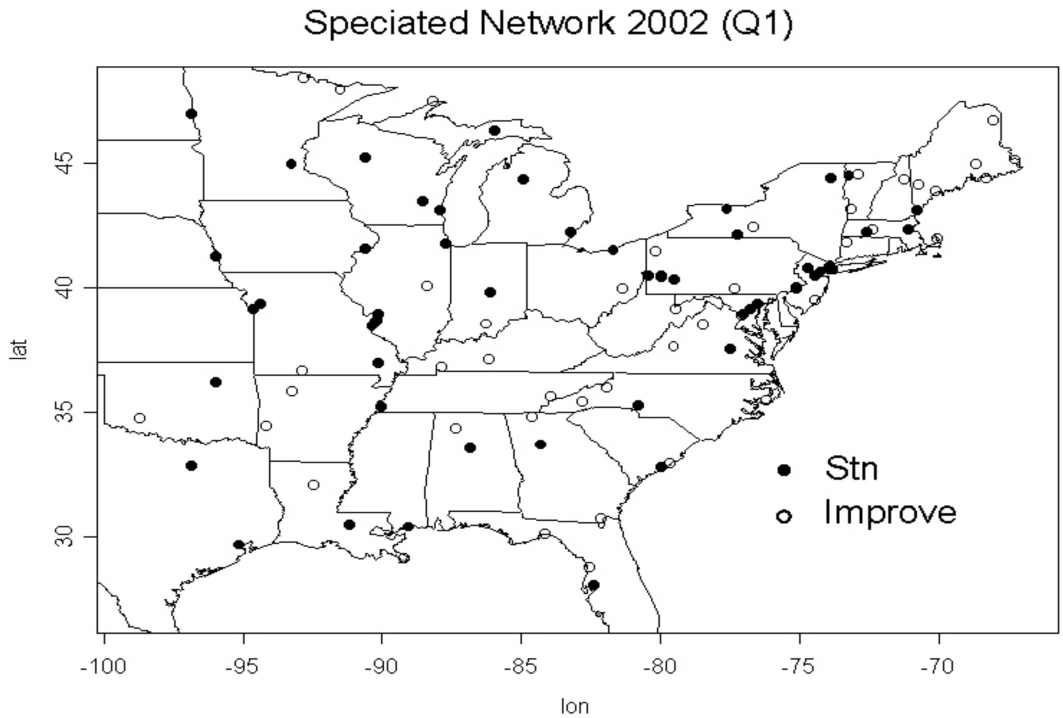

Figure 1. Speciated stations with at least 15 quarterly samples

Note: The number of stations meeting completeness criteria for the four quarters:

Quarter 3, 2001 – 103 sites
Quarter 4, 2001 – 106 sites
Quarter 1, 2002 – 105 sites
Quarter 2, 2002 – 117 sites

As noted in the modeling guidance, the mass associated with each component must be estimated based on assumptions about chemical composition. Table 3.4 in the modeling guidance provides recommended default assumptions which were applied for each of the species except sulfate and carbon compounds[4]. Because ammonium is reported in the STN, it was possible to analyze the degree to which sulfate measured on the filter was actually neutralized. The analysis concluded that, on average, sulfate was not completely neutralized resulting in use of the factor 1.25 rather than the value of 1.375 recommended in the guidance. The 1.25 factor was derived through a mass balance of measured ammonium, sulfate, and nitrate at the STN sites. It was assumed that all particulate nitrate was in the form of ammonium nitrate. The measurements of nitrate ion and particulate ammonium are known to be uncertain. The

[4]As recommended in the modeling guidance, organic carbon was multiplied by 1.4 and particulate nitrate was multiplied by 1.29.

calculation of the ammoniation of sulfate is subject to these uncertainties. Therfore, a single domainwide annual average value of 1.25 was used for all sites due to the uncertainties in the measurements of ammonium and nitrate. This value assumes that sulfate is, on average, partway between ammonium bisulfate and ammonium sulfate.

The elemental and organic carbon mass from the STN was adjusted downward based on measurements from field blanks which indicate a positive bias. The blank corrections were based on a draft report which examined the blank carbon data in the STN network (RTI, 2002). The carbon corrections are shown below in Table 1. The values were taken from Table 4.1 from the RTI report. The monitor dependent blank corrections were made to the quarterly average concentrations at each STN site. The IMPROVE carbon measurements are blank corrected by the IMPROVE program.

Sampler Type	Elemental Carbon ($\mu gC/m^3$)	Organic Carbon ($\mu gC/m^3$)
URG MASS	**0.03**	**0.29**
R and P 2300	**0.22**	**0.90**
Anderson RAAS	**0.09**	**1.19**
R&P 2025	**0.07**	**0.77**
MetOne SASS	**0.11**	**1.42**

Table 1. Carbon blank corrections

Finally, un-attributed mass was calculated for each of the STN monitors with a co-located FRM monitor. Un-attributed mass was not calculated for the IMPROVE sites since there were no collocated FRM PM2.5 data available. The results produced generally small positive estimates of un-attributed mass although for some sites, the estimate was negative. The un-attributed mass did not follow any clear spatial or temporal patterns. Due to the relatively random pattern of the un-attributed mass, a single quarterly value of un-attributed mass was used at each site. Table 2 summarizes the quarterly average un-attributed mass data. A quarterly average un-attributed mass value was calculated at each STN site by applying the un-attributed percentage to the quarterly average site specific FRM mass.

	Quarter 1 (Jan-Mar 02)	Quarter 2 (Apr-June 01)	Quarter 3 (July-Sept 01)	Quarter 4 (Oct - Dec 01)
Num of Monitoring sites	**47**	**31**	**43**	**46**
Avg FRM PM2.5 mass ($\mu g/m^3$)	**12.17**	**13.51**	**14.43**	**11.97**
Avg species mass sum ($\mu g/m^3$)	**12.12**	**13.41**	**13.70**	**11.74**
Un-attributed ($\mu g/m^3$)	**0.05**	**0.10**	**0.73**	**0.23**
Percent Un-attributed	**0.4 %**	**0.7 %**	**5.0 %**	**1.9 %**

Table 2. Average Un-attributed Mass of PM2.5

Species Component Estimation

Only a small fraction of PM2.5 sites have measured species information. For this reason, an objective procedure was developed for using the speciated component averages from the IMPROVE and STN networks to estimate concentrations of species mass at all FRM PM2.5 monitoring sites. Kriging was adopted as the method for estimating PM2.5 component mass at PM2.5 sites since software is readily available and can produce estimates of prediction error. Kriging was performed using an S-PLUS software package known as FIELDS (NCAR, 2002) developed by scientists at NCAR to perform generalized kriging and efficient spatial analysis of large data sets.

The Krig function in FIELDS estimates the parameters of the spatial field using the Generalized Cross Validation (GCV) error as the criterion for parameter estimation. A simple exponential covariance function was used to describe the variogram. Outputs from Krig include the parameter estimates (range, nugget and sill) along with predicted values at each of the PM2.5 monitor locations. Once the kriging equations were established for each species, quarterly average species concentrations were estimated for each of the FRM sites and for each grid cell in the modeling domain. The latter predictions were made so that estimated PM2.5 concentrations could be obtained for the entire modeling domain, allowing for a more complete spatial assessment of future PM2.5 levels. Figures 2 and 3 illustrate the spatially interpolated concentration fields for nitrates (quarter 1) and sulfates (quarter 3).

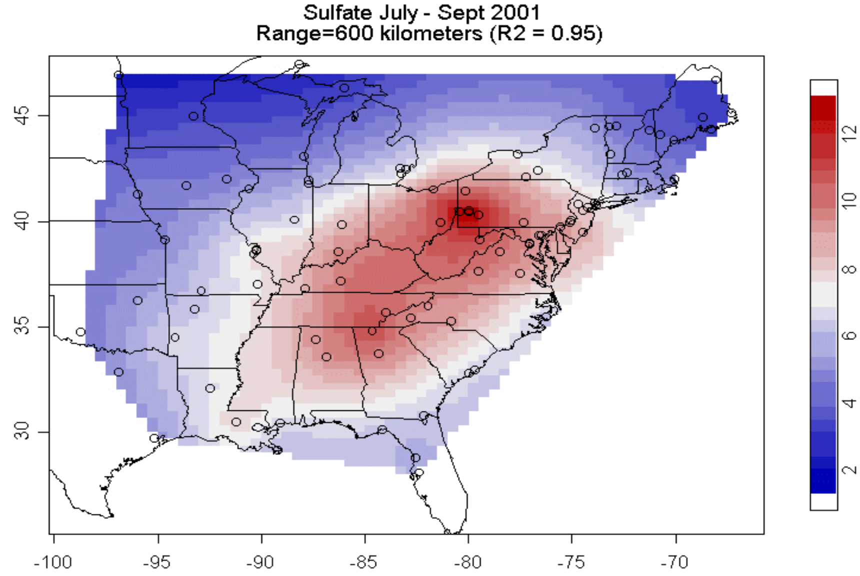

Figure 3 **Spatially Interpolated Sulfate Quarterly Average Concentrations (quarter 3)**

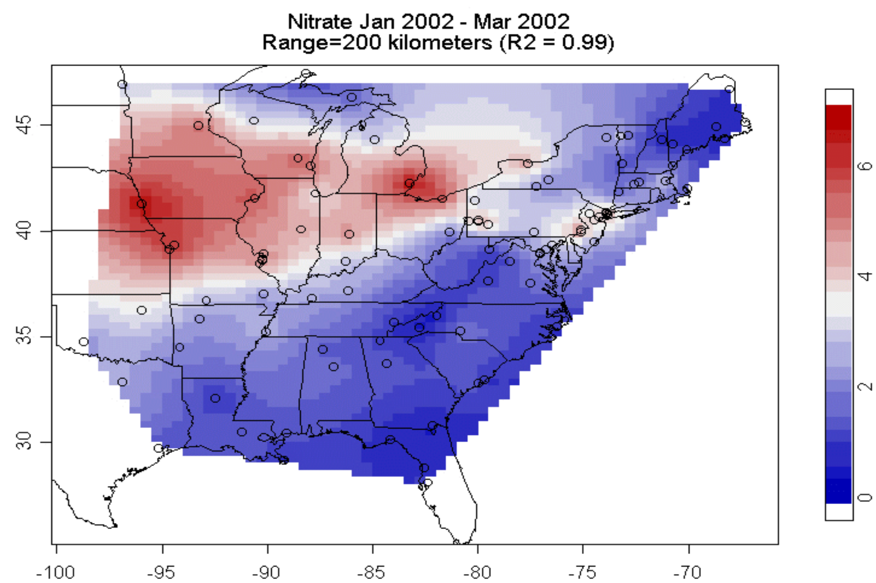

Figure 2 **Spatially Interpolated Nitrate Quarterly Average Concentrations (quarter 1)**

Kriging was not used for spatial interpolation of un-attributed mass since it only available for some of the STN sites and because there was no discernable spatial trend. Instead the quarterly average of the un-attributed mass from the STN sites was first expressed as a fraction of the average PM2.5 mass. The estimated fractions for each quarter were previously shown in Table 2.

For each quarter, predicted concentrations for each of the six species are combined with quarterly PM2.5 FRM averages to derive composition concentrations in the following manner. First, the un-attributed mass at each PM2.5 site was estimated by multiplying the average fraction of un-attributed mass by the quarterly average PM2.5 concentration for that site. For example, if a site in quarter 3 had an average PM2.5 mass of 20 $\mu g/m^3$, then the un-attributed mass would be 20 $\mu g/m^3$ x 0.05 = 1 $\mu g/m^3$. The total PM2.5 mass that is identifiable was calculated by subtracting the estimated un-attributed mass from each quarterly average PM2.5 value. Next, the component mass of each of the five identifiable species was estimated by multiplying the fraction of each species by the identifiable portion of the quarterly PM2.5mass. This procedure is repeated for each PM2.5 site and quarter to complete the calculation of current or baseline ambient concentrations used as the basis for future estimates of PM2.5 mass and its components. Table 3a shows an example of the un-attributed mass calculation and the species fractions for an FRM site in quarter 2. The species fractions in table 3a are derived from the quarterly interpolated (Kriged) spatial fields for each of the five species. Multiplying the un-attributed mass fraction of 0.7% (from table 2) times 17.0 (FRM mass from table 3a) yields the identifiable mass of 16.88. The identifiable mass can then be split into individual species component mass estimates by using the fractions in table 3a.

FRM Mass ($\mu g/m^3$)	% Un-atributed mass	Identifiable Mass ($\mu g/m^3$)	% Sulfate	% Nitrate	% Organic aerosol	% Elemental Carbon	% Crustal
17.0	0 .7	16.88	32.1	11.4	38.9	9.9	7.7

Table 3a. Un-attributed mass and species fractions for an FRM site in quarter 2

Table 3b shows the resultant mass for each of the component species at the same FRM site. The species mass is calculated by multiplying the fraction of each component by the identifiable mass. **The sum of the components is the observed FRM PM2.5 mass concentration (17.0 $\mu g/m^3$)**

FRM Mass ($\mu g/m^3$)	Un-atributed Mass ($\mu g/m^3$)	Sulfate Mass ($\mu g/m^3$)	Nitrate Mass ($\mu g/m^3$)	Organic aerosol Mass ($\mu g/m^3$)	Elemental Carbon Mass ($\mu g/m^3$)	Crustal Mass ($\mu g/m^3$)
17.0	0.12	5.42	1.92	6.57	1.67	1.30

Table 3b. Resultant species mass at an FRM site in quarter 2

Estimating Future Year PM2.5

Future concentrations of PM2.5 component species are estimated by assuming that the quarterly average component concentration will change in exactly the same proportion as the model predicted change. Model predicted changes in species concentrations (from a current year to a future year) are used to calculate "relative reduction factors". Relative reduction factors are calculated for each grid cell and species as the ratio of the quarterly average future predictions to the current base predictions. The relative reduction factor for each species is then multiplied by the estimated current year ambient species mass for the site to estimate future species concentrations. These future species concentrations at each FRM site are then summed over the five species to estimate the identifiable portion of future quarterly average PM2.5 concentration. The current year quarterly average estimate of un-attributed PM2.5 mass is added to the future quarterly average identifiable PM2.5 mass estimate. The four quarterly values are then averaged to obtain the estimated future annual average PM2.5 for each FRM site.

FRM sites close to or co-located with an STN monitor will have the least "error" in the estimation of species fractions[5]. There is more uncertainty associated with FRM monitoring sites that are not located near a speciation site. It should be noted that the sole use of the interpolated speciation data is to calculate the mass fractions of each of the PM2.5 components. All of the future year design value calculations at FRM sites are "anchored" by the FRM data itself.

The results of the analysis at each of the FRM monitoring sites (with complete data) were used in analyses such as Clear Skies and the IAQR. Application of SMAT with Kriged spatial fields allows us to take advantage of the design value information at each FRM site. In this way, a more complete attainment/nonattainment picture can be derived by not limiting the predictions of future year design values to only speciation monitoring sites.

Additional Spatial Information

PM2.5 concentrations can also be estimated over the entire field of grid locations that define the study domain (i.e., 72 x 66 grid cells). This requires that the quarterly average PM2.5 also be kriged to estimate PM2.5 average concentrations for each grid cell. Because the majority of PM2.5 measurement sites are urban oriented, the PM2.5 mass reported for the IMPROVE sites are also included in the spatial interpolation process to help minimize potential urban bias in more rural locations. Figure 4 shows the spatially interpolated base year (1999-2001) PM2.5 annual concentration field and figure 5 shows the projected future base case (2010) PM2.5 concentration field.

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[5]The species fractions at co-located FRM and speciation sites can be calculated without the use of spatial fields. However, for this application, the species fractions for **all** FRM sites were derived from the spatial fields. This allowed for consistent calculations at all sites.

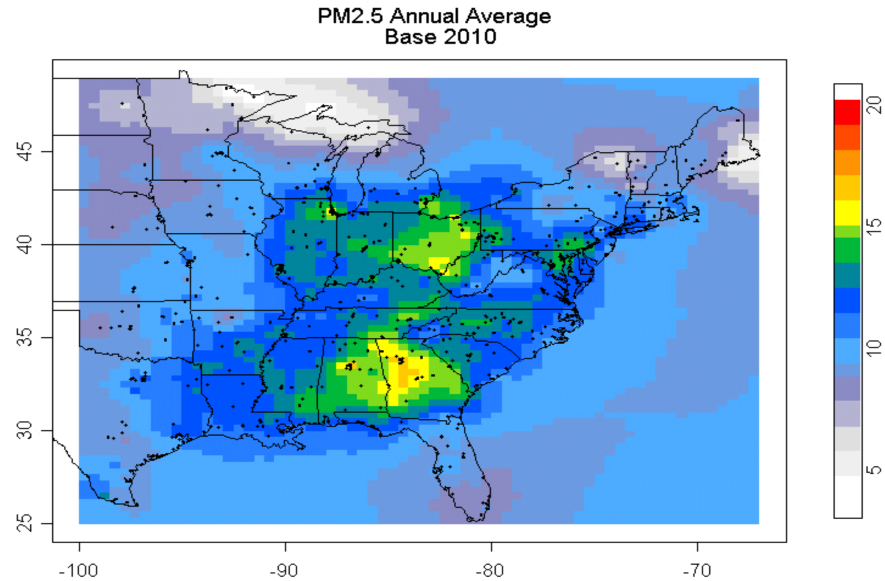

Figure 4 **Example spatial fields of future year (2010) annual average PM2.5 design values (calculated from relative reduction factors from the REMSAD model)**

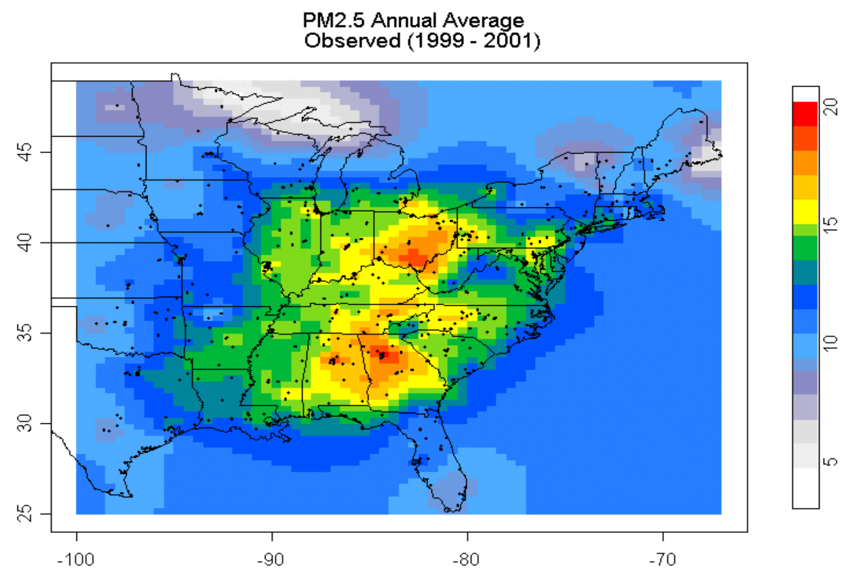

Figure 5 **Example spatial fields of base year (1999-2001) annual average PM2.5 design values**

Summary of Outputs

Future year design values can be calculated at monitoring sites which have co-located FRM and speciation monitors. Kriging of speciation data allows the calculation of future year design values at all FRM monitoring sites. Additional Kriging of all PM2.5 data (FRM and IMPROVE) allows the calculation of future year design values at all model grid cells. Table 4 shows the available outputs of the modeled attainment test with spatial fields.

	Ambient PM2.5 Data From:	**Ambient Speciation Data From:**
Case1- FRM monitoring sites	FRM monitor	Interpolated (Kriged) speciation data
Case 2-All grid cells	Interpolated (Kriged) PM2.5 data	Interpolated (Kriged) speciation data

Table 4. Sources of data for speciated modeled attainment test with spatial fields

There are uncertainties associated with many aspects of the analysis. There is uncertainty associated with collection and analysis of the ambient data (e.g. positive organic carbon artifacts and negative particulate nitrate artifacts associated with the ambient data collection and analysis), post-processing of the ambient data (e.g, assumptions regarding the 1.25 factor for sulfate or the 1.4 factor applied to organic carbon), interpolation of the data to the FRM sites and grids (e.g. Kriging error and replication of species gradients), use of the model predicted changes in species (e.g. errors and uncertainty in the model science and inventories), etc.

We have the most confidence in future estimates of PM2.5 at FRM monitoring locations (case 1). Therefore, the results of this analysis at each of the FRM monitoring sites (with complete data) will be used for regulatory purposes.

Caveats on use of SMAT with Spatial Fields

The details of this application of SMAT are specific to the short term use of the FRM and STN data in estimating future year PM2.5 concentrations. The use of a single year of speciation data interpolated to a modeling grid is necessary at this time, due to the relatively sparse ambient data sets. The amount of available ambient data will increase significantly in the future. As a resul, for many areas, the coverage of speciation data may be adequate so that interpolation of the data through spatial fields is not necessary. This application should serve as an example that can be replicated in the short term, but the techniques and assumptions will likely evolve over the long term.

Example Future Year Design Value Calculations

The following example shows the SMAT steps for the 2010 Base Case for several FRM PM2.5 sites in Alabama. The example follows the calculations for the future design values for each model run. There are four tables. One each for the 2010 Base Case design value calculations, the 2010 control case, the 2015 Base Case, and the 2015 control case. Each table contains three sections. The "Quarterly All Sites" section shows the quarterly average calculations for all FRM sites (only sites with complete date). The "Annual All Sites" section averages the quarterly data for each monitoring site and reports the annual average design values. The "Annual High Sites" section filters the data to show only the highest monitoring site in each county.

We start with the 1999-2001 and 2000-2002 design values at each FRM site (with complete data). For those sites that are measuring nonattainment in 2000-2002, the higher of the two design values is used in the analysis. The 2000-2002 design value are used for those sites that are attainment during this period. The design value is then broken down into quarterly averages. The following excerpt from the 2010 Base Case table (Quarterly All Sites section) shows the ambient design values for each quarter (column I) for several sites in Alabama.

A	B	C	D	E	F	G	H	I
State Fip	County Fip	State Name	County Name	AIRS Site Code	Row	Column	Quarter	1999-2001/ 2000-2002 Ambient FRM DV
1	49	Alabama	DeKalb County	010491003	31	81	1	13.7857115
1	49	Alabama	DeKalb County	010491003	31	81	2	14.10473748
1	49	Alabama	DeKalb County	010491003	31	81	3	21.92974988
1	49	Alabama	DeKalb County	010491003	31	81	4	17.22333333
1	53	Alabama	Escambia County	010530002	22	78	1	12.98124247
1	53	Alabama	Escambia County	010530002	22	78	2	12.94027641
1	53	Alabama	Escambia County	010530002	22	78	3	15.45416667
1	53	Alabama	Escambia County	010530002	22	78	4	13.47417442
1	73	Alabama	Jefferson County	010730023	29	79	1	17.88685887
1	73	Alabama	Jefferson County	010730023	29	79	2	19.89304794
1	73	Alabama	Jefferson County	010730023	29	79	3	26.24857762
1	73	Alabama	Jefferson County	010730023	29	79	4	22.28314749

The next step is to remove the unattributed mass from the design value. The unatributed mass is treated as a fixed fraction of FRM mass that varies by quarter. Column J shows the unatributed fraction and column K shows the quarterly averages with the unatributed mass removed.

J	K
Unatributed Fraction	FRM Mass without Unatributed
0.004108463	13.72907341
0.007401925	14.00033528
0.050589051	20.82034465
0.019214703	16.89239209
0.004108463	12.92790951
0.007401925	12.84449346
0.050589051	14.67235505
0.019214703	13.21527216
0.004108463	17.81337136
0.007401925	19.7458011
0.050589051	24.920687
0.019214703	21.85498341

Next the FRM PM2.5 mass is divided into the species components. This is done by calculating the species fractions from the Kriged surfaces. In the following example, The sulfate fraction for quarter 1 at the site in DeKalb county Alabama is 43.4% (column O). This is the fraction of total PM2.5 from column K.

L	M	N	O	P
Crustal Fraction	EC Fraction	OC Fraction	Sulfate Fraction	Nitrate Fraction
0.040554422	0.053856416	0.32917698	0.434901805	0.141510376
0.062691722	0.038491135	0.364702132	0.473525669	0.060589341
0.050784161	0.046509019	0.295064061	0.573991559	0.0336512
0.046598479	0.058149979	0.412990795	0.365473292	0.116787456
0.04323078	0.057282481	0.32142633	0.410296926	0.167763484
0.067217832	0.045197205	0.359264032	0.465347001	0.06297393
0.072306094	0.046501861	0.296886604	0.540717388	0.043588054
0.054660758	0.058832206	0.376710307	0.399193305	0.110603425
0.049615803	0.072993526	0.420536616	0.331436705	0.125417349
0.10227892	0.077315923	0.376565645	0.375782385	0.068057127
0.063257188	0.061957184	0.365119889	0.463406204	0.046259536
0.078780385	0.087789986	0.50144869	0.236116133	0.095864806

We can then get the quarterly species mass values at each site by multiplying the species fractions by the total PM2.5 (e.g. column O multiplied by Column K = column U)

Q	R	S	T	U	V
1999-2001/2000-2002 Ambient FRM Unatributed PM2.5 Mass	1999-2001/2000-2002 Ambient Crustal Mass	1999-2001/2000-2002 Ambient Elemental Carbon Mass	1999-2001/2000-2002 Ambient Organic Aerosol Mass	1999-2001/2000-2002 Ambient Ammonium Sulfate Mass	1999-2001/2000-2002 Ambient Ammonium Nitrate Mass
0.056638092	0.556774643	0.739398691	4.519294924	5.970798805	1.942806345
0.104402202	0.87770513	0.538888802	5.105952133	6.629518135	0.848271083
1.109405226	1.05734374	0.968333805	6.143335444	11.95070209	0.700629572
0.330941242	0.787159772	0.98229225	6.976402432	6.173718139	1.972819499
0.05333296	0.558883608	0.740542727	4.155370505	5.304281528	2.168831145

0.095782949	0.863379009	0.580535205	4.61456451	5.97714651	0.808868227
0.781811619	1.060900676	0.68229182	4.356025659	7.933597492	0.6395394
0.258902265	0.722356789	0.777483614	4.97832923	5.275448164	1.461654358
0.073487506	0.883824732	1.300260794	7.491174911	5.90400511	2.234105814
0.147246839	2.019579202	1.526664845	7.435590321	7.420124237	1.3438425
1.327890621	1.576412586	1.544015587	9.099038465	11.54840096	1.152819409
0.42816407	1.721744015	1.918648684	10.9591528	5.16031417	2.095123751

The relative reduction factors (RRF) are calculated from the REMSAD model results. The RRFs represent the percentage change for each specie for each site for each quarter. For example, the RRF for elemental carbon for quarter 1 at the DeKalb county site is 0.73 (column X), which represents a 26.6% reduction in elemental carbon mass between 2001 and 2010.

W	X	Y	Z	AA
RRF - IAQR 2010b Crustal Mass	RRF - IAQR 2010b Elemental Carbon Mass	RRF - IAQR 2010b Organic Aerosol Mass	RRF - IAQR 2010b Ammonium Sulfate Mass	RRF - IAQR 2010b Ammonium Nitrate Mass
0.984387805	0.734007875	0.894215346	1.004490725	0.936200299
1.010292927	0.75741159	0.901596815	0.899538483	0.722048795
1.023778779	0.699817783	0.876176087	0.881970652	0.522850118
1.003476273	0.717172235	0.913843769	0.977859617	0.979772342
0.976329385	0.878162793	0.950120354	0.966785809	0.933484255
1.000018254	0.902456596	0.951021008	0.90147797	0.896162069
1.000782489	0.836301085	0.925816993	0.916565498	0.829103207
0.983348583	0.84418583	0.950149933	0.938169407	0.961194783
1.031068875	0.724041957	0.94061741	0.991943586	0.939327718
1.048690141	0.741519805	0.933041132	0.916765785	0.790046338
1.054997488	0.693010181	0.910243813	0.927926735	0.756365551
1.039458529	0.707563728	0.951575967	0.974710839	0.986069043

The RRFs are applied to each of the species to get the future year 2010 base species mass values (columns AB-AF). The species mass values are then added together (along with the previuosly calculated unatributed mass from column Q) to get the total 2010 basecase mass by quarter (column AG).

AB	AC	AD	AE	AF	AG
2010b IAQR Crustal Mass	2010b IAQR Elemental Carbon Mass	2010b IAQR Organic Aerosol Mass	2010b IAQR Ammonium Sulfate Mass	2010b IAQR Ammonium Nitrate Mass	2010 base IAQR DV
0.548082169	0.542724462	4.041222874	5.997612021	1.818855881	13.0051355
0.886739285	0.408160624	4.603510181	5.963506689	0.612493114	12.57881209
1.082486083	0.677657217	5.38264361	10.54016852	0.366324255	19.15868491
0.789896154	0.704472728	6.375341896	6.037029653	1.93291398	16.17059565
0.545654489	0.65031707	3.948102093	5.12810411	2.024569726	12.35008045
0.863394769	0.523907825	4.38854779	5.388265905	0.724877024	11.98477626
1.06173082	0.570601389	4.032882577	7.271661737	0.530244168	14.24893231
0.710328525	0.65634065	4.730159187	4.949264077	1.404934544	12.70992925
0.911284172	0.94144337	7.046329543	5.856440004	2.098557516	16.92754211
2.117912797	1.132052218	6.937711612	6.802516022	1.061697846	18.19913733
1.663111318	1.070018521	8.282343471	10.71606999	0.871952887	23.93138681
1.789681501	1.357566216	10.42846642	5.029814154	2.065936673	21.09962904

The quarterly average mass from column AG is then averaged for all four quarters to get the annual average future year design value for each monitoring site. The result of this calculation is in the "Annual All Sites" worksheet (column H). The Annual All Sites worksheet also contains annual average summary information of species mass and RRFs for each monitoring site. The species mass and RRFs in this worksheet are for informational purposes only and are not used as part of the future year design value calculations. All calculations are done on a quarterly average basis and then summed at the end.

The "Annual High Sites" worksheet contains the final county level design values. Only the highest design value site in each county is retained for counties with multiple FRM sites. The values in this worksheet were used to determine future year attainment status for each county. Note that each projected PM2.5 design value is truncated at two places to the right of the decimal in order to determine whether the concentration is $\geq 15.05\ \mu g/m^3$ (i.e, nonattainment).

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Appendix F

PM2.5 Concentrations Projected for the 2010 Base Cases and 2015 Base Case

The table below contains PM2.5 annual average design values (µg/m^3) by county for those counties with PM2.5 concentrations above the National Ambient Air Quality Standard (i.e., design value >=15.05 µg/m^3) for the period 2000-2002. The ambient data listed for each site are the higher of the design values over the two periods: 1999-2001 and 2000-2002, as measured at Federal Reference Method (FRM) sites in the East. Thus, the ambient data are the highest values in each county during the periods 1999-2001 and 2000-2002 at those sites that measured concentrations >=15.05 in 2000-2002. Counties with measured concentrations below the NAAQS are not shown. In addition to the ambient data, the table provides the highest projected design value in each of these counties for the 2010 Base-1, 2010 Base-2, and 2015 Base Case scenarios. In all three future base cases, the highest concentration in each county occurs at the same site that has the highest concentration in 1999-2001/2000-2002. Note that these data have been truncated at two places to the right of the decimal. Row and Col denote the row and column coordinates of the REMSAD grid cell in which the monitoring site is located.

State FIPs	Cnty FIPs	State	County	AIRS Site ID	Row	Col	1999-2001/ 2000-2002 Ambient FRM	2010 Base-1	2010 Base-2	2015 Base
1	49	Alabama	DeKalb County	010491003	31	81	16.76	15.24	15.22	14.75
1	73	Alabama	Jefferson County	010730023	29	79	21.57	20.12	20.03	19.57
1	101	Alabama	Montgomery County	011010007	26	80	16.79	15.72	15.69	15.35
1	113	Alabama	Russell County	011130001	26	83	18.39	17.31	17.07	16.68
1	121	Alabama	Talladega County	011210002	28	80	17.75	16.46	16.44	15.97
9	9	Connecticut	New Haven County	090090018	52	107	16.80	15.45	15.43	15.13
10	3	Delaware	New Castle County	100032004	48	101	16.61	15.49	15.43	15.01
11	1	DC	District of Columbia	110010041	45	99	16.55	15.35	15.48	14.98
13	59	Georgia	Clarke County	130590001	30	86	18.61	17.05	17.04	16.46
13	63	Georgia	Clayton County	130630091	29	84	19.16	17.82	17.73	17.26
13	67	Georgia	Cobb County	130670003	31	83	18.56	17.24	16.80	16.28
13	89	Georgia	DeKalb County	130892001	30	84	19.56	18.26	18.26	17.93
13	115	Georgia	Floyd County	131150005	31	82	18.45	17.14	16.99	16.51
13	121	Georgia	Fulton County	131210039	30	84	21.20	19.79	19.79	19.44
13	139	Georgia	Hall County	131390003	31	85	17.24	15.61	15.62	15.05
13	215	Georgia	Muscogee County	132150011	26	83	17.97	16.92	16.68	16.31
13	223	Georgia	Paulding County	132230003	30	82	16.76	15.52	15.40	14.93
13	245	Georgia	Richmond County	132450091	29	88	17.36	16.03	15.99	15.51
13	319	Georgia	Wilkinson County	133190001	27	86	17.75	16.89	16.68	16.40
17	31	Illinois	Cook County	170310052	54	77	18.79	18.07	17.90	17.52
17	43	Illinois	DuPage County	170434002	54	76	15.44	14.91	14.74	14.34
17	119	Illinois	Madison County	171191007	45	72	17.45	16.48	16.41	16.03
17	163	Illinois	St. Clair County	171630010	44	72	17.42	16.32	16.31	15.91
17	197	Illinois	Will County	171971002	53	76	15.87	15.54	15.21	14.86
18	19	Indiana	Clark County	180190005	43	81	17.34	15.79	15.86	15.40
18	35	Indiana	Delaware County	180350006	49	82	15.07	13.88	13.93	13.41
18	39	Indiana	Elkhart County	180390003	54	81	15.45	14.32	14.34	13.83
18	43	Indiana	Floyd County	180431004	43	81	15.60	14.20	14.26	13.84
18	67	Indiana	Howard County	180670003	50	80	15.10	13.98	14.05	13.48
18	89	Indiana	Lake County	180890006	53	78	15.62	14.89	14.83	14.44
18	97	Indiana	Marion County	180970083	48	80	17.00	15.76	15.89	15.31
18	163	Indiana	Vanderburgh County	181630016	42	77	15.70	14.24	14.25	13.78

State FIPs	Cnty FIPs	State	County	AIRS Site ID	Row	Col	1999-2001/ 2000-2002 Ambient FRM	2010 Base-1	2010 Base-2	2015 Base
18	167	Indiana	Vigo County	181670018	47	78	15.15	13.82	14.00	13.38
21	19	Kentucky	Boyd County	210190017	44	87	15.67	14.27	14.56	13.99
21	29	Kentucky	Bullitt County	210290006	42	81	16.03	14.18	14.31	13.79
21	37	Kentucky	Campbell County	210370003	46	84	15.45	14.05	14.21	13.65
21	67	Kentucky	Fayette County	210670014	43	83	16.81	15.05	15.21	14.66
21	93	Kentucky	Hardin County	210930006	42	81	15.10	13.35	13.48	12.99
21	111	Kentucky	Jefferson County	211110044	43	81	17.28	15.71	15.79	15.32
21	117	Kentucky	Kenton County	211170007	46	83	15.86	14.37	14.52	14.01
24	3	Maryland	Anne Arundel County	240031003	46	99	15.81	14.66	14.72	14.30
24	5	Maryland	Baltimore County	240053001	46	100	15.10	13.77	13.81	13.38
24	510	Maryland	Baltimore city	245100040	46	99	17.82	16.53	16.58	16.11
26	115	Michigan	Monroe County	261150005	54	86	15.57	14.63	14.68	14.26
26	163	Michigan	Wayne County	261630033	55	86	19.85	18.76	18.78	18.28
29	510	Missouri	St. Louis city	295100085	44	72	16.28	15.26	15.25	14.89
34	17	New Jersey	Hudson County	340171003	51	104	15.88	13.46	13.49	13.20
34	39	New Jersey	Union County	340390004	50	104	16.26	14.13	14.11	13.93
36	5	New York	Bronx County	360050080	51	105	16.13	14.55	14.56	14.12
36	61	New York	New York County	360610056	51	105	18.04	16.29	16.30	15.82
37	25	North Carolina	Cabarrus County	370250004	35	91	15.67	13.53	13.68	13.13
37	35	North Carolina	Catawba County	370350004	36	90	17.10	15.04	15.26	14.62
37	57	North Carolina	Davidson County	370570002	36	92	17.27	15.32	15.52	14.92
37	67	North Carolina	Forsyth County	370670022	37	92	16.23	14.27	14.44	13.82
37	111	North Carolina	McDowell County	371110004	36	89	16.16	14.34	14.54	14.00
37	119	North Carolina	Mecklenburg County	371190010	34	91	16.77	15.07	15.18	14.61
39	17	Ohio	Butler County	390170003	47	84	17.40	15.87	16.01	15.39
39	35	Ohio	Cuyahoga County	390350038	53	89	20.25	18.99	19.13	18.58
39	49	Ohio	Franklin County	390490024	48	87	18.13	16.45	16.69	16.18
39	61	Ohio	Hamilton County	390610014	46	84	19.29	17.57	17.75	17.07
39	81	Ohio	Jefferson County	390810016	50	91	18.90	17.69	18.04	17.49
39	87	Ohio	Lawrence County	390870010	44	87	16.65	15.19	15.48	14.88
39	99	Ohio	Mahoning County	390990005	52	91	16.42	15.13	15.39	14.82
39	113	Ohio	Montgomery County	391130031	48	84	15.89	14.62	14.71	14.15
39	133	Ohio	Portage County	391330002	52	90	15.29	14.25	14.41	13.90
39	145	Ohio	Scioto County	391450013	45	87	20.03	18.02	18.40	17.62
39	151	Ohio	Stark County	391510017	51	90	18.28	16.80	17.09	16.42
39	153	Ohio	Summit County	391530017	52	90	17.34	16.17	16.35	15.78
39	155	Ohio	Trumbull County	391550007	52	91	16.15	14.89	15.13	14.58
42	3	Pennsylvania	Allegheny County	420030064	49	93	21.42	18.86	19.52	18.64
42	7	Pennsylvania	Beaver County	420070014	51	92	15.99	14.53	14.89	14.37
42	11	Pennsylvania	Berks County	420110009	49	101	16.67	15.28	15.39	14.95
42	21	Pennsylvania	Cambria County	420210011	49	95	15.76	14.10	14.52	13.89
42	43	Pennsylvania	Dauphin County	420430401	49	99	15.64	14.05	14.36	13.90
42	45	Pennsylvania	Delaware County	420450002	48	102	15.74	14.88	14.85	14.57
42	71	Pennsylvania	Lancaster County	420710007	49	100	17.08	15.27	15.46	14.87
42	101	Pennsylvania	Philadelphia County	421010136	48	102	15.29	14.46	14.43	14.15
42	125	Pennsylvania	Washington County	421250005	49	93	15.69	13.80	14.32	13.65
42	129	Pennsylvania	Westmoreland County	421290008	49	93	15.61	13.70	14.19	13.53
42	133	Pennsylvania	York County	421330008	48	99	17.05	15.50	15.68	15.13

State FIPs	Cnty FIPs	State	County	AIRS Site ID	Row	Col	1999-2001/ 2000-2002 Ambient FRM	2010 Base-1	2010 Base-2	2015 Base
45	45	South Carolina	Greenville County	450450009	33	88	16.50	14.93	15.06	14.53
47	37	Tennessee	Davidson County	470370023	37	79	17.04	15.31	15.36	14.90
47	65	Tennessee	Hamilton County	470654002	34	82	17.62	16.11	16.14	15.63
47	93	Tennessee	Knox County	470931017	36	85	20.41	18.16	18.36	17.73
47	107	Tennessee	McMinn County	471071002	35	83	16.07	14.36	14.45	13.95
47	145	Tennessee	Roane County	471450004	36	83	17.02	15.13	15.18	14.63
47	163	Tennessee	Sullivan County	471631007	38	87	16.97	15.06	15.24	14.69
51	520	Virginia	Bristol city	515200006	38	88	16.01	13.99	14.20	13.64
51	770	Virginia	Roanoke city	517700014	40	93	15.23	13.69	13.93	13.41
51	775	Virginia	Salem city	517750010	40	92	15.31	13.72	13.96	13.38
54	3	West Virginia	Berkeley County	540030003	47	97	16.24	14.59	14.96	14.38
54	9	West Virginia	Brooke County	540090005	50	91	17.40	16.28	16.60	16.10
54	11	West Virginia	Cabell County	540110006	44	88	17.84	15.98	16.39	15.70
54	29	West Virginia	Hancock County	540291004	50	91	17.49	16.37	16.69	16.18
54	39	West Virginia	Kanawha County	540391005	44	89	18.39	16.67	17.11	16.45
54	49	West Virginia	Marion County	540490006	47	92	15.74	13.99	14.50	13.82
54	51	West Virginia	Marshall County	540511002	48	91	16.52	14.90	15.53	14.78
54	69	West Virginia	Ohio County	540690008	49	91	15.65	14.15	14.64	13.96
54	107	West Virginia	Wood County	541071002	46	89	17.61	15.85	16.30	15.58

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Appendix G

Metrics for 8-Hour Ozone Contributions to Downwind Nonattainment Counties in 2010

Downwind Nonattainment Receptor		CAMx Source Apportionment Modeling						CAMx State Zero-Out Modeling				
		Base Case: Total Number of Exceedances (grid-hours) = 133						Base Case: Total Number of Exceedances (grids-days) = 37				
Crittenden AR	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**TN**	58%	45	52%	133	100%	51	100%	100%	37	100%	46.5
	GA	5%	10	11%	51	38%	11	23%	28%	12	32%	11.9
	AL	6%	12	13%	51	38%	14	34%	48%	15	41%	9.0
	MS	4%	8	9%	73	55%	8	29%	53%	19	51%	6.6
	IL	6%	10	11%	79	59%	11	11%	10%	6	16%	5.5
	KY	4%	5	6%	80	60%	6	24%	29%	15	41%	5.3
	MO	3%	6	6%	80	60%	7	11%	9%	6	16%	3.8
	IN	1%	4	5%	21	16%	4	7%	14%	3	8%	3.7
Contributions do not exceed screening criteria	**OH**	1%	2	3%	19	14%	3	2%	2%	0	0%	1.8
	FL	0%	2	2%	0	0%	2	4%	12%	0	0%	1.7
	LA	1%	2	2%	0	0%	2	2%	2%	0	0%	1.0
	NC	1%	1	1%	0	0%	1	2%	3%	0	0%	1.0
	SC	0%	1	1%	0	0%	1	3%	7%	0	0%	1.0
	VA	1%	1	2%	0	0%	1	3%	2%	0	0%	0.8
	WV	0%	0	1%	0	0%	1	1%	2%	0	0%	0.5
	IA	0%	1	1%	0	0%	2	1%	2%	0	0%	0.4
	WI	0%	1	2%	0	0%	2	1%	2%	0	0%	0.4
	MI	0%	1	1%	0	0%	1	0%	0%	0	0%	0.3
	PA	0%	1	1%	0	0%	1	1%	0%	0	0%	0.3
	MD	0%	0	1%	0	0%	0	0%	0%	0	0%	0.1
	MN	0%	0	0%	0	0%	0	0%	2%	0	0%	0.1
	NY	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	DE	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NJ	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor		CAMX Source Apportionment Modeling						CAMX State Zero-Out Modeling				
		Base Case: Total Number of Exceedances (grid-hours) = 110						Base Case: Total Number of Exceedances (grids-days) = 27				
Fairfield CT	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**NY**	21%	36	41%	110	100%	37	-10%	-14%	11	41%	22.5
	PA	23%	25	29%	108	98%	30	59%	57%	20	74%	21.2
	NJ	27%	21	24%	110	100%	28	47%	41%	27	100%	17.9
	VA	3%	7	8%	68	62%	7	10%	9%	8	30%	7.2
	OH	6%	7	7%	77	70%	10	15%	13%	9	33%	6.4
	MD	3%	7	8%	68	62%	7	9%	8%	5	19%	4.8
	WV	2%	3	3%	68	62%	3	7%	6%	2	7%	2.2
Contributions do not exceed screening criteria	**MI**	1%	4	5%	13	12%	4	3%	3%	0	0%	1.8
	NC	2%	2	2%	43	39%	3	3%	3%	0	0%	1.6
	DE	2%	2	2%	33	30%	3	3%	3%	0	0%	1.1
	IN	2%	2	2%	28	25%	3	3%	3%	0	0%	1.1
	IL	2%	2	2%	17	15%	2	3%	2%	0	0%	0.9
	KY	1%	2	2%	20	18%	3	2%	2%	0	0%	0.8
	WI	1%	2	2%	0	0%	2	1%	1%	0	0%	0.5
	MA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.4
	MO	1%	1	1%	0	0%	1	1%	1%	0	0%	0.3
	IA	1%	2	2%	0	0%	2	1%	1%	0	0%	0.2
	MN	0%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.2
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	AR	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	**CAMX Source Apportionment Modeling**							**CAMX State Zero-Out Modeling**				
	Base Case: Total Number of Exceedances (grid-hours) = 227							Base Case: Total Number of Exceedances (grids-days) = 31				
Middlesex CT	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**NY**	20%	18	21%	227	100%	25	35%	37%	31	100%	15.2
	PA	22%	23	25%	224	99%	28	46%	49%	29	94%	15.1
	NJ	23%	19	20%	227	100%	28	44%	46%	31	100%	13.7
	MA	1%	7	7%	23	10%	9	2%	2%	2	6%	7.0
	OH	5%	7	6%	110	48%	10	10%	14%	12	39%	6.7
	MD	4%	9	11%	182	80%	9	7%	7%	7	23%	5.3
	VA	3%	5	6%	101	44%	7	5%	6%	6	19%	4.0
Contributions do not exceed screening criteria	**WV**	2%	2	3%	92	41%	3	4%	5%	0	0%	1.9
	MI	1%	2	2%	32	14%	3	3%	2%	0	0%	1.7
	NC	1%	3	3%	76	33%	4	2%	2%	0	0%	1.4
	DE	2%	4	4%	82	36%	5	3%	3%	0	0%	1.3
	IN	2%	2	2%	41	18%	3	3%	3%	0	0%	1.2
	NH	0%	1	1%	0	0%	2	0%	0%	0	0%	1.1
	IL	1%	2	2%	23	10%	2	2%	3%	0	0%	1.0
	KY	1%	2	2%	17	7%	2	1%	2%	0	0%	0.8
	RI	0%	1	1%	0	0%	2	0%	0%	0	0%	0.5
	WI	0%	1	2%	0	0%	1	1%	1%	0	0%	0.5
	VT	0%	0	0%	0	0%	1	0%	0%	0	0%	0.4
	MO	0%	1	1%	0	0%	1	0%	1%	0	0%	0.3
	IA	0%	1	1%	0	0%	1	0%	1%	0	0%	0.2
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.2
	AR	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	GA	0%	0	1%	0	0%	0	0%	0%	0	0%	0.1
	ME	0%	0	0%	0	0%	1	0%	0%	0	0%	0.1
	MN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 178							Base Case: Total Number of Exceedances (grids-days) = 35				
New Haven CT	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**PA**	24%	24	27%	176	99%	28	51%	50%	35	100%	17.6
	NJ	24%	18	21%	178	100%	28	46%	46%	35	100%	15.2
	NY	20%	35	40%	178	100%	36	23%	24%	28	80%	13.8
	OH	6%	8	7%	117	66%	10	12%	14%	10	29%	6.8
	VA	4%	6	7%	103	58%	7	12%	11%	14	40%	6.1
	MD	4%	8	9%	139	78%	9	13%	12%	14	40%	5.4
	WV	2%	2	3%	85	48%	3	6%	6%	1	3%	2.1
Contributions do not exceed screening criteria	**MI**	1%	2	3%	24	13%	3	4%	4%	0	0%	1.8
	NC	2%	2	3%	57	32%	3	3%	3%	0	0%	1.6
	IN	2%	2	2%	38	21%	3	3%	4%	0	0%	1.2
	DE	2%	3	4%	46	26%	4	4%	3%	0	0%	1.0
	IL	2%	2	2%	24	13%	3	3%	3%	0	0%	1.0
	KY	1%	2	2%	22	12%	3	2%	2%	0	0%	0.8
	WI	1%	1	1%	0	0%	1	1%	1%	0	0%	0.5
	MA	0%	7	8%	6	3%	7	0%	0%	0	0%	0.4
	IA	0%	1	1%	0	0%	1	1%	1%	0	0%	0.3
	MO	0%	1	1%	0	0%	1	1%	1%	0	0%	0.3
	MN	0%	0	0%	0	0%	0	0%	1%	0	0%	0.2
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.2
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	NH	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	RI	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AR	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	1	1%	0	0%	1	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 149							Base Case: Total Number of Exceedances (grids-days) = 24				
Newcastle DE	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**MD**	48%	39	45%	149	100%	48	100%	100%	24	100%	33.6
	VA	7%	8	8%	105	70%	11	47%	33%	19	79%	17.0
	PA	8%	9	10%	107	72%	18	39%	51%	17	71%	15.3
	OH	8%	9	10%	128	86%	9	25%	20%	17	71%	5.4
	WV	4%	4	5%	81	54%	6	23%	17%	10	42%	4.3
	NC	3%	5	6%	63	42%	9	10%	5%	4	17%	3.5
	MI	2%	3	3%	54	36%	5	9%	10%	3	13%	3.3
Contributions do not exceed screening criteria	**NJ**	0%	1	2%	0	0%	2	2%	2%	0	0%	1.6
	IN	2%	3	3%	39	26%	3	6%	5%	0	0%	1.2
	IL	3%	4	4%	65	44%	4	6%	5%	0	0%	1.1
	IA	1%	2	2%	7	5%	2	4%	3%	0	0%	0.9
	KY	2%	2	3%	40	27%	4	4%	3%	0	0%	0.9
	NY	0%	1	1%	0	0%	1	1%	1%	0	0%	0.5
	MO	2%	2	2%	51	34%	2	2%	1%	0	0%	0.4
	WI	1%	1	1%	0	0%	1	2%	2%	0	0%	0.4
	CT	0%	0	1%	0	0%	0	0%	0%	0	0%	0.2
	MA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	AR	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	MN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	SC	0%	0	1%	0	0%	1	0%	0%	0	0%	0.1
	TN	1%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	FL	0%	0	0%	0	0%	1	0%	0%	0	0%	0.0
	GA	0%	0	0%	0	0%	1	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 8							Base Case: Total Number of Exceedances (grids-days) = 2				
Washington DC	Upwind State	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**VA**	11%	9	9%	8	100%	10	79%	79%	2	100%	18.7
	OH	5%	6	6%	7	88%	6	30%	30%	2	100%	6.6
	PA	7%	6	6%	8	100%	6	11%	11%	1	50%	2.7
	WV	2%	3	3%	4	50%	3	13%	13%	2	100%	2.3
Contributions do not exceed screening criteria	**IL**	3%	3	3%	4	50%	3	8%	8%	0	0%	1.7
	IN	2%	2	2%	1	13%	2	7%	7%	0	0%	1.3
	MI	2%	2	2%	0	0%	2	4%	4%	0	0%	0.9
	KY	0%	0	0%	0	0%	0	2%	2%	0	0%	0.8
	MO	2%	2	2%	0	0%	2	4%	4%	0	0%	0.7
	IA	0%	0	0%	0	0%	0	2%	2%	0	0%	0.6
	LA	2%	2	2%	0	0%	2	1%	1%	0	0%	0.4
	AR	1%	1	1%	0	0%	1	1%	1%	0	0%	0.2
	TN	0%	0	0%	0	0%	0	1%	1%	0	0%	0.2
	WI	0%	0	0%	0	0%	0	1%	1%	0	0%	0.2
	MS	1%	0	1%	0	0%	1	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	DE	1%	1	2%	0	0%	2	0%	0%	0	0%	0.0
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NJ	1%	2	2%	1	13%	2	0%	0%	0	0%	0.0
	NY	1%	1	1%	0	0%	1	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling						CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 1366						Base Case: Total Number of Exceedances (grids-days) = 199				
Fulton GA	Upwind State	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**AL**	4%	18	20%	550	40%	25	9%	6%	55	28%	22.2
	SC	2%	7	7%	390	29%	9	5%	4%	29	15%	8.2
	TN	5%	8	8%	1062	78%	10	11%	9%	80	40%	7.4
	NC	2%	5	5%	334	24%	6	4%	4%	36	18%	4.6
	KY	3%	6	6%	733	54%	7	5%	4%	24	12%	3.6
	VA	1%	2	2%	80	6%	3	2%	2%	4	2%	2.9
	WV	1%	3	3%	135	10%	3	2%	2%	9	5%	2.8
Contributions do not exceed screening criteria	**FL**	0%	5	5%	95	7%	6	1%	1%	15	8%	3.3
	MS	0%	2	2%	39	3%	3	1%	0%	2	1%	2.7
	AR	1%	2	2%	46	3%	3	1%	1%	0	0%	1.5
	OH	1%	3	3%	142	10%	4	1%	1%	0	0%	1.4
	PA	0%	2	3%	83	6%	3	0%	0%	0	0%	1.1
	IL	1%	2	2%	117	9%	2	1%	1%	0	0%	1.0
	IN	1%	2	2%	0	0%	2	1%	1%	0	0%	1.0
	MO	1%	2	2%	0	0%	2	1%	1%	0	0%	0.7
	LA	0%	0	1%	0	0%	1	0%	0%	0	0%	0.2
	MD	0%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	NY	0%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	IA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	NJ	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	WI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	DE	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 75							Base Case: Total Number of Exceedances (grids-days) = 33				
Lake IN	Upwind State	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**IL**	42%	40	45%	75	100%	47	92%	98%	31	94%	38.4
	MO	4%	4	4%	58	77%	4	30%	38%	24	73%	7.7
	OH	5%	15	18%	26	35%	15	2%	2%	3	9%	6.8
	WI	3%	3	4%	29	39%	6	8%	8%	5	15%	6.0
	IA	5%	8	9%	40	53%	8	15%	12%	12	36%	5.6
	PA	2%	11	12%	14	19%	11	1%	1%	2	6%	3.3
	MI	3%	6	7%	29	39%	7	2%	3%	1	3%	3.0
	TN	2%	2	2%	10	13%	2	7%	7%	2	6%	2.7
	VA	1%	3	3%	13	17%	3	1%	1%	2	6%	2.3
Contributions do not exceed screening criteria	**AR**	1%	2	2%	0	0%	2	9%	14%	4	12%	2.7
	AL	1%	2	2%	0	0%	2	6%	8%	0	0%	1.7
	GA	1%	2	2%	0	0%	2	6%	7%	0	0%	1.4
	WV	1%	2	2%	7	9%	2	1%	1%	0	0%	1.3
	LA	1%	2	2%	6	8%	2	2%	2%	0	0%	1.2
	MD	1%	3	3%	13	17%	3	1%	1%	0	0%	1.1
	KY	0%	0	1%	0	0%	1	2%	2%	0	0%	0.9
	MS	1%	1	1%	0	0%	1	3%	4%	0	0%	0.9
	NC	1%	2	2%	6	8%	2	1%	1%	0	0%	0.9
	MN	0%	1	1%	0	0%	1	0%	0%	0	0%	0.6
	FL	0%	1	1%	0	0%	1	0%	0%	0	0%	0.4
	NY	0%	3	4%	1	1%	3	0%	0%	0	0%	0.3
	SC	0%	1	1%	0	0%	1	1%	1%	0	0%	0.3
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	DE	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NJ	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 237							Base Case: Total Number of Exceedances (grids-days) = 55				
Anne Arundel MD	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**VA**	9%	16	18%	227	96%	18	61%	59%	49	89%	34.7
	OH	8%	10	10%	206	87%	12	26%	23%	35	64%	7.1
	PA	5%	11	13%	163	69%	13	18%	21%	28	51%	6.0
	WV	3%	4	5%	126	53%	5	13%	12%	13	24%	5.1
	NC	1%	5	6%	38	16%	10	3%	2%	5	9%	3.9
	MI	2%	3	4%	77	32%	3	5%	5%	4	7%	2.8
Contributions do not exceed screening criteria	**WI**	1%	3	4%	37	16%	4	3%	4%	0	0%	2.0
	IL	3%	4	4%	106	45%	5	6%	5%	0	0%	1.6
	IN	2%	3	3%	95	40%	3	5%	4%	0	0%	1.5
	KY	2%	3	3%	95	40%	4	3%	2%	0	0%	1.5
	NJ	0%	1	2%	0	0%	1	1%	1%	0	0%	0.8
	IA	1%	1	2%	0	0%	2	2%	2%	0	0%	0.6
	MO	2%	2	2%	69	29%	3	2%	1%	0	0%	0.6
	DE	0%	1	1%	0	0%	1	0%	1%	0	0%	0.5
	MN	0%	1	1%	0	0%	1	1%	1%	0	0%	0.5
	NY	0%	1	1%	0	0%	1	1%	1%	0	0%	0.5
	LA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.3
	MA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.3
	CT	0%	0	1%	0	0%	0	0%	0%	0	0%	0.2
	FL	0%	0	0%	0	0%	1	0%	0%	0	0%	0.2
	TN	1%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	AR	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	GA	0%	0	0%	0	0%	1	0%	0%	0	0%	0.1
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	SC	0%	0	1%	0	0%	1	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 296							Base Case: Total Number of Exceedances (grids-days) = 68				
Baltimore MD	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**VA**	10%	15	17%	269	91%	17	50%	44%	55	81%	24.8
	PA	7%	7	8%	234	79%	10	30%	24%	52	76%	18.4
	NC	3%	13	14%	61	21%	15	8%	5%	10	15%	10.4
	OH	4%	9	10%	157	53%	11	17%	16%	23	34%	6.2
	WV	2%	5	6%	73	25%	6	12%	9%	6	9%	5.6
	MI	1%	3	3%	60	20%	3	6%	6%	1	1%	3.0
Contributions do not exceed screening criteria	**WI**	1%	3	4%	10	3%	4	3%	3%	0	0%	2.0
	DE	1%	2	2%	20	7%	3	2%	1%	0	0%	1.6
	IL	2%	4	4%	77	26%	4	5%	5%	0	0%	1.5
	KY	0%	3	4%	20	7%	4	1%	1%	0	0%	1.4
	NJ	1%	2	2%	21	7%	3	2%	1%	0	0%	1.3
	IN	1%	3	3%	37	13%	3	4%	3%	0	0%	1.2
	SC	0%	2	2%	20	7%	4	1%	0%	0	0%	0.9
	IA	0%	1	2%	0	0%	2	1%	1%	0	0%	0.7
	MO	1%	2	3%	26	9%	3	2%	2%	0	0%	0.7
	MN	0%	1	1%	0	0%	1	1%	1%	0	0%	0.6
	NY	1%	1	2%	0	0%	2	1%	1%	0	0%	0.6
	LA	1%	1	1%	0	0%	2	1%	1%	0	0%	0.5
	MA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.3
	AR	0%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	CT	0%	0	1%	0	0%	0	0%	0%	0	0%	0.2
	FL	0%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	MS	0%	0	0%	0	0%	1	0%	0%	0	0%	0.2
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	GA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	TN	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 210							Base Case: Total Number of Exceedances (grids-days) = 31				
Cecil MD	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**PA**	9%	18	21%	167	80%	21	43%	46%	26	84%	17.2
	VA	6%	14	16%	129	61%	15	40%	37%	23	74%	14.2
	OH	7%	9	10%	159	76%	10	20%	20%	16	52%	5.4
	WV	3%	5	5%	77	37%	6	16%	17%	8	26%	4.8
	MI	2%	3	3%	73	35%	4	7%	7%	3	10%	3.0
	NC	2%	4	5%	55	26%	8	4%	4%	2	6%	2.3
Contributions do not exceed screening criteria	**IL**	3%	4	4%	75	36%	4	5%	5%	0	0%	1.2
	IN	2%	3	3%	96	46%	3	5%	4%	0	0%	1.2
	KY	2%	3	3%	48	23%	4	3%	3%	0	0%	1.2
	IA	1%	2	2%	0	0%	2	3%	2%	0	0%	0.9
	DE	0%	1	1%	3	1%	3	1%	1%	0	0%	0.7
	NJ	0%	1	2%	0	0%	2	1%	1%	0	0%	0.7
	NY	0%	1	1%	0	0%	1	1%	1%	0	0%	0.5
	MO	1%	2	2%	64	30%	3	2%	1%	0	0%	0.4
	LA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.3
	MA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.3
	WI	1%	3	4%	3	1%	3	1%	1%	0	0%	0.3
	CT	0%	0	1%	0	0%	0	0%	0%	0	0%	0.2
	FL	0%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	AR	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	GA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	MN	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	SC	0%	0	1%	0	0%	1	0%	0%	0	0%	0.1
	TN	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 187							Base Case: Total Number of Exceedances (grids-days) = 36				
Harford MD	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**PA**	9%	12	14%	156	83%	16	38%	36%	27	75%	17.5
	VA	7%	14	15%	104	56%	17	41%	36%	21	58%	15.7
	WV	2%	6	6%	29	16%	6	11%	10%	4	11%	5.9
	OH	6%	9	11%	139	74%	11	17%	18%	13	36%	4.7
	NC	1%	4	5%	33	18%	5	4%	5%	3	8%	3.0
	MI	2%	5	5%	83	44%	5	6%	7%	2	6%	2.4
Contributions do not exceed screening criteria	**KY**	1%	3	4%	24	13%	4	2%	2%	0	0%	1.6
	WI	1%	3	4%	17	9%	4	2%	3%	0	0%	1.6
	IL	2%	4	4%	68	36%	4	4%	5%	0	0%	1.3
	IN	1%	2	3%	41	22%	3	4%	4%	0	0%	1.0
	IA	1%	2	2%	0	0%	2	2%	2%	0	0%	0.8
	NJ	0%	1	2%	0	0%	2	1%	1%	0	0%	0.8
	MN	0%	1	1%	0	0%	1	1%	1%	0	0%	0.5
	MO	1%	2	3%	31	17%	3	1%	1%	0	0%	0.5
	NY	0%	1	1%	0	0%	1	1%	1%	0	0%	0.5
	LA	0%	1	1%	0	0%	2	1%	0%	0	0%	0.4
	FL	0%	1	1%	0	0%	1	0%	0%	0	0%	0.3
	MA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.3
	CT	0%	0	1%	0	0%	0	0%	0%	0	0%	0.2
	DE	0%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	GA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	SC	0%	0	1%	0	0%	1	0%	0%	0	0%	0.2
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AR	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	TN	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 210							Base Case: Total Number of Exceedances (grids-days) = 30				
Kent MD	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**VA**	8%	14	16%	159	76%	16	48%	50%	21	70%	26.4
	PA	5%	9	10%	140	67%	13	15%	15%	14	47%	9.5
	OH	10%	9	10%	188	90%	12	24%	25%	24	80%	6.0
	NC	3%	7	7%	58	28%	10	6%	6%	7	23%	4.2
	WV	4%	4	5%	124	59%	5	15%	16%	14	47%	4.0
	MI	2%	4	5%	49	23%	5	4%	4%	3	10%	2.6
Contributions do not exceed screening criteria	**IN**	3%	3	3%	123	59%	3	6%	6%	0	0%	1.5
	IL	3%	3	4%	91	43%	5	5%	6%	0	0%	1.4
	KY	2%	3	3%	100	48%	4	3%	2%	0	0%	0.9
	IA	1%	1	2%	0	0%	2	2%	2%	0	0%	0.8
	NJ	0%	2	2%	0	0%	2	1%	1%	0	0%	0.8
	MO	1%	2	2%	62	30%	3	1%	2%	0	0%	0.5
	NY	0%	1	1%	0	0%	1	1%	0%	0	0%	0.5
	DE	0%	1	1%	0	0%	1	0%	0%	0	0%	0.3
	MA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.3
	WI	1%	2	2%	1	0%	3	1%	1%	0	0%	0.3
	CT	0%	0	1%	0	0%	0	0%	0%	0	0%	0.2
	MN	0%	0	1%	0	0%	1	0%	0%	0	0%	0.2
	AR	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	SC	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	TN	1%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	FL	0%	0	1%	0	0%	1	0%	0%	0	0%	0.0
	GA	0%	0	0%	0	0%	1	0%	0%	0	0%	0.0
	LA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) =					176		Base Case: Total Number of Exceedances (grids-days) =				
Prince Georges MD	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**VA**	9%	16	19%	150	85%	16	77%	71%	48	91%	43.7
	PA	7%	7	7%	144	82%	10	20%	19%	33	62%	8.2
	OH	6%	10	11%	112	64%	11	23%	21%	29	55%	8.0
	WV	2%	4	5%	51	29%	4	11%	11%	8	15%	4.6
	MI	3%	3	3%	99	56%	4	6%	5%	2	4%	2.3
Contributions do not exceed screening criteria	**WI**	1%	3	4%	5	3%	3	4%	3%	1	2%	2.0
	NC	0%	6	6%	3	2%	7	2%	3%	5	9%	3.4
	IL	3%	4	4%	130	74%	4	7%	7%	0	0%	1.8
	KY	1%	3	3%	32	18%	4	2%	2%	0	0%	1.5
	DE	0%	1	2%	0	0%	2	1%	1%	0	0%	1.4
	NJ	0%	2	2%	2	1%	2	1%	1%	0	0%	1.4
	IN	2%	3	3%	32	18%	3	4%	4%	0	0%	1.3
	IA	1%	1	2%	0	0%	2	2%	2%	0	0%	0.7
	MO	2%	2	3%	29	16%	3	2%	2%	0	0%	0.7
	MN	0%	1	1%	0	0%	1	1%	1%	0	0%	0.6
	NY	0%	2	2%	0	0%	2	1%	1%	0	0%	0.6
	LA	1%	1	1%	0	0%	2	1%	1%	0	0%	0.5
	AR	0%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.2
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.2
	MS	0%	0	0%	0	0%	1	0%	0%	0	0%	0.2
	TN	0%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	SC	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 82							Base Case: Total Number of Exceedances (grids-days) = 10				
Bergen NJ	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**PA**	31%	33	34%	82	100%	37	92%	97%	10	100%	26.5
	VA	4%	9	9%	48	59%	9	21%	21%	5	50%	8.0
	OH	5%	7	7%	52	63%	9	23%	25%	6	60%	5.2
	MD	4%	7	7%	50	61%	9	12%	15%	3	30%	2.8
	MI	2%	6	6%	17	21%	6	5%	10%	1	10%	2.4
Contributions do not exceed screening criteria	**DE**	3%	4	5%	37	45%	5	6%	8%	0	0%	2.0
	WV	2%	3	3%	35	43%	3	13%	16%	0	0%	1.9
	NC	2%	2	2%	22	27%	3	8%	12%	0	0%	1.5
	IN	1%	2	2%	16	20%	3	5%	6%	0	0%	0.9
	KY	1%	2	2%	18	22%	3	3%	3%	0	0%	0.8
	WI	1%	1	1%	0	0%	2	2%	4%	0	0%	0.8
	IA	1%	2	2%	7	9%	2	2%	3%	0	0%	0.6
	IL	2%	2	2%	12	15%	2	4%	5%	0	0%	0.6
	MN	0%	0	0%	0	0%	0	1%	1%	0	0%	0.3
	MO	1%	1	1%	0	0%	1	1%	1%	0	0%	0.2
	FL	0%	0	1%	0	0%	0	0%	0%	0	0%	0.1
	NY	3%	9	10%	20	24%	11	-5%	-11%	0	0%	0.1
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	AR	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 106							Base Case: Total Number of Exceedances (grids-days) = 37				
Camden NJ	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**PA**	26%	30	35%	104	98%	39	71%	67%	33	89%	27.2
	MD	21%	27	29%	99	93%	32	45%	50%	28	76%	18.3
	VA	4%	6	7%	48	45%	8	16%	14%	16	43%	8.4
	DE	15%	13	15%	106	100%	16	42%	42%	34	92%	8.2
	OH	6%	8	9%	81	76%	8	16%	13%	15	41%	4.6
	MI	3%	4	5%	45	42%	6	11%	11%	9	24%	4.3
	WV	2%	4	4%	36	34%	5	9%	7%	6	16%	3.7
	NC	2%	5	5%	30	28%	6	4%	3%	3	8%	2.6
Contributions do not exceed screening criteria	**WI**	1%	2	3%	3	3%	2	3%	3%	0	0%	1.3
	IL	3%	3	4%	47	44%	4	4%	4%	0	0%	1.2
	IA	1%	2	2%	27	25%	2	3%	2%	0	0%	1.1
	NY	0%	2	2%	1	1%	2	2%	2%	0	0%	1.1
	IN	2%	2	3%	8	8%	2	4%	3%	0	0%	1.0
	KY	1%	2	2%	14	13%	3	1%	1%	0	0%	0.5
	MN	0%	0	1%	0	0%	0	1%	1%	0	0%	0.4
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.3
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.3
	MO	1%	2	2%	0	0%	2	1%	1%	0	0%	0.3
	SC	0%	0	1%	0	0%	0	0%	0%	0	0%	0.3
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.2
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	TN	0%	0	0%	0	0%	1	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	AR	0%	1	1%	0	0%	1	0%	0%	0	0%	0.0
	FL	0%	0	0%	0	0%	1	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 55							Base Case: Total Number of Exceedances (grids-days) = 18				
Cumberland NJ	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**PA**	9%	34	40%	35	64%	37	85%	92%	13	72%	23.4
	MD	34%	30	35%	51	93%	35	83%	80%	15	83%	18.1
	VA	6%	8	10%	25	45%	10	37%	20%	5	28%	15.5
	DE	8%	8	9%	48	87%	11	86%	90%	11	61%	8.8
	NC	4%	6	7%	20	36%	8	17%	12%	4	22%	5.2
	WV	3%	4	4%	21	38%	4	27%	18%	5	28%	4.0
	OH	9%	8	9%	51	93%	9	74%	62%	14	78%	3.8
	MI	2%	2	2%	12	22%	3	30%	38%	3	17%	2.2
Contributions do not exceed screening criteria	**NY**	0%	2	3%	2	4%	3	4%	6%	0	0%	1.3
	IL	4%	4	4%	31	56%	4	30%	28%	0	0%	1.2
	IA	2%	2	2%	0	0%	2	18%	20%	0	0%	0.9
	KY	2%	2	2%	10	18%	3	9%	6%	0	0%	0.8
	IN	2%	2	2%	1	2%	2	18%	16%	0	0%	0.7
	WI	1%	1	1%	0	0%	1	13%	14%	0	0%	0.5
	MO	2%	2	2%	0	0%	2	8%	8%	0	0%	0.4
	FL	0%	0	1%	0	0%	1	0%	0%	0	0%	0.1
	MN	0%	0	0%	0	0%	0	3%	2%	0	0%	0.1
	SC	0%	0	1%	0	0%	1	1%	0%	0	0%	0.1
	TN	1%	1	1%	0	0%	1	1%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	AR	1%	1	1%	0	0%	1	1%	0%	0	0%	0.0
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 85							Base Case: Total Number of Exceedances (grids-days) = 26				
Gloucester NJ	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**PA**	14%	40	47%	65	76%	42	66%	62%	19	73%	25.3
	MD	32%	33	36%	81	95%	39	69%	72%	23	88%	24.7
	DE	13%	14	16%	80	94%	19	65%	62%	23	88%	15.8
	VA	5%	6	7%	44	52%	8	23%	22%	12	46%	9.0
	OH	7%	6	7%	75	88%	7	17%	14%	18	69%	4.4
	WV	3%	4	5%	38	45%	5	12%	11%	7	27%	3.9
	MI	3%	4	4%	37	44%	5	12%	10%	8	31%	3.6
	NC	3%	5	5%	38	45%	6	5%	4%	2	8%	2.1
Contributions do not exceed screening criteria	**IL**	3%	3	4%	37	44%	4	6%	5%	0	0%	1.2
	IA	2%	2	2%	10	12%	2	4%	3%	0	0%	1.0
	IN	2%	2	2%	9	11%	2	5%	4%	0	0%	0.9
	NY	0%	2	2%	1	1%	2	1%	1%	0	0%	0.8
	KY	2%	2	2%	23	27%	3	2%	2%	0	0%	0.7
	WI	1%	1	1%	0	0%	1	3%	2%	0	0%	0.5
	MO	1%	2	2%	0	0%	2	1%	1%	0	0%	0.3
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.2
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	MN	0%	0	0%	0	0%	0	1%	1%	0	0%	0.1
	TN	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	AR	0%	1	1%	0	0%	1	0%	0%	0	0%	0.0
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	FL	0%	0	0%	0	0%	1	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 47							Base Case: Total Number of Exceedances (grids-days) = 5				
Hudson NJ	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**PA**	29%	32	32%	47	100%	37	100%	100%	5	100%	22.1
	MD	4%	7	7%	20	43%	8	16%	18%	2	40%	4.0
	NY	3%	6	6%	15	32%	8	-21%	-39%	1	20%	3.1
	VA	2%	7	8%	18	38%	8	12%	13%	2	40%	2.9
	MI	3%	6	6%	24	51%	7	14%	14%	2	40%	2.7
	OH	3%	5	5%	18	38%	6	12%	13%	2	40%	2.3
Contributions do not exceed screening criteria	**WV**	1%	3	3%	14	30%	3	8%	9%	0	0%	1.9
	DE	2%	5	5%	18	38%	6	7%	7%	0	0%	1.7
	NC	1%	3	3%	13	28%	3	7%	8%	0	0%	1.7
	WI	1%	1	1%	0	0%	1	4%	4%	0	0%	0.7
	IA	1%	2	2%	9	19%	2	3%	3%	0	0%	0.6
	IL	2%	3	3%	13	28%	3	4%	5%	0	0%	0.6
	IN	1%	2	2%	2	4%	2	4%	4%	0	0%	0.5
	KY	1%	2	2%	3	6%	2	1%	1%	0	0%	0.3
	MN	0%	0	0%	0	0%	0	1%	1%	0	0%	0.2
	MO	1%	1	1%	0	0%	1	1%	1%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	AR	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	FL	0%	0	1%	0	0%	0	0%	0%	0	0%	0.0
	GA	0%	0	1%	0	0%	0	0%	0%	0	0%	0.0
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 149							Base Case: Total Number of Exceedances (grids-days) = 35				
Hunterdon NJ	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**PA**	55%	42	48%	149	100%	52	97%	95%	35	100%	36.9
	VA	2%	10	12%	22	15%	11	12%	15%	6	17%	9.8
	MD	4%	10	12%	68	46%	13	14%	15%	8	23%	7.6
	OH	3%	7	8%	49	33%	8	13%	13%	6	17%	5.2
	DE	5%	7	8%	115	77%	8	14%	14%	8	23%	4.5
	MI	3%	4	4%	72	48%	4	10%	9%	3	9%	4.5
	WV	1%	4	4%	13	9%	4	6%	7%	4	11%	2.4
Contributions do not exceed screening criteria	**NY**	2%	2	2%	35	23%	5	8%	9%	0	0%	2.0
	IN	1%	2	3%	11	7%	3	3%	4%	0	0%	1.1
	KY	1%	3	3%	11	7%	3	2%	3%	0	0%	1.1
	NC	0%	2	3%	9	6%	3	3%	4%	0	0%	1.0
	WI	1%	2	2%	11	7%	2	4%	4%	0	0%	1.0
	IA	1%	1	1%	0	0%	1	1%	1%	0	0%	0.9
	IL	1%	2	2%	1	1%	2	4%	4%	0	0%	0.8
	MN	0%	0	1%	0	0%	0	1%	1%	0	0%	0.3
	MO	0%	1	1%	0	0%	1	1%	1%	0	0%	0.3
	FL	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	GA	0%	0	1%	0	0%	0	0%	0%	0	0%	0.1
	LA	0%	0	0%	0	0%	1	0%	0%	0	0%	0.1
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	AR	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 89							Base Case: Total Number of Exceedances (grids-days) = 17				
Mercer NJ	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**PA**	46%	44	45%	89	100%	51	87%	90%	17	100%	39.1
	MD	10%	13	15%	60	67%	20	16%	18%	6	35%	11.7
	DE	7%	8	9%	81	91%	10	10%	11%	5	29%	4.7
	MI	3%	6	6%	39	44%	7	8%	9%	4	24%	4.1
	VA	2%	5	5%	32	36%	7	6%	6%	4	24%	3.9
	OH	4%	5	6%	66	74%	7	6%	7%	3	18%	2.9
	WV	2%	4	4%	24	27%	4	4%	4%	4	24%	2.6
	NY	1%	3	3%	14	16%	3	4%	4%	1	6%	2.4
Contributions do not exceed screening criteria	**NC**	1%	4	4%	24	27%	5	2%	3%	0	0%	1.8
	IA	1%	2	2%	16	18%	2	2%	2%	0	0%	0.9
	IL	2%	3	3%	19	21%	3	3%	3%	0	0%	0.9
	IN	1%	2	2%	3	3%	2	2%	2%	0	0%	0.6
	KY	1%	2	2%	10	11%	3	1%	1%	0	0%	0.6
	WI	1%	2	2%	0	0%	2	2%	2%	0	0%	0.6
	MO	1%	2	2%	0	0%	2	1%	1%	0	0%	0.2
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	MN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	AR	0%	0	1%	0	0%	1	0%	0%	0	0%	0.0
	FL	0%	0	0%	0	0%	1	0%	0%	0	0%	0.0
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor		CAMX Source Apportionment Modeling						CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 175							Base Case: Total Number of Exceedances (grids-days) = 37				
Middlesex NJ	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**PA**	39%	34	40%	175	100%	46	72%	72%	34	92%	31.2
	VA	2%	4	4%	44	25%	6	6%	6%	11	30%	7.6
	MD	5%	11	12%	92	53%	14	9%	8%	12	32%	6.8
	MI	3%	6	6%	85	49%	7	6%	6%	7	19%	3.9
	DE	4%	5	6%	94	54%	8	5%	5%	5	14%	2.9
	NY	2%	4	4%	45	26%	6	5%	5%	7	19%	2.9
	OH	3%	5	5%	99	57%	7	5%	5%	5	14%	2.7
	WV	1%	3	3%	41	23%	4	3%	3%	2	5%	2.0
Contributions do not exceed screening criteria	**NC**	1%	3	3%	39	22%	4	2%	2%	0	0%	1.7
	IA	1%	2	2%	31	18%	2	1%	1%	0	0%	0.7
	IL	2%	3	3%	39	22%	3	2%	2%	0	0%	0.7
	IN	1%	2	2%	5	3%	2	2%	1%	0	0%	0.7
	WI	1%	1	1%	0	0%	1	1%	1%	0	0%	0.6
	KY	1%	2	2%	16	9%	3	1%	1%	0	0%	0.4
	MN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.2
	MO	1%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	AR	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 341							Base Case: Total Number of Exceedances (grids-days) = 65				
Monmouth NJ	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**PA**	37%	33	38%	339	99%	50	66%	65%	63	97%	35.4
	MD	9%	14	14%	244	72%	23	13%	13%	33	51%	10.1
	DE	6%	7	7%	278	82%	10	10%	10%	20	31%	5.1
	VA	3%	6	6%	131	38%	8	7%	7%	11	17%	5.1
	NY	1%	7	8%	37	11%	8	4%	4%	9	14%	4.6
	OH	4%	6	7%	210	62%	7	5%	5%	11	17%	3.9
	MI	2%	5	5%	103	30%	6	5%	4%	9	14%	3.2
	WV	1%	3	3%	80	23%	4	4%	4%	3	5%	2.4
Contributions do not exceed screening criteria	**NC**	1%	4	4%	84	25%	5	2%	2%	0	0%	1.8
	IN	1%	2	2%	7	2%	2	2%	2%	0	0%	0.9
	IA	1%	2	2%	44	13%	2	1%	1%	0	0%	0.8
	IL	2%	3	3%	91	27%	3	2%	2%	0	0%	0.8
	WI	1%	1	2%	0	0%	1	1%	1%	0	0%	0.5
	MA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.4
	CT	0%	1	1%	0	0%	1	0%	0%	0	0%	0.3
	KY	1%	1	1%	23	7%	3	1%	1%	0	0%	0.3
	SC	0%	1	1%	0	0%	1	0%	0%	0	0%	0.3
	MN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.2
	MO	1%	1	1%	0	0%	2	0%	0%	0	0%	0.2
	FL	0%	0	0%	0	0%	1	0%	0%	0	0%	0.1
	GA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	AR	0%	0	0%	0	0%	1	0%	0%	0	0%	0.0
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 223							Base Case: Total Number of Exceedances (grids-days) = 45				
Morris NJ	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**PA**	42%	34	39%	223	100%	52	80%	79%	45	100%	33.3
	VA	4%	9	10%	83	37%	10	21%	22%	15	33%	9.2
	MD	4%	8	9%	75	34%	11	11%	10%	15	33%	6.5
	OH	4%	8	9%	96	43%	10	11%	11%	11	24%	5.8
	DE	3%	5	6%	124	56%	7	9%	8%	10	22%	3.4
	MI	2%	6	7%	45	20%	7	5%	5%	4	9%	3.3
	NY	2%	4	5%	105	47%	7	5%	6%	3	7%	3.3
	WV	1%	3	4%	42	19%	3	6%	6%	2	4%	2.0
Contributions do not exceed screening criteria	**NC**	1%	2	2%	13	6%	3	3%	3%	0	0%	1.3
	IN	1%	2	3%	35	16%	3	2%	2%	0	0%	1.1
	KY	1%	3	3%	36	16%	4	2%	2%	0	0%	1.1
	WI	1%	2	2%	0	0%	2	2%	2%	0	0%	1.0
	IL	1%	2	3%	24	11%	3	2%	2%	0	0%	0.8
	IA	1%	2	3%	4	2%	2	1%	1%	0	0%	0.7
	MN	0%	0	0%	0	0%	0	1%	1%	0	0%	0.3
	MO	0%	1	1%	0	0%	1	1%	1%	0	0%	0.3
	FL	0%	0	1%	0	0%	0	0%	0%	0	0%	0.1
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	AR	0%	0	1%	0	0%	0	0%	0%	0	0%	0.0
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 406							Base Case: Total Number of Exceedances (grids-days) = 77				
Ocean NJ	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**PA**	35%	32	38%	406	100%	49	81%	82%	72	94%	31.6
	MD	14%	19	20%	353	87%	26	25%	29%	48	62%	12.4
	VA	3%	7	7%	198	49%	9	12%	14%	30	39%	11.6
	NC	1%	5	5%	78	19%	6	3%	3%	7	9%	7.1
	DE	10%	9	10%	396	98%	12	23%	23%	61	79%	6.5
	OH	5%	7	7%	304	75%	8	10%	9%	26	34%	4.0
	WV	2%	4	4%	101	25%	4	6%	6%	8	10%	3.6
	MI	3%	4	4%	167	41%	6	6%	6%	12	16%	3.5
Contributions do not exceed screening criteria	**NY**	0%	3	4%	2	0%	3	2%	2%	1	1%	3.1
	IL	3%	3	3%	194	48%	4	3%	3%	0	0%	1.0
	IA	1%	2	2%	77	19%	2	2%	2%	0	0%	0.9
	IN	2%	2	2%	19	5%	2	3%	2%	0	0%	0.9
	WI	1%	2	2%	0	0%	2	2%	1%	0	0%	0.6
	MA	0%	1	1%	0	0%	1	0%	1%	0	0%	0.5
	CT	0%	1	1%	0	0%	1	0%	0%	0	0%	0.4
	KY	1%	2	2%	17	4%	3	1%	1%	0	0%	0.4
	SC	0%	1	1%	0	0%	1	0%	0%	0	0%	0.4
	FL	0%	0	1%	0	0%	1	0%	0%	0	0%	0.2
	GA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	MN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.2
	MO	1%	1	2%	0	0%	2	1%	1%	0	0%	0.2
	TN	0%	0	0%	0	0%	1	0%	0%	0	0%	0.2
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AR	0%	0	1%	0	0%	1	0%	0%	0	0%	0.0
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 73							Base Case: Total Number of Exceedances (grids-days) = 13				
Erie NY	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**PA**	5%	13	15%	16	22%	15	1%	0%	1	8%	7.1
	WI	7%	6	7%	57	78%	7	54%	67%	12	92%	5.5
	NJ	2%	6	7%	16	22%	6	1%	0%	1	8%	4.1
	MD	3%	8	9%	16	22%	10	1%	0%	1	8%	3.8
	VA	2%	6	7%	16	22%	7	1%	0%	1	8%	3.0
	IL	4%	4	4%	57	78%	7	19%	20%	2	15%	2.9
	MI	4%	3	4%	56	77%	6	31%	39%	5	38%	2.5
Contributions do not exceed screening criteria	**DE**	1%	2	3%	16	22%	3	1%	0%	0	0%	1.5
	NC	1%	3	4%	16	22%	5	1%	0%	0	0%	1.2
	MO	3%	2	3%	40	55%	3	14%	17%	0	0%	1.1
	IA	3%	2	3%	53	73%	3	12%	14%	0	0%	1.0
	AR	1%	1	1%	0	0%	1	5%	6%	0	0%	0.5
	CT	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	MA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	MN	0%	0	0%	0	0%	1	2%	2%	0	0%	0.1
	OH	0%	0	0%	0	0%	0	1%	1%	0	0%	0.1
	SC	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	TN	0%	0	0%	0	0%	0	1%	1%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	IN	0%	0	0%	0	0%	0	1%	1%	0	0%	0.0
	KY	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	WV	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 81							Base Case: Total Number of Exceedances (grids-days) = 14				
Putnam NY	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**NJ**	40%	38	40%	81	100%	53	99%	99%	14	100%	28.8
	PA	20%	20	21%	81	100%	27	54%	64%	13	93%	15.2
	VA	6%	7	8%	47	58%	8	29%	29%	7	50%	7.3
	MD	5%	7	7%	47	58%	9	13%	13%	7	50%	3.4
Contributions do not exceed screening criteria	**DE**	2%	3	3%	41	51%	4	6%	7%	0	0%	1.6
	OH	2%	3	3%	47	58%	3	5%	5%	0	0%	1.3
	WV	1%	1	1%	0	0%	1	4%	4%	0	0%	0.9
	MI	1%	1	2%	0	0%	2	5%	5%	0	0%	0.8
	NC	1%	1	1%	0	0%	1	2%	1%	0	0%	0.4
	WI	1%	1	1%	0	0%	1	3%	3%	0	0%	0.4
	CT	0%	0	0%	0	0%	1	0%	0%	0	0%	0.2
	IA	0%	0	0%	0	0%	0	1%	1%	0	0%	0.2
	IL	1%	1	1%	0	0%	1	2%	2%	0	0%	0.2
	IN	0%	0	1%	0	0%	1	1%	1%	0	0%	0.2
	KY	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	MN	0%	0	0%	0	0%	0	1%	1%	0	0%	0.1
	MO	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	AR	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 66							Base Case: Total Number of Exceedances (grids-days) = 8				
Richmond NY	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**NJ**	42%	56	59%	66	100%	61	72%	74%	7	88%	40.3
	PA	28%	32	37%	66	100%	37	62%	56%	6	75%	21.7
	VA	2%	7	8%	22	33%	7	7%	7%	4	50%	5.6
	MD	5%	10	12%	38	58%	11	8%	8%	3	38%	4.8
	MI	2%	5	5%	27	41%	6	5%	5%	2	25%	2.7
	DE	3%	6	5%	28	42%	7	4%	4%	1	13%	2.3
	OH	3%	5	5%	35	53%	6	5%	4%	1	13%	2.0
Contributions do not exceed screening criteria	**WV**	1%	3	3%	15	23%	3	3%	3%	0	0%	1.9
	NC	1%	3	3%	15	23%	4	3%	2%	0	0%	1.8
	IL	2%	3	2%	14	21%	3	2%	1%	0	0%	0.7
	IA	1%	2	2%	9	14%	2	1%	1%	0	0%	0.6
	WI	1%	1	1%	0	0%	1	1%	1%	0	0%	0.5
	IN	1%	2	1%	0	0%	2	1%	1%	0	0%	0.4
	KY	1%	2	2%	4	6%	2	0%	0%	0	0%	0.3
	MN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.2
	FL	0%	0	1%	0	0%	1	0%	0%	0	0%	0.1
	GA	0%	0	1%	0	0%	0	0%	0%	0	0%	0.1
	MO	1%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	AR	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 1337							Base Case: Total Number of Exceedances (grids-days) = 177				
Suffolk NY	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**NJ**	29%	23	26%	1337	100%	64	69%	65%	177	100%	46.5
	PA	21%	28	29%	1324	99%	38	41%	40%	164	93%	22.7
	CT	2%	5	5%	339	25%	23	9%	6%	41	23%	14.6
	VA	3%	9	8%	492	37%	12	8%	6%	36	20%	8.5
	MD	7%	12	14%	1004	75%	15	12%	10%	99	56%	6.6
	DE	4%	5	6%	873	65%	8	8%	6%	44	25%	5.1
	NC	1%	5	5%	310	23%	7	3%	2%	14	8%	3.7
	OH	2%	4	5%	405	30%	6	4%	5%	25	14%	3.6
	MA	1%	2	2%	82	6%	6	1%	0%	1	1%	2.6
	WV	1%	2	2%	237	18%	3	3%	3%	9	5%	2.4
	MI	2%	4	4%	302	23%	5	3%	4%	6	3%	2.2
Contributions do not exceed screening criteria	**WI**	1%	1	1%	0	0%	2	1%	2%	0	0%	1.1
	IN	1%	1	1%	0	0%	2	1%	2%	0	0%	0.9
	IA	1%	2	2%	41	3%	2	1%	1%	0	0%	0.7
	IL	1%	2	2%	215	16%	3	1%	2%	0	0%	0.6
	MN	0%	0	0%	0	0%	1	1%	1%	0	0%	0.6
	KY	1%	1	1%	0	0%	2	0%	1%	0	0%	0.4
	RI	0%	1	1%	0	0%	2	0%	0%	0	0%	0.3
	MO	0%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	NH	0%	0	0%	0	0%	1	0%	0%	0	0%	0.2
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AR	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	GA	0%	0	0%	0	0%	1	0%	0%	0	0%	0.1
	ME	0%	0	0%	0	0%	1	0%	0%	0	0%	0.1
	SC	0%	0	0%	0	0%	1	0%	0%	0	0%	0.1
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	FL	0%	1	1%	0	0%	1	0%	0%	0	0%	0.0
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 62							Base Case: Total Number of Exceedances (grids-days) = 16				
Westchester NY	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**NJ**	33%	47	50%	62	100%	54	58%	8%	14	88%	28.0
	PA	28%	26	27%	62	100%	31	70%	79%	15	94%	21.6
	VA	5%	8	8%	45	73%	9	14%	22%	7	44%	7.9
	OH	7%	7	8%	50	81%	10	15%	19%	8	50%	5.9
	MD	4%	7	7%	45	73%	8	8%	13%	4	25%	3.1
	MI	1%	4	5%	4	6%	5	3%	2%	1	6%	2.2
	WV	2%	3	3%	39	63%	3	7%	12%	1	6%	2.1
Contributions do not exceed screening criteria	**NC**	2%	2	2%	22	35%	3	4%	10%	0	0%	1.8
	DE	2%	3	4%	22	35%	4	4%	6%	0	0%	1.7
	WI	1%	1	1%	0	0%	1	2%	2%	0	0%	1.1
	IN	2%	2	2%	21	34%	3	3%	4%	0	0%	1.0
	IL	2%	2	2%	11	18%	2	2%	3%	0	0%	0.8
	KY	2%	2	2%	17	27%	3	2%	2%	0	0%	0.8
	IA	1%	2	2%	0	0%	2	1%	1%	0	0%	0.6
	MN	0%	0	1%	0	0%	0	1%	1%	0	0%	0.4
	MO	1%	1	1%	0	0%	1	1%	1%	0	0%	0.2
	AR	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	**CAMX Source Apportionment Modeling**							**CAMX State Zero-Out Modeling**				
	Base Case: Total Number of Exceedances (grid-hours) = 108							Base Case: Total Number of Exceedances (grids-days) = 23				
Mecklenburg NC	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**SC**	14%	22	25%	89	82%	22	76%	69%	19	83%	20.6
	GA	5%	12	15%	71	66%	14	33%	27%	10	43%	11.9
	VA	3%	8	9%	31	29%	9	8%	7%	4	17%	9.3
	MD	1%	7	8%	8	7%	7	1%	1%	1	4%	4.7
	TN	2%	3	4%	23	21%	4	15%	15%	4	17%	3.0
	PA	1%	4	5%	10	9%	5	1%	1%	1	4%	2.4
Contributions do not exceed screening criteria	**OH**	1%	3	4%	29	27%	3	4%	3%	0	0%	1.7
	WV	1%	2	2%	2	2%	2	4%	3%	0	0%	1.4
	FL	1%	2	3%	4	4%	3	5%	4%	0	0%	1.2
	AL	1%	2	2%	0	0%	2	5%	4%	0	0%	0.8
	KY	2%	2	3%	4	4%	2	7%	6%	0	0%	0.7
	IN	1%	3	3%	4	4%	3	3%	3%	0	0%	0.6
	DE	0%	1	1%	0	0%	1	0%	0%	0	0%	0.5
	IL	2%	2	2%	0	0%	2	3%	3%	0	0%	0.4
	MO	1%	3	3%	4	4%	3	3%	3%	0	0%	0.4
	NJ	0%	1	1%	0	0%	1	0%	0%	0	0%	0.4
	AR	0%	1	1%	0	0%	1	1%	1%	0	0%	0.3
	LA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	MI	0%	0	1%	0	0%	1	0%	0%	0	0%	0.2
	NY	0%	3	3%	2	2%	3	0%	0%	0	0%	0.2
	CT	0%	0	1%	0	0%	0	0%	0%	0	0%	0.1
	IA	0%	0	0%	0	0%	0	1%	0%	0	0%	0.1
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	WI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 89							Base Case: Total Number of Exceedances (grids-days) = 19				
Geauga OH	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**IL**	12%	16	18%	85	96%	17	46%	42%	15	79%	11.7
	MI	11%	15	17%	78	88%	18	42%	46%	11	58%	5.4
	IN	3%	8	9%	65	73%	8	24%	16%	7	37%	5.2
	KY	1%	8	10%	2	2%	9	6%	2%	3	16%	4.6
	MO	4%	6	7%	72	81%	6	19%	13%	6	32%	2.8
	PA	1%	19	23%	4	4%	19	2%	2%	1	5%	2.3
Contributions do not exceed screening criteria	**WV**	0%	5	6%	4	4%	5	2%	2%	1	5%	3.1
	VA	0%	6	7%	4	4%	6	1%	2%	0	0%	1.6
	MD	0%	4	4%	3	3%	4	1%	1%	0	0%	0.7
	AR	1%	2	2%	0	0%	2	4%	3%	0	0%	0.6
	IA	2%	2	2%	0	0%	2	7%	5%	0	0%	0.6
	LA	2%	2	2%	35	39%	3	5%	5%	0	0%	0.6
	WI	1%	4	4%	9	10%	4	4%	3%	0	0%	0.6
	NY	0%	2	2%	0	0%	2	0%	0%	0	0%	0.4
	NJ	0%	1	1%	0	0%	1	0%	0%	0	0%	0.3
	TN	1%	1	2%	0	0%	2	1%	0%	0	0%	0.2
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	DE	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	MA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	MN	0%	0	0%	0	0%	0	1%	0%	0	0%	0.1
	MS	1%	1	1%	0	0%	1	1%	1%	0	0%	0.1
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AL	0%	1	1%	0	0%	1	0%	0%	0	0%	0.0
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NC	0%	4	4%	1	1%	4	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	SC	0%	1	1%	0	0%	1	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	**CAMX Source Apportionment Modeling**							**CAMX State Zero-Out Modeling**				
	Base Case: Total Number of Exceedances (grid-hours) = 195							Base Case: Total Number of Exceedances (grids-days) = 42				
Summit OH	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**PA**	14%	22	25%	101	52%	27	32%	30%	18	43%	24.5
	MI	9%	14	15%	100	51%	20	48%	49%	21	50%	14.3
	IL	4%	7	8%	100	51%	8	17%	16%	14	33%	12.4
	WV	3%	4	4%	87	45%	7	12%	12%	10	24%	5.2
	VA	2%	5	6%	48	25%	6	7%	8%	9	21%	3.2
	IN	1%	2	3%	19	10%	3	5%	5%	2	5%	2.4
	MD	1%	2	3%	38	19%	5	5%	5%	1	2%	2.0
Contributions do not exceed screening criteria	**WI**	2%	3	4%	79	41%	4	8%	7%	0	0%	2.0
	MO	1%	1	2%	0	0%	2	7%	6%	5	12%	2.5
	NC	1%	4	4%	38	19%	4	4%	4%	0	0%	1.9
	NY	1%	2	2%	19	10%	5	2%	2%	0	0%	1.0
	SC	0%	1	2%	1	1%	2	2%	2%	0	0%	0.9
	LA	1%	2	2%	0	0%	2	2%	1%	0	0%	0.7
	AR	1%	2	2%	4	2%	2	3%	2%	0	0%	0.6
	IA	1%	1	1%	0	0%	2	3%	3%	0	0%	0.6
	NJ	0%	0	0%	0	0%	1	0%	0%	0	0%	0.3
	AL	0%	1	1%	0	0%	1	1%	1%	0	0%	0.2
	FL	0%	0	0%	0	0%	1	0%	0%	0	0%	0.2
	GA	0%	0	0%	0	0%	1	1%	1%	0	0%	0.2
	TN	1%	1	1%	0	0%	1	1%	1%	0	0%	0.2
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	DE	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	KY	0%	0	0%	0	0%	1	0%	1%	0	0%	0.1
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	MN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	MS	0%	1	1%	0	0%	1	1%	1%	0	0%	0.1
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling						CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 392						Base Case: Total Number of Exceedances (grids-days) = 113				
Allegheny PA	Upwind State	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**OH**	28%	30	35%	387	99%	40	78%	78%	110	97%	21.5
	WV	5%	7	8%	248	63%	12	31%	31%	61	54%	9.0
	MI	5%	8	9%	267	68%	10	31%	34%	50	44%	8.0
	IN	5%	6	7%	250	64%	7	31%	32%	65	58%	6.0
	IL	5%	9	10%	356	91%	10	25%	27%	38	34%	5.6
	KY	2%	7	8%	43	11%	7	7%	8%	4	4%	2.8
Contributions do not exceed screening criteria	**VA**	0%	5	6%	13	3%	6	2%	1%	3	3%	5.3
	MD	0%	5	5%	13	3%	6	2%	1%	3	3%	2.8
	MO	2%	4	5%	100	26%	5	11%	11%	0	0%	1.9
	AR	2%	3	4%	108	28%	4	5%	5%	0	0%	1.3
	TN	1%	2	2%	23	6%	2	3%	3%	0	0%	0.7
	IA	1%	1	1%	0	0%	1	3%	3%	0	0%	0.6
	LA	1%	2	2%	0	0%	2	2%	2%	0	0%	0.6
	NY	0%	1	1%	0	0%	1	1%	0%	0	0%	0.6
	WI	1%	1	1%	0	0%	1	4%	3%	0	0%	0.6
	MN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.2
	MS	0%	1	1%	0	0%	1	1%	1%	0	0%	0.2
	NC	0%	0	0%	0	0%	1	0%	0%	0	0%	0.2
	AL	0%	0	1%	0	0%	1	1%	0%	0	0%	0.1
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	NJ	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	DE	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 129							Base Case: Total Number of Exceedances (grids-days) = 39				
Bucks PA	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**NJ**	5%	10	11%	52	40%	18	35%	24%	19	49%	15.2
	MD	9%	12	13%	109	84%	19	23%	29%	11	28%	11.1
	VA	2%	4	4%	32	25%	6	6%	7%	4	10%	10.0
	MI	3%	7	8%	45	35%	7	14%	13%	8	21%	5.3
	DE	10%	9	10%	125	97%	14	21%	21%	15	38%	4.9
	OH	4%	6	7%	79	61%	9	13%	13%	6	15%	4.6
	WV	2%	4	4%	30	23%	4	6%	7%	6	15%	2.7
Contributions do not exceed screening criteria	**NC**	1%	3	3%	23	18%	5	2%	3%	0	0%	1.6
	WI	1%	2	3%	10	8%	3	5%	4%	0	0%	1.5
	NY	1%	1	1%	0	0%	2	5%	5%	0	0%	1.4
	IA	1%	2	3%	8	6%	2	2%	3%	0	0%	1.0
	KY	1%	2	3%	22	17%	4	2%	2%	0	0%	1.0
	IL	2%	3	4%	11	9%	3	5%	5%	0	0%	0.9
	IN	1%	2	2%	15	12%	3	3%	4%	0	0%	0.9
	MN	0%	0	1%	0	0%	1	1%	1%	0	0%	0.5
	LA	0%	1	1%	0	0%	1	1%	1%	0	0%	0.3
	MO	1%	2	2%	0	0%	2	1%	1%	0	0%	0.3
	AR	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 50							Base Case: Total Number of Exceedances (grids-days) = 11				
Delaware PA	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**MD**	30%	26	30%	50	100%	33	73%	71%	11	100%	19.9
	DE	16%	25	29%	50	100%	27	56%	57%	9	82%	17.5
	NJ	1%	3	4%	8	16%	4	12%	11%	2	18%	4.9
	MI	2%	5	6%	11	22%	5	9%	10%	2	18%	4.3
	VA	4%	4	5%	31	62%	7	13%	12%	5	45%	3.7
	WV	3%	5	5%	18	36%	5	11%	9%	3	27%	3.6
	OH	6%	6	7%	31	62%	7	14%	12%	3	27%	3.4
Contributions do not exceed screening criteria	**WI**	1%	1	1%	0	0%	1	3%	3%	0	0%	1.6
	NC	2%	3	4%	17	34%	5	3%	3%	0	0%	1.2
	IA	1%	2	2%	7	14%	2	2%	2%	0	0%	1.0
	IL	2%	3	4%	11	22%	4	4%	4%	0	0%	0.9
	KY	2%	3	3%	14	28%	4	2%	2%	0	0%	0.8
	IN	2%	2	2%	10	20%	3	3%	3%	0	0%	0.7
	MN	0%	0	0%	0	0%	0	1%	1%	0	0%	0.5
	NY	0%	1	1%	0	0%	1	2%	2%	0	0%	0.4
	LA	0%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	MO	1%	2	2%	5	10%	2	1%	1%	0	0%	0.2
	TN	0%	0	1%	0	0%	1	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	AR	0%	1	1%	0	0%	1	0%	0%	0	0%	0.0
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 78							Base Case: Total Number of Exceedances (grids-days) = 22				
Montgomery PA	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**DE**	11%	16	17%	69	88%	18	46%	41%	11	50%	10.4
	MD	15%	27	31%	78	100%	28	59%	50%	16	73%	8.0
	NJ	6%	17	20%	32	41%	19	25%	22%	5	23%	7.9
	OH	5%	7	8%	44	56%	9	24%	21%	5	23%	5.0
	WV	2%	4	5%	23	29%	4	12%	11%	5	23%	3.0
	MI	2%	4	4%	7	9%	4	17%	13%	2	9%	2.3
	VA	4%	10	12%	35	45%	11	12%	11%	1	5%	2.2
Contributions do not exceed screening criteria	**NY**	1%	3	3%	20	26%	4	8%	5%	0	0%	1.9
	WI	1%	3	3%	2	3%	3	6%	5%	0	0%	1.5
	KY	1%	3	3%	19	24%	4	5%	4%	0	0%	1.2
	NC	1%	3	4%	20	26%	4	4%	4%	0	0%	1.1
	IN	2%	2	3%	17	22%	3	9%	6%	0	0%	1.0
	CT	0%	1	1%	0	0%	1	2%	1%	0	0%	0.9
	IL	2%	2	2%	3	4%	2	9%	6%	0	0%	0.7
	MN	0%	1	1%	0	0%	1	2%	1%	0	0%	0.5
	LA	0%	1	1%	0	0%	1	2%	1%	0	0%	0.4
	MO	1%	1	1%	0	0%	1	3%	2%	0	0%	0.4
	MA	0%	1	1%	0	0%	1	1%	0%	0	0%	0.3
	IA	1%	1	1%	0	0%	1	2%	2%	0	0%	0.2
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AR	0%	0	0%	0	0%	0	1%	1%	0	0%	0.1
	MS	0%	0	0%	0	0%	0	1%	0%	0	0%	0.1
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	TN	0%	0	0%	0	0%	0	1%	0%	0	0%	0.1
	FL	0%	0	1%	0	0%	1	0%	0%	0	0%	0.0
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 59							Base Case: Total Number of Exceedances (grids-days) = 13				
Philadelphia PA	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**MD**	22%	25	26%	58	98%	32	62%	65%	9	69%	19.2
	NJ	3%	7	8%	12	20%	9	15%	14%	4	31%	14.1
	DE	17%	18	20%	59	100%	21	49%	52%	12	92%	8.6
	MI	3%	6	6%	14	24%	6	14%	15%	4	31%	5.0
	VA	4%	5	6%	33	56%	8	15%	16%	4	31%	4.7
	WV	2%	4	4%	19	32%	5	9%	10%	3	23%	3.2
	OH	5%	6	6%	36	61%	7	14%	14%	3	23%	2.7
	NC	2%	4	4%	19	32%	6	5%	5%	1	8%	2.2
Contributions do not exceed screening criteria	**WI**	1%	1	1%	0	0%	1	4%	3%	0	0%	1.3
	IA	1%	2	2%	12	20%	2	3%	4%	0	0%	1.0
	IL	2%	3	4%	14	24%	4	5%	5%	0	0%	1.0
	NY	0%	1	1%	0	0%	1	3%	3%	0	0%	0.8
	IN	2%	2	2%	7	12%	2	4%	4%	0	0%	0.6
	KY	1%	2	2%	11	19%	3	1%	1%	0	0%	0.5
	MN	0%	0	0%	0	0%	0	1%	1%	0	0%	0.4
	MO	1%	2	2%	0	0%	2	1%	1%	0	0%	0.2
	LA	0%	0	1%	0	0%	1	0%	0%	0	0%	0.1
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	AR	0%	1	1%	0	0%	1	0%	0%	0	0%	0.0
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	FL	0%	0	0%	0	0%	1	0%	0%	0	0%	0.0
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 183							Base Case: Total Number of Exceedances (grids-days) = 22				
Kent RI	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**MA**	2%	19	22%	12	7%	28	4%	3%	3	14%	28.4
	NY	20%	17	19%	183	100%	24	58%	57%	19	86%	15.5
	NJ	21%	17	19%	180	98%	24	57%	52%	19	86%	14.3
	PA	20%	25	27%	171	93%	26	39%	37%	19	86%	13.1
	CT	8%	10	11%	161	88%	17	24%	31%	19	86%	8.8
	OH	4%	6	6%	83	45%	8	8%	10%	7	32%	3.6
	VA	3%	5	5%	83	45%	7	5%	4%	3	14%	2.8
Contributions do not exceed screening criteria	**NH**	0%	3	3%	11	6%	5	2%	2%	2	9%	2.9
	MD	4%	5	6%	150	82%	6	6%	5%	0	0%	1.6
	MI	1%	2	2%	33	18%	3	3%	4%	0	0%	1.3
	WV	1%	2	3%	67	37%	3	3%	3%	0	0%	1.3
	DE	2%	4	4%	75	41%	4	3%	3%	0	0%	1.0
	NC	2%	3	3%	72	39%	4	1%	1%	0	0%	0.9
	IN	1%	2	2%	11	6%	2	3%	3%	0	0%	0.7
	ME	0%	1	1%	0	0%	1	1%	1%	0	0%	0.7
	IL	1%	2	2%	2	1%	2	2%	3%	0	0%	0.5
	KY	1%	2	2%	0	0%	2	1%	1%	0	0%	0.3
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.3
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.2
	WI	0%	1	1%	0	0%	1	1%	1%	0	0%	0.2
	AR	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	IA	0%	0	1%	0	0%	1	0%	0%	0	0%	0.1
	MO	0%	0	1%	0	0%	1	0%	1%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 13							Base Case: Total Number of Exceedances (grids-days) = 7				
Denton TX	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions do not exceed screening criteria	**LA**	5%	3	4%	13	100%	4	84%	87%	0	0%	1.5
	AR	2%	1	2%	0	0%	2	57%	55%	0	0%	0.8
	OH	2%	1	1%	0	0%	1	33%	30%	0	0%	0.5
	KY	1%	1	1%	0	0%	1	26%	25%	0	0%	0.4
	TN	2%	1	1%	0	0%	1	28%	26%	0	0%	0.4
	IL	1%	1	1%	0	0%	1	23%	21%	0	0%	0.3
	IN	1%	1	1%	0	0%	1	25%	23%	0	0%	0.3
	MO	1%	1	1%	0	0%	1	22%	19%	0	0%	0.3
	MS	1%	1	1%	0	0%	1	13%	11%	0	0%	0.2
	AL	1%	1	1%	0	0%	1	8%	8%	0	0%	0.1
	GA	1%	0	0%	0	0%	0	6%	6%	0	0%	0.1
	MI	1%	0	0%	0	0%	0	8%	8%	0	0%	0.1
	NC	1%	1	1%	0	0%	1	8%	8%	0	0%	0.1
	PA	0%	0	0%	0	0%	0	8%	8%	0	0%	0.1
	VA	1%	0	0%	0	0%	0	7%	6%	0	0%	0.1
	WV	1%	0	0%	0	0%	0	9%	8%	0	0%	0.1
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	DE	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	IA	0%	0	0%	0	0%	0	1%	2%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MD	0%	0	0%	0	0%	0	1%	2%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MN	0%	0	0%	0	0%	0	1%	2%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NJ	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NY	0%	0	0%	0	0%	0	0%	2%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	SC	0%	0	0%	0	0%	0	3%	4%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	WI	0%	0	0%	0	0%	0	3%	4%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 1547							Base Case: Total Number of Exceedances (grids-days) = 334				
Harris TX	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**LA**	13%	13	15%	1547	100%	17	52%	49%	332	99%	10.2
	AL	3%	4	5%	650	42%	5	8%	8%	47	14%	2.9
	MS	3%	4	5%	744	48%	5	11%	10%	50	15%	2.8
	AR	2%	3	3%	423	27%	4	8%	7%	27	8%	2.3
Contributions do not exceed screening criteria	**GA**	1%	2	3%	376	24%	3	4%	4%	0	0%	1.2
	TN	2%	3	3%	572	37%	3	6%	5%	0	0%	1.2
	NC	1%	2	2%	5	0%	2	2%	2%	0	0%	1.0
	IL	1%	2	2%	0	0%	2	2%	2%	0	0%	0.9
	MO	1%	1	1%	0	0%	1	2%	2%	0	0%	0.8
	IN	0%	1	1%	0	0%	1	2%	1%	0	0%	0.7
	KY	1%	2	2%	0	0%	2	3%	2%	0	0%	0.7
	OH	1%	1	2%	0	0%	2	2%	2%	0	0%	0.7
	VA	1%	1	1%	0	0%	1	2%	2%	0	0%	0.6
	SC	0%	1	1%	0	0%	1	1%	1%	0	0%	0.5
	WV	0%	1	1%	0	0%	1	1%	1%	0	0%	0.4
	FL	0%	1	1%	0	0%	1	1%	1%	0	0%	0.3
	MI	0%	1	1%	0	0%	1	1%	1%	0	0%	0.2
	PA	0%	1	1%	0	0%	1	1%	1%	0	0%	0.2
	IA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	MD	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	WI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	DE	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NJ	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NY	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 12							Base Case: Total Number of Exceedances (grids-days) = 8				
Tarrant TX	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**LA**	10%	8	10%	12	100%	9	100%	100%	6	75%	7.1
	AR	4%	7	8%	7	58%	7	90%	88%	1	13%	5.0
	TN	3%	4	5%	2	17%	4	59%	52%	1	13%	2.1
Contributions do not exceed screening criteria	**MS**	3%	2	3%	9	75%	3	73%	78%	0	0%	1.4
	KY	1%	1	2%	0	0%	2	27%	20%	0	0%	0.6
	AL	2%	1	1%	0	0%	1	41%	37%	0	0%	0.5
	OH	1%	1	1%	0	0%	1	20%	15%	0	0%	0.5
	GA	1%	1	1%	0	0%	1	33%	29%	0	0%	0.3
	IL	1%	1	1%	0	0%	1	16%	12%	0	0%	0.3
	IN	0%	1	1%	0	0%	1	18%	14%	0	0%	0.3
	MO	1%	1	1%	0	0%	1	16%	12%	0	0%	0.3
	FL	0%	0	0%	0	0%	0	8%	8%	0	0%	0.1
	MI	0%	0	0%	0	0%	0	4%	3%	0	0%	0.1
	NC	1%	1	1%	0	0%	1	16%	14%	0	0%	0.1
	PA	0%	0	0%	0	0%	0	4%	3%	0	0%	0.1
	SC	0%	0	0%	0	0%	0	12%	11%	0	0%	0.1
	VA	0%	0	0%	0	0%	0	8%	6%	0	0%	0.1
	WV	0%	0	0%	0	0%	0	8%	5%	0	0%	0.1
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	DE	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	IA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MD	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NJ	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NY	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	WI	0%	0	0%	0	0%	0	2%	2%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 11							Base Case: Total Number of Exceedances (grids-days) = 3				
Arlington VA	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**MD**	51%	37	41%	11	100%	42	20%	20%	2	67%	18.4
	OH	5%	5	5%	7	64%	5	23%	23%	2	67%	6.8
	PA	7%	6	7%	11	100%	6	9%	9%	2	67%	5.1
Contributions do not exceed screening criteria	**MI**	2%	2	2%	1	9%	2	4%	4%	0	0%	1.9
	WV	2%	2	2%	5	45%	2	8%	8%	0	0%	1.8
	IL	3%	2	3%	7	64%	3	7%	7%	0	0%	1.7
	IN	2%	2	2%	0	0%	2	5%	5%	0	0%	1.3
	IA	1%	0	1%	0	0%	0	2%	2%	0	0%	0.7
	KY	0%	0	0%	0	0%	0	2%	2%	0	0%	0.7
	MO	2%	2	2%	0	0%	2	3%	3%	0	0%	0.7
	WI	1%	0	1%	0	0%	0	1%	1%	0	0%	0.7
	LA	2%	1	1%	0	0%	2	1%	1%	0	0%	0.3
	NY	1%	1	2%	0	0%	2	0%	1%	0	0%	0.3
	MN	0%	0	0%	0	0%	0	0%	1%	0	0%	0.2
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.2
	AR	1%	1	1%	0	0%	1	0%	1%	0	0%	0.1
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	CT	0%	0	0%	0	0%	1	0%	0%	0	0%	0.0
	DE	1%	2	2%	1	9%	2	0%	0%	0	0%	0.0
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NJ	1%	2	2%	3	27%	2	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 85							Base Case: Total Number of Exceedances (grids-days) = 25				
Fairfax VA	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**MD**	47%	37	43%	85	100%	54	55%	58%	25	100%	19.8
	PA	12%	19	22%	85	100%	23	26%	29%	25	100%	16.6
	NJ	4%	8	9%	23	27%	9	7%	7%	4	16%	5.9
	OH	3%	3	3%	59	69%	5	8%	10%	4	16%	3.8
	WV	2%	2	2%	16	19%	3	8%	8%	3	12%	3.6
Contributions do not exceed screening criteria	**MI**	1%	1	1%	0	0%	1	3%	3%	1	4%	2.3
	NY	2%	2	3%	16	19%	3	5%	5%	0	0%	1.8
	DE	2%	3	4%	23	27%	4	5%	6%	0	0%	1.3
	IN	2%	2	2%	19	22%	3	4%	4%	0	0%	1.3
	IL	2%	2	2%	0	0%	2	4%	4%	0	0%	1.2
	MO	1%	1	1%	0	0%	2	2%	3%	0	0%	0.8
	IA	0%	0	0%	0	0%	0	1%	1%	0	0%	0.7
	LA	1%	1	1%	0	0%	1	1%	2%	0	0%	0.6
	WI	0%	0	0%	0	0%	0	1%	1%	0	0%	0.5
	AR	1%	1	1%	0	0%	1	1%	1%	0	0%	0.3
	CT	0%	0	0%	0	0%	1	1%	1%	0	0%	0.3
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.2
	MN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.2
	MS	0%	0	0%	0	0%	0	0%	1%	0	0%	0.2
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	KY	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 76							Base Case: Total Number of Exceedances (grids-days) = 17				
Kenosha WI	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**IL**	54%	54	56%	76	100%	61	100%	100%	17	100%	48.2
	IN	8%	11	11%	63	83%	16	22%	28%	8	47%	10.0
	MI	3%	13	14%	16	21%	14	3%	2%	2	12%	9.4
	MO	7%	10	11%	63	83%	12	26%	30%	13	76%	6.8
	PA	2%	9	10%	11	14%	9	2%	0%	1	6%	4.5
	OH	2%	9	10%	15	20%	9	2%	1%	1	6%	4.1
	IA	1%	4	5%	8	11%	5	4%	5%	1	6%	2.3
Contributions do not exceed screening criteria	**AR**	2%	3	3%	24	32%	3	4%	6%	0	0%	1.6
	AL	1%	3	3%	5	7%	3	1%	2%	0	0%	1.4
	VA	1%	3	3%	11	14%	3	1%	0%	0	0%	1.2
	GA	0%	2	2%	0	0%	2	1%	2%	0	0%	1.0
	LA	2%	4	4%	23	30%	4	2%	3%	0	0%	1.0
	MS	1%	2	2%	5	7%	2	1%	2%	0	0%	0.9
	WV	0%	1	2%	0	0%	1	0%	0%	0	0%	0.7
	MD	0%	2	3%	11	14%	2	0%	0%	0	0%	0.6
	NC	0%	2	2%	0	0%	2	0%	0%	0	0%	0.6
	TN	1%	2	2%	0	0%	2	1%	1%	0	0%	0.5
	NY	0%	1	2%	0	0%	1	0%	0%	0	0%	0.4
	SC	0%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	KY	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	MN	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	NJ	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	DE	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling							CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 126							Base Case: Total Number of Exceedances (grids-days) = 33				
Racine WI	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**IL**	52%	54	54%	126	100%	61	100%	100%	33	100%	47.1
	IN	9%	11	11%	108	86%	15	23%	23%	16	48%	11.8
	MI	3%	14	17%	27	21%	16	2%	2%	1	3%	11.3
	MO	7%	10	10%	112	89%	12	28%	29%	26	79%	6.5
	PA	1%	9	10%	14	11%	9	0%	0%	1	3%	4.5
	OH	1%	8	9%	16	13%	9	0%	0%	1	3%	3.6
	IA	1%	5	5%	7	6%	5	6%	7%	4	12%	2.6
Contributions do not exceed screening criteria	**AR**	2%	3	3%	48	38%	3	4%	5%	0	0%	1.5
	AL	1%	3	3%	11	9%	3	2%	2%	0	0%	1.3
	LA	2%	4	4%	46	37%	4	3%	3%	0	0%	1.2
	VA	0%	3	3%	14	11%	3	0%	0%	0	0%	1.2
	GA	0%	2	2%	0	0%	2	1%	1%	0	0%	0.9
	MS	1%	2	2%	10	8%	2	1%	2%	0	0%	0.9
	MD	0%	2	3%	14	11%	2	0%	0%	0	0%	0.6
	NC	0%	2	2%	0	0%	2	0%	0%	0	0%	0.6
	WV	0%	1	1%	0	0%	1	0%	0%	0	0%	0.6
	TN	1%	2	2%	0	0%	2	1%	1%	0	0%	0.5
	NY	0%	1	2%	0	0%	2	0%	0%	0	0%	0.4
	SC	0%	1	1%	0	0%	1	0%	0%	0	0%	0.2
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	KY	0%	1	1%	0	0%	1	0%	0%	0	0%	0.1
	MN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	NJ	0%	0	0%	0	0%	0	0%	0%	0	0%	0.1
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	DE	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Downwind Nonattainment Receptor	CAMX Source Apportionment Modeling						CAMX State Zero-Out Modeling				
	Base Case: Total Number of Exceedances (grid-hours) = 41						Base Case: Total Number of Exceedances (grids-days) = 12				
Sheboygan WI	**Upwind State**	Average 4-episode % contribution	Highest daily average (ppb)	Highest daily average (%)	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution	% total ppb reduced	% pop-wgt total ppb reduced	# reduced >= 2 ppb	% reduced >= 2 ppb	max 8-hr ppb contribution
Contributions exceed screening criteria	**IL**	52%	36	39%	41	100%	41	100%	100%	12	100%	25.1
	IN	10%	7	8%	41	100%	10	34%	27%	8	67%	6.9
	MO	13%	9	10%	41	100%	10	43%	36%	8	67%	5.0
Contributions do not exceed screening criteria	**IA**	2%	1	1%	0	0%	1	12%	19%	3	25%	2.4
	MI	1%	1	1%	0	0%	1	1%	1%	0	0%	0.2
	AR	0%	0	0%	0	0%	0	-1%	-1%	0	0%	0.1
	MN	0%	0	0%	0	0%	0	1%	1%	0	0%	0.1
	AL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	CT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	DE	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	FL	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	GA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	KY	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	LA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MD	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	ME	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	MS	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NJ	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	NY	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	OH	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	PA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	RI	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	SC	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	TN	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VA	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	VT	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0
	WV	0%	0	0%	0	0%	0	0%	0%	0	0%	0.0

Note that due to rounding, some of the maximum contribution values that appear in the table as "2 ppb" for source apportionment or "2.0 ppb" for zero-out are actually less than the 2 ppb screening criteria. These occurances are denoted by a value "0" in the column labeled "# reduced >= 2 ppb". The linkages for these cases are listed in the tables as having contributions that do not exceed the screening criteria.

Technical Support Document for the Interstate Air Quality Rule Air Quality Modeling Analyses

Appendix H

PM2.5 Contributions to Downwind Nonattainment Counties in 2010

The tables below show the contribution from the State-by-State zero-out modeling to annual average PM2.5 concentrations at nonattainment receptors in other States. In these tables “NA” indicates that the given nonattainment county is not downwind of that particular upwind source State. That is, the county is either located within the source State or within that portion of an adjacent State that shares a model grid cell with the source State. States denoted as “combined” indicate those States that were paired in zero-out runs. The combined State runs were performed for North Dakota with Vermont; Nebraska with Maine; and South Dakota with New Hampshire. The maximum downwind contribution from each of the three Plains States included in combined runs(i.e., Nebraska, North Dakota, and South Dakota) was determined by indentifying the highest contribution to nonattainment counties in the Midwest. The maximum contribution from each of the three New England States included in combined runs (i.e., Maine, New Hampshire, and Vermont) was determined by identifying the highest contribution to nonattainment counties in the Northeast.

Downwind 2010 Nonattainment Counties			Downwind PM2.5 Contributions (ug/m3) from Upwind Source States based on Zero-Out Modeling of 2010 SO2+NOx Emissions.														
State Name	County Name	2010 Base-1 Case PM2.5 ($\mu g/m^3$)	AL	AR	CO	CT	DE	FL	GA	IA	IL	IN	KS	KY	LA	MA	MD/DC
Alabama	DeKalb County	15.24	NA	0.11	0.03	0.00	0.01	0.22	1.32	0.09	0.34	0.29	0.04	0.27	0.18	0.00	0.06
Alabama	Jefferson County	20.12	NA	0.12	0.03	0.00	0.01	0.26	0.82	0.10	0.33	0.25	0.05	0.25	0.25	0.00	0.05
Alabama	Montgomery County	15.72	NA	0.10	0.03	0.00	0.01	0.44	0.74	0.08	0.25	0.20	0.05	0.17	0.25	0.00	0.06
Alabama	Russell County	17.31	NA	0.10	0.03	0.00	0.01	0.52	1.52	0.09	0.28	0.23	0.05	0.19	0.22	0.00	0.07
Alabama	Talladega County	16.46	NA	0.10	0.03	0.00	0.01	0.33	0.88	0.09	0.30	0.24	0.05	0.21	0.22	0.00	0.05
Connecticut	New Haven County	15.45	0.05	0.01	0.01	NA	0.06	0.03	0.08	0.04	0.15	0.13	0.01	0.08	0.03	0.21	0.15
Delaware	New Castle County	15.49	0.08	0.02	0.01	0.02	NA	0.03	0.11	0.05	0.19	0.18	0.02	0.11	0.04	0.04	0.57
District of Columbia	District of Columbia	15.35	0.12	0.03	0.01	0.01	0.10	0.04	0.15	0.06	0.24	0.23	0.02	0.16	0.05	0.02	NA
Georgia	Clarke County	17.05	0.75	0.10	0.03	0.00	0.02	0.27	NA	0.07	0.27	0.26	0.04	0.23	0.15	0.00	0.09
Georgia	Clayton County	17.82	0.90	0.10	0.03	0.00	0.01	0.30	NA	0.07	0.26	0.23	0.04	0.20	0.16	0.00	0.07
Georgia	Cobb County	17.24	0.97	0.10	0.03	0.00	0.01	0.23	NA	0.08	0.28	0.26	0.04	0.24	0.16	0.00	0.06
Georgia	DeKalb County	18.26	0.93	0.11	0.03	0.00	0.01	0.27	NA	0.08	0.27	0.25	0.04	0.22	0.17	0.00	0.08
Georgia	Floyd County	17.14	1.17	0.11	0.03	0.00	0.01	0.24	NA	0.09	0.33	0.30	0.05	0.25	0.18	0.00	0.07
Georgia	Fulton County	19.79	0.99	0.11	0.03	0.00	0.01	0.28	NA	0.08	0.29	0.27	0.05	0.23	0.18	0.00	0.08
Georgia	Hall County	15.61	0.76	0.10	0.03	0.00	0.01	0.22	NA	0.07	0.26	0.25	0.04	0.23	0.15	0.00	0.08
Georgia	Muscogee County	16.92	NA	0.10	0.03	0.00	0.01	0.51	NA	0.08	0.27	0.22	0.05	0.19	0.21	0.00	0.07
Georgia	Paulding County	15.52	1.14	0.10	0.03	0.00	0.01	0.26	NA	0.08	0.29	0.26	0.04	0.22	0.17	0.00	0.06
Georgia	Richmond County	16.03	0.55	0.06	0.02	0.00	0.02	0.28	NA	0.06	0.22	0.21	0.03	0.18	0.12	0.00	0.09
Georgia	Wilkinson County	16.89	0.65	0.07	0.02	0.00	0.02	0.37	NA	0.07	0.22	0.20	0.03	0.18	0.15	0.00	0.07
Illinois	Cook County	18.07	0.08	0.11	0.03	0.00	0.00	0.01	0.04	0.33	NA	0.79	0.11	0.22	0.08	0.00	0.00
Illinois	Madison County	16.48	0.11	0.27	0.04	0.00	0.00	0.02	0.07	0.43	NA	0.45	0.15	0.20	0.21	0.00	0.01
Illinois	St. Clair County	16.32	0.12	0.29	0.04	0.00	0.00	0.02	0.07	0.40	NA	0.50	0.15	0.22	0.22	0.00	0.01
Illinois	Will County	15.54	0.08	0.11	0.03	0.00	0.00	0.01	0.04	0.35	NA	0.76	0.09	0.18	0.09	0.00	0.00
Indiana	Clark County	15.79	0.43	0.12	0.03	0.00	0.00	0.06	0.34	0.19	0.84	NA	0.06	1.10	0.16	0.00	0.04
Indiana	Marion County	15.76	0.19	0.10	0.03	0.00	0.00	0.03	0.12	0.25	1.11	NA	0.07	0.43	0.13	0.00	0.02
Kentucky	Fayette County	15.05	0.42	0.10	0.03	0.00	0.00	0.07	0.38	0.17	0.71	0.80	0.05	NA	0.15	0.00	0.04
Kentucky	Jefferson County	15.71	0.42	0.12	0.03	0.00	0.00	0.06	0.35	0.19	0.85	NA	0.06	NA	0.16	0.00	0.04
Maryland	Baltimore city	16.53	0.10	0.03	0.02	0.01	0.10	0.04	0.14	0.06	0.24	0.23	0.02	0.16	0.05	0.02	NA
Michigan	Wayne County	18.76	0.10	0.06	0.02	0.00	0.00	0.03	0.08	0.16	0.70	0.57	0.05	0.24	0.06	0.00	0.01
Missouri	St. Louis city	15.26	0.12	0.27	0.04	0.00	0.00	0.02	0.07	0.38	1.50	0.45	0.14	0.21	0.21	0.00	0.01
New York	New York County	16.29	0.05	0.02	0.01	0.07	0.09	0.02	0.08	0.04	0.16	0.15	0.01	0.09	0.03	0.12	0.22
North Carolina	Davidson County	15.32	0.27	0.06	0.02	0.00	0.02	0.11	0.54	0.06	0.28	0.29	0.02	0.28	0.08	0.00	0.13
North Carolina	Mecklenburg County	15.07	0.33	0.06	0.02	0.00	0.02	0.14	0.74	0.06	0.25	0.26	0.02	0.24	0.09	0.00	0.12
Ohio	Butler County	15.87	0.24	0.08	0.02	0.00	0.00	0.04	0.19	0.16	0.75	0.91	0.05	0.60	0.11	0.00	0.03

Downwind 2010 Nonattainment Counties			Downwind PM2.5 Contributions (ug/m3) from Upwind Source States based on Zero-Out Modeling of 2010 SO2+NOx Emissions.														
State Name	County Name	2010 Base-1 Case PM2.5 (µg/m^3)	AL	AR	CO	CT	DE	FL	GA	IA	IL	IN	KS	KY	LA	MA	MD/DC
Ohio	Franklin County	16.45	0.20	0.06	0.02	0.00	0.00	0.04	0.17	0.14	0.59	0.67	0.04	0.50	0.09	0.00	0.04
Ohio	Hamilton County	17.57	0.32	0.09	0.03	0.00	0.00	0.05	0.26	0.18	0.83	1.06	0.06	0.77	0.13	0.00	0.04
Ohio	Jefferson County	17.69	0.15	0.04	0.01	0.00	0.01	0.04	0.15	0.10	0.39	0.39	0.03	0.29	0.07	0.00	0.07
Ohio	Lawrence County	15.19	0.26	0.06	0.02	0.00	0.00	0.05	0.28	0.12	0.49	0.54	0.03	NA	0.10	0.00	0.05
Ohio	Mahoning County	15.13	0.13	0.04	0.02	0.00	0.00	0.03	0.11	0.10	0.38	0.36	0.03	0.24	0.06	0.00	0.05
Ohio	Scioto County	18.02	0.30	0.08	0.02	0.00	0.01	0.06	0.31	0.14	0.59	0.63	0.04	1.05	0.12	0.00	0.06
Ohio	Stark County	16.80	0.17	0.05	0.02	0.00	0.00	0.04	0.15	0.13	0.49	0.49	0.04	0.33	0.08	0.00	0.05
Ohio	Summit County	16.17	0.14	0.04	0.02	0.00	0.00	0.04	0.12	0.12	0.46	0.44	0.04	0.28	0.07	0.00	0.04
Pennsylvania	Allegheny County	18.86	0.17	0.05	0.02	0.00	0.02	0.04	0.19	0.11	0.43	0.43	0.03	0.35	0.08	0.00	0.20
Pennsylvania	Berks County	15.28	0.08	0.02	0.01	0.02	0.17	0.03	0.11	0.05	0.20	0.19	0.02	0.13	0.04	0.04	0.54
Pennsylvania	Lancaster County	15.27	0.09	0.03	0.02	0.02	0.09	0.03	0.13	0.06	0.23	0.22	0.02	0.15	0.05	0.04	0.68
Pennsylvania	York County	15.50	0.09	0.03	0.01	0.01	0.11	0.03	0.13	0.06	0.23	0.22	0.02	0.15	0.04	0.02	0.85
Tennessee	Davidson County	15.31	0.85	0.16	0.03	0.00	0.00	0.11	0.49	0.17	0.68	0.54	0.06	0.59	0.24	0.00	0.03
Tennessee	Hamilton County	16.11	0.94	0.12	0.03	0.00	0.01	0.17	1.08	0.11	0.41	0.39	0.04	0.37	0.18	0.00	0.05
Tennessee	Knox County	18.16	0.77	0.13	0.03	0.00	0.01	0.18	0.98	0.13	0.51	0.51	0.05	0.54	0.18	0.00	0.07
Tennessee	Roane County	15.13	0.80	0.13	0.03	0.00	0.01	0.15	0.77	0.12	0.48	0.46	0.05	0.47	0.17	0.00	0.05
Tennessee	Sullivan County	15.06	0.43	0.09	0.02	0.00	0.01	0.11	0.57	0.10	0.41	0.43	0.04	0.48	0.11	0.00	0.06
West Virginia	Brooke County	16.28	0.13	0.04	0.01	0.00	0.01	0.03	0.14	0.09	0.36	0.36	0.03	0.27	0.06	0.00	0.07
West Virginia	Cabell County	15.98	0.28	0.07	0.02	0.00	0.01	0.06	0.31	0.13	0.51	0.54	0.03	0.67	0.10	0.00	0.07
West Virginia	Hancock County	16.37	0.13	0.04	0.01	0.00	0.01	0.03	0.13	0.09	0.36	0.36	0.03	0.27	0.06	0.00	0.07
West Virginia	Kanawha County	16.67	0.27	0.06	0.02	0.00	0.01	0.06	0.31	0.12	0.47	0.49	0.03	0.60	0.09	0.00	0.08
West Virginia	Wood County	15.85	0.23	0.06	0.02	0.00	0.01	0.05	0.25	0.13	0.49	0.53	0.03	0.52	0.09	0.00	0.08

Downwind 2010 Nonattainment Counties			Downwind PM2.5 Contributions (ug/m3) from Upwind Source States based on Zero-Out Modeling of 2010 SO2+NOx Emissions.												
State Name	County Name	2010 Base-1 Case PM2.5 ($\mu g/m^3$)	MI	MN	MO	MS	MT	NC	ND & VT (Combined)	NE & ME (Combined)	NJ	NM	NY	OH	OK
Alabama	DeKalb County	15.24	0.12	0.05	0.18	0.19	0.01	0.20	0.04	0.03	0.02	0.02	0.04	0.30	0.06
Alabama	Jefferson County	20.12	0.10	0.06	0.19	0.30	0.01	0.15	0.04	0.03	0.02	0.02	0.04	0.24	0.07
Alabama	Montgomery County	15.72	0.08	0.05	0.15	0.26	0.01	0.15	0.04	0.03	0.02	0.02	0.05	0.21	0.06
Alabama	Russell County	17.31	0.10	0.05	0.15	0.22	0.01	0.21	0.04	0.03	0.03	0.02	0.06	0.27	0.06
Alabama	Talladega County	16.46	0.10	0.06	0.17	0.25	0.01	0.15	0.04	0.03	0.02	0.02	0.04	0.23	0.06
Connecticut	New Haven County	15.45	0.20	0.05	0.04	0.02	0.01	0.12	0.06	0.03	0.32	0.00	0.85	0.36	0.01
Delaware	New Castle County	15.49	0.24	0.05	0.06	0.02	0.01	0.15	0.04	0.02	0.21	0.01	0.33	0.52	0.02
District of Columbia	District of Columbia	15.35	0.24	0.06	0.08	0.04	0.01	0.26	0.04	0.02	0.14	0.01	0.24	0.67	0.02
Georgia	Clarke County	17.05	0.14	0.04	0.14	0.15	0.01	0.34	0.04	0.03	0.03	0.02	0.06	0.39	0.05
Georgia	Clayton County	17.82	0.11	0.04	0.14	0.17	0.01	0.23	0.04	0.03	0.02	0.02	0.05	0.30	0.05
Georgia	Cobb County	17.24	0.12	0.05	0.15	0.16	0.01	0.24	0.04	0.03	0.01	0.02	0.04	0.31	0.06
Georgia	DeKalb County	18.26	0.12	0.04	0.15	0.17	0.01	0.27	0.04	0.03	0.02	0.02	0.05	0.33	0.06
Georgia	Floyd County	17.14	0.13	0.05	0.17	0.19	0.01	0.23	0.05	0.03	0.02	0.02	0.05	0.33	0.06
Georgia	Fulton County	19.79	0.13	0.05	0.16	0.18	0.01	0.29	0.04	0.03	0.02	0.02	0.05	0.36	0.06
Georgia	Hall County	15.61	0.13	0.04	0.14	0.14	0.01	0.33	0.04	0.03	0.02	0.02	0.05	0.36	0.06
Georgia	Muscogee County	16.92	0.10	0.05	0.15	0.22	0.01	0.21	0.04	0.03	0.03	0.02	0.06	0.26	0.06
Georgia	Paulding County	15.52	0.12	0.05	0.16	0.18	0.01	0.21	0.04	0.03	0.02	0.02	0.05	0.29	0.06
Georgia	Richmond County	16.03	0.12	0.03	0.10	0.12	0.01	0.38	0.04	0.02	0.03	0.02	0.07	0.35	0.04
Georgia	Wilkinson County	16.89	0.11	0.04	0.11	0.15	0.01	0.26	0.04	0.02	0.03	0.02	0.07	0.30	0.05
Illinois	Cook County	18.07	0.73	0.39	0.30	0.05	0.03	0.01	0.12	0.06	0.00	0.02	0.05	0.39	0.07
Illinois	Madison County	16.48	0.24	0.27	0.89	0.10	0.03	0.02	0.10	0.08	0.00	0.02	0.03	0.33	0.14
Illinois	St. Clair County	16.32	0.24	0.25	NA	0.11	0.03	0.02	0.10	0.08	0.00	0.02	0.03	0.34	0.14
Illinois	Will County	15.54	0.58	0.33	0.30	0.05	0.03	0.01	0.11	0.05	0.00	0.02	0.05	0.36	0.06
Indiana	Clark County	15.79	0.29	0.13	0.27	0.13	0.02	0.06	0.07	0.04	0.01	0.02	0.05	0.73	0.06
Indiana	Marion County	15.76	0.51	0.19	0.25	0.08	0.02	0.02	0.08	0.04	0.00	0.02	0.05	0.72	0.06
Kentucky	Fayette County	15.05	0.30	0.12	0.24	0.12	0.02	0.08	0.06	0.04	0.01	0.02	0.06	0.87	0.06
Kentucky	Jefferson County	15.71	0.30	0.13	0.28	0.13	0.02	0.07	0.07	0.04	0.01	0.02	0.06	0.76	0.07
Maryland	Baltimore city	16.53	0.25	0.06	0.07	0.03	0.01	0.23	0.04	0.02	0.16	0.01	0.25	0.66	0.02
Michigan	Wayne County	18.76	NA	0.19	0.14	0.04	0.02	0.03	0.07	0.04	0.00	0.01	0.15	1.21	0.03
Missouri	St. Louis city	15.26	0.22	0.23	NA	0.11	0.02	0.02	0.09	0.08	0.00	0.02	0.03	0.31	0.13
New York	New York County	16.29	0.21	0.05	0.05	0.02	0.01	0.13	0.05	0.02	0.45	0.00	NA	0.41	0.01
North Carolina	Davidson County	15.32	0.16	0.04	0.11	0.06	0.01	NA	0.03	0.02	0.05	0.01	0.08	0.51	0.04
North Carolina	Mecklenburg County	15.07	0.14	0.03	0.11	0.08	0.01	NA	0.03	0.02	0.04	0.01	0.07	0.42	0.04
Ohio	Butler County	15.87	0.52	0.14	0.20	0.08	0.02	0.05	0.07	0.04	0.00	0.01	0.07	NA	0.05

Downwind 2010 Nonattainment Counties			Downwind PM2.5 Contributions (ug/m3) from Upwind Source States based on Zero-Out Modeling of 2010 SO2+NOx Emissions.												
State Name	County Name	2010 Base-1 Case PM2.5 ($\mu g/m^3$)	MI	MN	MO	MS	MT	NC	ND & VT (Combined)	NE & ME (Combined)	NJ	NM	NY	OH	OK
Ohio	Franklin County	16.45	0.61	0.13	0.16	0.06	0.02	0.06	0.06	0.03	0.01	0.01	0.08	NA	0.04
Ohio	Hamilton County	17.57	0.53	0.15	0.24	0.10	0.02	0.06	0.08	0.04	0.01	0.02	0.07	NA	0.06
Ohio	Jefferson County	17.69	0.48	0.09	0.11	0.04	0.01	0.09	0.05	0.02	0.01	0.01	0.11	NA	0.03
Ohio	Lawrence County	15.19	0.33	0.08	0.16	0.07	0.01	0.13	0.05	0.03	0.01	0.01	0.06	NA	0.04
Ohio	Mahoning County	15.13	0.55	0.09	0.10	0.04	0.01	0.06	0.05	0.03	0.01	0.01	0.16	NA	0.03
Ohio	Scioto County	18.02	0.43	0.11	0.19	0.09	0.02	0.13	0.07	0.03	0.01	0.02	0.08	NA	0.05
Ohio	Stark County	16.80	0.70	0.11	0.14	0.05	0.02	0.07	0.06	0.03	0.01	0.01	0.15	NA	0.03
Ohio	Summit County	16.17	0.71	0.11	0.12	0.05	0.01	0.06	0.06	0.03	0.01	0.01	0.16	NA	0.03
Pennsylvania	Allegheny County	18.86	0.50	0.09	0.13	0.06	0.02	0.15	0.06	0.03	0.04	0.02	0.14	1.82	0.04
Pennsylvania	Berks County	15.28	0.25	0.06	0.06	0.02	0.01	0.14	0.04	0.02	0.21	0.01	0.38	0.60	0.02
Pennsylvania	Lancaster County	15.27	0.28	0.06	0.07	0.03	0.01	0.16	0.04	0.02	0.23	0.01	0.39	0.72	0.02
Pennsylvania	York County	15.50	0.26	0.06	0.07	0.03	0.01	0.17	0.04	0.02	0.17	0.01	0.30	0.67	0.02
Tennessee	Davidson County	15.31	0.19	0.10	0.32	0.22	0.02	0.12	0.06	0.05	0.01	0.02	0.04	0.41	0.08
Tennessee	Hamilton County	16.11	0.16	0.06	0.20	0.17	0.01	0.21	0.05	0.03	0.01	0.02	0.04	0.40	0.07
Tennessee	Knox County	18.16	0.22	0.08	0.23	0.16	0.02	0.35	0.06	0.04	0.02	0.03	0.05	0.59	0.08
Tennessee	Roane County	15.13	0.18	0.07	0.23	0.16	0.01	0.19	0.05	0.04	0.01	0.02	0.04	0.47	0.07
Tennessee	Sullivan County	15.06	0.20	0.06	0.17	0.10	0.01	0.41	0.04	0.03	0.02	0.02	0.04	0.56	0.05
West Virginia	Brooke County	16.28	0.44	0.08	0.10	0.04	0.01	0.08	0.04	0.02	0.01	0.01	0.10	1.88	0.03
West Virginia	Cabell County	15.98	0.35	0.09	0.16	0.08	0.01	0.16	0.06	0.03	0.01	0.02	0.07	1.26	0.04
West Virginia	Hancock County	16.37	0.45	0.08	0.10	0.04	0.01	0.08	0.04	0.02	0.01	0.01	0.10	1.90	0.03
West Virginia	Kanawha County	16.67	0.33	0.09	0.15	0.07	0.01	0.19	0.05	0.03	0.01	0.02	0.07	1.20	0.04
West Virginia	Wood County	15.85	0.41	0.09	0.15	0.07	0.01	0.14	0.06	0.03	0.01	0.01	0.08	1.66	0.04

Downwind 2010 Nonattainment Counties			Downwind PM2.5 Contributions (ug/m3) from Upwind Source States based on Zero-Out Modeling of 2010 SO2+NOx Emissions.										
State Name	County Name	2010 Base-1 Case PM2.5 (µg/m^3)	PA	RI	SC	SD & NH (Combined)	TN	TX	VA	WI	WV	WY
Alabama	DeKalb County	15.24	0.15	0.00	0.16	0.02	0.55	0.21	0.10	0.11	0.13	0.03
Alabama	Jefferson County	20.12	0.14	0.00	0.13	0.02	0.45	0.22	0.09	0.11	0.11	0.03
Alabama	Montgomery County	15.72	0.15	0.00	0.15	0.01	0.30	0.20	0.09	0.09	0.10	0.03
Alabama	Russell County	17.31	0.17	0.00	0.26	0.02	0.36	0.21	0.11	0.10	0.11	0.03
Alabama	Talladega County	16.46	0.14	0.00	0.14	0.01	0.38	0.20	0.09	0.10	0.10	0.03
Connecticut	New Haven County	15.45	0.57	0.01	0.04	0.06	0.07	0.05	0.16	0.09	0.14	0.01
Delaware	New Castle County	15.49	1.17	0.00	0.05	0.02	0.10	0.06	0.35	0.10	0.26	0.01
District of Columbia	District of Columbia	15.35	0.86	0.00	0.09	0.02	0.15	0.08	0.67	0.13	0.37	0.02
Georgia	Clarke County	17.05	0.22	0.00	0.47	0.01	0.46	0.20	0.15	0.09	0.16	0.03
Georgia	Clayton County	17.82	0.17	0.00	0.28	0.01	0.40	0.19	0.12	0.09	0.13	0.03
Georgia	Cobb County	17.24	0.15	0.00	0.24	0.01	0.52	0.21	0.11	0.10	0.13	0.03
Georgia	DeKalb County	18.26	0.18	0.00	0.30	0.01	0.46	0.21	0.13	0.10	0.14	0.03
Georgia	Floyd County	17.14	0.16	0.00	0.21	0.02	0.57	0.22	0.11	0.12	0.14	0.03
Georgia	Fulton County	19.79	0.19	0.00	0.32	0.02	0.49	0.23	0.14	0.11	0.15	0.03
Georgia	Hall County	15.61	0.18	0.00	0.37	0.01	0.47	0.20	0.14	0.09	0.15	0.03
Georgia	Muscogee County	16.92	0.17	0.00	0.26	0.02	0.35	0.21	0.11	0.09	0.11	0.03
Georgia	Paulding County	15.52	0.16	0.00	0.19	0.01	0.47	0.20	0.11	0.11	0.13	0.03
Georgia	Richmond County	16.03	0.22	0.00	0.72	0.01	0.35	0.17	0.16	0.08	0.16	0.02
Georgia	Wilkinson County	16.89	0.19	0.00	0.39	0.01	0.35	0.17	0.12	0.08	0.13	0.03
Illinois	Cook County	18.07	0.11	0.00	0.00	0.04	0.14	0.21	0.01	1.00	0.04	0.04
Illinois	Madison County	16.48	0.11	0.00	0.01	0.04	0.22	0.37	0.02	0.35	0.07	0.05
Illinois	St. Clair County	16.32	0.10	0.00	0.01	0.04	0.24	0.37	0.02	0.32	0.08	0.05
Illinois	Will County	15.54	0.10	0.00	0.00	0.04	0.12	0.21	0.01	0.84	0.05	0.04
Indiana	Clark County	15.79	0.16	0.00	0.04	0.02	0.53	0.20	0.08	0.26	0.19	0.03
Indiana	Marion County	15.76	0.18	0.00	0.01	0.03	0.24	0.18	0.03	0.37	0.12	0.03
Kentucky	Fayette County	15.05	0.17	0.00	0.05	0.02	0.53	0.20	0.09	0.24	0.24	0.03
Kentucky	Jefferson County	15.71	0.18	0.00	0.04	0.02	0.52	0.20	0.08	0.26	0.20	0.03
Maryland	Baltimore city	16.53	1.01	0.00	0.08	0.02	0.15	0.08	0.58	0.13	0.38	0.02
Michigan	Wayne County	18.76	0.20	0.00	0.01	0.02	0.14	0.12	0.03	0.41	0.15	0.03
Missouri	St. Louis city	15.26	0.09	0.00	0.01	0.04	0.22	0.35	0.02	0.30	0.07	0.04
New York	New York County	16.29	0.95	0.00	0.05	0.04	0.08	0.05	0.21	0.10	0.17	0.01
North Carolina	Davidson County	15.32	0.29	0.00	0.38	0.01	0.38	0.13	0.32	0.10	0.25	0.02
North Carolina	Mecklenburg County	15.07	0.26	0.00	0.66	0.01	0.38	0.14	0.24	0.08	0.21	0.02
Ohio	Butler County	15.87	0.20	0.00	0.02	0.02	0.30	0.16	0.05	0.28	0.22	0.03

Downwind 2010 Nonattainment Counties			Downwind PM2.5 Contributions (ug/m3) from Upwind Source States based on Zero-Out Modeling of 2010 SO2+NOx Emissions.									
State Name	County Name	2010 Base-1 Case PM2.5 (µg/m^3)	PA	RI	SC	SD & NH (Combined)	TN	TX	VA	WI	WV	WY
Ohio	Franklin County	16.45	0.30	0.00	0.03	0.02	0.27	0.14	0.08	0.27	0.39	0.03
Ohio	Hamilton County	17.57	0.22	0.00	0.03	0.03	0.39	0.19	0.07	0.31	0.29	0.03
Ohio	Jefferson County	17.69	0.73	0.00	0.04	0.02	0.19	0.10	0.12	0.21	NA	0.02
Ohio	Lawrence County	15.19	0.21	0.00	0.07	0.02	0.35	0.14	0.13	0.18	0.60	0.02
Ohio	Mahoning County	15.13	0.70	0.00	0.03	0.02	0.16	0.10	0.09	0.20	0.53	0.02
Ohio	Scioto County	18.02	0.23	0.00	0.07	0.02	0.42	0.18	0.13	0.22	0.61	0.03
Ohio	Stark County	16.80	0.71	0.00	0.03	0.02	0.21	0.13	0.09	0.27	0.42	0.03
Ohio	Summit County	16.17	0.59	0.00	0.03	0.02	0.17	0.11	0.07	0.24	0.32	0.03
Pennsylvania	Allegheny County	18.86	NA	0.00	0.05	0.02	0.25	0.14	0.26	0.23	0.89	0.03
Pennsylvania	Berks County	15.28	NA	0.00	0.05	0.02	0.11	0.07	0.32	0.11	0.28	0.01
Pennsylvania	Lancaster County	15.27	NA	0.00	0.06	0.02	0.13	0.08	0.40	0.12	0.35	0.02
Pennsylvania	York County	15.50	NA	0.00	0.06	0.02	0.13	0.08	0.44	0.12	0.39	0.02
Tennessee	Davidson County	15.31	0.15	0.00	0.08	0.02	NA	0.27	0.07	0.19	0.16	0.03
Tennessee	Hamilton County	16.11	0.16	0.00	0.15	0.02	NA	0.23	0.09	0.14	0.16	0.03
Tennessee	Knox County	18.16	0.21	0.00	0.23	0.02	NA	0.28	0.15	0.17	0.24	0.04
Tennessee	Roane County	15.13	0.18	0.00	0.14	0.02	NA	0.24	0.10	0.15	0.19	0.03
Tennessee	Sullivan County	15.06	0.19	0.00	0.18	0.01	NA	0.20	0.16	0.13	0.26	0.03
West Virginia	Brooke County	16.28	0.67	0.00	0.03	0.01	0.17	0.10	0.11	0.20	NA	0.02
West Virginia	Cabell County	15.98	0.25	0.00	0.09	0.02	0.36	0.16	0.16	0.18	NA	0.02
West Virginia	Hancock County	16.37	0.68	0.00	0.03	0.01	0.17	0.09	0.11	0.20	NA	0.02
West Virginia	Kanawha County	16.67	0.28	0.00	0.10	0.02	0.36	0.16	0.19	0.17	NA	0.02
West Virginia	Wood County	15.85	0.31	0.00	0.07	0.02	0.30	0.15	0.14	0.20	NA	0.02

Technical Support Document for the Interstate Air Quality Rule Air Quality Modeling Analyses

Appendix I

Background Information on the Development of Local Control Measures for PM2.5

Appendix I. Memo from ECR summarizing references for cost estimates

To: Scott Mathias

From: Becky Battye, EC/R

Subject: Revised Costs of Local Control Measures

Date: June 20, 2003

This memorandum is an update from the June 2, 2003 memorandum - documenting the selection and costs for the recently modeled control measures. Note: this memo describes the costs for the measures we wanted to model, not the levels that were actually modeled, and many of the measures have been modified based on comments received and information obtained during the development of the costs. Major changes to this memo include the addition of the source category codes for the measures, separately referencing the source of the cost and control efficiency information, and providing more information on the NOx and VOC controls. This memo also incorporates the information you have forwarded from OTAQ (email from you (5/6/03) and from Katayama (5/20/03)).

Costs for the PM local control measures

Control Measures	Efficiency	Cost/ton	Notes	Reference (efficiency)	Reference (cost)
Replace fireplaces with natural gas inserts 2104008001	80	7508	Cost-effectiveness is calculated for PM10 precursors and assumes a $300/retrofit incentive	Not known - shouldn't this be 100%?	*Air Quality Mitigation Plan for the East Altamont Energy Center, California Energy Commission, Sacramento, CA, July 19, 2002 (Draft)*
Replace with non-catalytic certified woodstoves 2104008001	71	3872	"	*Residential Wood Combustion - $PM_{2.5}$.* Prepared for Westar by OMNI. July 1998.	*Air Quality Mitigation Plan for the East Altamont Energy Center, California Energy Commission, Sacramento, CA, July 19, 2002 (Draft)*
	84-91			*Final Report to the Govenor's Air Quality Strategies Task Force from the PM-10 Subcommittee* (1/98)	
Combination of measures to reduce gasoline highway vehicle emissions 2201001*** 2201020***	3 - 5	Costs applied to VOC	Costs were developed based on VOC reduction. Efficiency for LDGV & LDGT1 - 5% in Birmingham and 3% in Chicago and Philadelphia. Assume no reduction in VMT for LDGT2 (2201040*** - commercial applications).	From OTAQ email	National Research Council, 2002 (The Congestion Mitigation Air Quality Program)
Diesel Particulate Filter 2230070***	90	4000	Cost is probably high - (based on lack of LSD availability - which shouldn't be an issue in 2010). Filters cost about $7,500/vehicle	http://www.adeq.state.az.us/environ/air/browncloud/download/onroad/1002haze2.pdf	http://www.adeq.state.az.us/environ/air/browncloud/download/onroad/1002haze2.pdf

Control Measures	Efficiency	Cost/ton	Notes	Reference (efficiency)	Reference (cost)
Work day restrictions (commercial lawn and garden) 226004016; 021; 026; 031; 071	11	Cost applied to NOx	Cost-effectiveness for lawn service restrictions is calculated and reported for NOx. Effectiveness based on 1 ton reduction from 9.6 tons of NOx in Houston.	Emission reduction is calculated from SIP inventory - these numbers have not been verified	*TNRCC Ozone August 2000 draft SIP in Clearing Houston's Air,from Texas Public Policy Foundation website: http://www.tppf.org*
Buy back program (residential lawn and garden) 226004015; 020; 025; 030			Need relative emissions from 2-stroke and 4-stroke (we have a cost for marine buy back program for VOC emissions)		
Diesel Oxidation catalyst for Non-road diesel 2270002***	25	1,000	Cost based on the Big Dig in Boston (which isn't clear if this is for PM or NOx). Cost is applied to both PM and NOx.	*Retrofitting Emission Controls on Diesel-Powered Vehicles*, MECA 3/2002, pg.8	*Clean Air and Transportation Diesel Engine Retrofit*, DOT/FHA 1/2002
Marine -diesel			Have something for NOx - since we don't know the measures we don't know if there is a PM co-benefit		
Marine 2-stroke buy back program 2282005010; 015			Have a cost for VOC reduction - need a ratio of PM and NOx emissions to VOC emissions for 2- vs. 4- stroke engines		*Outboard Engine Buy-Back Program*, EPA Wisconsin conducted a survey but the costs were too high - not implemented
Vacuum sweeping of paved roads 2294000000	75	1,070		Best Management Practices document and FHWA (Sutherland & Jelen, 1996)	*Proposed BACM/T & RACM/T Demonstration for sources of PM10 and precursors in the SJVAB* 4/2003

Control Measures	Efficiency	Cost/ton	Notes	Reference (efficiency)	Reference (cost)
Gravel covering of unpaved roads 2296000000	90	2160 - 5920		Not sure where efficiency came from - believe its an old FACA number	*Proposed BACM/T & RACM/T Demonstration for sources of PM10 and precursors in the SJVAB* 4/2003
Watering construction road 2311000100	50	1960	Cost is actually for disturbed soils after demolition completion or at end of each day of cleanup (construction activities). Much lower cost for limiting speeds on unpaved parking lots and water suppression ($1960/ton)	*Air Quality Modeling of Elevated Particulates Concentrations in Tucson in 1999* Arizona DEQ. 6/2001	*Proposed BACM/T & RACM/T Demonstration for sources of PM10 and precursors in the SJVAB* 4/2003
Ban Open Burning 2610010000 2610020000 2610030000	100	0			SJVUAPD *Draft Staff Report Amendments to 4103 (Open Burning) and New Rule 4106 (Prescribed Burning and Hazard Reduction Burning)* 11/00
Soil conservation measures for tilling operations 2801000003	20	19		*Additional Control Measure Evaluation for the Integrated Implementation of the Ozone and Particulate Matter National Ambient Air Quality Standards, and Regional Haze Program.* July 17, 1997.	*BACM/T & RACM/T Demonstration for Souces of PM10 and PM Precursos in the SJVAB* 4/2003

Reductions for the LDGV, LDGT 1&2, and LDGT 3&4, are currently listed as reduce VMT and turn over fleet. The 5/6/03 email suggested we change the name to “combination of measures to reduce highway vehicle emissions.” We have costs for “regional ridesharing, vanpool programs, employer trip reduction programs, and bike/pedestrian improvements” - but need a rationale for distributing the costs between pollutants. We show the reductions for all 3 pollutants & put the cost on VOC. Also, OTAQ said they would work toward improving the basis for three subcategories “accelerated fleet turnover, technology-based programs, and activity-based programs” (item 4 of email). Is there any additional information from them? Meanwhile they want us to lower our expectations on overall control efficiency (which we have done). The costs we have are only applied to LDGV and LDGT1, we assume that LDGT2 are more commercial in nature and not amenable to the three programs for which we have costs. ***There is additional information (non-CMAQ measures) in the CMAQ document that we will extract to get the remaining reductions and also to address LDGT2.***

For the diesel particulate filter, the first email from OTAQ said an overall HDDV reduction of 37% is appropriate. We referred to the Katayama information when applying the diesel particulate filter. We had assumed a 30% penetration. He further restricted the use of the particulate filter to model years 1996 to 2006 and only for class 5-8 vehicles. Using references from OTAQ we estimate that 57% of the HDDV fleet is the applicable class and 54% of the fleet is the correct model year. Therefore only about 31% could retrofit with the filter. When he said 30% market penetration I assume he means only 30% could use the filter. So we’ll stick with the 90% efficiency and 30% applicability. We use a cost of $4,000 ton (middle of the range but probably high).

The costs for the lawn service restriction are reported for NOx. The cost is presented for NOx but the measure reduces both pollutants. We are currently just reporting the restrictions for commercial lawn and garden use with the Texas proposal as the basis. No efficiency is provided in the Texas document. We calculated an 11% reduction for the NOx and applied the 11% to PM. OTAQ said they would look into buy-back programs for lawn and garden.

First email (item 6) refers to the diesel oxidation catalyst as achieving 25% control (of PM10?). Neither OTAQ or EC/R have a good feel for pre-2007 non-road engines. To achieve the desired 18.3% overall control efficiency - the overall applicability would have to increase to 73% (because the efficiency decreased from 61 to 25%).

Banning open burning is listed as a free measure in the SJV analysis. We have some costs for collecting residential trash in CA but would need to work the numbers to get an efficiency and a cost effectiveness.

Costs for the NOx local control measures

Control Measures	Efficiency	Cost/ton	Notes	Reference (efficiency)	Reference (cost)
Point Sources					
Low NOx burners for lime calcining kiln and asphalt concrete rotary dryer 30501604 30500201	27	440 - 940	Technology transfer from cement kiln operations. Cost is dependent upon whether the burner is direct fired or indirect fired	*NOx Control Technologies for the Cement Industry*, EPA report, 9/2000	same
Cement kiln - mid-kiln firing 30500606	33	55	for dry process kiln	*NOx Control Technologies for the Cement Industry*, EPA report, 9/2000	same
Cement kiln - tire derived fuel 30500623	35	(1900)	for preheater/precalciner kiln	*NOx Control Technologies for the Cement Industry*, EPA report, 9/2000	same
Point and Area Source Combustion Categories					
SNCR for coal-fired pulverized boilers 10200202 2102002000	50	1055	Middle of the range for both efficiency and cost effectiveness. Efficiency is much higher at a slightly higher cost for SCR	EPA, TTN NAAQS OTAG Technical Supporting Document Chapter 5 Appendix C Charts page 4	same
SNCR for coal-fired stoker boilers 10200104 10200204	50	1160	Middle of the range for both efficiency and cost effectiveness. Efficiency is much higher at a slightly higher cost for SCR	EPA, TTN NAAQS OTAG Technical Supporting Document Chapter 5 Appendix C Charts page 4	same
SNCR for medium industrial external combustion natural gas fired boilers 10200602	45	5315	Middle of the range for both efficiency and cost effectiveness. Range is for 50 mmBTU/hr natural gas fired boilers	EPA, TTN NAAQS OTAG Technical Supporting Document Chapter 5 Appendix C Charts page 2	same

Control Measures	Efficiency	Cost/ton	Notes	Reference (efficiency)	Reference (cost)
SNCR for large industrial external combustion natural gas fired boilers 10200601	45	4950	Middle of the range for both efficiency and cost effectiveness. Range is for 150 mmBTU/hr natural gas fired boilers	EPA, TTN NAAQS OTAG Technical Supporting Document Chapter 5 Appendix C Charts page 2	same
Low NOx burner for small industrial natural gas fired boilers 10200603	50	10,200	Middle of the range for cost effectiveness. Range is for 10 mmBTU/hr natural gas fired boilers	EPA, TTN NAAQS OTAG Technical Supporting Document Chapter 5 Appendix C Charts page 2	same
SCR for continuous gas-fired turbine 20200201 20200203	90	1530	costs are dependent on size (3 sizes listed, 5MW, 25MW, and 100 MW) Average used.	EPA, TTN NAAQS OTAG Technical Supporting Document Chapter 5 Appendix C Charts page 12	same
NSCR for industrial reciprocating gas fired engine 20200202	94	230	Assume spark ignition, gas rich engine. Middle of the range for both efficiency and cost effectiveness.	EPA, TTN NAAQS OTAG Technical Supporting Document Chapter 5 Appendix C Charts page 9	same
ULNB & SNCR for Petroleum Refining Process Heaters 30600104 30600106	93	806	Assume medium size process heater (75 MMBtu/hr) and very good reduction	*Petroleum Refinery Tier 2 BACT Analysis Report*. ERG. 3/2000	*Petroleum Refinery Tier 2 BACT Analysis Report*. ERG. 3/2000
Area Sources					
Combination of measures to reduce gasoline highway vehicle emissions 22010001*** 2201020***	3-5	Costs applied to VOC	An average cost effectiveness for regional ridesharing, vanpool programs, and employer trip reduction programs (did not include bike/pedestrian improvements - too expensive)	Efficiency recommendation from OTAQ - first email	NRC, 2002 (The CMAQ Program)

Control Measures	Efficiency	Cost/ton	Notes	Reference (efficiency)	Reference (cost)
Work day restrictions for commercial lawn and garden 2260004016; 021; 031; 036; 071	11	16,600	Cost-effectiveness for lawn service restrictions is calculated and reported for NOx. Effectiveness based on 1 ton reduction from 9.6 tons of NOx in Houston.	*TNRCC Ozone August 2000 draft SIP in Clearing Houston's Air,from Texas Public Policy Foundation website: http://www.tppf.org*	*TNRCC Ozone August 2000 draft SIP in Clearing Houston's Air,from Texas Public Policy Foundation website: http://www.tppf.org*
Diesel oxidation catalyst are applied to HDDV & nonroad engines to control PM and NOx 2230070*** 2270002***	40	1,000	the 40% reduction for diesel oxidation catalyst was not reflected in the initial spreadsheets (Costs are in both PM and NOX since report says per ton of pollutant without specifying pollutant)	*Retrofitting Emission Controls on Diesel-Powered Vehicles*, MECA 3/2002	*Clean Air and Transportation Diesel Engine Retrofit*, DOT/FHA 1/2000 (Based on the Big Dig in Boston)
SCR for diesel locomotives 2285002000	72	1700		*Controlling Locomotive Emissions in California*, Engine, Fuel, and Emissions Engineering, Inc. 3/95	same
		1160			*The Carl Moyer Program Annual Status Report* CARB, 3/2002
DOC for locomotives 2285002000		1200			*Clean Air and Transportation Diesel Engine Retrofit*, DOT/FHA 1/2000 (Based on the Carl Moyer Program)
Diesel boat retrofits, repowers, diesel tug retrofits 2280002000		900, 1200, 1300	From the presentation for the *Conference on Marine Vessels and Air Quality*, San Francisco, CA, 2/2001		*Economic Incentives for Marine Vessels*, Arthur D. Little
		3044			*The Carl Moyer Program Annual Status Report* CARB, 3/2002

Control Measures	Efficiency	Cost/ton	Notes	Reference (efficiency)	Reference (cost)
Buy back program (residential lawn and garden)			Need relative emissions from 2-stroke and 4-stroke (we have a cost for marine buy back program)		
Marine 2-stroke buy back program			Have a cost for VOC reduction - need a ratio of PM and NOx emissions to VOC emissions for 2- vs. 4- stroke engines	*Outboard Engine Buy-Back Program*, EPA Wisconsin conducted a survey but the costs were too high - not implemented	
Ban Open Burning 2610010000 2610020000 2610030000	100	0		SJVUAPD *Draft Staff Report Amendments to 4103 (Open Burning) and New Rule 4106 (Prescribed Burning and Hazard Reduction Burning)* 11/00	SJVUAPD *Draft Staff Report Amendments to 4103 (Open Burning) and New Rule 4106 (Prescribed Burning and Hazard Reduction Burning)* 11/00

The use of low NOx burners for the lime calcining, asphalt rotary dryers, and industrial natural gas boilers and IC engines seems reasonable. The costs are transferred from the cement document which is probably appropriate for the lime calcining and rotary dryer but may be too low a cost for an industrial boiler (lower fuel consumption).

The use of SNCR technology on area sources of coal boilers and natural gas boilers and IC engines may not be appropriate (the boilers may be too small) but the point source efficiencies and costs are applied.

Costs for the VOC local control measures

Control Measures	Efficiency	Cost/ton	Notes	Reference
Point				
Solvent Substitution		2226	This is only based on solvent cleaning operations.	*Technical Assessment Memo Regulation 8, Rule 16 Solvent Cleaning Operations* Bay Area AQMD 5/1998
Area				
Combination of measures to reduce gasoline highway vehicle emissions	3-5	13,500 (average cost for the 3 measures)	Costs were developed based on VOC reduction. Efficiency for LDGV & LDGT1 - 5% in Birmingham and 3% in Chicago and Philadelphia. Assume no reduction in VMT for LDGT2 (commercial applications).	NRC, 2002 (The CMAQ Program)
Work day restrictions (commercial lawn and garden)	11		Cost-effectiveness for lawn service restrictions is calculated and reported for NOx. Effectiveness based on 1 ton reduction from 9.6 tons of NOx in Houston.	*TNRCC Ozone August 2000 draft SIP in Clearing Houston's Air,from Texas Public Policy Foundation website: http://www.tppf.org*
Buy back program (residential lawn and garden)			Need relative emissions from 2-stroke and 4-stroke (we have a cost for marine buy back program)	
Marine 2-stroke buy back program		4,000 - 10,000	Have a cost for VOC reduction (100 hp engine vs. 10 hp engine) - need a ratio of PM and NOx emissions to VOC emissions for 2- vs. 4- stroke engines	*Outboard Engine Buy-Back Program*, EPA Wisconsin conducted a survey but the costs were too high - not implemented
Ban Open Burning	100	0		SJVUAPD Draft Staff Report Amendments to 4103 (Open Burning) and New Rule 4106 (Prescribed Burning and Hazard Reduction Burning) 11/00

Technical Support Document for the Interstate Air Quality Rule Air Quality Modeling Analyses

Appendix J

290 Counties Included in the Local Control Study

STATE FIPS	COUNTY FIPS	STATE NAME	COUNTY NAME	MSA/CMSA/NECMA NAME
17	031	Illinois	Cook	Chicago--Gary--Kenosha, IL--IN--WI CMSA
17	037	Illinois	DeKalb	Chicago--Gary--Kenosha, IL--IN--WI CMSA
17	043	Illinois	DuPage	Chicago--Gary--Kenosha, IL--IN--WI CMSA
17	063	Illinois	Grundy	Chicago--Gary--Kenosha, IL--IN--WI CMSA
17	089	Illinois	Kane	Chicago--Gary--Kenosha, IL--IN--WI CMSA
17	091	Illinois	Kankakee	Chicago--Gary--Kenosha, IL--IN--WI CMSA
17	093	Illinois	Kendall	Chicago--Gary--Kenosha, IL--IN--WI CMSA
17	097	Illinois	Lake	Chicago--Gary--Kenosha, IL--IN--WI CMSA
17	111	Illinois	McHenry	Chicago--Gary--Kenosha, IL--IN--WI CMSA
17	197	Illinois	Will	Chicago--Gary--Kenosha, IL--IN--WI CMSA
18	089	Indiana	Lake	Chicago--Gary--Kenosha, IL--IN--WI CMSA
18	127	Indiana	Porter	Chicago--Gary--Kenosha, IL--IN--WI CMSA
55	059	Wisconsin	Kenosha	Chicago--Gary--Kenosha, IL--IN--WI CMSA
18	029	Indiana	Dearborn	Cincinnati--Hamilton, OH--KY--IN CMSA
18	115	Indiana	Ohio	Cincinnati--Hamilton, OH--KY--IN CMSA
21	015	Kentucky	Boone	Cincinnati--Hamilton, OH--KY--IN CMSA
21	037	Kentucky	Campbell	Cincinnati--Hamilton, OH--KY--IN CMSA
21	077	Kentucky	Gallatin	Cincinnati--Hamilton, OH--KY--IN CMSA
21	081	Kentucky	Grant	Cincinnati--Hamilton, OH--KY--IN CMSA
21	117	Kentucky	Kenton	Cincinnati--Hamilton, OH--KY--IN CMSA
21	191	Kentucky	Pendleton	Cincinnati--Hamilton, OH--KY--IN CMSA
39	015	Ohio	Brown	Cincinnati--Hamilton, OH--KY--IN CMSA
39	017	Ohio	Butler	Cincinnati--Hamilton, OH--KY--IN CMSA
39	025	Ohio	Clermont	Cincinnati--Hamilton, OH--KY--IN CMSA
39	061	Ohio	Hamilton	Cincinnati--Hamilton, OH--KY--IN CMSA
39	165	Ohio	Warren	Cincinnati--Hamilton, OH--KY--IN CMSA
39	007	Ohio	Ashtabula	Cleveland--Akron, OH CMSA
39	035	Ohio	Cuyahoga	Cleveland--Akron, OH CMSA
39	055	Ohio	Geauga	Cleveland--Akron, OH CMSA
39	085	Ohio	Lake	Cleveland--Akron, OH CMSA
39	093	Ohio	Lorain	Cleveland--Akron, OH CMSA
39	103	Ohio	Medina	Cleveland--Akron, OH CMSA
39	133	Ohio	Portage	Cleveland--Akron, OH CMSA
39	153	Ohio	Summit	Cleveland--Akron, OH CMSA
26	049	Michigan	Genesee	Detroit--Ann Arbor--Flint, MI CMSA
26	087	Michigan	Lapeer	Detroit--Ann Arbor--Flint, MI CMSA
26	091	Michigan	Lenawee	Detroit--Ann Arbor--Flint, MI CMSA
26	093	Michigan	Livingston	Detroit--Ann Arbor--Flint, MI CMSA
26	099	Michigan	Macomb	Detroit--Ann Arbor--Flint, MI CMSA

26	115	Michigan	Monroe	Detroit--Ann Arbor--Flint, MI CMSA
26	125	Michigan	Oakland	Detroit--Ann Arbor--Flint, MI CMSA
26	147	Michigan	St. Clair	Detroit--Ann Arbor--Flint, MI CMSA
26	161	Michigan	Washtenaw	Detroit--Ann Arbor--Flint, MI CMSA
26	163	Michigan	Wayne	Detroit--Ann Arbor--Flint, MI CMSA
09	005	Connecticut	Litchfield	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
09	007	Connecticut	Middlesex	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
34	003	New Jersey	Bergen	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
34	013	New Jersey	Essex	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
34	017	New Jersey	Hudson	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
34	019	New Jersey	Hunterdon	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
34	021	New Jersey	Mercer	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
34	023	New Jersey	Middlesex	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
34	025	New Jersey	Monmouth	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
34	027	New Jersey	Morris	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
34	029	New Jersey	Ocean	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
34	031	New Jersey	Passaic	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
34	035	New Jersey	Somerset	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
34	037	New Jersey	Sussex	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
34	039	New Jersey	Union	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
34	041	New Jersey	Warren	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
36	005	New York	Bronx	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
36	027	New York	Dutchess	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
36	047	New York	Kings	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
36	059	New York	Nassau	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
36	061	New York	New York	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA

36	071	New York	Orange	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
36	079	New York	Putnam	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
36	081	New York	Queens	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
36	085	New York	Richmond	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
36	087	New York	Rockland	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
36	103	New York	Suffolk	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
36	119	New York	Westchester	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
42	103	Pennsylvania	Pike	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
09	001	Connecticut	Fairfield	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
09	009	Connecticut	New Haven	New York--Northern New Jersey--Long Island, NY--NJ--CT--PA CMSA
10	003	Delaware	New Castle	Philadelphia--Wilmington--Atlantic City, PA--NJ--DE--MD CMSA
24	015	Maryland	Cecil	Philadelphia--Wilmington--Atlantic City, PA--NJ--DE--MD CMSA
34	001	New Jersey	Atlantic	Philadelphia--Wilmington--Atlantic City, PA--NJ--DE--MD CMSA
34	005	New Jersey	Burlington	Philadelphia--Wilmington--Atlantic City, PA--NJ--DE--MD CMSA
34	007	New Jersey	Camden	Philadelphia--Wilmington--Atlantic City, PA--NJ--DE--MD CMSA
34	009	New Jersey	Cape May	Philadelphia--Wilmington--Atlantic City, PA--NJ--DE--MD CMSA
34	011	New Jersey	Cumberland	Philadelphia--Wilmington--Atlantic City, PA--NJ--DE--MD CMSA
34	015	New Jersey	Gloucester	Philadelphia--Wilmington--Atlantic City, PA--NJ--DE--MD CMSA
34	033	New Jersey	Salem	Philadelphia--Wilmington--Atlantic City, PA--NJ--DE--MD CMSA
42	017	Pennsylvania	Bucks	Philadelphia--Wilmington--Atlantic City, PA--NJ--DE--MD CMSA
42	029	Pennsylvania	Chester	Philadelphia--Wilmington--Atlantic City, PA--NJ--DE--MD CMSA
42	045	Pennsylvania	Delaware	Philadelphia--Wilmington--Atlantic City, PA--NJ--DE--MD CMSA
42	091	Pennsylvania	Montgomery	Philadelphia--Wilmington--Atlantic City, PA--NJ--DE--MD CMSA
42	101	Pennsylvania	Philadelphia	Philadelphia--Wilmington--Atlantic City, PA--NJ--DE--MD CMSA
11	001	District of Columbia	District of Columbia	Washington--Baltimore, DC--MD--VA--WV CMSA
24	003	Maryland	Anne Arundel	Washington--Baltimore, DC--MD--VA--WV CMSA
24	005	Maryland	Baltimore	Washington--Baltimore, DC--MD--VA--WV CMSA
24	009	Maryland	Calvert	Washington--Baltimore, DC--MD--VA--WV CMSA
24	013	Maryland	Carroll	Washington--Baltimore, DC--MD--VA--WV CMSA
24	017	Maryland	Charles	Washington--Baltimore, DC--MD--VA--WV CMSA
24	021	Maryland	Frederick	Washington--Baltimore, DC--MD--VA--WV CMSA
24	025	Maryland	Harford	Washington--Baltimore, DC--MD--VA--WV CMSA
24	027	Maryland	Howard	Washington--Baltimore, DC--MD--VA--WV CMSA

24	031	Maryland	Montgomery	Washington--Baltimore, DC--MD--VA--WV CMSA
24	033	Maryland	Prince George's	Washington--Baltimore, DC--MD--VA--WV CMSA
24	035	Maryland	Queen Anne's	Washington--Baltimore, DC--MD--VA--WV CMSA
24	043	Maryland	Washington	Washington--Baltimore, DC--MD--VA--WV CMSA
24	510	Maryland	Baltimore City	Washington--Baltimore, DC--MD--VA--WV CMSA
51	013	Virginia	Arlington	Washington--Baltimore, DC--MD--VA--WV CMSA
51	043	Virginia	Clarke	Washington--Baltimore, DC--MD--VA--WV CMSA
51	047	Virginia	Culpeper	Washington--Baltimore, DC--MD--VA--WV CMSA
51	059	Virginia	Fairfax	Washington--Baltimore, DC--MD--VA--WV CMSA
51	061	Virginia	Fauquier	Washington--Baltimore, DC--MD--VA--WV CMSA
51	099	Virginia	King George	Washington--Baltimore, DC--MD--VA--WV CMSA
51	107	Virginia	Loudoun	Washington--Baltimore, DC--MD--VA--WV CMSA
51	153	Virginia	Prince William	Washington--Baltimore, DC--MD--VA--WV CMSA
51	177	Virginia	Spotsylvania	Washington--Baltimore, DC--MD--VA--WV CMSA
51	179	Virginia	Stafford	Washington--Baltimore, DC--MD--VA--WV CMSA
51	187	Virginia	Warren	Washington--Baltimore, DC--MD--VA--WV CMSA
51	510	Virginia	Alexandria	Washington--Baltimore, DC--MD--VA--WV CMSA
51	600	Virginia	Fairfax City	Washington--Baltimore, DC--MD--VA--WV CMSA
51	610	Virginia	Falls Church	Washington--Baltimore, DC--MD--VA--WV CMSA
51	630	Virginia	Fredericksburg	Washington--Baltimore, DC--MD--VA--WV CMSA
51	683	Virginia	Manassas	Washington--Baltimore, DC--MD--VA--WV CMSA
51	685	Virginia	Manassas Park	Washington--Baltimore, DC--MD--VA--WV CMSA
54	003	West Virginia	Berkeley	Washington--Baltimore, DC--MD--VA--WV CMSA
54	037	West Virginia	Jefferson	Washington--Baltimore, DC--MD--VA--WV CMSA
13	059	Georgia	Clarke	Athens, GA MSA
13	195	Georgia	Madison	Athens, GA MSA
13	219	Georgia	Oconee	Athens, GA MSA
13	013	Georgia	Barrow	Atlanta, GA MSA
13	015	Georgia	Bartow	Atlanta, GA MSA
13	045	Georgia	Carroll	Atlanta, GA MSA
13	057	Georgia	Cherokee	Atlanta, GA MSA
13	063	Georgia	Clayton	Atlanta, GA MSA
13	067	Georgia	Cobb	Atlanta, GA MSA
13	077	Georgia	Coweta	Atlanta, GA MSA
13	089	Georgia	DeKalb	Atlanta, GA MSA
13	097	Georgia	Douglas	Atlanta, GA MSA
13	113	Georgia	Fayette	Atlanta, GA MSA
13	117	Georgia	Forsyth	Atlanta, GA MSA
13	121	Georgia	Fulton	Atlanta, GA MSA
13	135	Georgia	Gwinnett	Atlanta, GA MSA
13	151	Georgia	Henry	Atlanta, GA MSA

13	217	Georgia	Newton	Atlanta, GA MSA
13	223	Georgia	Paulding	Atlanta, GA MSA
13	227	Georgia	Pickens	Atlanta, GA MSA
13	247	Georgia	Rockdale	Atlanta, GA MSA
13	255	Georgia	Spalding	Atlanta, GA MSA
13	297	Georgia	Walton	Atlanta, GA MSA
13	073	Georgia	Columbia	Augusta--Aiken, GA--SC MSA
13	189	Georgia	McDuffie	Augusta--Aiken, GA--SC MSA
13	245	Georgia	Richmond	Augusta--Aiken, GA--SC MSA
45	003	South Carolina	Aiken	Augusta--Aiken, GA--SC MSA
45	037	South Carolina	Edgefield	Augusta--Aiken, GA--SC MSA
01	009	Alabama	Blount	Birmingham, AL MSA
01	073	Alabama	Jefferson	Birmingham, AL MSA
01	115	Alabama	St. Clair	Birmingham, AL MSA
01	117	Alabama	Shelby	Birmingham, AL MSA
39	019	Ohio	Carroll	Canton--Massillon, OH MSA
39	151	Ohio	Stark	Canton--Massillon, OH MSA
54	039	West Virginia	Kanawha	Charleston, WV MSA
54	079	West Virginia	Putnam	Charleston, WV MSA
37	025	North Carolina	Cabarrus	Charlotte--Gastonia--Rock Hill, NC--SC MSA
37	071	North Carolina	Gaston	Charlotte--Gastonia--Rock Hill, NC--SC MSA
37	109	North Carolina	Lincoln	Charlotte--Gastonia--Rock Hill, NC--SC MSA
37	119	North Carolina	Mecklenburg	Charlotte--Gastonia--Rock Hill, NC--SC MSA
37	159	North Carolina	Rowan	Charlotte--Gastonia--Rock Hill, NC--SC MSA
37	179	North Carolina	Union	Charlotte--Gastonia--Rock Hill, NC--SC MSA
45	091	South Carolina	York	Charlotte--Gastonia--Rock Hill, NC--SC MSA
13	047	Georgia	Catoosa	Chattanooga, TN--GA MSA
13	083	Georgia	Dade	Chattanooga, TN--GA MSA
13	295	Georgia	Walker	Chattanooga, TN--GA MSA
47	065	Tennessee	Hamilton	Chattanooga, TN--GA MSA

47	115	Tennessee	Marion	Chattanooga, TN--GA MSA
01	113	Alabama	Russell	Columbus, GA--AL MSA
13	053	Georgia	Chattahoochee	Columbus, GA--AL MSA
13	145	Georgia	Harris	Columbus, GA--AL MSA
13	215	Georgia	Muscogee	Columbus, GA--AL MSA
39	041	Ohio	Delaware	Columbus, OH MSA
39	045	Ohio	Fairfield	Columbus, OH MSA
39	049	Ohio	Franklin	Columbus, OH MSA
39	089	Ohio	Licking	Columbus, OH MSA
39	097	Ohio	Madison	Columbus, OH MSA
39	129	Ohio	Pickaway	Columbus, OH MSA
37	001	North Carolina	Alamance	Greensboro--Winston-Salem--High Point, NC MSA
37	057	North Carolina	Davidson	Greensboro--Winston-Salem--High Point, NC MSA
37	059	North Carolina	Davie	Greensboro--Winston-Salem--High Point, NC MSA
37	067	North Carolina	Forsyth	Greensboro--Winston-Salem--High Point, NC MSA
37	081	North Carolina	Guilford	Greensboro--Winston-Salem--High Point, NC MSA
37	151	North Carolina	Randolph	Greensboro--Winston-Salem--High Point, NC MSA
37	169	North Carolina	Stokes	Greensboro--Winston-Salem--High Point, NC MSA
37	197	North Carolina	Yadkin	Greensboro--Winston-Salem--High Point, NC MSA
45	007	South Carolina	Anderson	Greenville--Spartanburg--Anderson, SC MSA
45	021	South Carolina	Cherokee	Greenville--Spartanburg--Anderson, SC MSA
45	045	South Carolina	Greenville	Greenville--Spartanburg--Anderson, SC MSA
45	077	South Carolina	Pickens	Greenville--Spartanburg--Anderson, SC MSA
45	083	South Carolina	Spartanburg	Greenville--Spartanburg--Anderson, SC MSA
37	003	North Carolina	Alexander	Hickory--Morganton--Lenoir, NC MSA
37	023	North Carolina	Burke	Hickory--Morganton--Lenoir, NC MSA

37	027	North Carolina	Caldwell	Hickory--Morganton--Lenoir, NC MSA
37	035	North Carolina	Catawba	Hickory--Morganton--Lenoir, NC MSA
21	019	Kentucky	Boyd	Huntington--Ashland, WV--KY--OH MSA
21	043	Kentucky	Carter	Huntington--Ashland, WV--KY--OH MSA
21	089	Kentucky	Greenup	Huntington--Ashland, WV--KY--OH MSA
39	087	Ohio	Lawrence	Huntington--Ashland, WV--KY--OH MSA
54	011	West Virginia	Cabell	Huntington--Ashland, WV--KY--OH MSA
54	099	West Virginia	Wayne	Huntington--Ashland, WV--KY--OH MSA
18	011	Indiana	Boone	Indianapolis, IN MSA
18	057	Indiana	Hamilton	Indianapolis, IN MSA
18	059	Indiana	Hancock	Indianapolis, IN MSA
18	063	Indiana	Hendricks	Indianapolis, IN MSA
18	081	Indiana	Johnson	Indianapolis, IN MSA
18	095	Indiana	Madison	Indianapolis, IN MSA
18	097	Indiana	Marion	Indianapolis, IN MSA
18	109	Indiana	Morgan	Indianapolis, IN MSA
18	145	Indiana	Shelby	Indianapolis, IN MSA
47	019	Tennessee	Carter	Johnson City--Kingsport--Bristol, TN--VA MSA
47	073	Tennessee	Hawkins	Johnson City--Kingsport--Bristol, TN--VA MSA
47	163	Tennessee	Sullivan	Johnson City--Kingsport--Bristol, TN--VA MSA
47	171	Tennessee	Unicoi	Johnson City--Kingsport--Bristol, TN--VA MSA
47	179	Tennessee	Washington	Johnson City--Kingsport--Bristol, TN--VA MSA
51	169	Virginia	Scott	Johnson City--Kingsport--Bristol, TN--VA MSA
51	191	Virginia	Washington	Johnson City--Kingsport--Bristol, TN--VA MSA
51	520	Virginia	Bristol	Johnson City--Kingsport--Bristol, TN--VA MSA
47	001	Tennessee	Anderson	Knoxville, TN MSA
47	009	Tennessee	Blount	Knoxville, TN MSA
47	093	Tennessee	Knox	Knoxville, TN MSA
47	105	Tennessee	Loudon	Knoxville, TN MSA
47	155	Tennessee	Sevier	Knoxville, TN MSA
47	173	Tennessee	Union	Knoxville, TN MSA
42	071	Pennsylvania	Lancaster	Lancaster, PA MSA
21	017	Kentucky	Bourbon	Lexington, KY MSA
21	049	Kentucky	Clark	Lexington, KY MSA

21	067	Kentucky	Fayette	Lexington, KY MSA
21	113	Kentucky	Jessamine	Lexington, KY MSA
21	151	Kentucky	Madison	Lexington, KY MSA
21	209	Kentucky	Scott	Lexington, KY MSA
21	239	Kentucky	Woodford	Lexington, KY MSA
18	019	Indiana	Clark	Louisville, KY--IN MSA
18	043	Indiana	Floyd	Louisville, KY--IN MSA
18	061	Indiana	Harrison	Louisville, KY--IN MSA
18	143	Indiana	Scott	Louisville, KY--IN MSA
21	029	Kentucky	Bullitt	Louisville, KY--IN MSA
21	111	Kentucky	Jefferson	Louisville, KY--IN MSA
21	185	Kentucky	Oldham	Louisville, KY--IN MSA
01	001	Alabama	Autauga	Montgomery, AL MSA
01	051	Alabama	Elmore	Montgomery, AL MSA
01	101	Alabama	Montgomery	Montgomery, AL MSA
47	021	Tennessee	Cheatham	Nashville, TN MSA
47	037	Tennessee	Davidson	Nashville, TN MSA
47	043	Tennessee	Dickson	Nashville, TN MSA
47	147	Tennessee	Robertson	Nashville, TN MSA
47	149	Tennessee	Rutherford	Nashville, TN MSA
47	165	Tennessee	Sumner	Nashville, TN MSA
47	187	Tennessee	Williamson	Nashville, TN MSA
47	189	Tennessee	Wilson	Nashville, TN MSA
39	167	Ohio	Washington	Parkersburg--Marietta, WV--OH MSA
54	107	West Virginia	Wood	Parkersburg--Marietta, WV--OH MSA
42	003	Pennsylvania	Allegheny	Pittsburgh, PA MSA
42	007	Pennsylvania	Beaver	Pittsburgh, PA MSA
42	019	Pennsylvania	Butler	Pittsburgh, PA MSA
42	051	Pennsylvania	Fayette	Pittsburgh, PA MSA
42	125	Pennsylvania	Washington	Pittsburgh, PA MSA
42	129	Pennsylvania	Westmoreland	Pittsburgh, PA MSA
42	011	Pennsylvania	Berks	Reading, PA MSA
17	027	Illinois	Clinton	St. Louis, MO--IL MSA
17	083	Illinois	Jersey	St. Louis, MO--IL MSA
17	119	Illinois	Madison	St. Louis, MO--IL MSA
17	133	Illinois	Monroe	St. Louis, MO--IL MSA

17	163	Illinois	St. Clair	St. Louis, MO--IL MSA
29	071	Missouri	Franklin	St. Louis, MO--IL MSA
29	099	Missouri	Jefferson	St. Louis, MO--IL MSA
29	113	Missouri	Lincoln	St. Louis, MO--IL MSA
29	183	Missouri	St. Charles	St. Louis, MO--IL MSA
29	189	Missouri	St. Louis	St. Louis, MO--IL MSA
29	219	Missouri	Warren	St. Louis, MO--IL MSA
29	510	Missouri	St. Louis	St. Louis, MO--IL MSA
39	081	Ohio	Jefferson	Steubenville--Weirton, OH--WV MSA
54	009	West Virginia	Brooke	Steubenville--Weirton, OH--WV MSA
54	029	West Virginia	Hancock	Steubenville--Weirton, OH--WV MSA
39	013	Ohio	Belmont	Wheeling, WV--OH MSA
54	051	West Virginia	Marshall	Wheeling, WV--OH MSA
54	069	West Virginia	Ohio	Wheeling, WV--OH MSA
42	133	Pennsylvania	York	York, PA MSA
39	029	Ohio	Columbiana	Youngstown--Warren, OH MSA
39	099	Ohio	Mahoning	Youngstown--Warren, OH MSA
39	155	Ohio	Trumbull	Youngstown--Warren, OH MSA
01	49	Alabama	DeKalb County	Rural County
01	121	Alabama	Talladega County	Rural County
13	115	Georgia	Floyd County	Rural County
13	139	Georgia	Hall County	Rural County
13	319	Georgia	Wilkinson County	Rural County
39	145	Ohio	Scioto County	Rural County
47	145	Tennessee	Roane County	Rural County

Technical Support Document for the Interstate Air Quality Rule Air Quality Modeling Analyses

Appendix K

Summary Emission Reductions from Local Control Measures for the 290 County Study

VOC Summary

VOC Emissions	Scenerio Totals				Difference			Percent Difference		
CMSA/MSA/FIP	VOC 2010 Base	VOC 2010 Control	VOC 2015 Base	VOC 2015 Control	VOC (2010C - 2010B)	VOC (2015B - 2010B)	VOC (2015C -2015B)	VOC (2010C - 2010B) / 2010B	VOC (2015B - 2010B) / 2010B	VOC (2015C - 2015B) / 2015B
Hall County, Georgia	2583.5	1844.0	2473.7	1699.0	-739.5	-109.8	-774.7	-28.6	-4.3	-31.3
Floyd County, Georgia	3237.2	2589.1	3129.7	2453.6	-648.1	-107.5	-676.1	-20.0	-3.3	-21.6
Atlanta, GA	52209.2	44246.3	47814.6	39546.1	-7962.9	-4394.6	-8268.4	-15.3	-8.4	-17.3
Nashville, TN	25406.9	21670.3	23027.8	19196.3	-3736.6	-2379.1	-3831.5	-14.7	-9.4	-16.6
Wilkinson County, Georgia	262.5	224.6	242.2	203.0	-37.9	-20.4	-39.2	-14.5	-7.8	-16.2
Washington-Baltimore, DC-MD-VA-WV	47772.6	41324.4	42926.7	36160.2	-6448.2	-4845.9	-6766.5	-13.5	-10.1	-15.8
Roane County, Tennessee	1041.7	905.2	955.8	814.7	-136.5	-85.9	-141.1	-13.1	-8.2	-14.8
DeKalb County, Alabama	1165.0	1028.3	1064.7	925.7	-136.7	-100.3	-139.0	-11.7	-8.6	-13.1
Charlotte-Gastonia-Rock Hill, NC-SC	25769.2	23151.3	23763.8	21088.5	-2617.9	-2005.4	-2675.3	-10.2	-7.8	-11.3
Cincinnati-Hamilton, OH-KY-IN	23192.1	20837.6	20480.8	18139.6	-2354.5	-2711.3	-2341.3	-10.2	-11.7	-11.4
Greensboro--Winston-Salem--High Point, NC	32699.6	29469.2	31302.3	27965.2	-3230.4	-1397.3	-3337.1	-9.9	-4.3	-10.7
Athens, GA	2998.0	2710.7	2727.6	2436.2	-287.3	-270.4	-291.4	-9.6	-9.0	-10.7
Scioto County, Ohio	1022.7	928.2	892.1	797.5	-94.5	-130.6	-94.5	-9.2	-12.8	-10.6
Louisville, KY-IN	25825.8	23728.0	23988.9	21894.5	-2097.8	-1836.9	-2094.4	-8.1	-7.1	-8.7
Indianapolis, IN	24328.0	22387.2	21835.4	19913.3	-1940.9	-2492.6	-1922.1	-8.0	-10.2	-8.8
Chattanooga, TN-GA	11589.0	10686.4	10793.8	9883.7	-902.7	-795.3	-910.1	-7.8	-6.9	-8.4
Augusta-Aiken, GA-SC	9279.7	8567.8	8658.5	7936.4	-711.8	-621.2	-722.0	-7.7	-6.7	-8.3
Huntington-Ashland, WV-KY-OH	6888.3	6385.0	6324.8	5821.3	-503.3	-563.5	-503.5	-7.3	-8.2	-8.0
Talladega County, Alabama	2583.9	2396.5	2594.9	2401.7	-187.4	11.0	-193.2	-7.3	0.4	-7.4
Greenville-Spartanburg-Anderson, SC	17159.3	15927.3	15757.4	14514.7	-1232.0	-1402.0	-1242.7	-7.2	-8.2	-7.9
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	68335.2	63475.5	63376.0	58449.7	-4859.7	-4959.2	-4926.4	-7.1	-7.3	-7.8
Hickory-Morganton-Lenoir, NC	17559.9	16331.5	17684.9	16406.1	-1228.3	125.0	-1278.7	-7.0	0.7	-7.2
Knoxville, TN	13673.0	12738.0	12517.4	11577.1	-934.9	-1155.6	-940.3	-6.8	-8.5	-7.5
Birmingham, AL	22982.4	21522.9	21650.3	20187.6	-1459.5	-1332.1	-1462.7	-6.4	-5.8	-6.8
Columbus, GA-AL	7276.4	6841.1	7008.9	6570.4	-435.3	-267.5	-438.5	-6.0	-3.7	-6.3
Wheeling, WV-OH	4332.8	4085.8	4097.5	3854.1	-247.0	-235.3	-243.4	-5.7	-5.4	-5.9
Steubenville-Weirton, OH-WV	4264.7	4028.7	4081.9	3845.6	-236.0	-182.8	-236.3	-5.5	-4.3	-5.8
Montgomery, AL	8435.4	7988.8	8175.7	7732.7	-446.5	-259.6	-443.0	-5.3	-3.1	-5.4
Lexington, KY	12386.6	11821.9	12336.6	11774.5	-564.6	-50.0	-562.1	-4.6	-0.4	-4.6
Youngstown-Warren, OH	6379.2	6102.7	5472.6	5215.7	-276.4	-906.5	-256.9	-4.3	-14.2	-4.7
Johnson City-Kingsport-Bristol, TN-VA	38385.1	37090.2	38951.9	37574.1	-1295.0	566.8	-1377.8	-3.4	1.5	-3.5
Cleveland-Akron, OH	21191.4	20608.0	17589.1	17100.0	-583.4	-3602.3	-489.0	-2.8	-17.0	-2.8
Columbus, OH	24089.8	23508.4	21836.3	21303.2	-581.4	-2253.5	-533.1	-2.4	-9.4	-2.4
St. Louis, MO-IL	38584.5	37726.4	35300.4	34510.9	-858.2	-3284.1	-789.5	-2.2	-8.5	-2.2
York, PA	3773.5	3694.3	3131.7	3068.3	-79.2	-641.8	-63.4	-2.1	-17.0	-2.0
Pittsburgh, PA	21398.8	20954.1	18329.9	17965.6	-444.7	-3068.9	-364.3	-2.1	-14.3	-2.0
Canton-Massillon, OH	6662.6	6526.5	6242.4	6117.8	-136.2	-420.3	-124.6	-2.0	-6.3	-2.0
Reading, PA	3771.3	3696.6	3244.3	3184.8	-74.6	-526.9	-59.5	-2.0	-14.0	-1.8
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	78789.2	77290.4	70804.3	69529.7	-1498.8	-7984.8	-1274.6	-1.9	-10.1	-1.8
Detroit-Ann Arbor-Flint, MI	71046.8	69888.2	66511.9	65516.8	-1158.7	-4534.9	-995.1	-1.6	-6.4	-1.5
Chicago-Gary-Kenosha, IL-IN-WI	107228.9	105530.1	101143.4	99659.2	-1698.8	-6085.5	-1484.2	-1.6	-5.7	-1.5
Parkersburg-Marietta, WV-OH	6604.6	6501.0	6584.0	6485.6	-103.6	-20.6	-98.4	-1.6	-0.3	-1.5
New Haven-Bridgeport-Stamford-Waterbury-Danbury, CT	12783.4	12587.7	10753.5	10590.7	-195.7	-2029.8	-162.8	-1.5	-15.9	-1.5
Lancaster, PA	6153.8	6064.1	5655.5	5582.1	-89.7	-498.3	-73.4	-1.5	-8.1	-1.3
Hartford, CT	1292.4	1275.1	1078.3	1063.9	-17.4	-214.1	-14.4	-1.3	-16.6	-1.3
Charleston, WV	8071.8	7972.9	7718.5	7633.3	-98.9	-353.2	-85.2	-1.2	-4.4	-1.1
Litchfield County, Connecticut	1407.9	1392.7	1154.7	1142.2	-15.1	-253.2	-12.5	-1.1	-18.0	-1.1

SO2 Summary

SO2 Emissions	Scenerio Totals				Difference			Percent Difference		
CMSA/MSA/FIP	SO2 2010 Base	SO2 2010 Control	SO2 2015 Base	SO2 2015 Control	SO2 (2010C - 2010B)	SO2 (2015B - 2010B)	SO2 (2015C - 2015B)	SO2 (2010C - 2010B) / 2010B	SO2 (2015B - 2010B) / 2010B	SO2 (2015C - 2015B) / 2015B
Roane County, Tennessee	78936.7	39671.4	78943.9	39651.4	-39265.2	7.2	-39292.5	-49.7	0.0	-49.8
Wheeling, WV-OH	221842.5	112435.7	166254.4	84615.6	-109406.8	-55588.0	-81638.8	-49.3	-25.1	-49.1
Charleston, WV	128870.4	65594.6	128780.0	65559.5	-63275.8	-90.4	-63220.5	-49.1	-0.1	-49.1
Atlanta, GA	251829.0	130483.4	251269.0	130326.0	-121345.6	-560.0	-120943.0	-48.2	-0.2	-48.1
Birmingham, AL	206784.4	110920.5	191125.5	103141.5	-95863.9	-15659.0	-87984.0	-46.4	-7.6	-46.0
Indianapolis, IN	70720.1	38822.2	42807.8	24937.6	-31897.9	-27912.3	-17870.2	-45.1	-39.5	-41.7
Charlotte-Gastonia-Rock Hill, NC-SC	60938.8	33942.5	62617.2	35577.2	-26996.3	1678.5	-27040.1	-44.3	2.8	-43.2
Talladega County, Alabama	12651.8	7099.3	13019.0	7339.2	-5552.5	367.1	-5679.8	-43.9	2.9	-43.6
Washington-Baltimore, DC-MD-VA-WV	282046.5	159048.2	279273.8	161885.7	-122998.3	-2772.7	-117388.0	-43.6	-1.0	-42.0
Floyd County, Georgia	52769.7	29824.6	45337.4	26325.4	-22945.1	-7432.3	-19012.0	-43.5	-14.1	-41.9
Nashville, TN	60041.6	34045.4	60082.9	34072.0	-25996.2	41.3	-26010.9	-43.3	0.1	-43.3
Steubenville-Weirton, OH-WV	252834.7	145786.1	242428.0	139581.1	-107048.6	-10406.6	-102846.9	-42.3	-4.1	-42.4
Detroit-Ann Arbor-Flint, MI	308294.8	185486.5	316431.8	189984.2	-122808.3	8137.0	-126447.6	-39.8	2.6	-40.0
Cincinnati-Hamilton, OH-KY-IN	280390.3	177154.5	247621.8	159967.1	-103235.9	-32768.5	-87654.8	-36.8	-11.7	-35.4
Greenville-Spartanburg-Anderson, SC	21137.5	13444.4	21749.4	13803.8	-7693.1	611.9	-7945.6	-36.4	2.9	-36.5
Cleveland-Akron, OH	338088.2	215882.8	283841.6	187605.2	-122205.4	-54246.6	-96236.4	-36.1	-16.0	-33.9
St. Louis, MO-IL	316680.5	207279.8	349077.2	226184.8	-109400.7	32396.7	-122892.4	-34.5	10.2	-35.2
Chicago-Gary-Kenosha, IL-IN-WI	300742.0	197154.8	299980.5	197992.4	-103587.2	-761.5	-101988.1	-34.4	-0.3	-34.0
Youngstown-Warren, OH	8722.2	5863.7	7969.5	7398.4	-2858.5	-752.7	-571.1	-32.8	-8.6	-7.2
Knoxville, TN	69578.6	46957.8	69984.4	47343.1	-22620.8	405.8	-22641.4	-32.5	0.6	-32.4
Johnson City-Kingsport-Bristol, TN-VA	93930.3	66225.3	94221.3	66470.3	-27705.0	291.0	-27751.0	-29.5	0.3	-29.5
Augusta-Aiken, GA-SC	28253.8	20300.6	27040.6	19880.6	-7953.2	-1213.2	-7160.0	-28.1	-4.3	-26.5
Parkersburg-Marietta, WV-OH	25891.6	19036.9	23397.7	13882.5	-6854.7	-2493.9	-9515.2	-26.5	-9.6	-40.7
Lancaster, PA	1062.6	787.0	1073.6	790.1	-275.6	11.0	-283.4	-25.9	1.0	-26.4
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	107863.1	81521.6	109500.6	82394.9	-26341.6	1637.5	-27105.7	-24.4	1.5	-24.8
Lexington, KY	11317.1	8555.9	13819.7	10380.7	-2761.2	2502.6	-3439.0	-24.4	22.1	-24.9
Huntington-Ashland, WV-KY-OH	20915.7	16085.1	21575.7	16449.9	-4830.7	660.0	-5125.8	-23.1	3.2	-23.8
Pittsburgh, PA	108480.2	86765.8	87787.6	67779.8	-21714.4	-20692.5	-20007.9	-20.0	-19.1	-22.8
Columbus, OH	18569.7	15254.9	18706.0	18705.8	-3314.8	136.3	-0.2	-17.9	0.7	-0.0
Louisville, KY-IN	71330.7	59393.6	71567.0	59650.8	-11937.1	236.3	-11916.3	-16.7	0.3	-16.7
Canton-Massillon, OH	2739.2	2374.0	2817.0	2429.3	-365.2	77.7	-387.7	-13.3	2.8	-13.8
Greensboro--Winston-Salem--High Point, NC	19820.7	17511.6	19581.6	17427.0	-2309.2	-239.1	-2154.6	-11.7	-1.2	-11.0
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	166583.9	150517.6	163870.5	147794.1	-16066.3	-2713.4	-16076.4	-9.6	-1.6	-9.8
Chattanooga, TN-GA	10115.5	9810.2	10346.3	10047.5	-305.3	230.8	-298.7	-3.0	2.3	-2.9
York, PA	107820.5	105123.8	111486.0	108786.5	-2696.7	3665.5	-2699.5	-2.5	3.4	-2.4
Athens, GA	144.3	144.1	142.2	142.2	-0.2	-2.1	-0.0	-0.1	-1.4	-0.0
Columbus, GA-AL	2216.1	2213.7	2301.5	2301.5	-2.3	85.5	-0.0	-0.1	3.9	-0.0
Hall County, Georgia	71.6	71.6	70.9	70.9	-0.0	-0.7	-0.0	-0.0	-1.0	-0.1
Reading, PA	17790.0	17782.9	19587.9	19587.8	-7.1	1797.9	-0.1	-0.0	10.1	-0.0
Hickory-Morganton-Lenoir, NC	1249.2	1248.7	1299.9	1299.8	-0.5	50.7	-0.1	-0.0	4.1	-0.0
DeKalb County, Alabama	143.7	143.7	145.7	145.7	-0.0	2.0	-0.0	-0.0	1.4	-0.0
Hartford, CT	773.2	773.1	790.0	789.9	-0.1	16.8	-0.0	-0.0	2.2	-0.0
Scioto County, Ohio	3040.9	3040.7	3069.0	3069.0	-0.2	28.1	-0.0	-0.0	0.9	-0.0
Litchfield County, Connecticut	146.5	146.5	146.8	146.8	0.0	0.3	-0.0	0.0	0.2	-0.0
Wilkinson County, Georgia	107.2	107.3	109.5	109.4	0.0	2.2	-0.0	0.0	2.1	-0.0
New Haven-Bridgeport-Stamford-Waterbury-Danbury, CT	7279.7	7282.1	7326.1	7325.9	2.4	46.5	-0.2	0.0	0.6	-0.0
Montgomery, AL	5156.0	5161.8	5404.7	5379.3	5.8	248.7	-25.4	0.1	4.8	-0.5
	4156713.5	2654278.4	3975780.7	2566529.3						

NOX Summary

NOX Emissions	Scenerio Totals				Difference			Percent Difference		
CMSA/MSA/FIP	NOX 2010 Base	NOX 2010 Control	NOX 2015 Base	NOX 2015 Control	NOX (2010C - 2010B)	NOX (2015B - 2010B)	NOX (2015C - 2015B)	NOX (2010C - 2010B) / 2010B	NOX (2015B - 2010B) / 2010B	NOX (2015C - 2015B) / 2015B
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	174144.8	157996.8	148766.9	134273.5	-16147.9	-25377.9	-14493.4	-9.3	-14.6	-9.7
Hall County, Georgia	3667.8	3332.7	2725.9	2437.2	-335.1	-941.9	-288.7	-9.1	-25.7	-10.6
Hickory-Morganton-Lenoir, NC	7926.2	7277.2	6069.7	5528.9	-648.9	-1856.5	-540.8	-8.2	-23.4	-8.9
Huntington-Ashland, WV-KY-OH	35264.7	32597.1	32726.1	30100.9	-2667.6	-2538.6	-2625.1	-7.6	-7.2	-8.0
Scioto County, Ohio	3069.0	2844.1	2589.5	2391.8	-225.0	-479.5	-197.8	-7.3	-15.6	-7.6
Athens, GA	5048.3	4692.9	3881.2	3595.6	-355.4	-1167.2	-285.6	-7.0	-23.1	-7.4
DeKalb County, Alabama	2280.9	2124.7	1821.8	1687.6	-156.2	-459.1	-134.2	-6.8	-20.1	-7.4
Greensboro--Winston-Salem--High Point, NC	39157.0	36616.5	31440.0	29389.6	-2540.6	-7717.0	-2050.4	-6.5	-19.7	-6.5
St. Louis, MO-IL	150203.4	140689.1	143718.4	134668.5	-9514.2	-6485.0	-9049.8	-6.3	-4.3	-6.3
New Haven-Bridgeport-Stamford-Waterbury-Danbury, CT	30932.6	28997.7	23620.2	22301.3	-1934.9	-7312.4	-1319.0	-6.3	-23.6	-5.6
Columbus, OH	37995.8	35630.3	29646.1	27918.2	-2365.5	-8349.7	-1727.9	-6.2	-22.0	-5.8
Nashville, TN	53314.0	50040.3	44263.8	41567.2	-3273.8	-9050.2	-2696.7	-6.1	-17.0	-6.1
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	301357.1	283489.7	243392.9	230519.1	-17867.4	-57964.2	-12873.8	-5.9	-19.2	-5.3
Greenville-Spartanburg-Anderson, SC	35709.1	33610.0	29907.5	28154.0	-2099.1	-5801.6	-1753.6	-5.9	-16.2	-5.9
Lancaster, PA	10405.4	9795.2	7722.7	7254.9	-610.2	-2682.7	-467.9	-5.9	-25.8	-6.1
Canton-Massillon, OH	10945.3	10307.4	8769.8	8268.0	-637.9	-2175.5	-501.8	-5.8	-19.9	-5.7
Columbus, GA-AL	12120.5	11434.5	10716.3	10150.9	-685.9	-1404.2	-565.5	-5.7	-11.6	-5.3
Youngstown-Warren, OH	16580.5	15646.7	13258.3	12567.6	-933.8	-3322.2	-690.7	-5.6	-20.0	-5.2
Charlotte-Gastonia-Rock Hill, NC-SC	54441.8	51392.6	47425.6	45003.0	-3049.2	-7016.2	-2422.6	-5.6	-12.9	-5.1
Reading, PA	11778.8	11119.8	10045.5	9479.1	-659.0	-1733.3	-566.4	-5.6	-14.7	-5.6
Knoxville, TN	34947.3	33010.3	30078.2	28412.6	-1937.0	-4869.1	-1665.6	-5.5	-13.9	-5.5
Indianapolis, IN	62322.1	58934.8	52765.1	50129.6	-3387.4	-9557.1	-2635.5	-5.4	-15.3	-5.0
Litchfield County, Connecticut	2482.1	2347.7	1729.1	1637.8	-134.4	-752.9	-91.4	-5.4	-30.3	-5.3
Chicago-Gary-Kenosha, IL-IN-WI	285964.2	270636.6	245603.1	232857.8	-15327.6	-40361.1	-12745.3	-5.4	-14.1	-5.2
Louisville, KY-IN	91194.1	86377.1	83293.7	78925.8	-4816.9	-7900.4	-4367.9	-5.3	-8.7	-5.2
Lexington, KY	23219.4	22010.0	21871.4	20817.7	-1209.4	-1348.0	-1053.7	-5.2	-5.8	-4.8
Chattanooga, TN-GA	17205.2	16336.5	13772.8	13082.1	-868.7	-3432.4	-690.7	-5.0	-19.9	-5.0
Atlanta, GA	171312.1	162850.1	143810.9	136976.6	-8462.0	-27501.2	-6834.3	-4.9	-16.1	-4.8
Montgomery, AL	15877.5	15101.6	14264.6	13511.0	-775.9	-1612.8	-753.6	-4.9	-10.2	-5.3
Cleveland-Akron, OH	86488.2	82304.4	72649.0	69573.3	-4183.8	-13839.2	-3075.7	-4.8	-16.0	-4.2
Washington-Baltimore, DC-MD-VA-WV	213187.6	202890.3	180789.9	172799.8	-10297.3	-32397.7	-7990.1	-4.8	-15.2	-4.4
Johnson City-Kingsport-Bristol, TN-VA	42335.2	40316.5	38769.2	36933.7	-2018.7	-3566.0	-1835.5	-4.8	-8.4	-4.7
Hartford, CT	3609.5	3440.4	2848.4	2724.3	-169.1	-761.1	-124.1	-4.7	-21.1	-4.4
Augusta-Aiken, GA-SC	25435.1	24339.5	22922.6	22008.4	-1095.6	-2512.4	-914.2	-4.3	-9.9	-4.0
York, PA	35769.1	34258.0	34226.1	32859.9	-1511.0	-1543.0	-1366.1	-4.2	-4.3	-4.0
Wilkinson County, Georgia	926.7	888.8	809.9	780.0	-37.9	-116.9	-29.9	-4.1	-12.6	-3.7
Parkersburg-Marietta, WV-OH	10897.6	10466.2	9754.2	9373.6	-431.4	-1143.4	-380.6	-4.0	-10.5	-3.9
Birmingham, AL	84872.2	81680.3	75596.9	72699.1	-3191.9	-9275.3	-2897.9	-3.8	-10.9	-3.8
Pittsburgh, PA	122868.2	118493.1	108262.2	104788.7	-4375.1	-14606.0	-3473.5	-3.6	-11.9	-3.2
Detroit-Ann Arbor-Flint, MI	211671.1	204318.2	191429.0	185626.6	-7352.9	-20242.2	-5802.4	-3.5	-9.6	-3.0
Cincinnati-Hamilton, OH-KY-IN	123066.7	118924.7	112209.5	108768.1	-4142.0	-10857.2	-3441.4	-3.4	-8.8	-3.1
Talladega County, Alabama	5992.1	5795.0	5589.8	5409.6	-197.2	-402.4	-180.1	-3.3	-6.7	-3.2
Wheeling, WV-OH	43899.2	42885.8	42724.3	41808.6	-1013.4	-1174.9	-915.7	-2.3	-2.7	-2.1
Charleston, WV	59044.9	57686.0	56644.7	55438.2	-1358.8	-2400.1	-1206.6	-2.3	-4.1	-2.1
Floyd County, Georgia	17372.4	17049.2	17040.7	16752.5	-323.2	-331.6	-288.3	-1.9	-1.9	-1.7
Roane County, Tennessee	12775.6	12654.8	12444.4	12363.6	-120.7	-331.1	-80.8	-0.9	-2.6	-0.6
Steubenville-Weirton, OH-WV	64511.5	63994.9	62928.7	62440.3	-516.6	-1582.8	-488.4	-0.8	-2.5	-0.8

Total Direct PM2_5 Summary

PM2.5 Emissions	Scenerio Totals				Difference			Percent Difference		
CMSA/MSA/FIP	PM2_5 2010 Base	PM2_5 2010 Control	PM2_5 2015 Base	PM2_5 2015 Control	PM2_5 (2010C - 2010B)	PM2_5 (2015B - 2010B)	PM2_5 (2015C - 2015B)	PM2_5 (2010C - 2010B) / 2010B	PM2_5 (2015B - 2010B) / 2010B	PM2_5 (2015C - 2015B) / 2015B
Hall County, Georgia	1485.4	841.8	1456.6	803.6	-643.7	-28.8	-653.0	-43.3	-1.9	-44.8
Nashville, TN	8202.4	5019.1	8076.9	4868.7	-3183.3	-125.5	-3208.2	-38.8	-1.5	-39.7
Hickory-Morganton-Lenoir, NC	3720.3	2337.7	3674.0	2275.3	-1382.6	-46.3	-1398.7	-37.2	-1.2	-38.1
Floyd County, Georgia	1896.4	1250.1	1948.0	1277.3	-646.3	51.6	-670.7	-34.1	2.7	-34.4
Greensboro--Winston-Salem--High Point, NC	9839.1	6502.2	9718.2	6349.2	-3336.9	-120.9	-3369.0	-33.9	-1.2	-34.7
Johnson City-Kingsport-Bristol, TN-VA	4706.0	3123.5	4682.6	3094.6	-1582.5	-23.4	-1588.0	-33.6	-0.5	-33.9
Atlanta, GA	22425.9	14900.1	22219.4	14589.0	-7525.9	-206.5	-7630.4	-33.6	-0.9	-34.3
Youngstown-Warren, OH	2678.5	1814.5	2598.0	1747.3	-864.1	-80.5	-850.7	-32.3	-3.0	-32.7
Detroit-Ann Arbor-Flint, MI	20544.8	13987.6	20266.4	13744.5	-6557.2	-278.4	-6521.9	-31.9	-1.4	-32.2
Charlotte-Gastonia-Rock Hill, NC-SC	9222.8	6288.4	9235.2	6278.4	-2934.4	12.5	-2956.8	-31.8	0.1	-32.0
Athens, GA	912.9	626.8	868.0	588.2	-286.1	-44.8	-279.9	-31.3	-4.9	-32.2
Canton-Massillon, OH	1814.6	1254.2	1777.9	1224.0	-560.4	-36.7	-553.9	-30.9	-2.0	-31.2
Cleveland-Akron, OH	14901.8	10391.7	14803.9	10312.0	-4510.1	-97.8	-4492.0	-30.3	-0.7	-30.3
Lancaster, PA	2299.5	1603.9	2248.0	1562.4	-695.7	-51.5	-685.5	-30.3	-2.2	-30.5
Huntington-Ashland, WV-KY-OH	4628.0	3253.4	4588.2	3217.7	-1374.6	-39.8	-1370.6	-29.7	-0.9	-29.9
DeKalb County, Alabama	588.3	414.7	553.5	387.5	-173.7	-34.9	-166.0	-29.5	-5.9	-30.0
Chattanooga, TN-GA	3970.1	2799.5	3917.8	2753.4	-1170.5	-52.3	-1164.4	-29.5	-1.3	-29.7
Parkersburg-Marietta, WV-OH	2064.4	1457.9	2029.0	1429.3	-606.5	-35.5	-599.6	-29.4	-1.7	-29.6
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	29574.9	20889.8	29661.1	20919.9	-8685.1	86.2	-8741.2	-29.4	0.3	-29.5
Louisville, KY-IN	6785.7	4794.8	6828.8	4821.8	-1990.9	43.1	-2007.0	-29.3	0.6	-29.4
Columbus, GA-AL	2051.3	1453.5	2083.2	1473.0	-597.8	31.9	-610.2	-29.1	1.6	-29.3
Reading, PA	2605.9	1852.2	2610.6	1856.8	-753.7	4.6	-753.8	-28.9	0.2	-28.9
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	45165.2	32213.1	44214.3	31460.3	-12952.1	-951.0	-12754.0	-28.7	-2.1	-28.8
Talladega County, Alabama	1876.2	1352.6	1931.5	1393.2	-523.6	55.3	-538.2	-27.9	2.9	-27.9
Roane County, Tennessee	831.1	601.6	838.1	604.6	-229.6	7.0	-233.5	-27.6	0.8	-27.9
Scioto County, Ohio	889.7	645.2	863.6	625.6	-244.5	-26.0	-238.1	-27.5	-2.9	-27.6
Lexington, KY	2261.0	1642.4	2265.9	1655.1	-618.6	4.9	-610.8	-27.4	0.2	-27.0
Columbus, OH	6031.0	4401.8	6134.9	4536.2	-1629.2	103.9	-1598.6	-27.0	1.7	-26.1
Montgomery, AL	2697.9	1970.1	2736.4	1999.9	-727.8	38.5	-736.5	-27.0	1.4	-26.9
Greenville-Spartanburg-Anderson, SC	5913.3	4347.1	5657.7	4144.6	-1566.2	-255.6	-1513.1	-26.5	-4.3	-26.7
Knoxville, TN	4867.9	3580.4	4764.1	3500.2	-1287.4	-103.8	-1263.9	-26.4	-2.1	-26.5
Pittsburgh, PA	13052.8	9645.1	12906.2	9546.4	-3407.7	-146.7	-3359.8	-26.1	-1.1	-26.0
York, PA	2428.1	1797.7	2378.1	1757.6	-630.4	-50.1	-620.5	-26.0	-2.1	-26.1
Indianapolis, IN	6813.4	5061.9	6870.1	5134.1	-1751.5	56.7	-1735.9	-25.7	0.8	-25.3
Cincinnati-Hamilton, OH-KY-IN	12200.1	9066.9	12148.0	9030.8	-3133.3	-52.1	-3117.2	-25.7	-0.4	-25.7
Wilkinson County, Georgia	2109.9	1574.7	2177.6	1624.6	-535.2	67.7	-553.0	-25.4	3.2	-25.4
Augusta-Aiken, GA-SC	5143.4	3867.1	5197.1	3898.6	-1276.2	53.7	-1298.5	-24.8	1.0	-25.0
Steubenville-Weirton, OH-WV	9136.4	7098.9	9248.2	7193.7	-2037.5	111.8	-2054.5	-22.3	1.2	-22.2
Chicago-Gary-Kenosha, IL-IN-WI	41544.2	32697.0	42001.8	33095.6	-8847.2	457.6	-8906.2	-21.3	1.1	-21.2
Birmingham, AL	10290.4	8124.1	10374.0	8197.9	-2166.2	83.7	-2176.2	-21.1	0.8	-21.0
Hartford, CT	404.0	320.6	379.6	302.6	-83.4	-24.4	-77.0	-20.7	-6.0	-20.3
St. Louis, MO-IL	24942.5	19989.0	25303.6	20336.9	-4953.4	361.2	-4966.7	-19.9	1.4	-19.6
Litchfield County, Connecticut	526.0	422.4	494.9	399.6	-103.6	-31.1	-95.3	-19.7	-5.9	-19.3
Charleston, WV	3116.0	2508.0	3038.6	2450.7	-607.9	-77.3	-587.9	-19.5	-2.5	-19.3
Washington-Baltimore, DC-MD-VA-WV	18514.4	15044.5	17917.6	14646.7	-3469.9	-596.8	-3270.9	-18.7	-3.2	-18.3
Wheeling, WV-OH	1661.3	1350.9	1625.6	1325.0	-310.3	-35.7	-300.5	-18.7	-2.1	-18.5
New Haven-Bridgeport-Stamford-Waterbury-Danbury, CT	2630.1	2169.7	2438.4	2029.6	-460.4	-191.7	-408.7	-17.5	-7.3	-16.8

Primary Organic Aerosol (POA) Summary

Primary Organic Aerosol Emissions	Scenerio Totals				Difference			Percent Difference		
CMSA/MSA/FIP	POA 2010 Base	POA 2010 Control	POA 2015 Base	POA 2015 Control	POA (2010C - 2010B)	POA (2015B - 2010B)	POA (2015C - 2015B)	POA (2010C - 2010B) / 2010B	POA (2015B - 2010B) / 2010B	POA (2015C - 2015B) / 2015B
Wilkinson County, Georgia	499.8	375.3	507.4	381.4	-124.4	7.7	-126.0	-24.9	1.5	-24.8
Steubenville-Weirton, OH-WV	1764.7	1329.7	1771.1	1335.6	-435.0	6.3	-435.5	-24.6	0.4	-24.6
Roane County, Tennessee	284.5	215.7	283.9	216.0	-68.8	-0.6	-67.9	-24.2	-0.2	-23.9
Parkersburg-Marietta, WV-OH	376.4	285.8	359.0	272.9	-90.6	-17.4	-86.1	-24.1	-4.6	-24.0
Huntington-Ashland, WV-KY-OH	959.7	729.8	911.4	693.7	-229.9	-48.3	-217.7	-24.0	-5.0	-23.9
Talladega County, Alabama	253.4	193.4	250.5	191.6	-60.0	-2.9	-58.9	-23.7	-1.1	-23.5
Charleston, WV	476.4	365.4	447.4	343.9	-111.0	-29.0	-103.5	-23.3	-6.1	-23.1
Augusta-Aiken, GA-SC	1020.3	783.6	1010.8	777.2	-236.6	-9.4	-233.6	-23.2	-0.9	-23.1
Hickory-Morganton-Lenoir, NC	1018.7	783.7	952.2	732.0	-235.0	-66.5	-220.2	-23.1	-6.5	-23.1
Scioto County, Ohio	174.9	134.9	158.5	122.5	-40.0	-16.5	-36.0	-22.9	-9.4	-22.7
Johnson City-Kingsport-Bristol, TN-VA	963.4	744.1	901.3	698.7	-219.2	-62.1	-202.5	-22.8	-6.4	-22.5
Greensboro--Winston-Salem--High Point, NC	2156.0	1672.4	2007.6	1561.8	-483.6	-148.4	-445.8	-22.4	-6.9	-22.2
Chattanooga, TN-GA	778.1	605.3	726.2	568.6	-172.7	-51.9	-157.5	-22.2	-6.7	-21.7
Hall County, Georgia	170.3	132.5	154.4	120.2	-37.8	-15.9	-34.2	-22.2	-9.3	-22.1
Knoxville, TN	1060.9	826.0	976.1	765.9	-234.9	-84.8	-210.2	-22.1	-8.0	-21.5
Columbus, GA-AL	305.8	238.1	298.6	233.5	-67.7	-7.2	-65.1	-22.1	-2.4	-21.8
Floyd County, Georgia	162.7	126.8	158.8	124.8	-35.9	-3.9	-33.9	-22.1	-2.4	-21.4
DeKalb County, Alabama	134.4	104.8	120.8	94.8	-29.6	-13.6	-26.0	-22.0	-10.1	-21.6
Chicago-Gary-Kenosha, IL-IN-WI	7107.1	5544.5	7152.1	5598.2	-1562.6	45.0	-1553.9	-22.0	0.6	-21.7
Greenville-Spartanburg-Anderson, SC	1446.1	1130.1	1336.0	1048.8	-316.1	-110.1	-287.2	-21.9	-7.6	-21.5
Reading, PA	273.0	213.4	259.1	204.4	-59.6	-13.9	-54.7	-21.8	-5.1	-21.1
Cleveland-Akron, OH	1949.6	1524.7	1848.0	1453.2	-424.9	-101.6	-394.8	-21.8	-5.2	-21.4
Canton-Massillon, OH	308.9	241.6	288.4	226.8	-67.3	-20.6	-61.6	-21.8	-6.7	-21.4
Wheeling, WV-OH	233.5	182.7	214.5	169.2	-50.9	-19.1	-45.3	-21.8	-8.2	-21.1
Youngstown-Warren, OH	427.2	334.6	391.6	308.1	-92.6	-35.6	-83.5	-21.7	-8.3	-21.3
York, PA	373.4	292.7	339.9	268.4	-80.8	-33.6	-71.5	-21.6	-9.0	-21.0
Nashville, TN	1312.8	1029.0	1187.4	937.0	-283.8	-125.4	-250.4	-21.6	-9.6	-21.1
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	3744.4	2936.3	3580.4	2825.8	-808.1	-164.0	-754.6	-21.6	-4.4	-21.1
Litchfield County, Connecticut	152.5	119.6	139.1	109.6	-32.9	-13.5	-29.5	-21.6	-8.8	-21.2
Lancaster, PA	443.5	347.9	417.9	329.5	-95.6	-25.6	-88.5	-21.6	-5.8	-21.2
Charlotte-Gastonia-Rock Hill, NC-SC	1641.4	1288.0	1525.0	1202.2	-353.4	-116.4	-322.8	-21.5	-7.1	-21.2
Hartford, CT	118.4	93.1	109.1	86.2	-25.3	-9.3	-22.8	-21.4	-7.9	-20.9
Montgomery, AL	359.0	282.8	354.2	281.5	-76.2	-4.7	-72.8	-21.2	-1.3	-20.5
Athens, GA	170.4	134.3	155.2	123.1	-36.1	-15.2	-32.1	-21.2	-8.9	-20.7
Cincinnati-Hamilton, OH-KY-IN	1495.7	1182.8	1421.6	1132.7	-312.9	-74.2	-288.9	-20.9	-5.0	-20.3
Pittsburgh, PA	1281.9	1017.0	1197.9	962.3	-264.9	-84.0	-235.6	-20.7	-6.6	-19.7
St. Louis, MO-IL	2542.5	2019.3	2458.6	1963.3	-523.2	-84.0	-495.2	-20.6	-3.3	-20.1
Lexington, KY	415.3	329.9	387.9	311.5	-85.4	-27.3	-76.4	-20.6	-6.6	-19.7
Birmingham, AL	968.5	769.5	951.9	762.4	-199.1	-16.6	-189.5	-20.6	-1.7	-19.9
Detroit-Ann Arbor-Flint, MI	2558.7	2034.3	2400.7	1922.8	-524.4	-158.0	-478.0	-20.5	-6.2	-19.9
Atlanta, GA	2498.2	2009.9	2324.1	1891.8	-488.3	-174.2	-432.3	-19.5	-7.0	-18.6
Columbus, OH	900.2	724.5	891.6	734.1	-175.7	-8.6	-157.4	-19.5	-1.0	-17.7
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	5965.2	4802.6	5637.5	4569.7	-1162.6	-327.6	-1067.9	-19.5	-5.5	-18.9
Louisville, KY-IN	704.1	570.1	680.5	557.6	-134.0	-23.6	-122.9	-19.0	-3.3	-18.1
Washington-Baltimore, DC-MD-VA-WV	3278.1	2672.9	3058.8	2525.6	-605.3	-219.3	-533.2	-18.5	-6.7	-17.4
New Haven-Bridgeport-Stamford-Waterbury-Danbury, CT	575.2	475.6	519.5	435.6	-99.6	-55.7	-83.9	-17.3	-9.7	-16.1
Indianapolis, IN	631.9	527.4	625.3	534.4	-104.5	-6.6	-90.9	-16.5	-1.1	-14.5

PEC (primary elemental carbon) Summary

Primary Elemental Carbon Emissions	Scenerio Totals				Difference			Percent Difference		
CMSA/MSA/FIP	PEC 2010 Base	PEC 2010 Control	PEC 2015 Base	PEC 2015 Control	PEC (2010C - 2010B)	PEC (2015B - 2010B)	PEC (2015C - 2015B)	PEC (2010C - 2010B) / 2010B	PEC (2015B - 2010B) / 2010B	PEC (2015C - 2015B) / 2015B
Hall County, Georgia	103.0	66.9	85.2	53.8	-36.1	-17.7	-31.4	-35.1	-17.2	-36.9
Floyd County, Georgia	90.9	60.6	82.2	54.4	-30.4	-8.8	-27.8	-33.4	-9.7	-33.8
Hickory-Morganton-Lenoir, NC	333.7	236.9	292.4	205.1	-96.9	-41.4	-87.2	-29.0	-12.4	-29.8
Nashville, TN	831.9	590.7	685.5	485.4	-241.1	-146.4	-200.0	-29.0	-17.6	-29.2
Johnson City-Kingsport-Bristol, TN-VA	390.1	279.6	345.3	252.3	-110.5	-44.7	-93.0	-28.3	-11.5	-26.9
Atlanta, GA	2108.5	1514.0	1669.3	1200.2	-594.5	-439.2	-469.1	-28.2	-20.8	-28.1
Greensboro--Winston-Salem--High Point, NC	886.3	637.5	751.3	535.5	-248.8	-135.0	-215.8	-28.1	-15.2	-28.7
Lancaster, PA	201.9	146.1	173.9	128.9	-55.8	-28.0	-45.0	-27.6	-13.9	-25.9
Detroit-Ann Arbor-Flint, MI	1839.9	1332.9	1441.1	1044.4	-506.9	-398.7	-396.7	-27.6	-21.7	-27.5
Reading, PA	154.6	112.1	140.7	105.3	-42.5	-14.0	-35.4	-27.5	-9.0	-25.1
DeKalb County, Alabama	53.4	38.8	45.7	34.0	-14.6	-7.7	-11.7	-27.3	-14.4	-25.7
Parkersburg-Marietta, WV-OH	417.4	303.6	397.3	289.8	-113.8	-20.1	-107.5	-27.3	-4.8	-27.1
Canton-Massillon, OH	159.4	116.1	122.6	89.8	-43.3	-36.8	-32.7	-27.2	-23.1	-26.7
Huntington-Ashland, WV-KY-OH	1080.3	787.3	1034.8	756.7	-293.0	-45.5	-278.1	-27.1	-4.2	-26.9
Athens, GA	98.5	72.2	78.1	57.8	-26.4	-20.4	-20.3	-26.8	-20.7	-26.0
Youngstown-Warren, OH	267.7	196.3	199.4	145.6	-71.4	-68.4	-53.7	-26.7	-25.5	-26.9
Chattanooga, TN-GA	328.1	240.7	283.3	212.2	-87.5	-44.8	-71.1	-26.7	-13.6	-25.1
Louisville, KY-IN	604.1	443.4	527.7	398.3	-160.6	-76.4	-129.5	-26.6	-12.6	-24.5
Cleveland-Akron, OH	2038.1	1496.2	1774.4	1307.8	-541.9	-263.7	-466.6	-26.6	-12.9	-26.3
Charlotte-Gastonia-Rock Hill, NC-SC	854.5	627.4	699.9	512.1	-227.1	-154.5	-187.9	-26.6	-18.1	-26.8
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	2986.9	2193.2	2621.3	1933.9	-793.7	-365.6	-687.4	-26.6	-12.2	-26.2
Talladega County, Alabama	151.8	111.9	151.2	112.5	-39.9	-0.6	-38.7	-26.3	-0.4	-25.6
Charleston, WV	852.7	629.2	811.9	600.4	-223.4	-40.8	-211.5	-26.2	-4.8	-26.0
York, PA	190.8	140.9	157.6	117.6	-49.9	-33.2	-40.1	-26.2	-17.4	-25.4
Roane County, Tennessee	80.3	59.4	77.4	57.8	-20.9	-2.9	-19.6	-26.1	-3.6	-25.3
Scioto County, Ohio	64.6	47.9	53.7	40.2	-16.7	-10.9	-13.5	-25.8	-16.9	-25.1
Greenville-Spartanburg-Anderson, SC	596.4	443.3	478.8	360.3	-153.1	-117.6	-118.5	-25.7	-19.7	-24.7
Montgomery, AL	276.4	205.6	261.4	198.4	-70.9	-15.0	-63.0	-25.6	-5.4	-24.1
Columbus, GA-AL	161.6	120.2	138.2	104.9	-41.3	-23.3	-33.4	-25.6	-14.4	-24.1
Wilkinson County, Georgia	61.6	45.8	61.0	45.5	-15.7	-0.6	-15.5	-25.5	-0.9	-25.4
Lexington, KY	218.2	163.1	189.8	147.7	-55.1	-28.4	-42.0	-25.2	-13.0	-22.1
Cincinnati-Hamilton, OH-KY-IN	987.3	738.3	826.4	631.7	-249.0	-160.8	-194.7	-25.2	-16.3	-23.6
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	7287.2	5449.8	6205.8	4640.0	-1837.3	-1081.4	-1565.8	-25.2	-14.8	-25.2
Augusta-Aiken, GA-SC	338.1	252.9	292.7	222.0	-85.2	-45.3	-70.7	-25.2	-13.4	-24.2
Knoxville, TN	470.4	352.2	399.0	306.3	-118.1	-71.4	-92.7	-25.1	-15.2	-23.2
Pittsburgh, PA	984.4	738.7	858.9	666.9	-245.7	-125.5	-192.0	-25.0	-12.8	-22.4
Wheeling, WV-OH	213.4	160.3	192.8	145.9	-53.2	-20.6	-46.9	-24.9	-9.7	-24.3
Hartford, CT	101.5	76.6	87.5	66.4	-24.9	-14.1	-21.0	-24.5	-13.8	-24.1
Indianapolis, IN	735.9	556.9	662.3	532.5	-179.0	-73.6	-129.8	-24.3	-10.0	-19.6
Steubenville-Weirton, OH-WV	206.6	156.5	193.3	148.0	-50.1	-13.3	-45.3	-24.3	-6.5	-23.4
Litchfield County, Connecticut	67.6	51.4	50.7	39.0	-16.2	-16.9	-11.7	-24.0	-24.9	-23.0
Birmingham, AL	502.7	382.6	445.0	353.0	-120.1	-57.7	-92.0	-23.9	-11.5	-20.7
Columbus, OH	703.6	541.2	737.6	617.2	-162.4	34.0	-120.4	-23.1	4.8	-16.3
St. Louis, MO-IL	1248.6	964.4	1104.5	874.9	-284.2	-144.1	-229.5	-22.8	-11.5	-20.8
Washington-Baltimore, DC-MD-VA-WV	2708.2	2096.7	2201.3	1747.0	-611.5	-506.9	-454.3	-22.6	-18.7	-20.6
New Haven-Bridgeport-Stamford-Waterbury-Danbury, CT	568.4	444.1	402.4	318.6	-124.3	-166.0	-83.8	-21.9	-29.2	-20.8
Chicago-Gary-Kenosha, IL-IN-WI	2632.2	2061.6	2185.5	1759.2	-570.6	-446.7	-426.3	-21.7	-17.0	-19.5

Primary nitrate (PNO3) Summary

Primary nitrate Emissions	Scenerio Totals				Difference			Percent Difference		
CMSA/MSA/FIP	PNO3 2010 Base	PNO3 2010 Control	PNO3 2015 Base	PNO3 2015 Control	PNO3 (2010C - 2010B)	PNO3 (2015B - 2010B)	PNO3 (2015C - 2015B)	PNO3 (2010C - 2010B) / 2010B	PNO3 (2015B - 2010B) / 2010B	PNO3 (2015C - 2015B) / 2015B
Athens, GA	1.2	0.9	1.1	0.9	-0.2	-0.1	-0.2	-20.7	-7.6	-20.3
Atlanta, GA	20.8	16.8	19.8	16.1	-4.0	-1.0	-3.7	-19.4	-4.9	-18.7
Augusta-Aiken, GA-SC	210.6	158.1	225.4	169.2	-52.5	14.8	-56.2	-24.9	7.0	-24.9
Birmingham, AL	19.0	14.6	19.2	14.8	-4.3	0.2	-4.4	-22.9	1.3	-22.8
Canton-Massillon, OH	3.1	2.4	3.0	2.3	-0.7	-0.1	-0.7	-22.2	-3.1	-22.0
Charleston, WV	3.0	2.3	2.8	2.2	-0.7	-0.2	-0.7	-23.9	-5.2	-23.8
Charlotte-Gastonia-Rock Hill, NC-SC	11.6	9.1	11.3	8.9	-2.5	-0.3	-2.4	-21.2	-2.7	-21.0
Chattanooga, TN-GA	7.2	5.6	7.1	5.5	-1.6	-0.1	-1.6	-22.8	-1.4	-22.6
Chicago-Gary-Kenosha, IL-IN-WI	181.0	137.4	186.9	141.9	-43.6	5.9	-44.9	-24.1	3.2	-24.0
Cincinnati-Hamilton, OH-KY-IN	19.0	14.7	19.1	14.8	-4.3	0.1	-4.3	-22.6	0.5	-22.4
Cleveland-Akron, OH	28.4	21.8	28.0	21.5	-6.6	-0.4	-6.5	-23.2	-1.3	-23.1
Columbus, GA-AL	4.4	3.4	4.6	3.5	-1.0	0.1	-1.1	-23.4	2.9	-23.3
Columbus, OH	8.3	6.7	8.3	6.8	-1.6	0.1	-1.5	-19.5	0.9	-18.1
DeKalb County, Alabama	0.8	0.6	0.7	0.6	-0.2	-0.1	-0.1	-20.4	-8.9	-19.9
Detroit-Ann Arbor-Flint, MI	25.7	20.2	24.8	19.6	-5.5	-0.9	-5.2	-21.4	-3.4	-21.1
Floyd County, Georgia	2.6	2.0	2.7	2.1	-0.6	0.1	-0.6	-23.4	5.4	-23.1
Greensboro--Winston-Salem--High Point, NC	10.7	8.4	10.1	7.9	-2.3	-0.6	-2.1	-21.5	-5.9	-21.3
Greenville-Spartanburg-Anderson, SC	8.9	7.0	8.4	6.6	-1.9	-0.5	-1.7	-21.2	-5.8	-20.8
Hall County, Georgia	1.2	1.0	1.1	0.9	-0.2	-0.1	-0.2	-20.0	-8.6	-19.5
Hartford, CT	0.7	0.6	0.7	0.5	-0.2	-0.0	-0.1	-22.0	-6.0	-21.6
Hickory-Morganton-Lenoir, NC	6.2	4.8	6.1	4.7	-1.4	-0.1	-1.4	-23.2	-1.9	-23.3
Huntington-Ashland, WV-KY-OH	8.4	6.3	8.3	6.3	-2.0	-0.1	-2.0	-24.3	-1.2	-24.2
Indianapolis, IN	8.8	7.1	8.8	7.2	-1.6	0.0	-1.6	-18.6	0.1	-17.8
Johnson City-Kingsport-Bristol, TN-VA	7.2	5.5	7.1	5.5	-1.7	-0.1	-1.6	-23.3	-1.3	-23.1
Knoxville, TN	7.8	6.1	7.6	5.9	-1.8	-0.3	-1.7	-22.5	-3.5	-22.3
Lancaster, PA	2.4	2.0	2.2	1.8	-0.4	-0.2	-0.4	-18.6	-6.3	-17.8
Lexington, KY	2.8	2.2	2.7	2.2	-0.6	-0.1	-0.5	-20.0	-3.3	-19.2
Litchfield County, Connecticut	0.9	0.7	0.8	0.7	-0.2	-0.1	-0.2	-21.3	-6.8	-20.8
Louisville, KY-IN	6.2	5.0	6.2	5.0	-1.2	-0.1	-1.2	-19.9	-0.9	-19.3
Montgomery, AL	17.3	13.1	17.8	13.4	-4.2	0.5	-4.3	-24.3	2.7	-24.2
Nashville, TN	7.2	5.8	6.6	5.3	-1.4	-0.6	-1.3	-19.8	-8.2	-19.1
New Haven-Bridgeport-Stamford-Waterbury-Danbury, CT	3.9	3.2	3.6	3.0	-0.7	-0.4	-0.6	-18.1	-9.1	-17.2
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	47.6	38.4	45.4	36.8	-9.2	-2.2	-8.6	-19.4	-4.6	-18.9
Parkersburg-Marietta, WV-OH	22.8	17.1	23.1	17.4	-5.7	0.3	-5.8	-24.9	1.5	-24.9
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	41.9	32.5	41.1	31.9	-9.5	-0.8	-9.2	-22.6	-1.9	-22.4
Pittsburgh, PA	97.2	73.3	102.0	76.9	-23.9	4.8	-25.1	-24.6	4.9	-24.6
Reading, PA	4.9	3.7	4.9	3.7	-1.1	-0.0	-1.1	-23.3	-0.3	-23.2
Roane County, Tennessee	0.8	0.6	0.8	0.6	-0.2	-0.0	-0.2	-23.4	-5.4	-23.2
Scioto County, Ohio	1.2	0.9	1.1	0.9	-0.3	-0.1	-0.3	-23.3	-5.3	-23.2
St. Louis, MO-IL	188.0	142.1	198.1	149.7	-45.9	10.1	-48.4	-24.4	5.4	-24.4
Steubenville-Weirton, OH-WV	32.2	24.2	32.5	24.4	-8.0	0.3	-8.1	-25.0	1.1	-24.9
Talladega County, Alabama	3.8	2.9	4.0	3.0	-0.9	0.2	-1.0	-24.2	4.0	-24.2
Washington-Baltimore, DC-MD-VA-WV	26.6	21.3	25.2	20.4	-5.3	-1.3	-4.8	-19.8	-5.0	-19.1
Wheeling, WV-OH	1.6	1.2	1.5	1.2	-0.4	-0.1	-0.3	-22.8	-4.7	-22.3
Wilkinson County, Georgia	9.3	7.0	9.7	7.2	-2.3	0.3	-2.4	-24.9	3.5	-24.9
York, PA	3.0	2.4	2.9	2.3	-0.7	-0.1	-0.6	-21.7	-4.2	-21.4
Youngstown-Warren, OH	5.2	4.0	5.1	3.9	-1.2	-0.1	-1.2	-22.9	-2.8	-22.7

GSO4 Summary										
GSO4 Emissions	Scenerio Totals				Difference			Percent Difference		
CMSA/MSA/FIP	GSO4 2010 Base	GSO4 2010 Control	GSO4 2015 Base	GSO4 2015 Control	GSO4 (2010C - 2010B)	GSO4 (2015B - 2010B)	GSO4 (2015C - 2015B)	GSO4 (2010C - 2010B) / 2010B	GSO4 (2015B - 2010B) / 2010B	GSO4 (2015C - 2015B) / 2015B
Athens, GA	18.5	7.6	19.1	7.6	-11.0	0.5	-11.4	-59.2	2.8	-59.9
Atlanta, GA	972.6	563.7	1008.9	578.6	-408.9	36.3	-430.3	-42.0	3.7	-42.7
Augusta-Aiken, GA-SC	446.0	336.7	467.1	352.0	-109.3	21.1	-115.1	-24.5	4.7	-24.6
Birmingham, AL	999.8	779.7	1024.6	797.8	-220.1	24.8	-226.8	-22.0	2.5	-22.1
Canton-Massillon, OH	112.6	72.9	116.1	75.1	-39.7	3.4	-40.9	-35.3	3.1	-35.3
Charleston, WV	189.0	165.6	188.7	164.8	-23.4	-0.3	-23.9	-12.4	-0.2	-12.7
Charlotte-Gastonia-Rock Hill, NC-SC	545.7	349.9	584.3	377.5	-195.8	38.6	-206.8	-35.9	7.1	-35.4
Chattanooga, TN-GA	339.8	235.2	351.9	243.5	-104.6	12.1	-108.4	-30.8	3.5	-30.8
Chicago-Gary-Kenosha, IL-IN-WI	3745.9	2847.5	3831.9	2912.2	-898.4	86.0	-919.7	-24.0	2.3	-24.0
Cincinnati-Hamilton, OH-KY-IN	1056.0	786.9	1077.0	801.7	-269.1	21.0	-275.3	-25.5	2.0	-25.6
Cleveland-Akron, OH	1230.4	857.7	1251.9	873.2	-372.7	21.6	-378.7	-30.3	1.8	-30.3
Columbus, GA-AL	393.4	286.2	422.5	307.5	-107.3	29.1	-115.0	-27.3	7.4	-27.2
Columbus, OH	221.3	134.7	234.4	145.7	-86.6	13.2	-88.8	-39.1	6.0	-37.9
DeKalb County, Alabama	9.7	3.9	10.0	4.0	-5.8	0.3	-6.0	-60.0	2.9	-60.0
Detroit-Ann Arbor-Flint, MI	1729.8	1183.5	1761.1	1203.4	-546.3	31.2	-557.6	-31.6	1.8	-31.7
Floyd County, Georgia	374.1	271.4	403.5	292.9	-102.6	29.5	-110.6	-27.4	7.9	-27.4
Greensboro--Winston-Salem--High Point, NC	456.1	276.1	470.7	282.4	-179.9	14.7	-188.4	-39.4	3.2	-40.0
Greenville-Spartanburg-Anderson, SC	135.5	82.9	138.8	84.7	-52.5	3.4	-54.1	-38.8	2.5	-39.0
Hall County, Georgia	46.1	13.0	48.2	13.4	-33.2	2.1	-34.8	-71.9	4.5	-72.2
Hartford, CT	21.7	16.4	22.0	16.7	-5.2	0.3	-5.3	-24.2	1.6	-24.1
Hickory-Morganton-Lenoir, NC	214.9	126.4	228.7	134.9	-88.5	13.9	-93.8	-41.2	6.4	-41.0
Huntington-Ashland, WV-KY-OH	421.2	298.5	436.5	309.7	-122.8	15.3	-126.9	-29.1	3.6	-29.1
Indianapolis, IN	300.5	196.5	316.0	209.1	-104.0	15.5	-106.9	-34.6	5.2	-33.8
Johnson City-Kingsport-Bristol, TN-VA	391.6	262.1	412.8	276.6	-129.5	21.2	-136.1	-33.1	5.4	-33.0
Knoxville, TN	162.8	112.4	167.1	115.0	-50.3	4.3	-52.1	-30.9	2.6	-31.2
Lancaster, PA	54.6	24.5	55.6	24.9	-30.1	1.0	-30.7	-55.1	1.9	-55.2
Lexington, KY	120.6	82.3	130.1	90.0	-38.3	9.6	-40.1	-31.7	7.9	-30.8
Litchfield County, Connecticut	11.9	9.1	11.9	9.1	-2.8	0.0	-2.8	-23.4	0.4	-23.4
Louisville, KY-IN	390.3	274.8	402.2	282.4	-115.4	11.9	-119.8	-29.6	3.0	-29.8
Montgomery, AL	300.4	217.7	323.5	235.0	-82.7	23.0	-88.5	-27.5	7.7	-27.3
Nashville, TN	293.6	131.0	301.3	132.4	-162.5	7.7	-168.9	-55.4	2.6	-56.1
New Haven-Bridgeport-Stamford-Waterbury -Danbury, CT	68.3	55.9	65.8	53.9	-12.5	-2.6	-11.9	-18.2	-3.7	-18.1
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	4341.2	3024.9	4379.2	3050.5	-1316.3	38.0	-1328.6	-30.3	0.9	-30.3
Parkersburg-Marietta, WV-OH	107.2	73.4	107.8	73.7	-33.8	0.5	-34.1	-31.5	0.5	-31.6
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	2668.5	1873.3	2709.5	1899.8	-795.1	41.1	-809.7	-29.8	1.5	-29.9
Pittsburgh, PA	1383.0	1037.3	1387.5	1041.4	-345.7	4.5	-346.1	-25.0	0.3	-24.9
Reading, PA	318.1	228.4	325.0	233.6	-89.7	6.8	-91.4	-28.2	2.2	-28.1
Roane County, Tennessee	33.5	24.4	34.5	25.1	-9.1	1.0	-9.5	-27.1	3.0	-27.4
Scioto County, Ohio	67.7	48.5	68.9	49.4	-19.2	1.2	-19.6	-28.3	1.8	-28.4
St. Louis, MO-IL	1961.3	1527.5	2058.1	1607.0	-433.8	96.8	-451.1	-22.1	4.9	-21.9
Steubenville-Weirton, OH-WV	2741.1	2088.6	2780.4	2119.1	-652.5	39.3	-661.3	-23.8	1.4	-23.8
Talladega County, Alabama	340.8	250.6	366.4	269.7	-90.2	25.6	-96.7	-26.5	7.5	-26.4
Washington-Baltimore, DC-MD-VA-WV	760.6	606.9	760.3	607.3	-153.6	-0.3	-153.0	-20.2	-0.0	-20.1
Wheeling, WV-OH	125.3	108.8	127.3	110.5	-16.5	1.9	-16.8	-13.2	1.5	-13.2
Wilkinson County, Georgia	339.3	253.6	350.5	261.8	-85.7	11.1	-88.6	-25.3	3.3	-25.3
York, PA	236.5	175.9	244.8	182.0	-60.7	8.3	-62.8	-25.6	3.5	-25.7
Youngstown-Warren, OH	235.2	158.0	239.0	160.2	-77.2	3.8	-78.8	-32.8	1.6	-33.0

Summary for other unspecified PMFINE emissions

PMFINE Emissions	Scenerio Totals				Difference			Percent Difference		
CMSA/MSA/FIP	PMFINE 2010 Base	PMFINE 2010 Control	PMFINE 2015 Base	PMFINE 2015 Control	PMFINE (2010C - 2010B)	PMFINE (2015B - 2010B)	PMFINE (2015C - 2015B)	PMFINE (2010C - 2010B) / 2010B	PMFINE (2015B - 2010B) / 2010B	PMFINE (2015C - 2015B) / 2015B
Athens, GA	624.3	411.7	614.5	398.7	-212.6	-9.8	-215.8	-34.1	-1.6	-35.1
Atlanta, GA	16819.7	10783.8	17197.4	10902.4	-6035.9	377.7	-6295.0	-35.9	2.2	-36.6
Augusta-Aiken, GA-SC	3128.7	2336.0	3201.1	2378.3	-792.8	72.3	-822.8	-25.3	2.3	-25.7
Birmingham, AL	7804.0	6174.1	7933.3	6269.8	-1629.9	129.3	-1663.4	-20.9	1.7	-21.0
Canton-Massillon, OH	1229.8	821.1	1247.9	829.9	-408.7	18.1	-418.0	-33.2	1.5	-33.5
Charleston, WV	1593.9	1346.7	1587.8	1339.4	-247.2	-6.2	-248.4	-15.5	-0.4	-15.6
Charlotte-Gastonia-Rock Hill, NC-SC	6162.8	4016.6	6414.6	4177.7	-2146.2	251.9	-2237.0	-34.8	4.1	-34.9
Chattanooga, TN-GA	2518.4	1712.0	2549.3	1723.5	-806.4	30.8	-825.8	-32.0	1.2	-32.4
Chicago-Gary-Kenosha, IL-IN-WI	27874.2	22090.6	28645.4	22684.0	-5783.7	771.2	-5961.4	-20.7	2.8	-20.8
Cincinnati-Hamilton, OH-KY-IN	8640.8	6346.7	8804.0	6449.9	-2294.1	163.2	-2354.0	-26.5	1.9	-26.7
Cleveland-Akron, OH	9654.4	6491.4	9901.6	6656.2	-3163.0	247.2	-3245.4	-32.8	2.6	-32.8
Columbus, GA-AL	1186.4	804.8	1219.3	823.7	-381.6	32.9	-395.7	-32.2	2.8	-32.5
Columbus, OH	4197.1	2995.7	4262.9	3032.4	-1201.4	65.8	-1230.5	-28.6	1.6	-28.9
DeKalb County, Alabama	389.8	266.7	376.3	254.1	-123.1	-13.5	-122.1	-31.6	-3.5	-32.5
Detroit-Ann Arbor-Flint, MI	14383.7	9411.5	14638.7	9554.3	-4972.2	254.9	-5084.4	-34.6	1.8	-34.7
Floyd County, Georgia	1265.5	790.3	1300.8	803.1	-475.2	35.4	-497.7	-37.5	2.8	-38.3
Greensboro--Winston-Salem--High Point, NC	6331.0	3907.8	6478.5	3961.6	-2423.2	147.5	-2516.9	-38.3	2.3	-38.8
Greenville-Spartanburg-Anderson, SC	3724.4	2682.0	3695.7	2644.1	-1042.4	-28.8	-1051.5	-28.0	-0.8	-28.5
Hall County, Georgia	1164.3	628.5	1167.7	615.3	-535.8	3.4	-552.4	-46.0	0.3	-47.3
Hartford, CT	162.1	133.9	160.4	132.7	-28.3	-1.7	-27.7	-17.4	-1.1	-17.3
Hickory-Morganton-Lenoir, NC	2146.5	1186.5	2194.6	1198.6	-960.1	48.1	-996.1	-44.7	2.2	-45.4
Huntington-Ashland, WV-KY-OH	2159.9	1431.6	2197.2	1451.2	-728.3	37.3	-745.9	-33.7	1.7	-33.9
Indianapolis, IN	5143.2	3774.7	5257.7	3850.9	-1368.5	114.5	-1406.8	-26.6	2.2	-26.8
Johnson City-Kingsport-Bristol, TN-VA	2953.3	1833.9	3016.1	1861.4	-1119.4	62.8	-1154.7	-37.9	2.1	-38.3
Knoxville, TN	3167.2	2281.8	3214.4	2307.1	-885.4	47.2	-907.3	-28.0	1.5	-28.2
Lancaster, PA	1597.4	1084.0	1598.3	1077.3	-513.5	0.8	-520.9	-32.1	0.1	-32.6
Lexington, KY	1503.7	1065.8	1555.4	1103.6	-437.8	51.7	-451.8	-29.1	3.4	-29.0
Litchfield County, Connecticut	292.6	241.3	292.3	241.2	-51.3	-0.3	-51.1	-17.5	-0.1	-17.5
Louisville, KY-IN	5081.1	3501.3	5212.2	3578.5	-1579.8	131.1	-1633.7	-31.1	2.6	-31.3
Montgomery, AL	1744.2	1250.1	1779.5	1271.5	-494.1	35.3	-507.9	-28.3	2.0	-28.5
Nashville, TN	5761.4	3267.1	5896.2	3308.6	-2494.3	134.8	-2587.6	-43.3	2.3	-43.9
New Haven-Bridgeport-Stamford-Waterbury -Danbury, CT	1414.9	1190.1	1447.1	1218.5	-224.9	32.2	-228.6	-15.9	2.3	-15.8
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	27504.2	18880.4	27946.4	19163.3	-8623.8	442.2	-8783.1	-31.4	1.6	-31.4
Parkersburg-Marietta, WV-OH	1140.3	777.9	1141.8	775.5	-362.4	1.4	-366.2	-31.8	0.1	-32.1
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD	20130.6	13856.8	20708.7	14228.4	-6273.8	578.1	-6480.3	-31.2	2.9	-31.3
Pittsburgh, PA	9306.0	6776.4	9360.0	6798.9	-2529.6	53.9	-2561.0	-27.2	0.6	-27.4
Reading, PA	1855.5	1294.6	1880.9	1309.7	-560.9	25.4	-571.2	-30.2	1.4	-30.4
Roane County, Tennessee	432.8	300.8	441.5	305.1	-132.0	8.8	-136.4	-30.5	2.0	-30.9
Scioto County, Ohio	581.0	413.3	581.4	412.6	-167.7	0.4	-168.8	-28.9	0.1	-29.0
St. Louis, MO-IL	18996.3	15335.7	19484.3	15742.0	-3660.6	488.0	-3742.4	-19.3	2.6	-19.2
Steubenville-Weirton, OH-WV	4391.8	3495.4	4470.9	3566.7	-896.4	79.1	-904.2	-20.4	1.8	-20.2
Talladega County, Alabama	1125.9	795.3	1159.4	816.4	-330.6	33.5	-343.0	-29.4	3.0	-29.6
Washington-Baltimore, DC-MD-VA-WV	11745.4	9644.6	11872.0	9746.5	-2100.7	126.6	-2125.5	-17.9	1.1	-17.9
Wheeling, WV-OH	1087.3	898.5	1089.5	898.3	-188.8	2.2	-191.2	-17.4	0.2	-17.6
Wilkinson County, Georgia	1200.0	892.7	1249.0	928.6	-307.3	49.0	-320.4	-25.6	4.1	-25.7
York, PA	1624.9	1185.9	1632.8	1187.3	-439.1	7.9	-445.4	-27.0	0.5	-27.3
Youngstown-Warren, OH	1744.0	1121.4	1762.9	1129.4	-622.6	18.9	-633.6	-35.7	1.1	-35.9

Technical Support Document for the Interstate Air Quality Rule Air Quality Modeling Analyses

Appendix L

Summaries of Impacts on PM2.5 and PM2.5 Species from Local Control Measures for the 290 County Study

Table L-1 Results for 2010 Base Case vs. Local Control Case

		PM2.5		Crustal		Elemental Carbon		Organic Aerosol		Ammonium Sulfate		Ammonium Nitrate	
MSA/CMSA	Reduction	(Local - Base)	% Change Local vs Base	(Local - Base)	% Change Local vs Base	(Local - Base)	% Change Local vs Base	(Local - Base)	% Change Local vs Base	(Local - Base)	% Change Local vs Base	(Local - Base)	% Change Local vs Base
Athens, GA MSA	Minimum	-1.11	-6.5%	-0.11	-12.4%	-0.06	-8.6%	-0.12	-2.0%	-0.83	-10.8%	0.02	1.7%
Athens, GA MSA	Maximum	-1.11	-6.5%	-0.11	-12.4%	-0.06	-8.6%	-0.12	-2.0%	-0.83	-10.8%	0.02	1.7%
Athens, GA MSA	Average	-1.11	-6.5%	-0.11	-12.4%	-0.06	-8.6%	-0.12	-2.0%	-0.83	-10.8%	0.02	1.7%
Atlanta, GA MSA	Minimum	-0.94	-6.1%	-0.08	-10.1%	-0.05	-7.9%	-0.09	-1.6%	-0.75	-10.8%	0.03	2.6%
Atlanta, GA MSA	Maximum	-1.53	-8.8%	-0.18	-22.0%	-0.13	-14.6%	-0.26	-3.3%	-1.03	-14.1%	0.02	1.5%
Atlanta, GA MSA	Average	-1.34	-7.6%	-0.14	-16.7%	-0.10	-12.4%	-0.19	-2.8%	-0.92	-12.4%	0.03	2.0%
Augusta-Aiken, GA-SC MSA	Minimum	-1.05	-6.6%	-0.10	-11.8%	-0.06	-9.7%	-0.21	-3.5%	-0.69	-10.0%	0.01	0.8%
Augusta-Aiken, GA-SC MSA	Maximum	-1.05	-6.6%	-0.10	-11.8%	-0.06	-9.7%	-0.21	-3.5%	-0.69	-10.0%	0.01	0.8%
Augusta-Aiken, GA-SC MSA	Average	-1.05	-6.6%	-0.10	-11.8%	-0.06	-9.7%	-0.21	-3.5%	-0.69	-10.0%	0.01	0.8%
Birmingham, AL MSA	Minimum	-1.33	-6.6%	-0.25	-15.4%	-0.12	-10.7%	-0.25	-3.1%	-0.76	-10.7%	0.03	2.0%
Birmingham, AL MSA	Maximum	-1.33	-6.6%	-0.25	-15.4%	-0.12	-10.7%	-0.25	-3.1%	-0.76	-10.7%	0.03	2.0%
Birmingham, AL MSA	Average	-1.33	-6.6%	-0.25	-15.4%	-0.12	-10.7%	-0.25	-3.1%	-0.76	-10.7%	0.03	2.0%
Canton-Massillon, OH MSA	Minimum	-1.29	-7.5%	-0.12	-13.8%	-0.07	-11.3%	-0.20	-4.9%	-0.95	-11.8%	0.07	2.3%
Canton-Massillon, OH MSA	Maximum	-1.29	-7.5%	-0.12	-13.8%	-0.07	-11.3%	-0.20	-4.9%	-0.95	-11.8%	0.07	2.3%
Canton-Massillon, OH MSA	Average	-1.29	-7.5%	-0.12	-13.8%	-0.07	-11.3%	-0.20	-4.9%	-0.95	-11.8%	0.07	2.3%
Charleston, WV MSA	Minimum	-1.66	-9.7%	-0.09	-12.2%	-0.14	-20.6%	-0.33	-7.2%	-1.16	-12.7%	0.06	3.8%
Charleston, WV MSA	Maximum	-1.66	-9.7%	-0.09	-12.2%	-0.14	-20.6%	-0.33	-7.2%	-1.16	-12.7%	0.06	3.8%
Charleston, WV MSA	Average	-1.66	-9.7%	-0.09	-12.2%	-0.14	-20.6%	-0.33	-7.2%	-1.16	-12.7%	0.06	3.8%
Charlotte-Gastonia-Rock Hill, NC-SC MSA	Minimum	-1.13	-7.4%	-0.11	-14.9%	-0.07	-12.1%	-0.24	-4.1%	-0.72	-11.2%	0.01	0.8%
Charlotte-Gastonia-Rock Hill, NC-SC MSA	Maximum	-1.13	-7.4%	-0.11	-14.9%	-0.07	-12.1%	-0.24	-4.1%	-0.72	-11.2%	0.01	0.8%
Charlotte-Gastonia-Rock Hill, NC-SC MSA	Average	-1.13	-7.4%	-0.11	-14.9%	-0.07	-12.1%	-0.24	-4.1%	-0.72	-11.2%	0.01	0.8%
Chattanooga, TN-GA MSA	Minimum	-1.34	-8.3%	-0.13	-13.5%	-0.07	-12.1%	-0.23	-4.6%	-0.92	-11.6%	0.02	1.6%
Chattanooga, TN-GA MSA	Maximum	-1.34	-8.3%	-0.13	-13.5%	-0.07	-12.1%	-0.23	-4.6%	-0.92	-11.6%	0.02	1.6%
Chattanooga, TN-GA MSA	Average	-1.34	-8.3%	-0.13	-13.5%	-0.07	-12.1%	-0.23	-4.6%	-0.92	-11.6%	0.02	1.6%
Chicago-Gary-Kenosha, IL-IN-WI CMSA	Minimum	-0.99	-6.5%	-0.08	-11.4%	-0.04	-7.4%	-0.35	-8.5%	-0.56	-10.2%	0.06	1.5%
Chicago-Gary-Kenosha, IL-IN-WI CMSA	Maximum	-1.28	-7.2%	-0.13	-15.7%	-0.08	-11.0%	-0.57	-10.5%	-0.57	-10.2%	0.06	1.2%
Chicago-Gary-Kenosha, IL-IN-WI CMSA	Average	-1.14	-6.8%	-0.10	-13.5%	-0.06	-9.2%	-0.46	-9.5%	-0.57	-10.2%	0.06	1.4%
Cincinnati-Hamilton, OH-KY-IN CMSA	Minimum	-1.09	-6.8%	-0.10	-12.7%	-0.05	-9.4%	-0.20	-4.6%	-0.79	-11.0%	0.06	1.9%
Cincinnati-Hamilton, OH-KY-IN CMSA	Maximum	-1.32	-7.4%	-0.13	-16.5%	-0.08	-13.3%	-0.22	-5.4%	-0.97	-11.6%	0.05	1.6%
Cincinnati-Hamilton, OH-KY-IN CMSA	Average	-1.20	-7.1%	-0.12	-14.6%	-0.06	-11.4%	-0.21	-5.0%	-0.88	-11.3%	0.06	1.7%
Cleveland-Akron, OH CMSA	Minimum	-1.16	-7.1%	-0.12	-14.3%	-0.08	-11.5%	-0.19	-4.6%	-0.87	-12.0%	0.13	3.1%
Cleveland-Akron, OH CMSA	Maximum	-1.44	-7.5%	-0.29	-22.3%	-0.11	-12.5%	-0.23	-4.8%	-0.93	-12.4%	0.09	2.8%
Cleveland-Akron, OH CMSA	Average	-1.30	-7.3%	-0.20	-18.3%	-0.10	-12.0%	-0.21	-4.7%	-0.90	-12.2%	0.11	3.0%
Columbus, GA-AL MSA	Minimum	-0.77	-4.6%	-0.08	-9.0%	-0.03	-4.0%	-0.07	-1.2%	-0.64	-8.7%	0.06	4.0%
Columbus, GA-AL MSA	Maximum	-0.80	-4.7%	-0.09	-9.8%	-0.04	-5.4%	-0.08	-1.4%	-0.65	-8.8%	0.05	3.4%
Columbus, GA-AL MSA	Average	-0.78	-4.7%	-0.08	-9.4%	-0.04	-4.7%	-0.07	-1.3%	-0.64	-8.8%	0.06	3.7%
Columbus, OH MSA	Minimum	-1.12	-6.7%	-0.11	-12.4%	-0.05	-9.3%	-0.17	-4.2%	-0.84	-11.2%	0.07	2.1%
Columbus, OH MSA	Maximum	-1.12	-6.7%	-0.11	-12.4%	-0.05	-9.3%	-0.17	-4.2%	-0.84	-11.2%	0.07	2.1%
Columbus, OH MSA	Average	-1.12	-6.7%	-0.11	-12.4%	-0.05	-9.3%	-0.17	-4.2%	-0.84	-11.2%	0.07	2.1%
Detroit-Ann Arbor-Flint, MI CMSA	Minimum	-1.25	-6.7%	-0.19	-20.2%	-0.09	-10.8%	-0.27	-5.4%	-0.81	-12.5%	0.10	1.9%
Detroit-Ann Arbor-Flint, MI CMSA	Maximum	-1.25	-6.7%	-0.19	-20.2%	-0.09	-10.8%	-0.27	-5.4%	-0.81	-12.5%	0.10	1.9%
Detroit-Ann Arbor-Flint, MI CMSA	Average	-1.25	-6.7%	-0.19	-20.2%	-0.09	-10.8%	-0.27	-5.4%	-0.81	-12.5%	0.10	1.9%

Greensboro--Winston-Salem--High Point, NC MSA	Minimum	-1.37	-8.8%	-0.16	-20.8%	-0.09	-16.1%	-0.33	-6.0%	-0.83	-12.0%	0.04	2.9%
Greensboro--Winston-Salem--High Point, NC MSA	Maximum	-1.37	-8.8%	-0.16	-20.8%	-0.09	-16.1%	-0.33	-6.0%	-0.83	-12.0%	0.04	2.9%
Greensboro--Winston-Salem--High Point, NC MSA	Average	-1.37	-8.8%	-0.16	-20.8%	-0.09	-16.1%	-0.33	-6.0%	-0.83	-12.0%	0.04	2.9%
Greenville-Spartanburg-Anderson, SC MSA	Minimum	-1.15	-7.6%	-0.08	-11.8%	-0.06	-11.1%	-0.19	-3.5%	-0.84	-11.9%	0.03	3.0%
Greenville-Spartanburg-Anderson, SC MSA	Maximum	-1.15	-7.6%	-0.08	-11.8%	-0.06	-11.1%	-0.19	-3.5%	-0.84	-11.9%	0.03	3.0%
Greenville-Spartanburg-Anderson, SC MSA	Average	-1.15	-7.6%	-0.08	-11.8%	-0.06	-11.1%	-0.19	-3.5%	-0.84	-11.9%	0.03	3.0%
Hickory-Morganton-Lenoir, NC MSA	Minimum	-1.35	-8.8%	-0.14	-20.0%	-0.08	-13.3%	-0.33	-6.3%	-0.82	-11.5%	0.02	1.7%
Hickory-Morganton-Lenoir, NC MSA	Maximum	-1.35	-8.8%	-0.14	-20.0%	-0.08	-13.3%	-0.33	-6.3%	-0.82	-11.5%	0.02	1.7%
Hickory-Morganton-Lenoir, NC MSA	Average	-1.35	-8.8%	-0.14	-20.0%	-0.08	-13.3%	-0.33	-6.3%	-0.82	-11.5%	0.02	1.7%
Huntington-Ashland, WV-KY-OH MSA	Minimum	-1.35	-8.2%	-0.08	-11.8%	-0.12	-17.6%	-0.28	-6.0%	-0.92	-11.0%	0.06	3.9%
Huntington-Ashland, WV-KY-OH MSA	Maximum	-1.41	-9.1%	-0.10	-15.2%	-0.12	-18.2%	-0.31	-7.1%	-0.93	-11.8%	0.05	3.1%
Huntington-Ashland, WV-KY-OH MSA	Average	-1.38	-8.7%	-0.09	-13.5%	-0.12	-17.9%	-0.30	-6.6%	-0.92	-11.4%	0.05	3.5%
Indianapolis, IN MSA	Minimum	-0.95	-6.0%	-0.11	-16.9%	-0.06	-11.5%	-0.15	-3.4%	-0.69	-10.7%	0.04	1.1%
Indianapolis, IN MSA	Maximum	-0.95	-6.0%	-0.11	-16.9%	-0.06	-11.5%	-0.15	-3.4%	-0.69	-10.7%	0.04	1.1%
Indianapolis, IN MSA	Average	-0.95	-6.0%	-0.11	-16.9%	-0.06	-11.5%	-0.15	-3.4%	-0.69	-10.7%	0.04	1.1%
Johnson City-Kingsport-Bristol, TN-VA MSA	Minimum	-1.32	-8.7%	-0.11	-16.4%	-0.07	-11.5%	-0.24	-5.2%	-0.93	-12.0%	0.04	3.3%
Johnson City-Kingsport-Bristol, TN-VA MSA	Maximum	-1.32	-8.7%	-0.11	-16.4%	-0.07	-11.5%	-0.24	-5.2%	-0.93	-12.0%	0.04	3.3%
Johnson City-Kingsport-Bristol, TN-VA MSA	Average	-1.32	-8.7%	-0.11	-16.4%	-0.07	-11.5%	-0.24	-5.2%	-0.93	-12.0%	0.04	3.3%
Knoxville, TN MSA	Minimum	-1.55	-8.4%	-0.14	-15.4%	-0.08	-12.1%	-0.31	-5.7%	-1.06	-11.2%	0.04	2.8%
Knoxville, TN MSA	Maximum	-1.55	-8.4%	-0.14	-15.4%	-0.08	-12.1%	-0.31	-5.7%	-1.06	-11.2%	0.04	2.8%
Knoxville, TN MSA	Average	-1.55	-8.4%	-0.14	-15.4%	-0.08	-12.1%	-0.31	-5.7%	-1.06	-11.2%	0.04	2.8%
Lancaster, PA MSA	Minimum	-1.11	-7.2%	-0.10	-16.4%	-0.06	-11.3%	-0.25	-6.2%	-0.70	-10.5%	0.01	0.3%
Lancaster, PA MSA	Maximum	-1.11	-7.2%	-0.10	-16.4%	-0.06	-11.3%	-0.25	-6.2%	-0.70	-10.5%	0.01	0.3%
Lancaster, PA MSA	Average	-1.11	-7.2%	-0.10	-16.4%	-0.06	-11.3%	-0.25	-6.2%	-0.70	-10.5%	0.01	0.3%
Lexington, KY MSA	Minimum	-1.01	-6.6%	-0.07	-10.1%	-0.04	-7.8%	-0.11	-3.0%	-0.81	-10.3%	0.02	0.9%
Lexington, KY MSA	Maximum	-1.01	-6.6%	-0.07	-10.1%	-0.04	-7.8%	-0.11	-3.0%	-0.81	-10.3%	0.02	0.9%
Lexington, KY MSA	Average	-1.01	-6.6%	-0.07	-10.1%	-0.04	-7.8%	-0.11	-3.0%	-0.81	-10.3%	0.02	0.9%
Louisville, KY-IN MSA	Minimum	-1.24	-7.8%	-0.15	-19.5%	-0.07	-13.2%	-0.18	-4.7%	-0.85	-11.0%	0.04	1.6%
Louisville, KY-IN MSA	Maximum	-1.26	-8.0%	-0.16	-20.3%	-0.07	-13.2%	-0.19	-4.8%	-0.87	-11.1%	0.03	1.3%
Louisville, KY-IN MSA	Average	-1.25	-7.9%	-0.16	-19.9%	-0.07	-13.2%	-0.18	-4.7%	-0.86	-11.0%	0.03	1.5%
Montgomery, AL MSA	Minimum	-0.82	-5.2%	-0.11	-11.5%	-0.05	-7.5%	-0.08	-1.5%	-0.62	-9.1%	0.03	2.2%
Montgomery, AL MSA	Maximum	-0.82	-5.2%	-0.11	-11.5%	-0.05	-7.5%	-0.08	-1.5%	-0.62	-9.1%	0.03	2.2%
Montgomery, AL MSA	Average	-0.82	-5.2%	-0.11	-11.5%	-0.05	-7.5%	-0.08	-1.5%	-0.62	-9.1%	0.03	2.2%
Nashville, TN MSA	Minimum	-1.09	-7.1%	-0.15	-14.6%	-0.06	-12.2%	-0.17	-4.3%	-0.72	-9.4%	0.01	0.5%
Nashville, TN MSA	Maximum	-1.09	-7.1%	-0.15	-14.6%	-0.06	-12.2%	-0.17	-4.3%	-0.72	-9.4%	0.01	0.5%
Nashville, TN MSA	Average	-1.09	-7.1%	-0.15	-14.6%	-0.06	-12.2%	-0.17	-4.3%	-0.72	-9.4%	0.01	0.5%
New Haven-Bridgeport-Stamford-Waterbury -Danbury, CT NECMA	Minimum	-0.71	-4.6%	-0.08	-10.5%	-0.07	-10.1%	-0.14	-3.2%	-0.55	-8.6%	0.12	4.1%
New Haven-Bridgeport-Stamford-Waterbury -Danbury, CT NECMA	Maximum	-0.71	-4.6%	-0.08	-10.5%	-0.07	-10.1%	-0.14	-3.2%	-0.55	-8.6%	0.12	4.1%
New Haven-Bridgeport-Stamford-Waterbury -Danbury, CT NECMA	Average	-0.71	-4.6%	-0.08	-10.5%	-0.07	-10.1%	-0.14	-3.2%	-0.55	-8.6%	0.12	4.1%
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA CMSA	Minimum	-1.27	-7.8%	-0.18	-21.7%	-0.16	-15.4%	-0.23	-5.1%	-0.73	-11.7%	0.05	1.5%
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA CMSA	Maximum	-1.27	-7.8%	-0.18	-21.7%	-0.16	-15.4%	-0.23	-5.1%	-0.73	-11.7%	0.05	1.5%

New York-Northern New Jersey-Long Island, NY-NJ-CT-PA CMSA	Average	-1.27	-7.8%	-0.18	-21.7%	-0.16	-15.4%	-0.23	-5.1%	-0.73	-11.7%	0.05	1.5%
Parkersburg-Marietta, WV-OH MSA	Minimum	-1.38	-8.5%	-0.09	-12.3%	-0.11	-16.2%	-0.23	-5.9%	-1.03	-11.5%	0.06	3.6%
Parkersburg-Marietta, WV-OH MSA	Maximum	-1.38	-8.5%	-0.09	-12.3%	-0.11	-16.2%	-0.23	-5.9%	-1.03	-11.5%	0.06	3.6%
Parkersburg-Marietta, WV-OH MSA	Average	-1.38	-8.5%	-0.09	-12.3%	-0.11	-16.2%	-0.23	-5.9%	-1.03	-11.5%	0.06	3.6%
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD CMSA	Minimum	-1.20	-7.8%	-0.17	-27.4%	-0.11	-17.5%	-0.23	-5.3%	-0.78	-12.6%	0.09	2.7%
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD CMSA	Maximum	-1.20	-7.8%	-0.17	-27.4%	-0.11	-17.5%	-0.23	-5.3%	-0.78	-12.6%	0.09	2.7%
Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD CMSA	Average	-1.20	-7.8%	-0.17	-27.4%	-0.11	-17.5%	-0.23	-5.3%	-0.78	-12.6%	0.09	2.7%
Pittsburgh, PA MSA	Minimum	-1.70	-8.7%	-0.20	-19.6%	-0.10	-13.5%	-0.24	-4.7%	-1.21	-12.7%	0.03	1.2%
Pittsburgh, PA MSA	Maximum	-1.70	-8.7%	-0.20	-19.6%	-0.10	-13.5%	-0.24	-4.7%	-1.21	-12.7%	0.03	1.2%
Pittsburgh, PA MSA	Average	-1.70	-8.7%	-0.20	-19.6%	-0.10	-13.5%	-0.24	-4.7%	-1.21	-12.7%	0.03	1.2%
Reading, PA MSA	Minimum	-1.04	-6.8%	-0.12	-19.7%	-0.07	-13.2%	-0.21	-5.4%	-0.71	-10.8%	0.07	2.0%
Reading, PA MSA	Maximum	-1.04	-6.8%	-0.12	-19.7%	-0.07	-13.2%	-0.21	-5.4%	-0.71	-10.8%	0.07	2.0%
Reading, PA MSA	Average	-1.04	-6.8%	-0.12	-19.7%	-0.07	-13.2%	-0.21	-5.4%	-0.71	-10.8%	0.07	2.0%
St. Louis, MO-IL MSA	Minimum	-0.96	-6.3%	-0.15	-12.8%	-0.07	-10.3%	-0.22	-4.9%	-0.55	-9.5%	0.03	1.0%
St. Louis, MO-IL MSA	Maximum	-1.14	-6.9%	-0.15	-14.0%	-0.07	-10.8%	-0.31	-6.5%	-0.64	-10.2%	0.02	0.6%
St. Louis, MO-IL MSA	Average	-1.04	-6.5%	-0.15	-13.3%	-0.07	-10.6%	-0.26	-5.4%	-0.59	-9.8%	0.02	0.8%
Steubenville-Weirton, OH-WV MSA	Minimum	-1.77	-10.6%	-0.13	-16.2%	-0.08	-13.3%	-0.39	-10.0%	-1.33	-15.2%	0.18	7.4%
Steubenville-Weirton, OH-WV MSA	Maximum	-1.92	-10.7%	-0.15	-17.3%	-0.08	-14.5%	-0.43	-10.2%	-1.44	-15.3%	0.16	7.1%
Steubenville-Weirton, OH-WV MSA	Average	-1.82	-10.6%	-0.14	-16.9%	-0.08	-14.1%	-0.41	-10.1%	-1.37	-15.2%	0.17	7.3%
Washington-Baltimore, DC-MD-VA-WV CMSA	Minimum	-1.05	-6.8%	-0.07	-9.5%	-0.08	-12.5%	-0.18	-4.1%	-0.80	-11.3%	0.08	3.6%
Washington-Baltimore, DC-MD-VA-WV CMSA	Maximum	-1.26	-7.6%	-0.08	-9.6%	-0.10	-13.5%	-0.30	-5.8%	-0.84	-12.2%	0.06	2.3%
Washington-Baltimore, DC-MD-VA-WV CMSA	Average	-1.16	-7.2%	-0.08	-9.5%	-0.09	-13.0%	-0.24	-4.9%	-0.82	-11.8%	0.07	3.0%
Wheeling, WV-OH MSA	Minimum	-1.39	-9.0%	-0.08	-10.8%	-0.07	-13.0%	-0.17	-4.9%	-1.17	-13.6%	0.08	4.4%
Wheeling, WV-OH MSA	Maximum	-1.39	-9.0%	-0.08	-10.8%	-0.07	-13.0%	-0.17	-4.9%	-1.17	-13.6%	0.08	4.4%
Wheeling, WV-OH MSA	Average	-1.39	-9.0%	-0.08	-10.8%	-0.07	-13.0%	-0.17	-4.9%	-1.17	-13.6%	0.08	4.4%
York, PA MSA	Minimum	-1.16	-7.4%	-0.09	-14.1%	-0.08	-13.3%	-0.23	-5.7%	-0.83	-11.9%	0.07	2.3%
York, PA MSA	Maximum	-1.16	-7.4%	-0.09	-14.1%	-0.08	-13.3%	-0.23	-5.7%	-0.83	-11.9%	0.07	2.3%
York, PA MSA	Average	-1.16	-7.4%	-0.09	-14.1%	-0.08	-13.3%	-0.23	-5.7%	-0.83	-11.9%	0.07	2.3%
Youngstown-Warren, OH MSA	Minimum	-1.22	-8.1%	-0.14	-16.5%	-0.07	-11.7%	-0.22	-5.8%	-0.89	-12.9%	0.10	3.8%
Youngstown-Warren, OH MSA	Maximum	-1.26	-8.2%	-0.15	-17.2%	-0.08	-13.3%	-0.22	-5.9%	-0.92	-12.9%	0.10	3.7%
Youngstown-Warren, OH MSA	Average	-1.24	-8.1%	-0.14	-16.9%	-0.08	-12.5%	-0.22	-5.8%	-0.90	-12.9%	0.10	3.8%
DeKalb County, Alabama	Minimum	-0.93	-6.1%	-0.07	-8.5%	-0.04	-6.9%	-0.08	-1.6%	-0.76	-10.7%	0.01	0.8%
DeKalb County, Alabama	Maximum	-0.93	-6.1%	-0.07	-8.5%	-0.04	-6.9%	-0.08	-1.6%	-0.76	-10.7%	0.01	0.8%
DeKalb County, Alabama	Average	-0.93	-6.1%	-0.07	-8.5%	-0.04	-6.9%	-0.08	-1.6%	-0.76	-10.7%	0.01	0.8%
Talladega County, Alabama	Minimum	-0.99	-6.0%	-0.10	-10.5%	-0.05	-7.2%	-0.09	-1.5%	-0.80	-11.3%	0.05	3.6%
Talladega County, Alabama	Maximum	-0.99	-6.0%	-0.10	-10.5%	-0.05	-7.2%	-0.09	-1.5%	-0.80	-11.3%	0.05	3.6%
Talladega County, Alabama	Average	-0.99	-6.0%	-0.10	-10.5%	-0.05	-7.2%	-0.09	-1.5%	-0.80	-11.3%	0.05	3.6%
Floyd County, Georgia	Minimum	-1.34	-7.9%	-0.18	-18.6%	-0.07	-10.9%	-0.15	-2.6%	-0.96	-12.2%	0.03	2.4%
Floyd County, Georgia	Maximum	-1.34	-7.9%	-0.18	-18.6%	-0.07	-10.9%	-0.15	-2.6%	-0.96	-12.2%	0.03	2.4%
Floyd County, Georgia	Average	-1.34	-7.9%	-0.18	-18.6%	-0.07	-10.9%	-0.15	-2.6%	-0.96	-12.2%	0.03	2.4%
Hall County, Georgia	Minimum	-1.31	-8.4%	-0.15	-19.5%	-0.08	-12.5%	-0.17	-3.1%	-0.93	-12.8%	0.01	1.0%
Hall County, Georgia	Maximum	-1.31	-8.4%	-0.15	-19.5%	-0.08	-12.5%	-0.17	-3.1%	-0.93	-12.8%	0.01	1.0%
Hall County, Georgia	Average	-1.31	-8.4%	-0.15	-19.5%	-0.08	-12.5%	-0.17	-3.1%	-0.93	-12.8%	0.01	1.0%
Wilkinson County, Georgia	Minimum	-1.05	-6.3%	-0.09	-10.8%	-0.05	-6.8%	-0.22	-3.6%	-0.76	-10.5%	0.07	5.3%
Wilkinson County, Georgia	Maximum	-1.05	-6.3%	-0.09	-10.8%	-0.05	-6.8%	-0.22	-3.6%	-0.76	-10.5%	0.07	5.3%
Wilkinson County, Georgia	Average	-1.05	-6.3%	-0.09	-10.8%	-0.05	-6.8%	-0.22	-3.6%	-0.76	-10.5%	0.07	5.3%

Scioto County, Ohio	Minimum	-1.37	-7.4%	-0.09	-11.2%	-0.09	-12.5%	-0.27	-5.4%	-0.99	-10.9%	0.06	2.5%
Scioto County, Ohio	Maximum	-1.37	-7.4%	-0.09	-11.2%	-0.09	-12.5%	-0.27	-5.4%	-0.99	-10.9%	0.06	2.5%
Scioto County, Ohio	Average	-1.37	-7.4%	-0.09	-11.2%	-0.09	-12.5%	-0.27	-5.4%	-0.99	-10.9%	0.06	2.5%
Roane County, Tennessee	Minimum	-1.08	-7.1%	-0.07	-9.2%	-0.04	-7.5%	-0.11	-2.5%	-0.89	-11.3%	0.04	3.2%
Roane County, Tennessee	Maximum	-1.08	-7.1%	-0.07	-9.2%	-0.04	-7.5%	-0.11	-2.5%	-0.89	-11.3%	0.04	3.2%
Roane County, Tennessee	Average	-1.08	-7.1%	-0.07	-9.2%	-0.04	-7.5%	-0.11	-2.5%	-0.89	-11.3%	0.04	3.2%
Overall	Minimum	-0.71	-4.6%	-0.07	-8.5%	-0.03	-4.0%	-0.07	-1.2%	-0.55	-8.6%	0.18	7.4%
Overall	Maximum	-1.92	-10.7%	-0.29	-27.4%	-0.16	-20.6%	-0.57	-10.5%	-1.44	-15.3%	0.01	0.3%
Overall	Average	-1.23	-7.5%	-0.13	-14.9%	-0.08	-11.8%	-0.22	-4.8%	-0.86	-11.5%	0.05	2.5%

Table L-2 Results for 2015 Base Case vs. Local Control Case

		PM2.5		Crustal		Elemental Carbon		Organic Aerosol		Ammonium Sulfate		Ammonium Nitrate	
MSA/CMSA	Reduction	(Local - Base)	% Change Local vs Base	(Local - Base)	% Change Local vs Base	(Local - Base)	% Change Local vs Base	(Local - Base)	% Change Local vs Base	(Local - Base)	% Change Local vs Base	(Local - Base)	% Change Local vs Base
Athens, GA	Minimum	-1.05	-6.4%	-0.11	-12.1%	-0.05	-8.1%	-0.12	-2.0%	-0.78	-10.6%	0.00	0.0%
Athens, GA	Maximum	-1.05	-6.4%	-0.11	-12.1%	-0.05	-8.1%	-0.12	-2.0%	-0.78	-10.6%	0.00	0.0%
Athens, GA	Average	-1.05	-6.4%	-0.11	-12.1%	-0.05	-8.1%	-0.12	-2.0%	-0.78	-10.6%	0.00	0.0%
Atlanta, GA	Minimum	-1.28	-7.4%	-0.14	-15.6%	-0.08	-11.0%	-0.18	-2.6%	-0.83	-11.9%	0.02	1.7%
Atlanta, GA	Maximum	-1.44	-8.7%	-0.18	-21.4%	-0.11	-13.9%	-0.23	-3.0%	-0.98	-13.8%	0.01	0.7%
Atlanta, GA	Average	-1.37	-7.7%	-0.16	-18.5%	-0.09	-11.9%	-0.20	-2.8%	-0.93	-12.6%	0.01	1.0%
Augusta-Aiken, GA-SC	Minimum	-1.00	-6.4%	-0.10	-11.5%	-0.04	-7.3%	-0.20	-3.4%	-0.65	-9.7%	0.01	0.9%
Augusta-Aiken, GA-SC	Maximum	-1.00	-6.4%	-0.10	-11.5%	-0.04	-7.3%	-0.20	-3.4%	-0.65	-9.7%	0.01	0.9%
Augusta-Aiken, GA-SC	Average	-1.00	-6.4%	-0.10	-11.5%	-0.04	-7.3%	-0.20	-3.4%	-0.65	-9.7%	0.01	0.9%
Birmingham, AL	Minimum	-1.29	-6.6%	-0.25	-15.0%	-0.09	-8.8%	-0.24	-3.0%	-0.72	-10.5%	0.01	0.7%
Birmingham, AL	Maximum	-1.29	-6.6%	-0.25	-15.0%	-0.09	-8.8%	-0.24	-3.0%	-0.72	-10.5%	0.01	0.7%
Birmingham, AL	Average	-1.29	-6.6%	-0.25	-15.0%	-0.09	-8.8%	-0.24	-3.0%	-0.72	-10.5%	0.01	0.7%
Canton-Massillon, OH	Minimum	-1.20	-7.3%	-0.13	-14.6%	-0.06	-11.3%	-0.19	-4.8%	-0.89	-11.6%	0.05	1.7%
Canton-Massillon, OH	Maximum	-1.20	-7.3%	-0.13	-14.6%	-0.06	-11.3%	-0.19	-4.8%	-0.89	-11.6%	0.05	1.7%
Canton-Massillon, OH	Average	-1.20	-7.3%	-0.13	-14.6%	-0.06	-11.3%	-0.19	-4.8%	-0.89	-11.6%	0.05	1.7%
Charleston, WV	Minimum	-1.56	-9.5%	-0.10	-13.2%	-0.12	-19.0%	-0.30	-6.8%	-1.10	-12.6%	0.06	3.9%
Charleston, WV	Maximum	-1.56	-9.5%	-0.10	-13.2%	-0.12	-19.0%	-0.30	-6.8%	-1.10	-12.6%	0.06	3.9%
Charleston, WV	Average	-1.56	-9.5%	-0.10	-13.2%	-0.12	-19.0%	-0.30	-6.8%	-1.10	-12.6%	0.06	3.9%
Chattanooga, TN-GA	Minimum	-1.27	-8.1%	-0.14	-14.1%	-0.05	-9.8%	-0.22	-4.5%	-0.88	-11.4%	0.02	1.7%
Chattanooga, TN-GA	Maximum	-1.27	-8.1%	-0.14	-14.1%	-0.05	-9.8%	-0.22	-4.5%	-0.88	-11.4%	0.02	1.7%
Chattanooga, TN-GA	Average	-1.27	-8.1%	-0.14	-14.1%	-0.05	-9.8%	-0.22	-4.5%	-0.88	-11.4%	0.02	1.7%
Chicago-Gary-Kenosha, IL-IN-WI	Minimum	-1.28	-7.3%	-0.13	-15.1%	-0.06	-9.7%	-0.58	-10.6%	-0.55	-10.2%	0.04	0.8%
Chicago-Gary-Kenosha, IL-IN-WI	Maximum	-1.28	-7.3%	-0.13	-15.1%	-0.06	-9.7%	-0.58	-10.6%	-0.55	-10.2%	0.04	0.8%
Chicago-Gary-Kenosha, IL-IN-WI	Average	-1.28	-7.3%	-0.13	-15.1%	-0.06	-9.7%	-0.58	-10.6%	-0.55	-10.2%	0.04	0.8%
Cincinnati-Hamilton, OH-KY-IN	Minimum	-1.03	-6.7%	-0.10	-12.3%	-0.04	-8.9%	-0.18	-4.3%	-0.73	-10.6%	0.04	1.4%
Cincinnati-Hamilton, OH-KY-IN	Maximum	-1.23	-7.2%	-0.13	-16.0%	-0.05	-9.8%	-0.20	-5.1%	-0.91	-11.3%	0.04	1.3%
Cincinnati-Hamilton, OH-KY-IN	Average	-1.13	-6.9%	-0.12	-14.2%	-0.04	-9.3%	-0.19	-4.7%	-0.82	-11.0%	0.04	1.3%
Cleveland-Akron, OH	Minimum	-1.09	-6.9%	-0.12	-14.0%	-0.07	-10.8%	-0.17	-4.3%	-0.80	-11.6%	0.11	2.7%
Cleveland-Akron, OH	Maximum	-1.39	-7.5%	-0.29	-21.8%	-0.09	-12.7%	-0.22	-4.7%	-0.90	-12.4%	0.08	2.6%
Cleveland-Akron, OH	Average	-1.24	-7.2%	-0.20	-17.9%	-0.08	-11.8%	-0.20	-4.5%	-0.85	-12.0%	0.09	2.7%
Columbus, GA-AL	Minimum	-0.75	-4.6%	-0.08	-8.8%	-0.03	-4.3%	-0.07	-1.2%	-0.61	-8.5%	0.05	3.4%
Columbus, GA-AL	Maximum	-0.76	-4.6%	-0.09	-9.6%	-0.03	-4.3%	-0.08	-1.3%	-0.61	-8.6%	0.04	2.8%
Columbus, GA-AL	Average	-0.75	-4.6%	-0.08	-9.2%	-0.03	-4.3%	-0.08	-1.3%	-0.61	-8.5%	0.04	3.1%
Columbus, OH	Minimum	-1.04	-6.4%	-0.12	-13.0%	-0.04	-7.7%	-0.15	-3.8%	-0.79	-11.0%	0.05	1.6%
Columbus, OH	Maximum	-1.04	-6.4%	-0.12	-13.0%	-0.04	-7.7%	-0.15	-3.8%	-0.79	-11.0%	0.05	1.6%
Columbus, OH	Average	-1.04	-6.4%	-0.12	-13.0%	-0.04	-7.7%	-0.15	-3.8%	-0.79	-11.0%	0.05	1.6%
Detroit-Ann Arbor-Flint, MI	Minimum	-1.22	-6.7%	-0.21	-21.6%	-0.07	-9.6%	-0.25	-5.1%	-0.78	-12.3%	0.08	1.6%
Detroit-Ann Arbor-Flint, MI	Maximum	-1.22	-6.7%	-0.21	-21.6%	-0.07	-9.6%	-0.25	-5.1%	-0.78	-12.3%	0.08	1.6%
Detroit-Ann Arbor-Flint, MI	Average	-1.22	-6.7%	-0.21	-21.6%	-0.07	-9.6%	-0.25	-5.1%	-0.78	-12.3%	0.08	1.6%
Huntington-Ashland, WV-KY-OH	Minimum	-1.26	-8.0%	-0.08	-11.6%	-0.11	-18.0%	-0.26	-5.8%	-0.86	-10.8%	0.05	3.2%

Huntington-Ashland, WV-KY-OH	Maximum	-1.26	-8.0%	-0.08	-11.6%	-0.11	-18.0%	-0.26	-5.8%	-0.86	-10.8%	0.05	3.2%
Huntington-Ashland, WV-KY-OH	Average	-1.26	-8.0%	-0.08	-11.6%	-0.11	-18.0%	-0.26	-5.8%	-0.86	-10.8%	0.05	3.2%
Indianapolis, IN	Minimum	-0.87	-5.7%	-0.11	-16.4%	-0.04	-8.5%	-0.13	-3.0%	-0.62	-10.1%	0.03	0.9%
Indianapolis, IN	Maximum	-0.87	-5.7%	-0.11	-16.4%	-0.04	-8.5%	-0.13	-3.0%	-0.62	-10.1%	0.03	0.9%
Indianapolis, IN	Average	-0.87	-5.7%	-0.11	-16.4%	-0.04	-8.5%	-0.13	-3.0%	-0.62	-10.1%	0.03	0.9%
Knoxville, TN	Minimum	-1.47	-8.3%	-0.14	-14.9%	-0.07	-11.9%	-0.29	-5.6%	-1.01	-11.0%	0.03	2.2%
Knoxville, TN	Maximum	-1.47	-8.3%	-0.14	-14.9%	-0.07	-11.9%	-0.29	-5.6%	-1.01	-11.0%	0.03	2.2%
Knoxville, TN	Average	-1.47	-8.3%	-0.14	-14.9%	-0.07	-11.9%	-0.29	-5.6%	-1.01	-11.0%	0.03	2.2%
Louisville, KY-IN	Minimum	-1.19	-7.7%	-0.16	-20.0%	-0.07	-14.6%	-0.17	-4.5%	-0.82	-10.9%	0.03	1.3%
Louisville, KY-IN	Maximum	-1.21	-7.9%	-0.17	-20.7%	-0.07	-14.6%	-0.18	-4.7%	-0.84	-11.1%	0.02	0.9%
Louisville, KY-IN	Average	-1.20	-7.8%	-0.16	-20.4%	-0.07	-14.6%	-0.18	-4.6%	-0.83	-11.0%	0.02	1.1%
Montgomery, AL	Minimum	-0.79	-5.1%	-0.11	-11.2%	-0.04	-6.3%	-0.08	-1.5%	-0.60	-9.1%	0.03	2.3%
Montgomery, AL	Maximum	-0.79	-5.1%	-0.11	-11.2%	-0.04	-6.3%	-0.08	-1.5%	-0.60	-9.1%	0.03	2.3%
Montgomery, AL	Average	-0.79	-5.1%	-0.11	-11.2%	-0.04	-6.3%	-0.08	-1.5%	-0.60	-9.1%	0.03	2.3%
New Haven-Bridgeport-Stamford-Waterbury-Danbury, CT	Minimum	-0.68	-4.5%	-0.09	-11.5%	-0.05	-8.5%	-0.12	-2.8%	-0.53	-8.5%	0.11	3.7%
New Haven-Bridgeport-Stamford-Waterbury-Danbury, CT	Maximum	-0.68	-4.5%	-0.09	-11.5%	-0.05	-8.5%	-0.12	-2.8%	-0.53	-8.5%	0.11	3.7%
New Haven-Bridgeport-Stamford-Waterbury-Danbury, CT	Average	-0.68	-4.5%	-0.09	-11.5%	-0.05	-8.5%	-0.12	-2.8%	-0.53	-8.5%	0.11	3.7%
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	Minimum	-1.21	-7.6%	-0.18	-21.2%	-0.13	-15.1%	-0.21	-4.8%	-0.71	-11.6%	0.03	0.9%
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	Maximum	-1.21	-7.6%	-0.18	-21.2%	-0.13	-15.1%	-0.21	-4.8%	-0.71	-11.6%	0.03	0.9%
New York-Northern New Jersey-Long Island, NY-NJ-CT-PA	Average	-1.21	-7.6%	-0.18	-21.2%	-0.13	-15.1%	-0.21	-4.8%	-0.71	-11.6%	0.03	0.9%
Parkersburg-Marietta, WV-OH	Minimum	-1.30	-8.3%	-0.09	-12.2%	-0.10	-15.9%	-0.21	-5.6%	-0.95	-11.3%	0.05	3.0%
Parkersburg-Marietta, WV-OH	Maximum	-1.30	-8.3%	-0.09	-12.2%	-0.10	-15.9%	-0.21	-5.6%	-0.95	-11.3%	0.05	3.0%
Parkersburg-Marietta, WV-OH	Average	-1.30	-8.3%	-0.09	-12.2%	-0.10	-15.9%	-0.21	-5.6%	-0.95	-11.3%	0.05	3.0%
Pittsburgh, PA	Minimum	-1.59	-8.5%	-0.19	-18.4%	-0.08	-11.9%	-0.22	-4.4%	-1.12	-12.5%	0.02	0.8%
Pittsburgh, PA	Maximum	-1.59	-8.5%	-0.19	-18.4%	-0.08	-11.9%	-0.22	-4.4%	-1.12	-12.5%	0.02	0.8%
Pittsburgh, PA	Average	-1.59	-8.5%	-0.19	-18.4%	-0.08	-11.9%	-0.22	-4.4%	-1.12	-12.5%	0.02	0.8%
St. Louis, MO-IL	Minimum	-1.01	-6.3%	-0.15	-12.5%	-0.06	-10.5%	-0.22	-4.5%	-0.59	-9.7%	0.02	0.7%
St. Louis, MO-IL	Maximum	-1.14	-7.1%	-0.15	-13.5%	-0.07	-11.3%	-0.30	-6.4%	-0.65	-10.5%	0.01	0.3%
St. Louis, MO-IL	Average	-1.08	-6.7%	-0.15	-13.0%	-0.06	-10.9%	-0.26	-5.5%	-0.62	-10.1%	0.02	0.5%
Steubenville-Weirton, OH-WV	Minimum	-1.71	-10.5%	-0.14	-16.9%	-0.06	-12.2%	-0.39	-10.1%	-1.26	-15.0%	0.16	6.6%
Steubenville-Weirton, OH-WV	Maximum	-1.84	-10.6%	-0.15	-17.1%	-0.08	-14.8%	-0.42	-10.2%	-1.36	-15.1%	0.14	6.3%
Steubenville-Weirton, OH-WV	Average	-1.75	-10.6%	-0.14	-17.0%	-0.07	-13.8%	-0.40	-10.2%	-1.29	-15.1%	0.15	6.5%
Washington-Baltimore, DC-MD-VA-WV	Minimum	-1.18	-7.3%	-0.08	-9.4%	-0.08	-12.1%	-0.27	-5.4%	-0.80	-12.1%	0.05	2.0%
Washington-Baltimore, DC-MD-VA-WV	Maximum	-1.18	-7.3%	-0.08	-9.4%	-0.08	-12.1%	-0.27	-5.4%	-0.80	-12.1%	0.05	2.0%
Washington-Baltimore, DC-MD-VA-WV	Average	-1.18	-7.3%	-0.08	-9.4%	-0.08	-12.1%	-0.27	-5.4%	-0.80	-12.1%	0.05	2.0%
York, PA	Minimum	-1.10	-7.3%	-0.09	-13.8%	-0.06	-11.5%	-0.21	-5.3%	-0.78	-11.6%	0.05	1.7%
York, PA	Maximum	-1.10	-7.3%	-0.09	-13.8%	-0.06	-11.5%	-0.21	-5.3%	-0.78	-11.6%	0.05	1.7%
York, PA	Average	-1.10	-7.3%	-0.09	-13.8%	-0.06	-11.5%	-0.21	-5.3%	-0.78	-11.6%	0.05	1.7%

Talladega County, Alabama	Minimum	-0.94	-5.9%	-0.10	-10.3%	-0.05	-7.7%	-0.09	-1.6%	-0.73	-10.7%	0.04	3.0%
Talladega County, Alabama	Maximum	-0.94	-5.9%	-0.10	-10.3%	-0.05	-7.7%	-0.09	-1.6%	-0.73	-10.7%	0.04	3.0%
Talladega County, Alabama	Average	-0.94	-5.9%	-0.10	-10.3%	-0.05	-7.7%	-0.09	-1.6%	-0.73	-10.7%	0.04	3.0%
Floyd County, Georgia	Minimum	-1.29	-7.8%	-0.19	-19.0%	-0.06	-10.5%	-0.14	-2.5%	-0.93	-12.1%	0.02	1.7%
Floyd County, Georgia	Maximum	-1.29	-7.8%	-0.19	-19.0%	-0.06	-10.5%	-0.14	-2.5%	-0.93	-12.1%	0.02	1.7%
Floyd County, Georgia	Average	-1.29	-7.8%	-0.19	-19.0%	-0.06	-10.5%	-0.14	-2.5%	-0.93	-12.1%	0.02	1.7%
Hall County, Georgia	Minimum	-1.25	-8.3%	-0.16	-20.3%	-0.07	-12.5%	-0.15	-2.8%	-0.88	-12.6%	0.00	0.0%
Hall County, Georgia	Maximum	-1.25	-8.3%	-0.16	-20.3%	-0.07	-12.5%	-0.15	-2.8%	-0.88	-12.6%	0.00	0.0%
Hall County, Georgia	Average	-1.25	-8.3%	-0.16	-20.3%	-0.07	-12.5%	-0.15	-2.8%	-0.88	-12.6%	0.00	0.0%
Wilkinson County, Georgia	Minimum	-1.04	-6.3%	-0.10	-11.6%	-0.04	-5.9%	-0.22	-3.6%	-0.74	-10.4%	0.06	4.6%
Wilkinson County, Georgia	Maximum	-1.04	-6.3%	-0.10	-11.6%	-0.04	-5.9%	-0.22	-3.6%	-0.74	-10.4%	0.06	4.6%
Wilkinson County, Georgia	Average	-1.04	-6.3%	-0.10	-11.6%	-0.04	-5.9%	-0.22	-3.6%	-0.74	-10.4%	0.06	4.6%
Scioto County, Ohio	Minimum	-1.28	-7.3%	-0.10	-12.2%	-0.07	-10.8%	-0.25	-5.2%	-0.92	-10.7%	0.05	2.2%
Scioto County, Ohio	Maximum	-1.28	-7.3%	-0.10	-12.2%	-0.07	-10.8%	-0.25	-5.2%	-0.92	-10.7%	0.05	2.2%
Scioto County, Ohio	Average	-1.28	-7.3%	-0.10	-12.2%	-0.07	-10.8%	-0.25	-5.2%	-0.92	-10.7%	0.05	2.2%
Overall	Minimum	-0.68	-4.5%	-0.08	-8.8%	-0.03	-4.3%	-0.07	-1.2%	-0.53	-8.5%	0.16	6.6%
Overall	Maximum	-1.84	-10.6%	-0.29	-21.8%	-0.13	-19.0%	-0.58	-10.6%	-1.36	-15.1%	0.00	0.0%
Overall	Average	-1.21	-7.3%	-0.14	-15.1%	-0.07	-11.0%	-0.22	-4.6%	-0.84	-11.4%	0.05	2.1%

Technical Support Document for the Interstate Air Quality Rule Air Quality Modeling Analyses

Appendix M

Projected Visibility Summaries for 20% Best and 20% Worst Days at IMPROVE Monitoring Sites

Example Calculation of the Predicted Change in Visibility on the 20% Worst Days at Acadia National Park
The example shows the predicted improvement in visibility from 2001 to the 2015 IAQR control case

Day	1996 IMPROVE Deciviews	IMPROVE bext	IMPROVE SO4 bext	IMPROVE NO3 bext	IMPROVE OMC bext	IMPROVE EC bext	IMPROVE soil bext	IMPROVE coarse bext	2015c RRF SO4	2015c RRF NO3	2015c RRF OMC	2015c RRF EC	2015c RRF soil	2015c RRF coarse
Day 1	21.66	87.27	46.45	14.53	9.10	3.87	0.46	2.86	1.04	1.01	0.85	0.77	0.96	1.04
Day 2	21.50	85.83	53.58	4.50	7.79	3.92	0.65	5.38	0.95	1.02	0.95	0.80	0.99	1.06
Day 3	23.54	105.31	67.83	11.24	8.32	4.26	0.30	3.35	0.58	0.73	0.83	0.70	1.04	1.07
Day 4	20.11	74.72	53.60	1.93	4.84	3.04	0.13	1.18	0.59	1.71	0.75	0.61	1.03	1.05
Day 5	21.85	88.93	51.43	7.38	10.18	1.43	0.25	8.26	0.62	1.84	0.81	0.62	1.09	1.09
Day 6	23.83	108.41	74.33	4.42	10.62	4.13	0.28	4.63	0.63	1.39	0.85	0.63	1.07	1.07
Day 7	24.69	118.16	80.05	5.64	12.08	7.95	0.47	1.98	0.63	1.01	0.77	0.58	1.09	1.08
Day 8	22.34	93.35	41.44	1.65	30.37	6.73	0.28	2.88	0.78	0.69	0.92	0.85	1.03	1.06
Day 9	22.47	94.56	59.46	4.35	12.62	3.66	0.29	4.19	0.92	0.64	0.83	0.64	1.06	1.08
Day 10	24.11	111.40	88.74	1.26	6.50	3.49	0.02	1.39	0.65	0.46	0.81	0.59	1.09	1.09
Day 11	32.94	269.47	235.95	1.29	15.09	6.52	0.09	0.54	0.59	0.74	0.80	0.64	1.07	1.08
Day 12	25.23	124.60	90.91	4.25	12.87	4.67	0.33	1.58	0.72	0.40	0.90	0.70	1.06	1.08
Day 13	30.50	211.16	179.59	3.26	11.20	5.42	0.07	1.62	0.57	1.26	0.77	0.62	1.08	1.07
Day 14	22.30	93.00	57.95	8.26	10.37	3.50	0.28	2.65	0.63	0.56	0.80	0.59	1.07	1.08
Day 15	24.07	111.05	77.79	3.03	13.68	3.47	0.23	2.85	0.78	1.05	0.90	0.67	1.04	1.06
Day 16	23.37	103.49	69.05	2.34	10.74	4.87	0.33	6.15	0.86	0.97	0.88	0.78	1.04	1.06
Day 17	20.27	75.91	54.19	1.77	4.66	2.45	0.16	2.69	1.00	0.91	0.94	0.96	0.97	1.04
Day 18	19.98	73.76	46.74	2.46	6.05	5.49	0.15	2.85	0.74	0.67	0.82	0.74	0.95	1.04
Day 19	22.15	91.58	65.68	2.83	6.14	4.43	0.11	2.38	0.77	1.15	0.84	0.71	0.97	1.03
Average dv	**23.52**													

1996 Observed values at the Acadia IMPROVE site
(10 Mm-1 is added to each total bext value to account for Rayleigh scattering)

Relative Reduction Factors are calculated from REMSAD for each species based on the model predicted % reduction for each day.

RRFs represent the predicted reduction from the 2001 base case to the 2015 IAQR control case. An RRF of 0.85 indicates a 15% reduction.

2015c SO4 bext	2015c NO3 bext	2015c OMC bext	2015c EC bext	2015c soil bext	2015c coarse bext	2015c Total bext	2015c Deciviews
48.37	14.70	7.74	2.99	0.44	2.99	87.23	21.66
50.86	4.61	7.44	3.14	0.64	5.73	82.41	21.09
39.67	8.25	6.90	2.98	0.31	3.58	71.69	19.70
31.76	3.29	3.62	1.87	0.13	1.24	51.91	16.47
31.86	13.61	8.23	0.89	0.27	9.03	73.89	20.00
46.93	6.13	9.04	2.59	0.31	4.96	79.96	20.79
50.46	5.70	9.30	4.64	0.51	2.14	82.74	21.13
32.36	1.14	27.98	5.72	0.29	3.06	80.56	20.86
54.68	2.78	10.50	2.33	0.31	4.50	85.10	21.41
57.47	0.58	5.24	2.06	0.02	1.51	76.89	20.40
138.81	0.96	12.05	4.17	0.10	0.58	166.67	28.13
65.89	1.69	11.58	3.28	0.35	1.71	94.49	22.46
101.73	4.11	8.64	3.37	0.07	1.74	129.67	25.62
36.71	4.63	8.26	2.08	0.30	2.86	64.84	18.69
60.92	3.17	12.27	2.34	0.24	3.01	91.96	22.19
59.35	2.28	9.44	3.81	0.34	6.52	91.74	22.16
54.08	1.61	4.36	2.35	0.15	2.79	75.33	20.19
34.74	1.64	4.96	4.06	0.15	2.97	58.51	17.67
50.31	3.25	5.14	3.16	0.10	2.46	74.43	20.07
			Average dv 2015c				**21.09**
			Reduction in dv from 2001-2015 control				**-2.43**

The RRFs are multiplied by the base year bext values to get the 2015 control bext predictions. The daily total bext values are converted to deciviews and then the deciview values are averaged across all days. The resultant average dv value for 2015c is subtracted from the observed value to get the predicted visibility improvement on the 20% worst days (-2.43 dv).

Projected Visibility Summaries for 20% Best Days at IMPROVE Monitoring Sites

IMPROVE Site ID	Site Name	State	Base 2010 Improvement from 2001 (dv)	IAQR Control 2010 Improvement from 2001 (dv)	2010 Improvement from IAQR Only (dv)	Base 2015 Improvement from 2001 (dv)	IAQR Control 2015 Improvement from 2001 (dv)	2015 Improvement from IAQR Only (dv)
ACAD	Acadia National Park	Maine	-0.25	-0.47	**-0.22**	-0.34	-0.56	**-0.22**
BADL	Badlands National Park	South Dakota	-0.29	-0.35	**-0.06**	-0.33	-0.40	**-0.07**
BAND	Bandelier National Monument	New Mexico	-0.28	-0.29	**0.00**	-0.39	-0.38	**0.00**
BIBE	Big Bend National Park	Texas	-0.35	-0.35	**-0.01**	-0.37	-0.37	**-0.01**
BLIS	Bliss State Park(TRPA)	California	-0.40	-0.41	**-0.01**	-0.54	-0.55	**-0.01**
BRCA	Bryce Canyon National Park	Colorado	-0.30	-0.30	**0.00**	-0.39	-0.39	**0.00**
BRID	Bridger Wilderness	Wyoming	-0.19	-0.19	**0.00**	-0.23	-0.23	**0.00**
BRIG	Brigantine National Wildlife Refuge	New Jersey	-0.28	-0.77	**-0.50**	-0.27	-0.83	**-0.56**
CANY	Canyonlands National Park	Utah	-0.17	-0.17	**0.00**	-0.18	-0.18	**0.00**
CHAS	Chassahowitzka National Wildlife	Florida	-0.96	-1.91	**-0.96**	-1.12	-2.41	**-1.29**
CHIR	Chiricahua National Monument	Arizona	-0.16	-0.16	**0.00**	-0.16	-0.17	**0.00**
CRLA	Crater Lake National Park	Oregon	-0.30	-0.30	**0.00**	-0.38	-0.38	**0.00**
DOSO	Dolly Sods /Otter Creek Wildernes	West Virginia	-0.43	-1.64	**-1.22**	-0.64	-1.98	**-1.34**
GICL	Gila Wilderness	New Mexico	-0.17	-0.17	**0.00**	-0.19	-0.19	**0.00**
GLAC	Glacier National Park	Montana	-0.48	-0.48	**0.00**	-0.58	-0.58	**0.00**
GRCA	Grand Canyon- Hopi Point	Arizona	-0.24	-0.25	**-0.01**	-0.26	-0.27	**-0.01**
GRSA	Great Sand Dunes National Monument	Colorado	-0.29	-0.29	**0.00**	-0.33	-0.33	**0.00**
GRSM	Great Smoky Mountains National Park	Tennessee	-0.44	-1.21	**-0.76**	-0.58	-1.60	**-1.02**
GUMO	Guadalupe Mountains National Park	Texas	-0.36	-0.40	**-0.05**	-0.40	-0.46	**-0.05**
JARB	Jarbidge Wilderness	Nevada	-0.18	-0.18	**0.00**	-0.22	-0.22	**0.00**
JEFF	Jefferson/James River Face Wilderness	Virginia	-0.26	-1.14	**-0.88**	-0.54	-1.49	**-0.95**
LAVO	Lassen Volcanic National Park	California	-0.32	-0.32	**0.00**	-0.41	-0.41	**0.00**
LYBR	Lye Brook Wilderness	Vermont	-0.34	-0.50	**-0.16**	-0.44	-0.59	**-0.15**
MACA	Mammoth Cave National Park	Kentucky	-0.76	-1.43	**-0.67**	-0.95	-1.64	**-0.69**
MEVE	Mesa Verde National Park	Colorado	-0.35	-0.35	**0.00**	-0.38	-0.38	**0.00**
MOOS	Moosehorn NWR	Maine	-0.20	-0.37	**-0.17**	-0.26	-0.42	**-0.16**
MORA	Mount Rainier National Park	Washington	-0.48	-0.48	**0.00**	-0.58	-0.58	**0.00**
MOZI	Mount Zirkel Wilderness	Colorado	-0.18	-0.18	**0.00**	-0.19	-0.19	**0.00**
OKEF	Okefenokee National Wildlife Refuge	Georgia	-0.54	-1.18	**-0.64**	-0.67	-1.46	**-0.80**
PEFO	Petrified Forest National Park	Arizona	-0.27	-0.27	**0.00**	-0.29	-0.29	**0.00**
PINN	Pinnacles National Monument	California	-0.65	-0.65	**0.00**	-0.82	-0.82	**0.00**
PORE	Point Reyes National Seashore	California	-0.76	-0.76	**0.00**	-0.92	-0.92	**0.00**
REDW	Redwood National Park	California	-0.22	-0.22	**0.00**	-0.24	-0.24	**0.00**
ROMA	Cape Romain National Wildlife Refuge	South Carolina	-0.36	-0.95	**-0.59**	-0.42	-1.15	**-0.73**
SAGO	San Gorgonio Wilderness	California	-0.36	-0.36	**0.00**	-0.43	-0.43	**0.00**
SEQU	Sequoia National Park	California	-0.52	-0.52	**0.00**	-0.65	-0.65	**0.00**
SHEN	Shenandoah National Park	Virginia	-0.23	-1.34	**-1.10**	-0.43	-1.56	**-1.13**
SHRO	Shining Rock Wilderness	North Carolina	-0.24	-0.75	**-0.51**	-0.31	-0.98	**-0.67**
SIPS	Sipsy Wilderness	Alabama	-0.57	-1.08	**-0.51**	-0.71	-1.26	**-0.54**
SOLA	South Lake Tahoe	California	-0.78	-0.79	**0.00**	-1.07	-1.07	**-0.01**
THIS	Three Sisters Wilderness	Idaho	-0.23	-0.23	**0.00**	-0.29	-0.29	**0.00**
TONT	Tonto National Monument	Arizona	-0.23	-0.23	**0.00**	-0.24	-0.24	**0.00**
UPBU	Upper Buffalo Wilderness	Arkansas	-0.55	-0.83	**-0.28**	-0.70	-1.06	**-0.36**
WEMI	Weminuche Wilderness	Colorado	-0.28	-0.28	**0.00**	-0.35	-0.35	**0.00**
YOSE	Yosemite National Park	California	-0.45	-0.45	**0.00**	-0.31	-0.31	**0.00**

Projected Visibility Summaries for 20% Worst Days at IMPROVE Monitoring Sites

IMPROVE Site ID	Site Name	State	Base 2010 Improvement from 2001 (dv)	IAQR Control 2010 Improvement from 2001 (dv)	2010 Improvement from IAQR Only (dv)	Base 2015 Improvement from 2001 (dv)	IAQR Control 2015 Improvement from 2001 (dv)	2015 Improvement from IAQR Only (dv)
ACAD	Acadia National Park	Maine	-0.97	-2.03	**-1.06**	-1.24	-2.43	**-1.20**
BADL	Badlands National Park	South Dakota	-0.54	-0.95	**-0.41**	-0.73	-1.17	**-0.44**
BAND	Bandelier National Monument	New Mexico	-0.56	-0.64	**-0.08**	-0.75	-0.85	**-0.10**
BIBE	Big Bend National Park	Texas	-0.30	-0.34	**-0.04**	-0.33	-0.39	**-0.06**
BLIS	Bliss State Park(TRPA)	California	-1.15	-1.15	**0.00**	-1.58	-1.58	**0.00**
BRCA	Bryce Canyon National Park	Colorado	-0.73	-0.74	**-0.01**	-0.91	-0.92	**-0.01**
BRID	Bridger Wilderness	Wyoming	-0.84	-0.85	**-0.01**	-1.01	-1.02	**-0.01**
BRIG	Brigantine National Wildlife Refuge	New Jersey	-0.71	-2.24	**-1.52**	-1.03	-2.70	**-1.67**
CANY	Canyonlands National Park	Utah	-0.57	-0.57	**-0.01**	-0.66	-0.67	**-0.01**
CHAS	Chassahowitzka National Wildlife	Florida	-1.46	-3.05	**-1.59**	-1.70	-3.69	**-1.98**
CHIR	Chiricahua National Monument	Arizona	-0.23	-0.25	**-0.02**	-0.23	-0.25	**-0.02**
CRLA	Crater Lake National Park	Oregon	-1.34	-1.35	**-0.01**	-1.63	-1.65	**-0.01**
DOSO	Dolly Sods /Otter Creek Wildernes	West Virginia	-1.36	-3.92	**-2.56**	-2.02	-4.62	**-2.61**
GICL	Gila Wilderness	New Mexico	-0.58	-0.61	**-0.03**	-0.72	-0.76	**-0.04**
GLAC	Glacier National Park	Montana	-0.70	-0.70	**0.00**	-0.87	-0.88	**-0.01**
GRCA	Grand Canyon- Hopi Point	Arizona	-0.59	-0.62	**-0.03**	-0.67	-0.71	**-0.04**
GRSA	Great Sand Dunes National Monument	Colorado	-0.65	-0.67	**-0.02**	-0.73	-0.76	**-0.02**
GRSM	Great Smoky Mountains National Park	Tennessee	-1.38	-3.55	**-2.17**	-1.94	-4.52	**-2.58**
GUMO	Guadalupe Mountains National Park	Texas	-0.42	-0.53	**-0.11**	-0.47	-0.60	**-0.13**
JARB	Jarbidge Wilderness	Nevada	-0.90	-0.90	**0.00**	-1.14	-1.14	**0.00**
JEFF	Jefferson/James River Face Wilderness	Virginia	-1.11	-2.98	**-1.88**	-1.75	-3.83	**-2.07**
LAVO	Lassen Volcanic National Park	California	-1.03	-1.03	**0.00**	-1.26	-1.26	**0.00**
LYBR	Lye Brook Wilderness	Vermont	-0.70	-1.77	**-1.06**	-0.95	-2.02	**-1.07**
MACA	Mammoth Cave National Park	Kentucky	-1.88	-4.10	**-2.22**	-2.47	-5.08	**-2.62**
MEVE	Mesa Verde National Park	Colorado	-0.79	-0.80	**0.00**	-0.88	-0.88	**0.00**
MOOS	Moosehorn NWR	Maine	-0.77	-1.85	**-1.09**	-0.98	-2.12	**-1.14**
MORA	Mount Rainier National Park	Washington	-1.67	-1.67	**0.00**	-1.89	-1.89	**0.00**
MOZI	Mount Zirkel Wilderness	Colorado	-0.68	-0.69	**-0.01**	-0.76	-0.78	**-0.02**
OKEF	Okefenokee National Wildlife Refuge	Georgia	-0.99	-2.32	**-1.33**	-1.27	-2.91	**-1.64**
PEFO	Petrified Forest National Park	Arizona	-0.51	-0.54	**-0.03**	-0.58	-0.60	**-0.02**
PINN	Pinnacles National Monument	California	-1.25	-1.26	**-0.01**	-1.67	-1.68	**-0.02**
PORE	Point Reyes National Seashore	California	-1.43	-1.47	**-0.04**	-1.85	-1.90	**-0.05**
REDW	Redwood National Park	California	-1.66	-1.66	**0.00**	-1.96	-1.96	**0.00**
ROMA	Cape Romain National Wildlife Refuge	South Carolina	-0.51	-1.80	**-1.29**	-0.71	-2.36	**-1.66**
SAGO	San Gorgonio Wilderness	California	-2.08	-2.08	**0.00**	-2.88	-2.88	**0.00**
SEQU	Sequoia National Park	California	-1.63	-1.63	**0.00**	-2.25	-2.25	**0.00**
SHEN	Shenandoah National Park	Virginia	-1.00	-3.43	**-2.43**	-1.62	-4.25	**-2.63**
SHRO	Shining Rock Wilderness	North Carolina	-1.67	-3.70	**-2.04**	-2.21	-4.62	**-2.41**
SIPS	Sipsy Wilderness	Alabama	-1.28	-3.29	**-2.01**	-1.86	-4.35	**-2.49**
SOLA	South Lake Tahoe	California	**-1.39**	-1.39	**0.00**	-1.89	-1.89	**0.00**
THIS	Three Sisters Wilderness	Idaho	-1.52	-1.52	**0.00**	-1.88	-1.88	**0.00**
TONT	Tonto National Monument	Arizona	-0.68	-0.70	**-0.02**	-0.76	-0.79	**-0.03**
UPBU	Upper Buffalo Wilderness	Arkansas	-0.57	-2.43	**-1.85**	-1.02	-3.13	**-2.10**
WEMI	Weminuche Wilderness	Colorado	-0.72	-0.75	**-0.02**	-0.88	-0.90	**-0.02**
YOSE	Yosemite National Park	California	-1.32	-1.32	**0.00**	-1.59	-1.59	**0.0**