STATE OF MISSOURI
PLAN FOR $PM_{2.5}$

AND

ATTAINMENT DEMONSTRATION FOR THE ST. LOUIS METROPOLITAN AREA

Missouri Air Conservation Commission
Adopted: September 24, 2009

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ACRONYM AND ABBREVIATIONS

AERMOD	AERMIC Modeling System
AERMIC	American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee
ASIP	Atlanta SIP
BC	Boundary Conditions
CAA	Clean Air Act
CAIR	Clean Air Interstate Rule
CAMR	Clean Air Mercury Rule
CAMx	Comprehensive Air-quality Modeling with Extensions
CASTNet	**C**lean **A**ir **S**tatus **T**rends **Net**work
CENRAP	Central Regional Air Planning Association
CMAQ	Community Multiscale Air Quality
CO	Carbon Monoxide
CSR	Code of State Regulations
CTM	Chemical Transport Model
Department	Department Of Natural Resources
DOJ	Department of Justice
DVC	Design Value Base Case
DVF	Design Value Final
EC	Elemental Carbon
EGU	Electric Generating Unit
EIQ	Emission Inventory Questionnaire
EPA	United States Environmental Protection Agency
FRM	Federal Reference Method
g/mi	grams per mile
GVWR	Gross Vehicle Weight Rating
HDDV	Heavy Duty Diesel Vehicle
IEPA	Illinois Environmental Protection Agency
IL	Illinois
IMPROVE	**I**nteragency **M**onitoring of **PRO**tected **V**isual **E**nvironments
I/M	Inspection/Maintenance
KM	Kilometer
LBS	Pounds
MACT	Maximum Achievable Control Technology
MATS	Modeled Attainment Test Software
MDAW	Model and Data Analysis Workgroup
MM5	Mesoscale Meteorological Model, Version 5.0
MO	Missouri
MMBTUs	Million British Thermal Units
NAA	Nonattainment Area
NH_3	Ammonia
NAAQS	National Ambient Air Quality Standard
NMIM	National Mobile Inventory Model

NO_x	Nitrogen oxides
OCM	Organic Carbon Mass
OTB	On-The-Books
PAVE	Package for Analysis and Visualization of Environmental Data
PM	Particulate Matter
$PM_{2.5}$	Fine Particulate Matter
PM_{10}	Particulate Matter less than 10 microns
PPM	Parts Per Million
QA/QC	Quality Assurance/Quality Control
RACT	Reasonably Available Control Technology
RACM	Reasonably Available Control Measures
RPO	Regional Planning Organization
RFG	Reformulated Gasoline
RFP	Reasonable Further Progress
RRF	Relative Response Factors
SIP	State Implementation Plan
SMAT	Speciated Modeled Attainment Test
SO_2	Sulfur dioxide
SOA	Secondary Organic Aerosols
STN	Speciated Trends Network
TPY	Tons per Year
TSD	Technical Support Document
$\mu g/m^3$	micrograms per cubic meter
VISTA	Visibility Improvements States and Tribes
VOC	Volatile Organic Compounds
VMT	Vehicle Miles Traveled
WOE	Weight of Evidence
WRAP	Western Regional Air Partnership

EXECUTIVE SUMMARY

In July 1997, the United States Environmental Protection Agency (EPA) issued the National Ambient Air Quality Standard (NAAQS) for fine particulate matter ($PM_{2.5}$). The 1997 annual standard was established as a level of 15 micrograms per cubic meter ($\mu g/m^3$), based on the 3-year average of annual mean $PM_{2.5}$ concentrations. The 1997 24-hour standard was established as a level of 65 $\mu g/m^3$, determined by the 3-year average of the annual 98th percentile concentrations. NOTE: EPA has subsequently revised the 24-hour $PM_{2.5}$ standard to 35 $\mu g/m^3$ in 2006. However, this plan only addresses the requirements of the 1997 annual standard.

On December 17, 2004, EPA made $PM_{2.5}$ nonattainment area determinations. The St. Louis region was designated as a $PM_{2.5}$ nonattainment area with a compliance date of 2010, unless the state demonstrates that more time is necessary in which case up to five additional years may be granted. The nonattainment designations triggered the requirement to develop an implementation plan. A significant requirement of a $PM_{2.5}$ plan is an attainment demonstration to define effective emissions control strategies and confirm that attainment can be achieved after implementation of the strategies by the attainment date.

The St. Louis region is a bi-state nonattainment area for violating the annual $PM_{2.5}$ standard (Figure ES-1). All areas of Missouri and neighboring areas within other states (Kansas City – Kansas and St. Louis - Illinois) met the 1997 daily $PM_{2.5}$ standard. The St. Louis nonattainment area includes the City of St. Louis and the Counties of Franklin, Jefferson, St. Charles, and St. Louis. The Illinois portion of the St. Louis nonattainment area includes the Counties of Madison, Monroe, St. Clair and the Baldwin Township of Randolph County.

Upon designation, states have three years to prepare plans to address $PM_{2.5}$. Based on this deadline, the $PM_{2.5}$ plan was scheduled to be finished in April 2008. All submissions must address basic plan requirements related to the attainment including emission inventories, monitoring and modeling attainment, and maintenance and enforcement of the standards. The plan outlines the measures that the state will take in order to improve air quality. The deadline for attaining the $PM_{2.5}$ standard is no later than five years after the formal designation of the $PM_{2.5}$ nonattainment area. However, on April 25, 2007, the EPA published the Clean Air Fine Particle Implementation Rule (EPA, 2007) which prescribes the requirements that must be met with the $PM_{2.5}$ plan. The extremely late publication of this rule did not provide sufficient time for the states to conclude planning efforts in the regulatory time frame. In the rule, EPA provides rules and guidance on the Clean Air Act (CAA) requirements for state plans to implement the 1997 final particle $PM_{2.5}$ NAAQS.

Figure ES-1. Annual $PM_{2.5}$ Nonattainment Area for St. Louis (MO-IL) region

The Missouri $PM_{2.5}$ plan depends upon a number of federal (regional) and state (local) control measures to reduce fine particle emissions to assist in complying with the annual $PM_{2.5}$ standard in St. Louis. These control measures include the following:

- Clean Air Interstate Rule (CAIR) – Phase I;
- Heavy-Duty Diesel Engine Standards and Low-Sulfur Diesel;
- Illinois' Multi-pollutant Rule (pre-2012 requirements);
- Tier 2 Vehicle Standards;
- Tier 4 Rule – Off-Road Mobile Engine Standards;
- Reformulated Gasoline (RFG);
- Gateway Vehicle Inspection Program;
- NO_x SIP Call; and
- Reasonably Available Control Technology (RACT).

The downward trend of emissions as shown in Figure ES-2 is consistent with historic and current air quality data along with the implementation of some of the existing control measures listed above. This consistency is very likely to continue when new control measures are implemented through this plan.

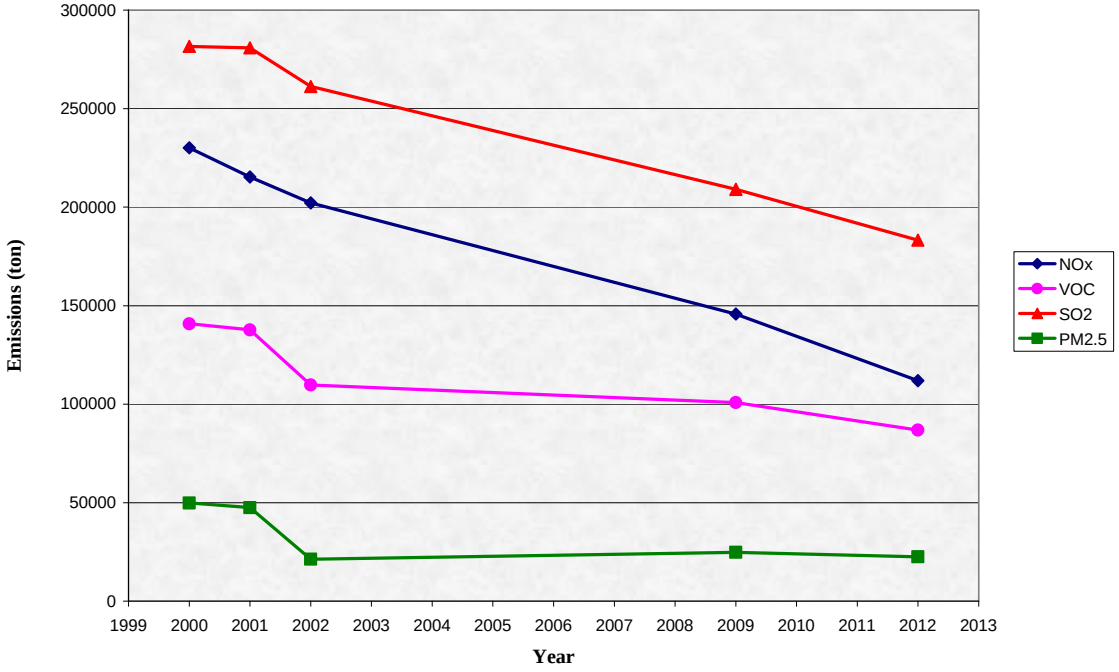


Figure ES-2. St. Louis Nonattainment Area Emissions Trends

In 2002, there were three monitoring sites [Granite City (IL), East St. Louis (IL), & Mound Street (MO)] violating the annual $PM_{2.5}$ NAAQS (Table ES-1). Regional photochemical modeling for 2009 (attainment year analyses) using the Community Multiscale Air Quality (CMAQ) model with on-the-book (OTB) controls showed that only one site (Granite City) was still in violation of the air quality standard. This is consistent with the most recent air quality data which shows that both East St. Louis and Mound Street site attained the NAAQS at the end of 2008.

The trends in annual average ambient air $PM_{2.5}$ design values for the St. Louis area show a decided downward trend since 2003. This trend is demonstrated effectively in Table ES-2.

Table ES-1. Current and Future Year Projected 2009 and 2012 Annual $PM_{2.5}$ Design Values in ug/m^3

Monitoring Site Name		Excel	MATS v1.3.1
	(2002)	(2009)	(2012)
	$PM_{2.5}$ DVC Observed	$PM_{2.5}$ DVF CMAQ Base 5a	$PM_{2.5}$ DVF CMAQ Base 5b12
Washington Ave.	N/A	N/A	N/A
Granite City	17.27	15.53	15.28
Alton	14.58	12.99	12.29
Wood River	14.70	13.09	12.51
Tilden City	12.41	10.94	10.31
East St. Louis	16.19	14.54	14.13
Swansea	14.68	13.10	12.58
Arnold	14.43	12.91	12.27
West Alton	14.08	12.54	11.93
Sunset Hills	12.52	11.36	10.76
Clayton	14.02	12.70	12.02
Ferguson	13.77	12.16	11.93
S. Broadway	14.55	13.29	12.70
Blair St.	14.93	13.42	13.12
Margaretta	13.93	12.59	12.07
2nd & Mound	15.16	13.62	13.10

Table ES-2. St. Louis Area $PM_{2.5}$ Annual Average Design Values

Monitor Site	$PM_{2.5}$ Annual Std = 15.0 µg/m^3									3-year average						
	2000	2001	2002	2003	2004	2005	2006	2007	2008	00-02	01-03	02-04	03-05	04-06	05-07	06-08
Missouri																
West Alton	14.8	15.0	14.0	14.0	11.9	15.2	11.6	13.2	Disc	14.6	14.3	13.3	13.7	12.9	13.3	n/a
Margaretta	15.2	14.2	14.3	13.5	12.1	15.3	12.5	Disc	Disc	14.6	14.0	13.3	13.6	13.3	Disc	Disc
Blair Street	16.4	15.2	15.4	14.1	13.2	16.1	13.4	13.9	12.9	15.7	14.9	14.2	14.5	14.2	14.5	13.4
Mound Street	16.0	15.4	15.8	14.7	13.6	15.9	13.7	14.3	12.7	15.7	15.2	14.7	14.7	14.4	14.6	13.5
South Broadway	15.3	14.8	15.3*	14.4	13.1	15.9	13.1	14.0	12.5	15.1**	14.8**	14.3**	14.5	14.0	14.3	13.2
Clayton	15.1	13.9	14.6	13.6	12.2	15.5	11.8	13.1	12.0	14.5	14.0	13.5	13.8	13.2	13.4	12.3
Arnold	15.2	14.5	15.1	13.9	12.6	15.4	12.6	13.8	11.4***	14.9	14.5	13.9	14.0	13.5	13.9	12.6
Illinois																
Alton	16.0	15.8	14.7	14.0	11.5	16	13.1	14.9	12.5	15.5	14.8	13.4	13.8	13.5	14.7	13.5
Wood River	15.9	15.0	15.1	14.0	13.2	16	13.1	14.2	12.2	15.3	14.7	14.1	14.4	14.1	14.4	13.2
Granite City	17.4	17.3	17.7	17.5	15.4	18.2	16.3	15.1	15.7	17.5	17.5	16.9	17.0	16.6	16.5	15.6
East St. Louis	17.4	17.0	16.7	16.6	14.7	17.1	14.5	15.6	12.6	17.0	16.8	16.0	16.1	15.4	15.7	14.2
Swansea	15.0	15.5	15.1	14.3	13.2	16	13.4	13.3	12.6	15.2	15.0	14.2	14.5	14.2	14.2	13.1

*Less than four full quarters
**Less than three full years
***Sampler moved to Arnold West

Based on the fact that EPA's implementation rule for the 1997 PM standard was not issued until April 2007, and some control measures, including new RACT rules and Illinois' Multi-pollutant rule, will not be implemented until after 2009, the state of Missouri is requesting an attainment date extension to 2012 to comply with 1997 PM NAAQS. The Missouri Department of Natural Resources (department) implemented new RACT requirements that will reduce sulfur dioxide (SO_2) and nitrogen oxides (NO_x) emissions by 20,133 tons per year (tpy) and 1,067 tpy, respectively after 2011. These reductions showed some progress toward attainment but more reductions, particularly from nearby sources influencing the Granite City monitoring site, are needed to attain the NAAQS of 15 $\mu g/m^3$.

The Conceptual Model [Technical Support Document (TSD), Appendix A, Chapter 2] concluded that Granite City monitoring site is influenced by local industrial sources which contribute a significant fraction (between 2 and 3 $\mu g/m^3$) of the annual $PM_{2.5}$ concentrations. Furthermore, the "Chemical Mass Balance Source Apportionment Results for the Granite City Area and Urban Excess" (Turner 2007a,b,c,d) showed that local Granite City sources are the dominant influence on air quality impacts to the Granite City fire station site. The Department's Air Program sensitivity modeling analyses concluded that controlling direct $PM_{2.5}$ emissions from local sources near the Granite City monitoring site was far more effective than Missouri's SO_2 and NO_x RACT requirements.

There are several $PM_{2.5}$ nonattainment areas, including Atlanta, Birmingham, Detroit, and Pittsburg that all showed significant contribution of direct $PM_{2.5}$ emissions from local sources. EPA modeling guidance requires a more refined analysis to evaluate the contribution from these local sources. As the local sources contributing to $PM_{2.5}$ at the Granite City monitor are in Illinois, they are in the jurisdiction of the Illinois Environmental Protection Agency (IEPA). Thus, the IEPA is performing local-scale analysis using CMAQ and AERMOD to identify the specific level of local control needed to attain the annual $PM_{2.5}$ NAAQS at this critical monitor.

The Department's Air Program has identified major direct PM sources in the Missouri portion of the nonattainment area that emitted above 10 tons per year of $PM_{2.5}$ or 25 tons per year of PM_{10} in 2002. The largest direct PM sources include the four electric generating unit facilities. All these units have electrostatic precipitators installed to control PM emissions at a control efficiency of 98 percent. Additional information for Direct PM sources evaluation is provided in the Reasonably Available Control Technology TSD. In addition, the modeling analysis conducted for direct PM sources in Missouri demonstrates that these PM sources do not contribute significantly to the violating monitor at Granite City.

Section 172(c)(9) of the CAA requires plan revisions to include specific contingency measures that can be implemented without further action by the state. Contingency measures are triggered if the state fails to meet a Reasonable Further Progress (RFP) milestone or if monitoring shows that the standard has not been attained. Federal or local

measures that provide emission reductions in excess of those needed to meet a RFP or attainment milestone may be used as a contingency measure. The final $PM_{2.5}$ implementation rule requires that the contingency measures provide for emission reductions equivalent to about one year of reductions needed for RFP, based on the overall level of reductions needed to demonstrate attainment divided by the number of years from the 2002 base year to the attainment year. The contingency measure target for total reductions is 10,024 tons.

To fulfill the contingency measure target, the Department's Air Program has identified Doe Run Herculaneum smelter SO_2 reductions beyond the attainment demonstration requirements, federal motor vehicle controls, and the St. Louis heavy duty diesel vehicle idling reduction rule as contingency measures for the annual $PM_{2.5}$ standard.

As part of the RACT requirements for SO_2 emission sources in the St. Louis nonattainment area, the Department's Air Program revised a regulation (10 CSR 10-6.260 Restriction of Emission of Sulfur Compounds) to control SO_2 emissions from the Herculaneum primary lead smelter operated by the Doe Run Company. This regulation was modified to include new emission targets for the facility in 2012 (RACT requirement) and 2014 (for contingency measures). These targets represent the on-going operation of the facility utilizing improved operation of the existing sulfuric acid plant and are phased to include a zero emission target after 2016.

The turnover of the on-road fleet of cars, trucks, and buses (i.e., the rate at which newer vehicles replace older ones in the fleet population) as a result of federal motor vehicle controls will result in direct $PM_{2.5}$ and NO_x emission benefits beyond 2012. This is because newer vehicles subject to federal motor vehicle programs are cleaner than the vehicles they are replacing.

Direct $PM_{2.5}$ and NO_x emission reductions are expected from the implementation of rule 10 CSR 10-5.385 Control of Heavy Duty Diesel Vehicle Idling Emissions. This rule requires that all commercial, public and institutional diesel vehicles with a gross vehicle weight rating (GVWR) over 10,000 pounds in the St. Louis, Missouri nonattainment counties to limit their idling to thirty (30) minutes while waiting to load or unload at a freight load/unload location. It also limits these vehicles from idling for more than five (5) minutes in any sixty (60) minute period. The total amount of emission reductions achieved by these three contingency measures is 14,814 tons (nearly 5,000 tons more than required).

Ultimately, the Department's Air Program has determined that based upon existing federal and state controls promulgated and the implementation of RACT, along with the necessary control of local sources around the Granite City, Illinois monitor, that the St. Louis nonattainment area can achieve the NAAQS by 2012. However, the initial compliance date of 2010 is not achievable due primarily to insufficient time to develop and implement the necessary local controls on sources in both Missouri and Illinois.

1.0 INTRODUCTION AND BACKGROUND

EPA establishes NAAQS for each of six criteria pollutants. These standards apply to the concentration of a pollutant in outdoor air. If the air quality in a geographic area meets or is cleaner than the national standard, it is designated an attainment area; areas that do not meet the national standard or contribute to another area that violates the air quality standard are designated as nonattainment areas. Fine particulate matter or $PM_{2.5}$ is one of the criteria pollutants.

Particulate matter is a mixture of microscopic solids and liquid droplets suspended in air. $PM_{2.5}$ describes particulate matter that is 2.5 micrometers in diameter and smaller - 1/30th the diameter of a human hair. Fine particles are generally emitted from activities such as industrial and residential combustion and from vehicle exhaust. Fine particles are also formed in the atmosphere when gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds are chemically transformed in the atmosphere into particles.

1.1 Particulate Matter Sources

Fine particulate matter can be emitted as a direct pollutant from stationary and mobile sources. Sources of primary $PM_{2.5}$ include:

- Stationary sources that burn fossil fuels, such as power plants and industrial, commercial and residential heating equipment,
- Mobile sources that burn fossil fuels such as cars, trucks, and buses,
- Industrial processes such as smelting,
- Asphalt production,
- Residential wood burning,
- Construction activities, including fugitive dust and exhaust from off-road equipment,
- Agricultural operations, and
- Non-anthropogenic sources such as wild fires.

Fine particle pollution can also be formed secondarily in the atmosphere. $PM_{2.5}$ precursors emitted into the air react to form secondary particulate matter. Sulfates are a type of secondary particle formed from sulfur dioxide emissions from power plants and industrial facilities. Nitrates, another type of fine particle, are formed from emissions of nitrogen oxides from power plants, automobiles, and other combustion sources. Secondary organic aerosols are also a type of $PM_{2.5}$ resulting from emissions of semi-volatile or volatile organic compounds. These emissions occur from a variety of sources, including gasoline evaporation or biogenic emissions. Any given particle may contain particulate matter from several sources. Secondary formation is a long term process which can take hours and/or days and is a component in long range transportation contribution to $PM_{2.5}$ levels in other areas. Potential sources of secondary $PM_{2.5}$ precursors that react in the air include:

- Stationary and mobile fossil fuel combustion processes,
- Gasoline fueling and refining,
- Surface coating operations,
- Industrial processes,
- Cement and lime kilns,
- Agricultural operations, and
- Mining.

1.2 Health Effects from Elevated Concentrations of $PM_{2.5}$

Health studies have shown a significant association between exposure to fine particles and premature death from heart or lung disease. Fine particles can aggravate heart and lung diseases and have been linked to effects such as: cardiovascular symptoms; cardiac arrhythmias; heart attacks; respiratory symptoms; asthma attacks; and bronchitis. These effects can result in increased hospital admissions, emergency room visits, absences from school or work, and restricted activity days.

Roughly one out of every three people in the United States is at a higher risk of experiencing $PM_{2.5}$ related health effects. One group at high risk is active children because they often spend a lot of time playing outdoors and their bodies are still developing. In addition, the elderly population is often at high risk due to reduced lung capacity or preexisting medical conditions. People of all ages who are active outdoors are at increased risk because, during physical activity, $PM_{2.5}$ penetrates deeper into the parts of the lungs that are more vulnerable to injury.

1.3 PM National Ambient Air Quality Standard

EPA issued the fine particle standards in July of 1997 after evaluating health studies and conducting an extensive peer review process. The 1997 annual standard was established as a level of 15 micrograms per cubic meter, based on the 3-year average of annual mean $PM_{2.5}$ concentrations. The 1997 24-hour standard was established as a level of 65 micrograms per cubic meter, determined by the 3-year average of the annual 98th percentile concentrations.

At the time the fine particle standards were established in 1997, EPA also issued standard methods for monitoring fine particle levels in the ambient air to determine which parts of the country were subject to unhealthy levels. The issuance of this standard required a monitoring network to be implemented by Missouri and Illinois. A map of the $PM_{2.5}$ monitoring sites in the St. Louis area is shown in Figure 1-1. On this map, blue dots represent monitors that are currently active in the area and pink dots represent monitors that have been eliminated due to network revisions in the years since the network was established.

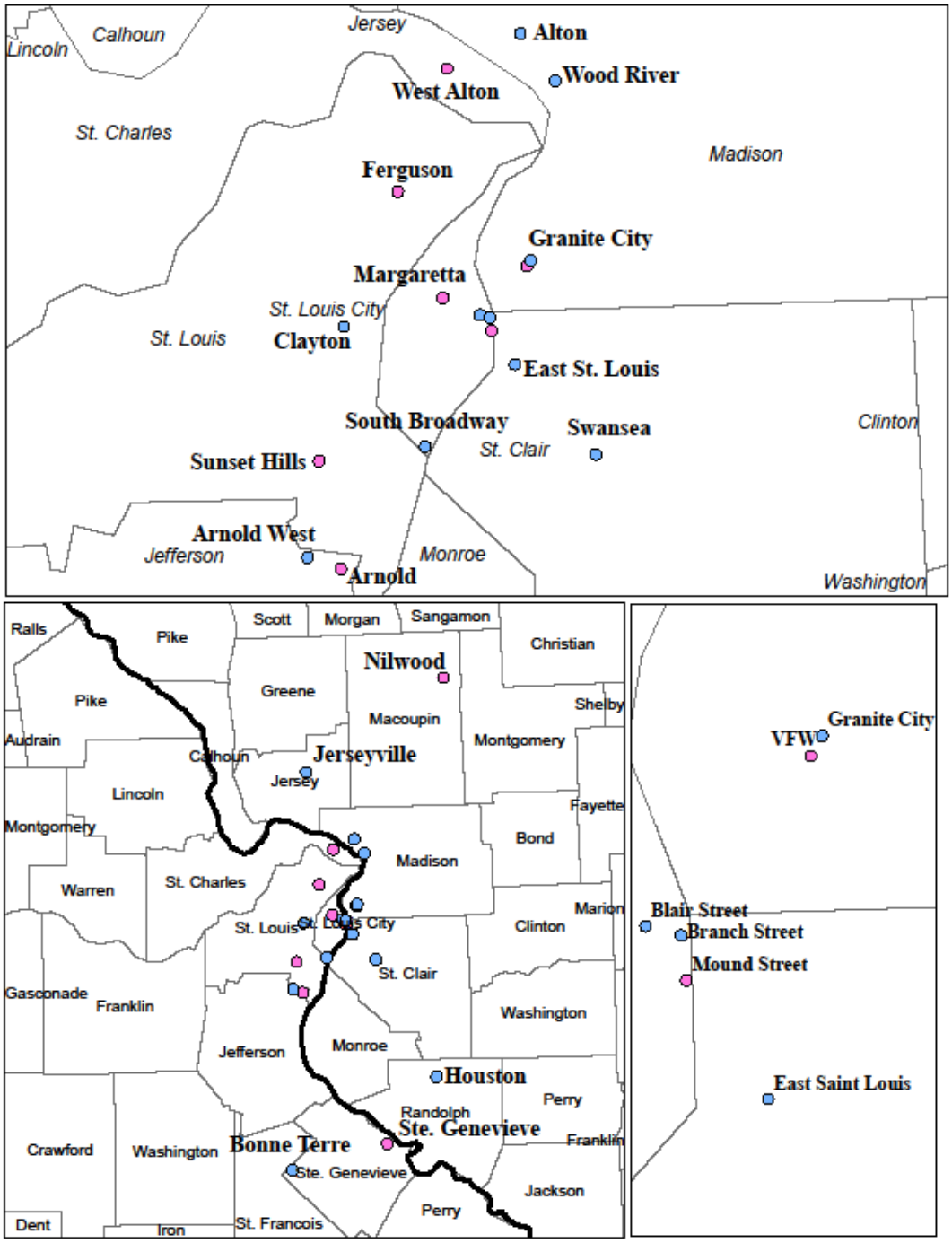


Figure 1-1. $PM_{2.5}$ Monitoring Sites in the St. Louis Area

The $PM_{2.5}$ standards are based on averaging air quality measurements both annually and on a 24 hour basis. The annual standard for $PM_{2.5}$ is met whenever the 3 year average of the annual mean $PM_{2.5}$ concentrations for designated monitoring sites in an area is less than or equal to 15.0 $\mu g/m^3$. The 1997 24-hour $PM_{2.5}$ standard is met whenever the 3 year average of the annual 98th percentile of values at designated monitoring sites in an area is less than or equal to 65 $\mu g/m^3$.

After EPA promulgated the $PM_{2.5}$ and 8-hour ozone standards in July 1997, several industry organizations and state governments challenged EPA's action in the U.S. Court of Appeals for the District of Columbia Circuit (the D.C. Circuit). On May 14, 1999, the three-judge panel of the D.C. Circuit held in a split decision that the Clean Air Act, as applied by EPA in setting the 1997 standards for PM and ozone, was unconstitutional as an improper delegation of legislative authority to EPA. The ruling did not question the science or decision-making process used to establish the standards. The Court remanded the $PM_{2.5}$ standards to EPA but did not vacate them. In June 1999, the Department of Justice (DOJ) and EPA petitioned the Court for a rehearing en banc with the entire D.C. Circuit Court. On October 29, 1999, the Court denied the petition for rehearing.

The DOJ and EPA then filed a petition for certiorari with the United States Supreme Court in December 1999 to appeal the decision of the D.C. Circuit, and the Supreme Court issued its decision to hear the appeal in November 2000. The Supreme Court issued its decision on the merits of the appeal on February 27, 2001. In that decision, the Supreme Court held that EPA's approach to setting the National Ambient Air Quality Standards in accordance with the CAA did not constitute an unconstitutional delegation of authority. The Supreme Court unanimously affirmed the constitutionality of the CAA provision that authorizes the EPA to set national air quality standards, stating that this provision "fits comfortably within the scope of discretion permitted by our precedent." The Supreme Court also affirmed that the CAA requires EPA to set standards at levels necessary to protect the public health and welfare, without considering the economic costs of implementing the standards. The Supreme Court remanded several other issues back to the D.C. Circuit, including the issue of whether EPA acted arbitrarily and capriciously in establishing the specific levels of the standards.

The D.C. Circuit heard arguments in this remanded case in December 2001 and issued its decision on March 26, 2002. The D.C. Circuit found that the Agency had "engaged in reasoned decision making," rejecting the claim that the Agency had acted arbitrarily and capriciously in setting the levels of the standards. This last decision by the D.C. Circuit gave EPA a clear path to move forward with implementation of the $PM_{2.5}$ standards.

1.4 Designation

When EPA promulgates NAAQS, states are required to evaluate and make recommendations for their state. The Clean Air Act allows each state to recommend initial designations of the attainment status for all areas of the state. The Department's Air Program began this process in 2002.

The 2004 designation submittal included the monitoring data from 2000-02 and indicated violations of the annual fine particle standard at several monitors in and around the St. Louis area (Table 1-1). Seven sites, Blair St. and S. Broadway in Missouri and Granite City, E. St. Louis, Alton, Wood River, and Swansea in Illinois, were in violation of the NAAQS annual standard. There were no areas of the Missouri that show violation of the 24-hour fine particle standard.

Table 1-1. St. Louis Annual $PM_{2.5}$ Total Mass for 2000-2002

24-hr Std = 65 μg/m^3, 98th percentile **Annual Mean Std = 15.0 μg/m^3**

	98th percentile				**Annual Mean**			
Missouri	**2000**	**2001**	**2002**	**00-02**	**2000**	**2001**	**2002**	**00 - 02**
West Alton	34.4	36.5	35.0	**35.3**	14.8	15.0	14.2	**14.6**
Margaretta	33.5	33.7	35.5	**34.2**	14.8	14.3	14.5	**14.5**
Blair Street	34.8	34.0	36.5	**35.1**	16.0	15.3	15.4	**15.6**
Mound St.	35.6	33.8	35.9	**35.1**		**Middle scale site**		
S.Broadway	32.0	34.4	36.5	**34.3**	15.6*	14.8	15.3	**15.2****
Ferguson	33.3	32.7	38.4	**34.8**	14.3	13.4	13.5	**13.7**
Clayton	33.4	33.6	36.9	**34.6**	15.2	13.9	14.5	**14.5**
Sunset Hills		26.3	34.0	**30.2****	-	11.7*	13.0	**12.4**
Arnold	33.1	32.1	46.5	**37.2**	15.2	14.5	15.1	**14.9**
Illinois								
Alton	36.3	39.6	34.5	**36.8**	16.0	15.8	14.7	**15.5**
Wood River	32.1	33.9	33.9	**33.3**	15.9	14.9	15.1	**15.3**
VFW	37.4	42.9	44.6	**41.6**		**Middle scale site**		
Granite City	33.5	35.0	42.9	**37.1**	17.4	17.3	17.7	**17.5**
E. St. Louis	36.1	33.7	40.9	**36.9**	17.4	17.0	16.7	**17.0**
Swansea	32.8	39.3	37.2	**36.4**	15.0	15.5	15.1	**15.2**

* less than four full quarters
** less than three full years

The designation process plays an important role in identifying for the general public whether the air quality in a given area is healthy. In April 2003, EPA issued a

memorandum outlining the schedule for designating areas under the $PM_{2.5}$ standard and related guidance on nine factors to consider in identifying nonattainment areas. In responding to EPA's promulgation of the PM NAAQS and in developing the boundary recommendation, the Department's Air Program made a number of technical findings that provided insight into the St. Louis nonattainment recommendation and designation area.

There are sixteen Federal Reference Method monitoring sites in the St. Louis area. Fourteen are neighborhood scale and two are middle scale. The middle scale sites, Mound Street (St.) and VFW, are source oriented and not appropriate for comparison to the annual average national ambient air quality standard (NAAQS). In addition, there are four speciation sites and the St. Louis Supersite in East St. Louis, operated by Washington University, that provide detailed information on the different species of $PM_{2.5}$ in addition to total mass. Also, two continuous $PM_{2.5}$ monitors have been operated in the area, one at the Blair St. site in St. Louis and one at the St. Louis Supersite.

Contributions from emissions within the nonattainment shall be considered "urban scale influences" and "local source influences" while contributions from emissions outside the nonattainment area will be considered "regional source influences." The differential between "local" versus "urban" influences occurs in regards to whether specific sources near a monitor contribute to the $PM_{2.5}$ at that monitor (e.g., an industrial source located adjacent to the monitor) versus more dispersed urban source contributions to $PM_{2.5}$ concentrations (e.g., motor vehicles). There is a widespread regional background of about 10-11 $\mu g/m^3$ of $PM_{2.5}$ and an additional 5-6 $\mu g/m^3$ of $PM_{2.5}$ in the St. Louis urban area. $PM_{2.5}$ speciation data provides insight. Sulfate tends to be high in the summer and contributes to summer mass peaks and nitrate tends to be high in the winter and contribute to winter mass peaks. Organic and elemental carbon peaks do not show as much seasonality, but tend to occur more in the fall. A comparison of monitoring data between urban and rural sites suggests that the rural background $PM_{2.5}$ mass concentration is approximately 11 micrograms per cubic meter ($\mu g/m^3$). Therefore, the urban excess ranges up to 5 micrograms or so. The urban excess can be further characterized by species as follows:

- $PM_{2.5}$ mass concentration 5 $\mu g/m^3$ (rural background $PM_{2.5}$ mass concentration is 11 $\mu g/m^{3)}$,
- Sulfate 0.5 $\mu g/m^3$,
- Ammonium 0.2 $\mu g/m^3$,
- Nitrate 0.6 $\mu g/m^3$,
- Total carbonaceous mass 2.5 to 3 $\mu g/m^3$,
- Crustal 0.6 $\mu g/m^3$.

The data shows that the total carbonaceous mass is the species that contributes most to the urban excess. This conclusion has been confirmed in other studies around the country. It is likely that the carbonaceous mass has more of a local origin, and is less likely to be from transport.

In addition to air quality data, EPA guidance on the $PM_{2.5}$ designations process also discusses other important factors, including emissions of pollutants that lead to $PM_{2.5}$ formation, population, commuting patterns, and expected growth, that states should evaluate in order to determine whether a county is a likely contributor to the area's air quality problem.

A formal recommendation on nonattainment area boundaries was submitted to EPA on March 2004. In its submittal the Department's Air Program recommended that the counties of Jefferson, Franklin, St. Charles, and St. Louis along with the City of St. Louis be designated as nonattainment for annual fine particle standard (Figure 1-2). The Illinois counties of Madison, Monroe, and St. Clair are also part of the nonattainment area along with the Baldwin township in Randolph County. After working with Missouri and considering the information from air quality monitors, EPA issued official designations for the $PM_{2.5}$ standard on December 17, 2004 and made final modifications in April 2005.

Figure 1-2. Annual $PM_{2.5}$ Nonattainment Area for St. Louis (MO-IL) region

The final designation of the St. Louis area (MO-IL) by EPA in April 2005 is the trigger for the Clean Air Act timing of plan submittals and attainment dates. Upon designation, states have three years to prepare plans to address $PM_{2.5}$ and five years to attain the standard. Therefore, the attainment date was established as 2010 and the plan submittals were due in April 2008. However, EPA did not publish the implementation rule for the 1997 $PM_{2.5}$ NAAQS until April 2007. This caused significant delays in the regulatory process for all states. Further, the rule did not establish an emission threshold for control of large stationary sources as was done for ozone planning. This caused a great deal of

confusion within the regulated community about applicability of these specific control requirements. The CAA allows states the option of requesting an attainment date extension of no more than five years (e.g. 2015) with the 1997 $PM_{2.5}$ NAAQS.

This document has been prepared to satisfy the requirement for submittal of a plan to detail how the St. Louis nonattainment area will be brought into compliance with the annual NAAQS.

In addition to this document, the Department's Air Program developed a technical support document (TSD) which contains additional information supporting the plan and its findings (Appendix A). Specifically, the TSD provides technical detail regarding the attainment demonstration analyses along with the RACT findings for the St. Louis area.

2.0 OVERVIEW OF 1997 $PM_{2.5}$ FEDERAL REQUIREMENTS AND CLEAN AIR FINE PARTICLE IMPLEMENTATION RULE

2.1 Introduction

The CAA requires that states submit a plan to the EPA consistent with the requirements of sections 110 (a)(1) and (2) of the Act. All submissions must address basic plan requirements related to the attainment of a new or revised NAAQS including emission inventories, monitoring and modeling attainment, and maintenance and enforcement of the standards. Plans meeting the requirements of the CAA sections 110(a)(1) and (2) must be submitted within three (3) years after promulgation of a new or revised standard. Section 110(a)(1) contains the general requirements for submitting a plan to address new or revised primary NAAQS within three (3) years of their promulgation. Section 110(a)(2) contains specific elements to be included in these plans.

2.2 Clean Air Fine Particle Implementation Rule

On April 25, 2007, the EPA published the Clean Air Fine Particle Implementation Rule which prescribes the requirements that must be met with the $PM_{2.5}$ plan. In the rule EPA provides rules and guidance on the CAA requirements for state plans to implement the 1997 $PM_{2.5}$ NAAQS. Each $PM_{2.5}$ plan must identify and evaluate sources of both $PM_{2.5}$ direct emissions and precursors.

2.3 Precursors and Pollutants

In the fine particle rule, EPA has not made a finding that all precursors should be evaluated for possible controls in each specific nonattainment area. Instead it requires SO_2 to be evaluated for control measures in all areas, and describes general presumptive policies for NO_x, ammonia, and VOC for all nonattainment areas. The rule provides a mechanism by which the state and/or EPA can make an area-specific demonstration to reverse the general presumption for these three precursors.

<u>SO_2</u>
States are required to address sulfur dioxide as a $PM_{2.5}$ attainment plan precursor and evaluate SO_2 for possible control measures in all areas. Sulfate is an important precursor to $PM_{2.5}$ formation in all areas and has a strong regional impact on $PM_{2.5}$ concentrations.

<u>NOx</u>
Under this rule, states are required to address NOx as a $PM_{2.5}$ attainment plan precursor and evaluate reasonable controls for NOx in $PM_{2.5}$ attainment plans, unless the state and EPA make a finding that NOx emissions from sources in the state do not significantly contribute to $PM_{2.5}$ concentrations in the relevant nonattainment area. No such finding was made for the St. Louis area.

Ammonia

Ammonia is also presumed not to be a $PM_{2.5}$ attainment plan precursor, meaning that the state is not required to address ammonia in its attainment plan or evaluate sources of ammonia emissions for reduction measures.

Volatile Organic Compounds (VOCs)

States are not required to address VOC in $PM_{2.5}$ implementation plans and evaluate control measures for such pollutants unless the state or EPA makes a technical demonstration that emissions of VOCs from sources in the state significantly contribute to $PM_{2.5}$ concentrations in a given nonattainment area. No such finding was made for the St. Louis area.

Direct PM

The rule requires that states address the direct emissions of particulate matter in their $PM_{2.5}$ attainment plans.

2.4 Reasonably Available Control Technology and Reasonably Available Control Measures (RACT/RACM)

Section 172(c)(1) requires that each attainment plan "provide for the implementation of all reasonably available control measures as expeditiously as practicable (including such reductions in emissions from existing sources in the area as may be obtained through the adoption, at a minimum, of reasonably available control technology), and shall provide for attainment of the national primary ambient air quality standards."

The state must conduct a thorough analysis of reasonably available measures; states need not analyze every conceivable measure, as explained in the guidance. Instead, "reason" should drive a states identification of potential measures, but states should remain mindful of the public health risks of $PM_{2.5}$.

2.5 Emission Inventory

Clean Air Act Section 172(c)(3) requires that plans for nonattainment areas "shall include a comprehensive, accurate, current inventory of actual emissions from all sources of the relevant pollutant or pollutants in such area…" This core nonattainment requirement establishes the emission inventory for the base year (e.g. 2002) that will be used to demonstrate reasonable further progress and is the basis for the attainment demonstration modeling analyses.

2.6 Reasonable Further Progress (RFP)

Clean Air Act Section 172(c)(2) requires that plans for nonattainment areas "shall require reasonable further progress," which as defined in Section 171(1) "means such annual incremental reductions in emissions of the relevant air pollutant as are required by this part or may reasonably be required by the Administrator for the purpose of ensuring attainment of the applicable national ambient air quality standard by the applicable date." This section describes the requirements that EPA is establishing for states to achieve reasonable further progress.

An area that demonstrates attainment by 2010 will be considered to have satisfied the RFP requirement and need not submit any additional material to satisfy the RFP requirement. The EPA will view the attainment demonstration as also demonstrating that the area is making reasonable further progress toward attainment.

The final rule requires a state to submit an RFP plan along with its attainment demonstration and plan for any area for which the state justifies an extension of the attainment date beyond 2010. The RFP plan must provide emission reductions such that emissions in 2009 represent generally linear progress from the 2002 baseline year to the attainment year. Where the state justifies an extension of the attainment deadline to 2014 or 2015, the state must additionally provide emission reductions such that emissions in 2012 represent generally linear progress from the 2002 baseline year to the attainment year.

2.7 Attainment Dates

Section 172(a)(2) states that an area's attainment date "shall be the date by which attainment can be achieved as expeditiously as practicable, but no later than 5 years from the date such area was designated nonattainment * * *, except that the Administrator may extend the attainment date to the extent the Administrator determines appropriate, for a period no greater than 10 years from the date of designation as nonattainment considering the severity of nonattainment and the availability and feasibility of pollution control measures."

Since $PM_{2.5}$ designations have an effective date of April 5, 2005, the initial 5-year attainment date for $PM_{2.5}$ areas would be no later than April 5, 2010. For an area with an attainment date of April 5, 2010, EPA would determine whether it had attained the standard by evaluating air quality data from the three previous calendar years (i.e. 2007, 2008, and 2009).

For any areas that are granted the full 5 year attainment date extension under section 172, the attainment date would be no later than April 5, 2015. For such areas, EPA would determine whether they have attained the standard by evaluating air quality data from years 2012, 2013, and 2014. Section 51.1004 of the proposed regulations addressed the attainment date requirement. Section 51.1004(b) provided that in their attainment demonstrations, states would propose an attainment date representing attainment as expeditiously as practicable based upon implementation of existing Federal and State

measures, and all new reasonable local and intrastate measures. The EPA would approve a particular attainment date based on its review of the attainment demonstration. Missouri and Illinois have requested an attainment date extension until 2012 for the St. Louis $PM_{2.5}$ nonattainment area.

2.8 Modeling and Attainment Demonstration

Section 172(c) requires states with nonattainment areas to submit an attainment demonstration. An attainment demonstration consists of: (1) Technical analyses that locate, identify, and quantify sources of emissions that are contributing to violations of the $PM_{2.5}$ NAAQS; (2) analyses of future year emissions reductions and air quality improvement resulting from already-adopted national and local programs, and from potential new local measures to meet the RACT, RACM, and RFP requirements in the area; (3) adopted emission reduction measures with schedules for implementation; and (4) contingency measures required under section 172(c)(9) of the CAA.

2.9 Transportation Conformity and General Conformity

The Clean Air Act (Section 176) requires that federal actions conform to a state's plan. To implement this requirement the Clean Air Act directed the EPA to issue rules that governed how conformity determinations would be conducted for two categories of actions/activities; a) those dealing with transportation plans, programs, and projects (Transportation Conformity), and b) all other actions, e.g., projects requiring federal permits. This latter category is referred to as General Conformity. *De minimis* levels for $PM_{2.5}$ were published in 2006 (EPA, 2006). Projects whose direct and indirect emissions exceed the *de minimis* levels are required to offset their emissions. The Federal Transportation Conformity Rule (40 C.F.R. Sect. 93.100-160) provides the process by which the air quality impact of transportation plans, transportation improvement programs, and projects are analyzed.

2.10 Contingency Measures

Under subpart 1 of the CAA, all $PM_{2.5}$ nonattainment areas must include in their plan contingency measures consistent with section 172(c)(9). Contingency measures are additional control measures to be implemented in the event that an area fails to meet RFP or fails to attain the standards by its attainment date. These contingency measures must be fully adopted rules or control measures that are ready to be implemented quickly upon failure to meet RFP or failure of the area to meet the standard by its attainment date. The plan should contain trigger mechanisms for the contingency measures, specify a schedule for implementation, and indicate that the measures will be implemented without significant further action by the State or by EPA. The contingency measures should consist of other control measures for the area that are not included in the control strategy for the plan.

3.0 EMISSION INVENTORY – BASE YEAR, RFP (2009), AND ATTAINMENT YEAR (2012)

The base year (2002) emission inventory for the St. Louis area includes annual emissions of direct PM (PM_{10} and $PM_{2.5}$), ammonia (NH_3), oxides of nitrogen (NO_x), volatile organic compounds (VOC), sulfur dioxide (SO_2), and carbon monoxide (CO). These annual emissions were categorized into the following source groups: point [electric generating units (EGU) and non-EGU], area, on-road mobile, off-road mobile, and biogenic. The initial inventory utilized for the development of this inventory was the 2007 8-hour ozone planning base-year inventory. This inventory was chosen to maximize consistency between the plans for ozone and fine particles and because of the substantial amount of quality assurance performed on the ozone plan submittal.

The process of producing a model-ready inventory is iterative, with data corrections or improvements invariably leading to a succession of more refined modeling inventories. As noted previously, all emission inventories corrections and improvements from St. Louis 8-Hour Ozone modeling were implemented in the $PM_{2.5}$ modeling. The St. Louis modeling commenced with Base 1 and concluded with Base 5. The latter reflects processing of Midwest Regional Planning Organization (RPO) inventory updates through the Base K inventory, Central Regional Air Planning Association (CENRAP) inventory updates through the Base G, Visibility Improvement States and Tribes (VISTAS) Base G emissions for the VISTAS states, and emission updates for the St. Louis Nonattainment Area (NAA) and the remainder of Missouri and Illinois from the Missouri Department of Natural Resources and IEPA.

This inventory was used as the basis for the future year (2009 and 2012) inventory projections, the RFP goal calculation, and the attainment demonstration.

The attached TSD (Appendix A) includes detailed documentation of the development of the base year inventory. A brief summary of how the emissions were estimated for each type of emission source is presented here:

- Point sources, EGU and non-EGU, are large, stationary, identifiable sources of emissions. The Department's Air Program defines point sources as sources with a Basic, Intermediate, or Part 70 operating permit that must report their actual emissions to the Department's Air Program on an annual basis. The 2002 point source inventory for Missouri is based on information reported by facilities on Emission Inventory Questionnaires (EIQs). The 2002 emissions reported by facilities reflect any controls in place in the St. Louis area, including previously identified RACT requirements from ozone planning activities in St. Louis.

- Area sources are stationary sources that do not qualify as point sources under the relevant emissions cutoffs. Area sources encompass more widespread sources that may be abundant but individually release small amounts of a given pollutant. Examples of area sources include auto-body painting, fires, and consumer solvent use. Area source emissions are estimated based on a variety of methods, typically

- Offroad mobile sources are mobile and portable internal-combustion powered equipment not generally licensed or certified for highway use. Offroad engines are classified according to distinct nonroad equipment categories, ranging from small lawn and garden equipment to heavy-duty construction equipment, large aircraft, and diesel locomotives. The majority of the offroad mobile emissions are calculated using the EPA's NONROAD model, which includes equipment populations and accounts for the impacts of any federal emission standards impacting offroad engines.

- Onroad mobile sources include motor vehicles such as cars, vans, trucks, buses, and motorcycles that are used for transportation of passengers and goods on public roads and streets. Onroad mobile emissions were calculated by multiplying emission rates generated using the EPA's MOBILE6.2 model by vehicle miles traveled. The MOBILE6 emission rates reflect local programs that were in place during 2002, including reformulated gasoline, the basic Inspection and Maintenance (I/M) program in Franklin County, and the enhanced I/M program in Jefferson, St. Charles, and St. Louis Counties and the City of St. Louis. The emission rates also account for the impacts of any federal emission standards.

- Biogenic sources are natural sources (plants, animals, marshes, and earth itself) which emit significant quantities of pollutants. Vegetation, for example, emits large amounts of isoprene, terpenes, and other organic compounds, which are precursors of $PM_{2.5}$ and ozone.

Table 3-1 displays the annual NO_x, VOC, NH_3, SO_2, PM_{10}, $PM_{2.5}$ and CO emissions for counties within the St. Louis NAA by major source category (area, non-road mobile, on-road mobile, EGU point and non-EGU point) for the baseline year 2002.

Table 3-1. 2002 Annual Emission Summaries for the St. Louis Nonattainment Counties in tons per year.

County	Area						
	NO_x	VOC	NH_3	SO_2	PM_{10}	$PM_{2.5}$	CO
Missouri							
Franklin	706	2004	1923	1045	11335	2422	4820
Jefferson	660	3703	225	793	13297	3010	7698
St. Charles	1225	3664	793	2071	13602	2744	3060
St. Louis	5321	13781	2238	10638	10204	2771	4123
St. Louis City	2102	5061	27	4129	2270	714	1276
Illinois							
Madison	1020	6059	1077	109	1461	674	3120
Monroe	86	1713	850	12	532	258	1074
Randolph*	0	0	0	0	0	0	0
St. Clair	711	4634	810	75	1431	537	1648

County	Non-EGU Point							EGU Point						
	NO_x	VOC	NH_3	SO_2	PM_{10}	$PM_{2.5}$	CO	NO_x	VOC	NH_3	SO_2	PM_{10}	$PM_{2.5}$	CO
Missouri														
Franklin	32	562	32	3	82	35	18	7820	252	0	47608	996	679	2102
Jefferson	5206	529	109	42647	1113	189	939	3997	135	2	23256	513	350	1126
St. Charles	465	1273	15	687	219	99	241	14122	180	1	45955	156	143	841
St. Louis	928	4067	588	228	572	223	1936	9489	85	2	16453	318	161	716
St. Louis City	1995	3808	8	6697	935	539	1290	0	0	0	0	0	0	0
Illinois														
Madison	8123	2685	23	19075	2161	1644	17683	2492	44	4	7266	145	63	353
Monroe	1	23	0	0	72	1	39	2	0	0	0	0	0	0
Randolph*	29	1	0	28	14	0	1	22367	337	2	26267	2139	1038	1837
St. Clair	366	1036	14	1541	428	25	1179	6	0	0	0	0	0	1

County	Offroad Mobile							Onroad Mobile						
	NO_x	VOC	NH_3	SO_2	PM_{10}	$PM_{2.5}$	CO	NO_x	VOC	NH_3	SO_2	PM_{10}	$PM_{2.5}$	CO
Missouri														
Franklin	1584	791	1	138	102	93	6234	5103	2063	138	98	37	73	34934
Jefferson	1781	1170	1	180	110	101	12935	6203	2603	178	127	48	94	42061
St. Charles	2140	2242	2	213	212	195	22910	8325	3595	242	173	65	128	56552
St. Louis	9643	8123	6	880	698	637	121830	35406	15340	1032	739	276	545	241957
St. Louis City	4181	1555	2	358	157	144	24458	9475	4509	295	212	79	156	67488
Illinois														
Madison	5560	1554	4	446	264	241	19251	8139	4162	310	309	53	118	64148
Monroe	1978	217	1	163	84	77	2019	1352	724	54	54	9	21	10986
Randolph*	0	0	0	0	0	0	0	0	0	0	0	0	0	0
St. Clair	3827	1211	3	290	204	186	15874	8202	4311	318	317	54	121	65007

*Partial emissions from Randolph County

These tables illustrate a large amount of NOx and SO_2 being emitted from the point and mobile source groups.

Future year emissions for 2009 and 2012 were projected from 2002 using growth and control factors (Table 3-2). The control requirements and other significant difference included in the development of these factors for both 2009 and 2012 are as follows:

2009

- CAIR (NOx control only);
- NOx SIP Call;
- MACT Standards;
- Tier 2 Rule – Light-Duty Vehicle Standards and Low-Sulfur Gasoline;
- Heavy-Duty Diesel Engine Standards and Low-Sulfur Diesel;
- Tier 4 Rule – Off-Road Mobile Engine Standards; and
- Basic Inspection and Maintenance Vehicle Emission Controls.

2012

- CAIR (including Phase I SO_2 control);
- NOx SIP Call;
- MACT Standards;
- Tier 2 Rule – Light-Duty Vehicle Standards and Low-Sulfur Gasoline;
- Heavy-Duty Diesel Engine Standards and Low-Sulfur Diesel;
- Tier 4 Rule – Off-Road Mobile Engine Standards;
- Illinois' Multi-pollutant Standard Rule (pre-2012 requirements for sources outside the NAA);
- Missouri Basic Inspection and Maintenance Vehicle Emission Controls with 90% Program Control Efficiency;
- Illinois Basic Inspection and Maintenance Program;
- One new ethanol plant in the NAA permitted by IEPA;
- New Missouri SO_2 and NO_x RACT requirements; and
- Illinois RACT requirements.

Generally, emissions from non-road and on-road mobile, non-EGU point and EGU point source categories are decreasing from the current- to future-years, whereas emissions from the area source category are going up slightly from the current- to future-years. The exceptions to this are as follows:

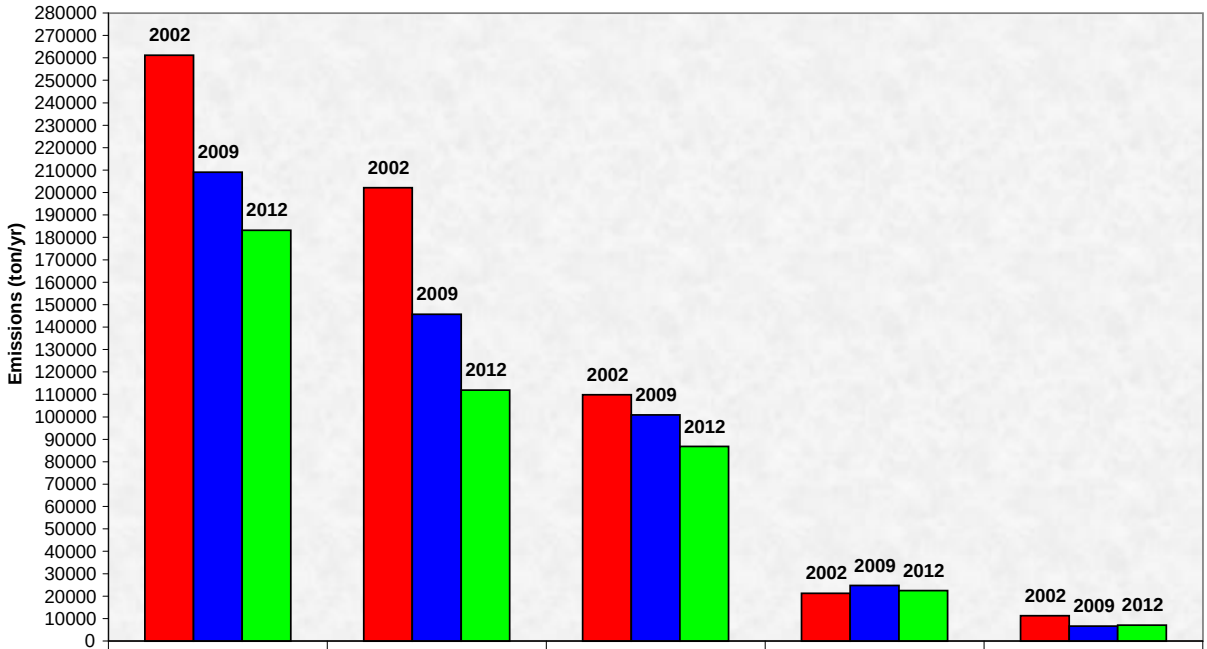
- VOC emissions from non-attainment area are projected to decrease from the current- to future-years.
- Ammonia emissions from area sources are projected to decrease, whereas ammonia emissions from on-road mobile, non-EGU point and EGU points are projected to increase from the current- to future-years. The on-road mobile source ammonia increase is related to higher vehicle miles traveled (VMT) due to on-road vehicles equipped with catalysts exhaust controls that emit ammonia. The increase in the point source ammonia emissions is related to more wide-

- Increases in EGU point source PM_{10} and CO emissions between current- and future-years and slight increase in off-road mobile PM_{10} and CO emissions between 2002 to 2009 and then reductions to 2012.

Table 3-2. Annual Emissions Summaries for the St. Louis Nonattainment Area in tons per year.

	Area			Offroad mobile			Onroad mobile			Non-EGU point			EGU point		
Year	2002	2009	2012	2002	2009	2012	2002	2009	2012	2002	2009	2012	2002	2009	2012
NO_x	11831	12521	12797	30694	29486	23562	82204	52631	35325	17145	14852	8877	60295	36227	31342
VOC	40618	41722	43420	16863	16001	10820	37307	24313	17993	13982	17605	13443	1033	1188	1171
NH_3	7943	2410	2607	20	40	8	2566	2799	3024	788	954	1024	10	489	481
SO_2	18872	19354	19419	2669	723	411	2029	345	290	70906	34004	35317	166805	154638	127778
PM_{10}	54131	54474	54673	1832	1985	1405	620	345	214	5596	5589	4834	4267	8478	4621
$PM_{2.5}$	13130	13318	13444	1674	1816	1312	1257	862	682	2754	1338	3491	2434	7391	3545
CO	26819	26960	27731	225510	337880	253361	583133	385106	320605	23325	8912	21637	6976	8136	8006

Overall, it is expected that all pollutants will decrease from 2002 to 2012 except $PM_{2.5}$ as shown in the Table and Figure 3-1.



	SO2	NOx	VOC	PM2.5	NH3
2002	261281	202168	109802	21249	11327
2009	209064	145717	100829	24725	6691
2012	183215	111903	86847	22474	7144

Figure 3-1. St. Louis Non-Attainment Area Emissions Trends Total of all Source Categories

In order to calculate RFP requirements for $PM_{2.5}$ nonattainment areas requesting an attainment data extension, EPA guidance provides two distinct options. The first is the linear option which assesses progress for each precursor against the required rate of progress without considering how much each precursor contributes to ambient $PM_{2.5}$ concentrations. The second is the equivalency option which uses information gained from the attainment demonstration modeling to consider how much reductions of each pollutant contribute to attainment. The Department's Air Program has selected the first option to demonstrate "general linear progress" toward the attainment date.

3.1 Linear RFP

As part of the St. Louis nonattainment area plan, the states of Missouri and Illinois have requested an extension until 2012 to attain the NAAQS. Therefore, in order to demonstrate RFP using the first option, emissions would be sufficiently reduced by 2009 to achieve a generally linear incremental improvement in air quality. The base year inventory (2002) and the attainment demonstration inventory (2012) are used to establish the trend line for the 2009 RFP target. To meet the linear RFP test, the area should

achieve emission reductions by 2009 representing roughly 7/10th of the emission reductions needed to attain the standards. Table 3-3 and Figure 3-2 illustrate the RFP calculations for 2009 for the Missouri portion of the nonattainment area. The pollutants that were required to be included in the control scenarios for the St. Louis area (SO_2, NO_x, and direct $PM_{2.5}$) were considered as part of the RFP demonstration. As can be seen in Table 3-3 and Figure 3-2, the total emission reductions in 2009 demonstrate generally linear progress to attainment. Per EPA request, Table 3-4 has been included to illustrate the same information for the entire St. Louis area emissions (Missouri and Illinois).

Table 3-3. RFP calculations for 2009 (Missouri)

Pollutant	**NOx**	**SO_2**	**$PM_{2.5}$**	**Total**
2002 Emissions (tons/day)	377.8	562.5	44.5	984.9
2009 Emissions (tons/day)	305.3	462.0	54.4	821.7
2012 Emissions (tons/day)	226.6	439.2	44.6	710.4
2012 Attainment Emissions (tons/day)	226.6	439.2	44.6	710.4
2012 Attainment Reductions (tons/day)	151.3	123.4	-0.1	274.5
2009 Required % Reductions (7/10)	70%	70%	70%	70%
2009 Required Reductions (tons/day)	105.9	86.4	-0.1	192.2
2009 Emissions Goals (tons/day)	271.9	476.2	44.6	792.7
2009 Actual Reductions (tons/day)	72.5	100.6	-9.9	163.2
2009 Actual % Reductions	48%	82%		59%

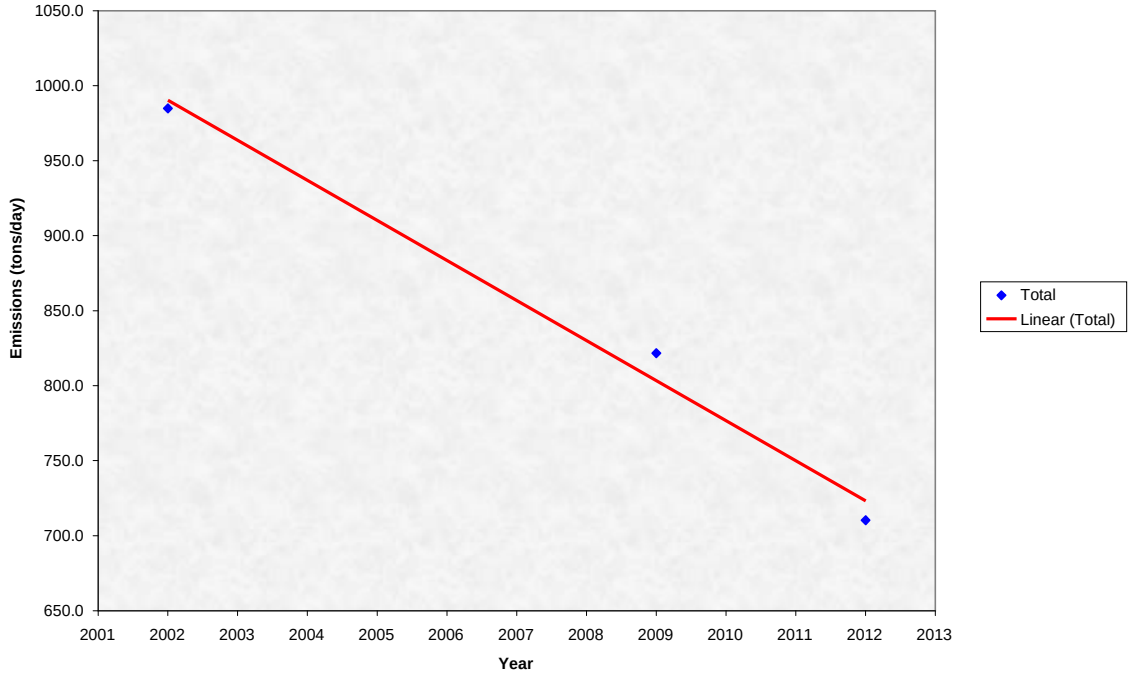


Figure 3-2: $PM_{2.5}$ 2009 Reasonable Further Progress

Table 3-4. RFP calculations for 2009 (Missouri + Illinois)

Pollutant	**NOx**	**SO_2**	**$PM_{2.5}$**	**Total**
2002 Emissions (tons/day)	553.9	715.8	58.2	1327.9
2009 Emissions (tons/day)	399.2	572.8	67.7	1039.7
2012 Emissions (tons/day)	306.6	502.0	61.6	870.1
2012 Attainment Emissions (tons/day)	306.6	502.0	60.8	869.4
2012 Attainment Reductions (tons/day)	247.3	213.9	-2.6	458.6
2009 Required % Reductions (7/10)	70%	70%	70%	70%
2009 Required Reductions (tons/day)	173.1	149.7	-1.8	321.0
2009 Emissions Goals (tons/day)	380.8	566.1	60.0	1006.9
2009 Actual Reductions (tons/day)	154.7	143.1	-9.5	288.2
2009 Actual % Reductions	63%	67%		63%

4.0 RACT, RACM, AND OTHER CONTROL MEASURES

4.1 Missouri RACT findings

The following provides a summary of the St. Louis Annual $PM_{2.5}$ RACT determinations and an outline of the proposed approach for regulatory actions. A more detailed description of the RACT process can be found in Appendix B. These determinations were based on a technical review of materials provided by facilities that met certain emission criteria and were asked to participate in the RACT stakeholder process. The facilities in the RACT process represented the largest, base-year emitters of NOx and SO_2 located in the nonattainment area, with the exception of the electric generating units that must comply with the Clean Air Interstate Rule (CAIR). These EGU facilities were determined by Missouri to have met the RACT requirements by complying with this federal rule. A description of the identification of the RACT process facilities and the stakeholder process is detailed in the following technical determination.

In general, the Department's Air Program sent a letter to the facilities identified and EPA Region VII inviting them to attend an informational meeting on August 23, 2007. This kick-off meeting was well attended and the Department's Air Program provided background information to the group including a discussion of the RACT evaluation process. Subsequently, the Department's Air Program provided a questionnaire designed to better understand the emission processes at each facility along with an opportunity to provide control and cost feasibility for each potential control technology. A second meeting was held to answer questions about the questionnaire in on November 16, 2007. After submittals of the responses and review by staff, the Department's Air Program scheduled meetings with each facility to discuss their responses and provide preliminary RACT findings. These discussions led to the following conclusions regarding RACT.

With respect to oxides of nitrogen (NOx), a review of the materials provided by the facilities clearly indicates that the construction of control equipment is not reasonable because of the expense. The annualized cost estimates ranged from approximately $4,200 per ton for a Selective Catalytic Reduction process installed on the exhaust of the natural gas-fired internal combustion engines at the Laclede Gas Building to $33,000 per ton for a similar technology applied to the landfill gas-fired boilers at Chrysler. The RACT findings for NOx are identical to the previous 8-hour ozone RACT findings for sources that were evaluated for both ozone and PM. Some additional sources were included in the PM RACT evaluations because the size threshold chosen by the Department's Air Program was lower than for the ozone RACT determinations.

Several facilities, however, did indicate that they had reduced NOx and/or SO_2 emissions or were planning changes at their facilities that would result in emission reductions. Coal-fired boilers at Washington University and Boeing have been replaced with boilers that are natural gas-fired. New nonattainment area construction permits would be required to switch back to coal-fired boilers for these facilities.

The St. Louis Metropolitan Sewer District's Coldwater Creek wastewater Treatment Plant proposed to remove several internal combustion engines and replace them with electric engines. However, due to economics, the facility could not conduct the replacement and provided additional cost information that led to the Department's Air Program finding that no additional control would be necessary. MEMC has plans to continue to operate their scrubbers for the control of NOx from their acid bath process. A permanent and enforceable consent agreement with this company was signed on July 2, 2009, to mandate the continued use of this scrubbing system (Appendix C). This scrubbing system at MEMC was the only source to require a "new" enforceable mechanism for NOx RACT.

The sulfur dioxide non-utility sources were divided into three (3) groups. The first group are those that have clearly demonstrated that SO_2 controls are not feasible because of cost. The second group is the Doe Run Herculaneum facility, and the third group is the industrial boilers. For SO_2 sources, there were no previous RACT evaluations in the St. Louis area and these determinations reflect considerable additional emission control for the area.

The first group includes St. Gobain Containers, River Cement and the St. Louis Metropolitan Sewer District. These sources have provided annualized cost estimates for control technology that range from approximately $10,000 to $23,000 per ton, demonstrating that additional or new SO_2 controls for these facilities are not cost effective.

The second group includes the single largest non-utility source of SO_2 in the St. Louis nonattainment area. 10 CSR 10-6.260, Restriction of Emission of Sulfur Compounds, currently limits SO_2 emissions from the Doe Run Herculaneum facility to 20,000 pounds per hour. This facility operates an acid plant that converts strong acid gases from the front end of their sintering process into sulfuric acid, but the overall efficiency is relatively poor. Even with the acid plant in operation, base year emissions utilized in the attainment demonstration were 44,300 tons per year for Doe Run sources. Because Doe Run's emissions are quite high, it is evident that the installation and operation of an SO_2 scrubbing system would be cost effective on a per ton basis. Although the cost per ton would be reasonable, the overall capital costs of a scrubbing system for the gas streams at this facility would be considerable. In an effort to significantly reduce emissions from the plant and allow for continued operation of the facility, 10 CSR 10-6.260 was amended to establish a tiered approach which required an emission limit of twenty-five thousand one hundred (25,100) tons SO_2 per year in the attainment year of 2012 as RACT. Then, the emission limit will be reduced to sixteen thousand three-hundred-fifty (16,350) tons SO_2 per year in 2014, and zero (0) tons SO_2 per year in 2017. Doe Run is considering a pilot plant to manufacture lead using a proprietary leaching and electrowinning process to replace the primary lead smelting operation at Herculaneum. This new process would completely eliminate SO_2 emissions.

Industrial boilers are the third group. After a review of the literature, regulations in neighboring states, and particularly a review of the materials provided by the

stakeholders, a new regulation that limits the large industrial boilers to 1.0 pounds of SO_2 per million British Thermal Units (MMBTU) on a thirty-day (30) rolling average was adopted. This new regulation 10 CSR 10-5.570, Control of Sulfur Emissions From Stationary Boilers, was designed to limit emissions from all non-utility boilers greater than 50 MMBTU/hr that burn non-gaseous fuels. There were five total facilities that have boilers subject to this regulation: Chrysler, General Motors, Trigen, Mallinckrodt, and Anheuser Busch. Three of the five facilities can meet the new limit based on current operation and fuel mix (Chrysler, GM, and Trigen). One of the other facilities will also be able to meet the new limit using the averaging provisions of the regulation without installation of add-on control equipment for SO_2 (Mallinckrodt).

The other facility was segregated from this provision of the regulation due to its emission size when compared to the other facilities in the group. Anheuser Busch emitted over six thousand tons of SO_2 in 2002 due to the use of Midwestern medium to high-sulfur coal (2%-3.5% sulfur) at several non-utility boilers. This fuel sulfur content, even with lower sulfur content fuels used by Anheuser Busch, translates to an overall average of 3.5 lb SO_2/MMBTU for the whole facility. Anheuser Busch's suggested RACT approach was a proposed 40% reduction in emissions, relying on fuel switching at a cost of nearly $2,000 per ton reduced. Anheuser Busch also pointed out some technical feasibility issues with the installation of wet scrubbing equipment including space constraints at the brewery power house, structural/safety concerns, and vendors for this type of technology would not quote for the existing boiler configuration at Anheuser Busch. Further, the company provided a cost estimate for the installation of dry scrubbers (~90% control) on all four coal-fired boilers of $3,000 per ton reduced. However, the initial capital cost for the installation of the dry scrubbing equipment would be nearly $80 million. Anheuser Busch argued that, along with the existing space constraints at the power house, the overall cost of the dry scrubbing technology would preclude the installation of this technology. This would result in a sizable reduction of SO_2 from this facility, at an annualized cost of approximately $20 million. Based on current fuel costs, the 40% percent proposal from Anheuser Busch cost nearly $6 million per year in additional expenditure. The Department's Air Program evaluated this proposal and asked that Anheuser Busch provide additional information regarding the methodology used to derive the fuel costs. This additional data allowed the Department's Air Program to optimize the fuel mix vs. cost using additional types of coal available for use as fuel. This optimization led to a proposed regulation that limited SO_2 emissions to 370 lb/1000 barrels produced. As part of the regulatory process, this limit was later changed to a cap of 3,050 tons per year. Also, based on current production projections, the facility was projected to emit over 7,200 tons per year SO_2 in 2012. This nearly 60 percent reduction in SO_2 emissions with a cost of slightly over $6 million in increased fuel expenditure (~$1,400/ton) was determined to be RACT.

The Department's Air Program did not find any sources that required additional control of direct $PM_{2.5}$ emissions based on downwind impact at the Granite City monitor. The geographic extent of impacts from $PM_{2.5}$ or PM_{10} direct emissions are not nearly as pervasive as the secondary pollutants (e.g. NOx and SO_2). Nonetheless, as part of the RACT determination process, the Department's Air Program identified direct PM sources

(both $PM_{2.5}$ and PM_{10}) in the St. Louis nonattainment area above 25 tons of actual PM_{10} emissions and/or above 10 tons of actual $PM_{2.5}$ emissions in 2002. These sources were evaluated for existing control of direct PM. Based on other state evaluations of direct PM control, the Department's Air Program investigated existing emissions and controls on any sources within 10 miles of the violating monitor as part of the RACT process. To be clear, there are several other large sources within the nonattainment area at great distance from the violating monitor (>30 miles). These sources are too distant to provide any significant impact on the Granite City monitor. There are several sources within the 10 mile radius that are already controlled well (Anheuser Busch – existing ESP control on their coal-fired boilers; Procter & Gamble, Federal Mogul Friction Products, and Mallinckrodt – baghouses on all substantive fugitive or process-related emissions; Beelman River Terminals and American Commercial Terminals – water sprays and sweepers for fugitive dust control on road and storage piles; St. Louis MSD – Bissel Plant – combined scrubber for 6 sludge incinerators). The control efficiencies for all these sources are well above 50 percent and, in the case of Anheuser Busch, the control efficiency is 95 percent. Also, Washington University Medical School has permanently removed the coal-fired boilers contributing significantly to the emission total (discussed later under NOx/SO_2 RACT). The only other remaining source within the 10 mile radius is PQ Corporation. Some of the PM emissions from this source are controlled using baghouses, but the largest source (sodium silicate furnace) is uncontrolled at around 50 tons per year. In comparison to the large direct PM emitters near the Granite City monitor, this source is a tiny fraction of those emissions. The direct PM emissions from the large sources near the Granite City monitor are over 1,500 tons per year.

Therefore, the Department's Air Program determined that additional control of direct PM sources in Missouri beyond the current control in place is not necessary due to the limited impact of these sources on the violating monitor at Granite City, Illinois.

Further, many of the largest point sources of direct PM emissions are already controlled with precipitators or baghouses designed to minimize opacity or PM emissions for other purposes.

4.2 Reasonably Available Control Measures

Based on the long history of ozone control in the St. Louis area for NOx including previous RACT/RACM demonstrations and implementation of certain Clean Air Act Section 108(f) motor vehicle control measures, the current RACT evaluation for NOx emitters, the extremely short time frame to proceed with additional rulemaking for RACM, and the limited impact of Missouri nonattainment NOx emissions on the violating monitor; the Department's Air Program has determined that there are no additional reasonable measures for NOx that would advance the attainment date in St. Louis.

The significant amount of RACT control determined to be necessary under the current planning exercise for SO_2, along with federal motor vehicle controls for SO_2 and the fact

that SO_2 emissions are predominantly point sources allowed the Department's Air Program to determine that there are no additional local measures that would reasonably advance the attainment date requested by one year for SO_2.

As detailed in the RACT Technical Support Document, the Department's Air Program evaluated additional control for "large" direct PM emitters in the St. Louis area. This evaluation indicated a significant amount of control is already in place. This finding along with the existing fugitive dust regulations, recently revised open burning regulations, and heavy-duty diesel idling regulation outlined in the contingency measures section allowed the Department's Air Program to conclude that no additional PM controls are necessary to advance the attainment date of the area. Further, the nature of the "large" direct PM sources in the inventory and the location of those sources with respect to the violating monitor provides further credibility to the conclusion that these emissions do not impact the monitor significantly. Therefore, additional controls on Missouri PM sources would not advance the attainment date of the area.

Overall, these findings were utilized to determine additional measures for any of the regulated pollutants would not advance the attainment date. Therefore, the state of Missouri has satisfied the RACM requirement for the St. Louis $PM_{2.5}$ nonattainment area.

4.3 Other Controls

EPA has worked to develop national and regional rules to reduce emissions. The Clean Air Interstate Rule to reduce sulfur dioxide and nitrogen oxide emissions from power plants and regulations to address emission from new cars, trucks and buses are a few examples. States are responsible for evaluating local sources and implementing regulations to complement the regional and national strategies in a cost effective manner.

The Missouri $PM_{2.5}$ plan relies upon a number of federal and state/local control measures to reduce fine particle emissions. The following is a summary of the control measures that the state used in the attainment demonstration.

4.4 Federal Control Measures

<u>Clean Air Interstate Rule (CAIR)</u>

On March 10, 2005, the EPA issued the Clean Air Interstate Rule to reduce the emissions of NO_X and SO_2 in the eastern U.S. Once fully implemented, CAIR will reduce SO_2 emissions in 23 eastern states by over 70 percent and NO_X emissions by over 60 percent from 2003 levels. This will be the largest reductions of these pollutants since the implementation of the Acid Rain program in the early 1990s. In order to comply with these regulations, utility companies will need to meet lower emission levels. The utilities can do this in a number of ways, such as: installation of control equipment for NO_X and SO_2 on affected electric generating units, transferring credits between electric generating

units, retiring units from service or purchasing additional emission allocations from the market. This plan only utilizes Phase I NO_X and SO_2 reductions from CAIR for control in 2012 to assist in attaining the annual PM NAAQS.

Heavy-Duty Diesel Engine Standards and Low-Sulfur Diesel

On January 18, 2001, the EPA established a comprehensive national control program that will regulate the heavy-duty vehicle and its fuel as a single system. As part of this program, new emission standards will begin to take effect in model year 2007, and will apply to heavy-duty highway engines and vehicles. These standards are based on the use of high-efficiency catalytic exhaust emission control devices or comparably effective advanced technologies. Because these devices are damaged by sulfur, EPA is also reducing the level of sulfur in highway diesel fuel significantly by mid-2006.

This program will reduce particulate matter and oxides of nitrogen emissions from heavy duty engines by 90 percent and 95 percent below current standard levels, respectively. In order to meet these more stringent standards for diesel engines, the program calls for a 97 percent reduction in the sulfur content of diesel fuel. As a result, diesel vehicles will standards for heavy-duty gasoline vehicles, based in part on the use of the low sulfur gasoline that will be available when the standards go into effect.

Tier 2 Rule - Vehicle Standards

Tier 2 standards are federal emission standards for passenger cars, light trucks, and larger passenger vehicles. The program is designed to focus on reducing the emissions most responsible for the ozone and PM impact from these vehicles -- NOx and non-methane organic gases, consisting primarily of hydrocarbons and contributing to ambient VOCs. The program also applies the same set of federal standards to all passenger cars, light trucks, and medium-duty passenger vehicles. The program thus ensures that essentially all vehicles designed for passenger use in the future will be very clean vehicles. The Tier 2 standards will reduce new vehicle NOx levels to an average of 0.07 grams per mile (g/mi). For new passenger cars and light duty trucks, these standards were phased in starting in 2004, and the standards were fully phased in by 2007. For heavy trucks and similar vehicles, the Tier 2 standards will be phased in beginning in 2008, with full compliance in 2009.

During the phase-in period from 2004-2007, all passenger cars and light trucks not certified to the primary Tier 2 standards had to meet an interim average standard of 0.30 g/mi NOx. During the period 2004-2008, heavy trucks and similar vehicles not certified to the final Tier 2 standards will phase in to an interim program with an average standard of 0.20 g/mi NOx, with those not covered by the phase-in meeting a per-vehicle standard (i.e., an emissions “cap”) of 0.60 g/mi NOx trucks and 0.09 for similar vehicles.

Tier 4 Rule - Off-Road Mobile Engine Standards

EPA's Clean Air Nonroad Diesel Rule (Tier 4) requires stringent pollution controls on diesel engines used in industries such as construction, agriculture and mining, and it will slash sulfur content of diesel fuel. This rule is the latest in a series of actions that are designed to reduce emissions from nearly every type of diesel vehicle and equipment. This nonroad diesel program combines cleaner engine technologies with cleaner fuel -- similar to the on-highway diesel program. The new standards will cut emissions from nonroad diesel engines by over 90 percent. Nonroad diesel equipment, as described in this rule, currently accounts for 47 percent of diesel PM and 25 percent of NOx from mobile sources nationwide.

Sulfur levels will also be reduced in nonroad diesel fuel by 99 percent from base-year levels [from approximately 3,000 parts per million (ppm) to 15 ppm in 2010]. The lower sulfur fuel will also reduce PM from engines in existing nonroad equipment. It makes it possible for engine manufacturers to use advanced clean technologies, similar to catalytic technologies used in passenger cars. The new engine standards take effect, based on engine horsepower, starting in 2008.

Reformulated Gasoline (RFG)

Federal RFG is a year-round program that reduces evaporative and exhaust emissions by improving the quality and adjusting the quantities of certain components found in conventional gasoline. RFG is an emissions-based program with performance standard requirements for reduced ozone precursors (VOCs and NO_x) and air toxics emissions. RFG achieves these emissions reductions through oxygen content requirements and limits on olefins, sulfur, distillation temperatures, aromatics and benzene.

The Clean Air Act Amendments of 1990 established emissions-based performance standards for RFG. For Phase I (1995-1999), RFG was required to achieve a minimum 15 percent reduction in VOC emissions over conventional gasoline, a minimum 15 percent reduction in air toxics emissions on a year-round basis and no increase in NO_x emissions. For Phase II (2000 and beyond), RFG must achieve a minimum of 25 percent VOC reductions, a 20 percent reduction in air toxics and a five to seven percent reduction in NO_x emissions. To be clear, the Department's Air Program did not find that the VOC reductions achieved under this rule are necessary for attainment of the standard in St. Louis, but are co-benefits with the NOx control.

4.5 State/Local Control Measures

Gateway Vehicle Inspection Program

Motor vehicles are a leading source of air pollution in the St. Louis area due to the large number of vehicles on the road and amount of miles traveled daily. The Gateway

Vehicle Inspection Program is part of Missouri's continuing effort to improve air quality in the St. Louis region. The Gateway Vehicle Inspection Program is a combined emissions testing and safety inspection program for vehicles registered in the St. Louis ozone nonattainment area. This program is a de-centralized basic Inspection and Maintenance Program that includes the counties in the St. Louis ozone and PM nonattainment areas. It should be noted that the state of Illinois also has a basic Inspection and Maintenance Program for the St. Louis area.

NOx SIP Call

The NO_x SIP call was designed to assist downwind ozone areas in attaining the one-hour and 8-hour ozone NAAQS by providing upwind NO_x emission control. The final NO_x SIP call was published in the Federal Register on October 27, 1998. The following states were included in the finding of significant contribution control region (subject to control): Alabama, Connecticut, Delaware, District of Columbia, Georgia, Illinois, Indiana, Kentucky, Massachusetts, Maryland, Michigan, Missouri, North Carolina, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Virginia, West Virginia, and Wisconsin. The NO_x SIP call prohibits specified amounts of emissions of one of the main precursors of ground-level ozone, NOx, in order to reduce ozone transport across State boundaries in the eastern half of the United States.

In the March 15, 2000 Missouri Register, the Department's Air Program published proposed rule 10 CSR 10-6.350, Emissions Limitations and Emissions Trading of Oxides of Nitrogen. This rulemaking proposed to develop a NO_x trading program based on control requirements to eliminate ozone season (May – September) transport into downwind nonattainment areas. These restrictions required a 0.18 pound of NOx emissions per million BTU heat input (lb/MMBTU) for utilities in the St. Louis ozone nonattainment area, 0.25 lb/MMBTU for utilities in the eastern one-third of Missouri, and 0.35 lb/MMBTU for the remaining utilities in the western two-thirds of the state. The rule also provided a 0.68 lb/MMBTU limit for utilities in the western portion of the state that burned tire-derived fuel. The Missouri Air Conservation Commission adopted rule 10 CSR 10-6.350 on May 25, 2000. On September 30, 2000, Rule 10 CSR 10-6.350, Emissions Limitations and Emissions Trading of Oxides of Nitrogen, became effective. This rulemaking required control to be implemented by May 1, 2003. Missouri submitted the state NO_x rule in lieu of a SIP for the eastern 1/3 of Missouri, with a compliance date of May 1, 2005.

After this submittal, EPA required Missouri to submit another rule so that utilities in the eastern third of the state to meet the ozone season budget requirements of the federal NOx SIP call (0.15 lb/MMBTU). These utility NOx control requirements and requirements for large non-utility boilers were codified in 10 CSR 10-6.360, Control of NOx Emissions from Electric Generating Units and Non-Electric Generating Boilers. Also, 10 CSR 10-6.380, Control of NOx Emissions from Portland Cement Kilns, and 10 CSR 10-6.390, Control of NOx Emission from Large Stationary Internal Combustion Engines, were implemented to limit ozone season NOx emissions from these two source

categories This set of three rules constitutes Missouri's response to EPA's NOx SIP Call.

Illinois NOx RACT rules

The IEPA is in the process of concluding NOx RACT rulemakings as part of the St. Louis 8-hour ozone State Implementation Plan. The anticipated reductions from these rules were included in the $PM_{2.5}$ attainment demonstration modeling analyses. The emission control factors for these regulations were applied in the 2012 attainment demonstration for all affected sources. The details regarding the RACT findings will be documented in the IEPA plan submittal related to the ozone NAAQS.

4.6 Federal Consent Agreements

Consent Decree---Dynegy Midwest Generation (*USA v. IL Power Co., et. al. 3:99-cv-833 Consent Decree, March 2005, U.S. District Court for the Southern District of Illinois*)
As of the date of lodging of the Illinois Power Company/Dynegy Midwest Generation, Inc. Consent Decree (March 7, 2005), selective catalytic reduction (SCR) systems for NOx control had been installed on Units 1 and 2 at the Baldwin Power Plant and Unit 6 at the Havana Power Plant within the Dynegy Midwest Generation system. The settlement reached with Dynegy Midwest Generation for alleged violations at the Baldwin Generating Station included the requirement that "Beginning 45 days after entry of this Consent Decree" (the Consent Decree was entered by the Court on May 27, 2005), "and continuing thereafter, DMG shall commence operation of the SCRs installed at Baldwin Unit 1, Unit 2, and Havana Unit 6 so as to achieve and maintain a 30-Day Rolling Average Emission Rate from each such Unit of not greater than 0.100 lb/MMBTU NOx" and "maintain a 30-day rolling average emission rate of not greater than 0.120 lb/MMBTU NOx at Baldwin Unit 3". A maximum average limit of 0.1 lb NOx/MMBTU for the Baldwin boilers had to be met within 30 days of entry of the Consent Decree. The Consent Decree actually imposes a near-immediate operational timeframe in specifying that "Beginning 30 days after entry of this Consent Decree, and continuing thereafter, DMG shall operate each SCR in the DMG system at all times when the Unit it serves is in operation . . ." Additionally, "Beginning 45 days from entry of this Consent Decree, DMG shall operate low NOx burners ("LNB") and/or Overfire Air Technology ("OFA") on the DMG System Units" including Baldwin Units 1-3, Havana Unit 6, Hennepin Units 1 and 2, Vermilion Unit 2, and Wood River Units 4 and 5. For SO_2 emission reductions, flue gas desulfurization control had to be installed by December 31st 2010, December 31st 2011, and December 31st 2012 on one of each of the three electrical generating units, respectively.

Consent Decree---ConocoPhillips (*ConocoPhillips Global Refinery Settlement, filed January 27, 2005, U.S. District Court for the Southern District in Texas*)
The ConocoPhillips settlement provides for near-term installation (no later than December 31, 2009) of Low-NOx Burners and Ultra Low-NOx Burners on combustion

units at its “DistillingWest” operations. Other NOx emission reduction requirements are set forth in the consent decree, as are provisions for CO, SO_2, and particulate matter reductions.

5.0 ATTAINMENT DEMONSTRATION

The St. Louis $PM_{2.5}$ modeling study was conducted to address the need to demonstrate attainment of the annual $PM_{2.5}$ NAAQS for the St. Louis nonattainment area. One of the primary goals of the study was to develop photochemical modeling data bases and allied analysis tools necessary to reliably simulate the processes responsible for $PM_{2.5}$ exceedances in the region and to assist the development of realistic emissions reduction strategies for the St. Louis nonattainment area. Future-year regional $PM_{2.5}$ modeling was conducted using a 36/12 kilometer (km) 2002 database to project 2009 and 2012 Design Values.

Although the modeling analyses for 2009 indicated that most $PM_{2.5}$ monitoring sites would achieve the NAAQS for $PM_{2.5}$, one site was still projected to exceed the annual $PM_{2.5}$ NAAQS due to the contribution of local sources. The Granite City monitor was projected to have a 2009 design value of 15.53 $\mu g/m^3$. The conceptual model performed by Turner et. al. (2007a,b,c,d) showed that local sources are contributing a significant fraction, 2 -3 $\mu g/m^3$, of the annual $PM_{2.5}$ concentrations at the Granite City Federal Reference Method (FRM) monitor.

Thus, $PM_{2.5}$ attainment in St. Louis will be addressed in two components. The first component is a regional modeling that is discussed in more details in the TSD - Attainment Demonstration Modeling and Analysis (Appendix A). The regional modeling was performed by the Missouri Department of Natural Resources, IEPA, and ENVIRON.

The second component is a local modeling. It is important to note that the monitor projected to be in violation is located in the Illinois portion of the St. Louis area and the "local" PM sources contributing to this projected violation are under the jurisdiction of the IEPA. Therefore, the local component that will examine the contributions of local sources is being conducted by IEPA and will be submitted at a later date.

5.1 Conceptual Model

EPA guidance for performing a $PM_{2.5}$ attainment demonstration recommends developing a conceptual model that contains a description of the potential processes, sources and other factors that contribute to exceedances of the $PM_{2.5}$ standard in the region (EPA, 2007a). This "conceptual model" for $PM_{2.5}$ over the St. Louis area helps to guide the development and application of chemical transport models (CTM) and receptor-based models. These models are necessary for quantitatively understanding source-receptor relationships which is the foundation needed for evaluating control strategy scenarios (Vickery, 2004). The conceptual model is focused on the information needed to support the development and implementation of control strategies to meet the annual average $PM_{2.5}$ NAAQS.

In general, the conceptual model includes descriptions of the following:

1. annual and seasonal levels of $PM_{2.5}$ in relation to the mass-based standards;
2. compositional analysis of $PM_{2.5}$;
3. meteorological influences;
4. atmospheric processes contributing to $PM_{2.5}$;
5. sources and source regions contributing to the principle chemicals of concern; and
6. implications to the St. Louis $PM_{2.5}$ plan.

Chapter 2 of the TSD (Appendix A) provides the details of the Conceptual Model for $PM_{2.5}$ in the St. Louis area. Regional transport of sulfate, nitrate, ammonium and organic carbon mass (OCM) are major contributors to the St. Louis $PM_{2.5}$ problem. The sulfate contribution is primarily transported from outside of the St. Louis NAA, with approximately 20% of the nitrate believed to be local in origin. Regional transport of OCM from outside the area is primarily believed to be secondary organic aerosols (SOA) with biogenic VOCs (e.g., isoprene and terpene) being the primary contributors.

Local sources are believed to be major contributors to $PM_{2.5}$ at the St. Louis FRM site that currently violates the annual $PM_{2.5}$ standard (Granite City, IL). The U.S. Steel facility, in particular, is identified as contributing to $PM_{2.5}$ nonattainment at this monitor.

5.2 Regional Modeling Development

Modeling Protocol and Modeling Domains

The St. Louis $PM_{2.5}$ study includes meteorological, emissions and regional air quality modeling followed the procedures outlined in the Modeling Protocol (ENVIRON and Alpine Geophysics, 2005). The Modeling Protocol addressed attainment demonstration modeling for both the 8-hour ozone and $PM_{2.5}$ standards and describes the overall modeling activities performed by the Department's Air Program, IEPA, EPA Region 7, and Ameren as well as the modeling contractor. Its main function was to serve as a means for planning and communicating how the modeled attainment demonstrations would be performed. The protocol guided the technical details of the modeling study and provided a formal framework within which the scientific assumptions, operational details, commitments and expectations of the various participants were communicated explicitly. The modeling protocol also set forth means for resolution of potential differences of technical and policy opinion to be worked out openly and within prescribed time and budget constraints.

The St. Louis regional $PM_{2.5}$ modeling was conducted on a 36/12 km modeling domain as depicted in Figure 5-1. The 36 km grid (Domain 1) consisted of an array of 68 x 68 grid cells with an origin at (-792.0, -1656.0). The larger 12 km domain had an origin at (-264.0, -1272.0) with 128 by 149 12 km grid cells.

For the CMAQ simulations, one-way grid nesting was used between the St. Louis 36 km and 12 km regional-scale modeling domains (i.e., CMAQ was first run on the 36 km grid

and the three-dimensional hourly instantaneous concentrations were then processed into boundary conditions for the 12 km CMAQ simulation). Whereas for the CAMx St. Louis 36/12 km simulations, two-way interactive grid nesting was used (i.e., concentrations are allowed to pass back and forth between the 36 km and 12 km domains during the simulations). For both the CMAQ and CAMx St. Louis 36/12 km regional-scale modeling, the boundary conditions (BCs) along the lateral edges of the 36 km domain were defined using output from the VISTAS continental U.S. 36 km CMAQ simulation of the 2002 annual period for the 2002, 2009 and 2018 Base G emission scenarios (Morris et al., 2007). The VISTAS 2002 and 2009 CMAQ results were used to define BCs for the 2002 and 2009 St. Louis simulations, whereas the BCs for the St. Louis 2012 simulations were obtained by interpolating between the 2009 and 2012 VISTAS results.

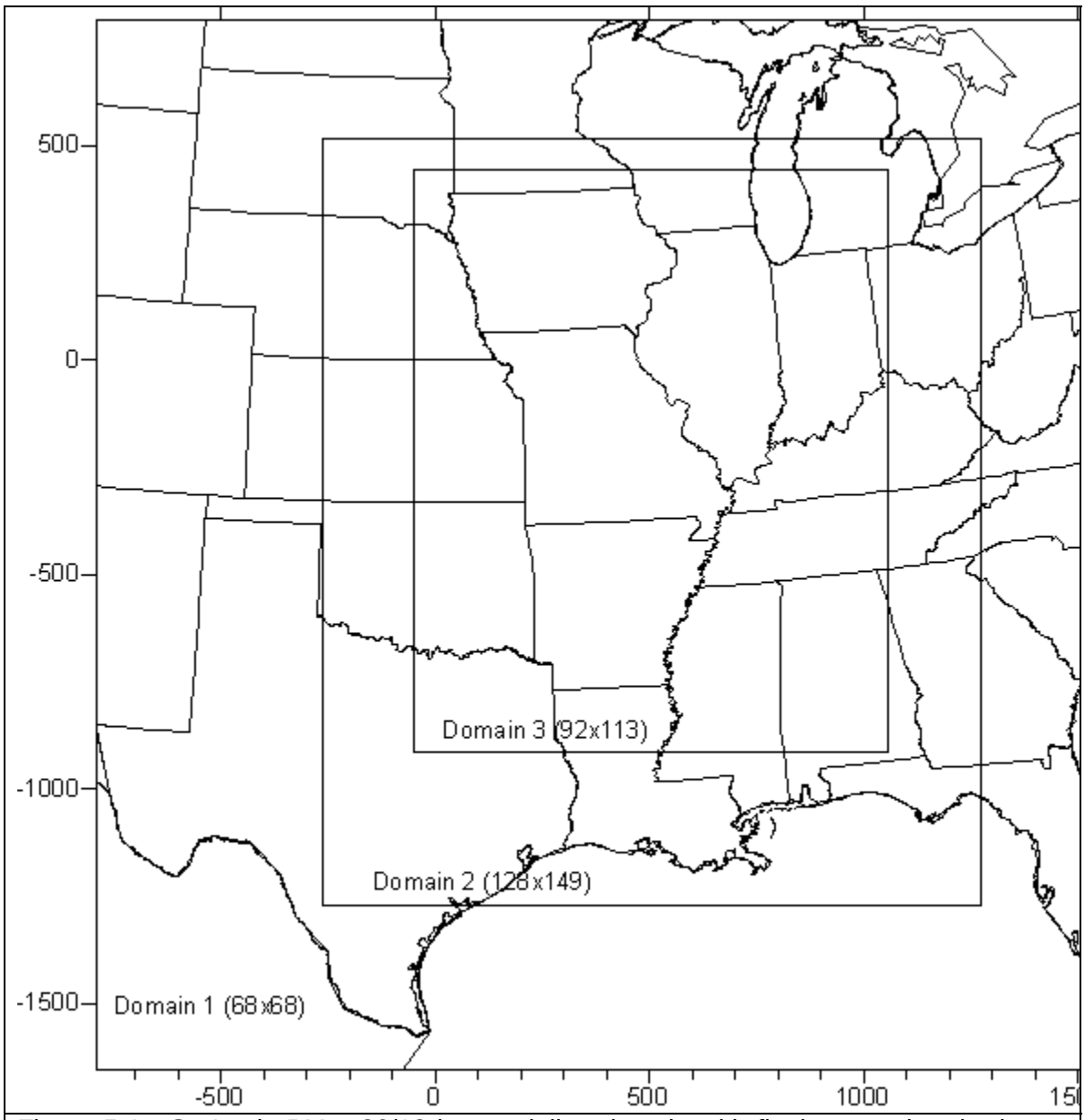


Figure 5-1. St. Louis $PM_{2.5}$ 36/12 km modeling domain with final runs using the larger (Domain 2) of the two 12 km domains.

Air Quality Data

Data from ambient monitoring networks for both gas and aerosol species were used in the model performance evaluation. However, in the model performance evaluation, we focused on the evaluation of modeled surface layer $PM_{2.5}$ mass and species concentrations within the 12 km regional-scale domain (Figure 5-1) and the St. Louis NAA. Three monitoring networks were operating in the St. Louis NAA during the 2002 modeling period:

- $PM_{2.5}$ mass was collected at 12 FRM monitoring sites in the St. Louis NAA as depicted in Figure 5-2.
- Speciated $PM_{2.5}$ concentrations were measured at 4 Speciated Trends Network (STN) monitoring site, as well as at the East St. Louis locations as part of the St. Louis Super Site (StL-SS) as shown in Figure 5-3.

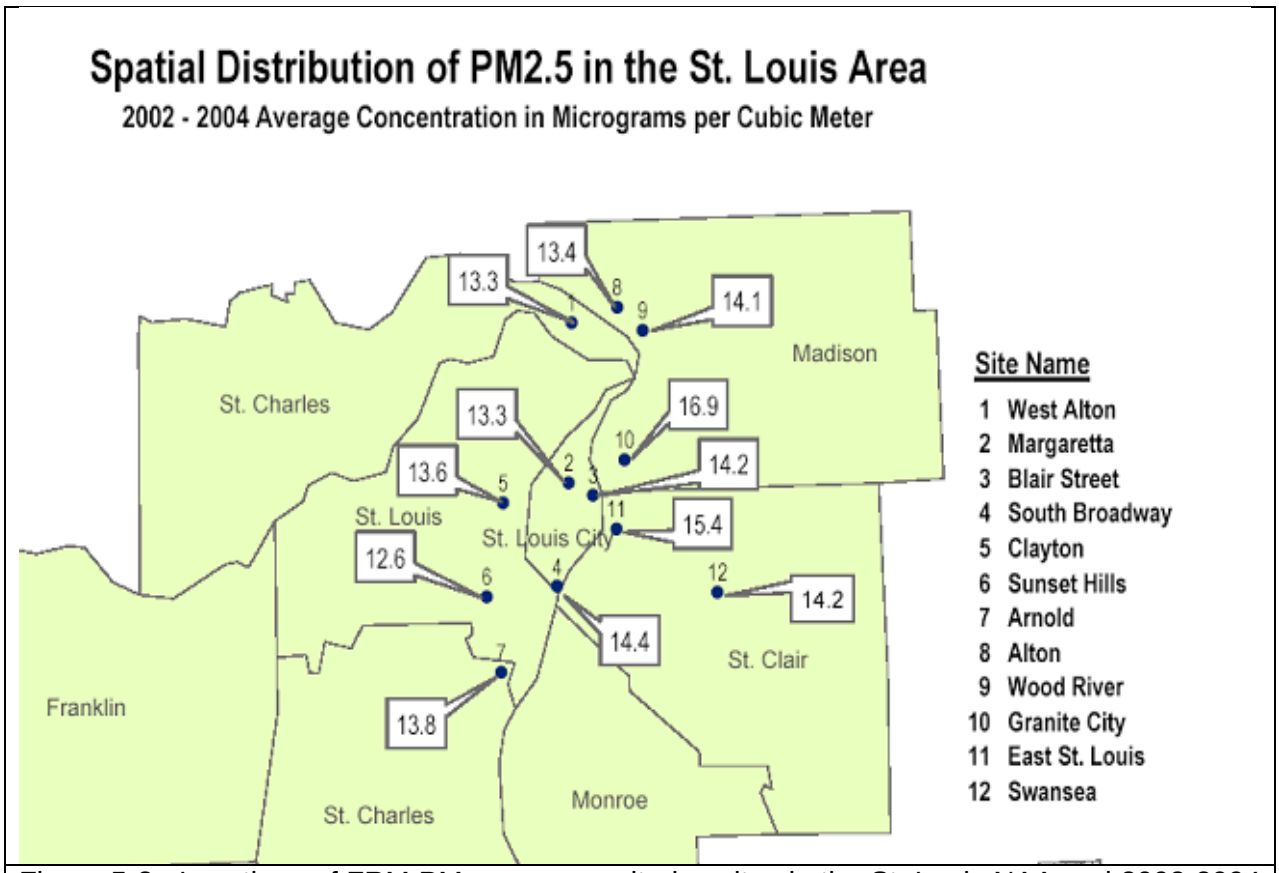


Figure 5-2. Locations of FRM $PM_{2.5}$ mass monitoring sites in the St. Louis NAA and 2002-2004 $PM_{2.5}$ Design Values ($\mu g/m^3$).

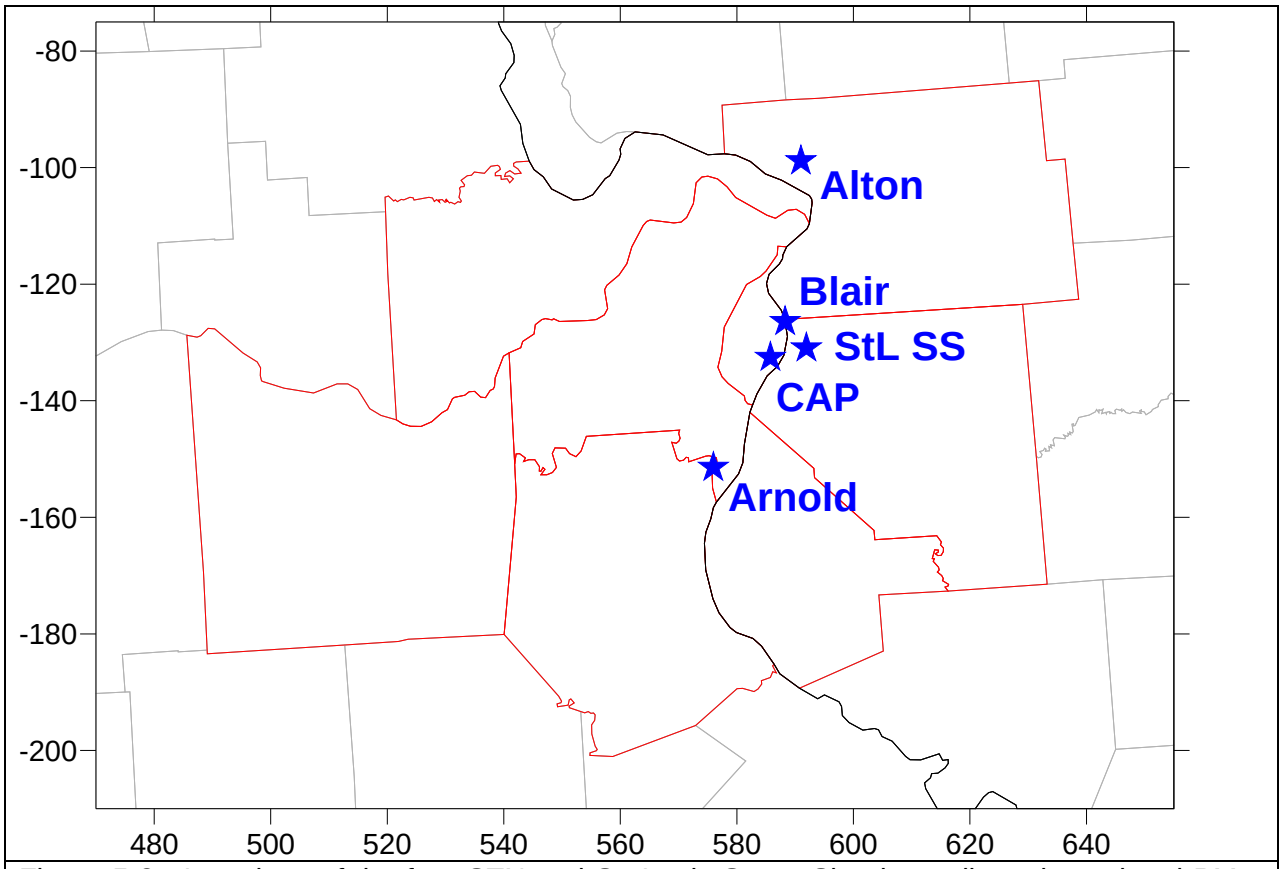


Figure 5-3. Locations of the four STN and St. Louis Super Site that collected speciated $PM_{2.5}$ measurements.

Episode Selection

The calendar year 2002 was selected for the St. Louis $PM_{2.5}$ modeling. EPA recommends that the selection of a modeling period for annual $PM_{2.5}$ modeling be based on the following four criteria (EPA, 2007a):

1. Choose time periods from each quarter which reflect a variety of meteorological conditions that represent average concentrations for that quarter and year;
2. Model time periods in which observed concentrations are close to the appropriate baseline design value;
3. Model time periods for which extensive air quality/meteorological data bases exist; and
4. Model a sufficient number of days so that the modeled attainment test applied at each monitor violating the NAAQS is based on multiple days.

.

EPA also lists several 'other considerations' to bear in mind when choosing potential PM episodes including: choose periods which have already been modeled, choose periods which are drawn from the years upon which the current design values are based, include

weekend days among those chosen, and choose modeling periods that meet as many episode selection criteria as possible in the maximum number of nonattainment or Class I areas as possible.

The St. Louis $PM_{2.5}$ modeling team elected to model a complete single calendar year to assure that sufficient days are present to represent each quarter of the year, which follows EPA recommendations (page 149, EPA, 2007a). The 2002 calendar year was selected by the St. Louis $PM_{2.5}$ modeling study for annual $PM_{2.5}$ modeling for the following reasons:

- Based on available information, 2002 appears to be a fairly typical year in terms of meteorology;
- 2003 and 2004 appeared to be colder and wetter than typical in the eastern US;
- The enhanced **I**nteragency **M**onitoring of **PRO**tected **V**isual **E**nvironments (IMPROVE) and IMPROVE Protocol and Supersite PM monitoring data were fully operational by 2002 with much less IMPROVE monitoring data available during 2000-2001;
- The STN speciated $PM_{2.5}$ and FRM $PM_{2.5}$ mass monitors were fully operational in 2002;
- 2002 was being modeled by CENRAP, VISTAS and other RPOs; and
- 2002 was the base year used for the 8-hour ozone analysis in St. Louis.

Emissions Input Preparation and Quality Assurance/Quality Control (QA/QC)

The primary function of the emissions modeling software is to speciate emission inventory data, allocate it in space and time, and place it into formatted files that can be directly input into the chemical transport model. An important part of this process is the quality control checks integral to the emissions modeling software that generate warning or error messages on suspect or incorrect records because of data that is missing, "out-of-bounds", duplicative, lacking matching cross-reference data, or is otherwise deficient. Numerous software programs, external to the main emissions modeling software, have been used to generate emissions summaries, graphical depictions of emissions data, and other data probing or analysis techniques to assure the highest quality emission inputs are being used for photochemical modeling. These programs were relied upon extensively in the processing of inventories.

Illinois and Missouri, both separately and jointly, conducted quality assurance checks on their respective state inventories. Additionally, ENVIRON, the consultant, retained to provide assistance with the St. Louis modeling, constituted a third independent entity to assess the inputs and outputs to the emissions model. For emissions outside of the States of Missouri and Illinois, the latest inventories from the CENRAP, VISTAS and Metropolitan Regional Planning Organizations were utilized.

The process of producing a model validation inventory is iterative, with data corrections or improvements invariably leading to a succession of more refined modeling inventories. The Midwest RPO modeling effort has gone from "Base A" to "Base K" inventories. The

St. Louis validation modeling commenced with "Basecase 1" and concluded with "Basecase 5b", and the latter reflects processing of Midwest RPO inventory updates through the "Base K" inventory, and the CENRAP and VISTAS Base G inventories.

Meteorological Input Preparation and QA/QC

Meteorological data were generated using the Mesoscale Meteorological Model, Version 5.0 (MM5) prognostic meteorological model. MM5 runs for the 2002 annual period were performed at 5½ day increments on the 36/12 km domains that overlapped by 12 hours. A 12 hour spin up period was used for each 5½ day increment. The MM5 parameterization and module settings are essentially the same as those used by the Iowa Department of Natural Resources for their 2002 annual MM5 simulation on the 36 km continental US domain. Details on the configuration may be found in Johnson (2007).

The modeling team processed the MM5 data using the MCIP and MM5 CAMx processors to generate meteorological inputs for the CMAQ and CAMx models, respectively. Model and Data Analysis Workgroup (MDAW) participants performed the 36 km annual and 12 km MM5 modeling and conducted their own QA/QC and evaluation of the meteorological fields. In addition, the ENVIRON Team also performed some QA/QC of the meteorological data to assure that it was transferred correctly, to obtain an assessment of the quality of the data, and to assist in the interpretation of the air quality modeling results.

The Missouri Department of Natural Resources/MDAW and Team meteorological gatekeepers performed the following tasks:

- Analyses of the MM5 data to assure that it had been transferred correctly;
- Evaluation of the MM5 data using METSTAT and the surface meteorological network;
- Evaluation of upper-air MM5 meteorological estimates by comparing them to upper-air observations and satellite images;
- Comparison of the MDAW modeling hub's 2002 36 km MM5 simulation with those generated by Western Regional Air Partnership (WRAP) and VISTAS; and
- Generation of the CMAQ-ready meteorological inputs using the MCIP2.3 processor and CAMx-ready inputs with the MM5CAMx processor.

5.3 Other QA/QC Activities

Key aspects of QA for the CMAQ and CAMx input and output data included the following:

- Verification that correct configuration and science options were used in compiling and running each module in the CMAQ and CAMx modeling systems, where these included (for CMAQ) the MCIP, JPROC, ICON, BCON and the CCTM;

- Verification that the correct configuration and science options were used in running each model in the CAMx modeling system where these included MM5CAMx, TUV, land use, CAMx, and the CMAQ-to-CAMx emissions and IC/BC processors;

- Verification that correct input data sets were used when running each model;

- Evaluation of CMAQ and CAMx results to verify that model output was reasonable and consistent with general expectations;

- Processing of ambient monitoring data for use in the model performance evaluation;

- Evaluation of the CMAQ and CAMx results against concurrent observations and each other; and

- Backup and archiving of critical model input data.

The most critical element for CMAQ and CAMx simulations was the QA/QC of the meteorological and emissions input files, which is discussed above. The major QA issue specifically associated with the air quality model simulations was verification that the correct science options were specified in the model itself and that the correct input files were used when running the model. For CMAQ modeling, the modeling team employed a system of naming conventions using environment variables in the compile and run scripts that guaranteed that correct inputs and science options were used. Similar procedures were used in CAMx modeling using file and directory naming conventions. The team employed a redundant naming system so that the names of key science options or inputs are included in the name of the CMAQ and CAMx executable program, in the name of the CMAQ and CAMx output files, and in the name of the directory in which the files were located. This was accomplished by using the environment variables in the scripts to specify the names and locations of key input files.

A second key QA procedure was to avoid “recycling” run scripts, i.e., the team always preserved the original run scripts and directory structures that were used in performing a model simulation.

The St. Louis modeling team also performed a post-processing QA of the CMAQ and CAMx output files similar to that described for the emissions processing. Animated graphic files were generated using Package for Analysis and Visualization of Environmental Data (PAVE), and were viewed to search for unexpected patterns in the CMAQ and CAMx output files. In the case of model sensitivity studies, the animated graphic files were prepared as difference plots for the sensitivity case minus the base case. This was done to screen for errors in the emissions inputs.

5.4 Base Case Modeling and Model Performance Evaluation

The St. Louis $PM_{2.5}$ modeling team performed annual modeling of the 2002 calendar year using a 36/12 km grid with several iterations of the 2002 base case emission scenarios. The final 2002 base case emissions scenario was Base 5b. Chapter 4 of the TSD (Appendix A) provides detailed model performance evaluation of the CMAQ and CAMx models for the 2002 Base 5b emissions scenario with additional model evaluation plots. The focus of this model evaluation was on the operational evaluation of $PM_{2.5}$ mass and $PM_{2.5}$ species model performance. The model was evaluated on the regional-scale using PM measurements for all PM monitors within Missouri/Illinois and nearby states. The model was also evaluated focusing on PM measurements within the St. Louis NAA. Figure 5-4 shows all monitoring sites within the St. Louis 12 km modeling grid used in the regional model performance evaluation.

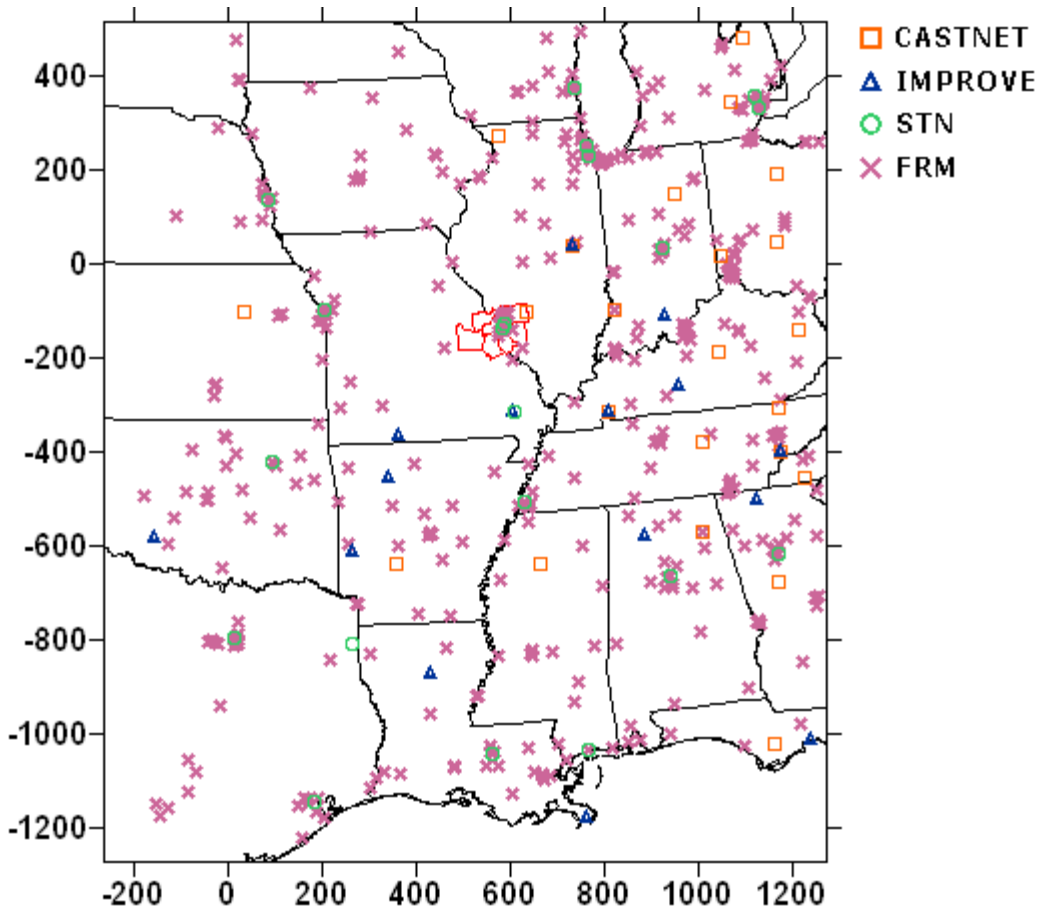


Figure 5-4. Monitoring Sites Used in the Model Performance Evaluation

In the St. Louis modeling performance evaluation, the CMAQ and CAMx modeling results are compared with observational data from the IMPROVE, STN, **C**lean **A**ir **S**tatus **T**rends **Net**work (CASTNet), and FRM $PM_{2.5}$ mass monitoring networks. In addition, the model performance evaluation also used observational data from the St. Louis Super Site that was operating during the 2002 modeling period, which greatly enhanced the evaluation of the model over just using routinely available data. The St. Louis PM model performance evaluation focuses primarily on the operational model evaluation of the air quality model's performance with respect to individual components of $PM_{2.5}$, as good model performance of the PM component species are used in the procedures used to project future-year $PM_{2.5}$ Design Values.

The main implications of the major findings in the St. Louis PM model performance evaluation were as follows:

- Good Sulfate Performance: The CMAQ and CAMx performance for sulfate was generally good. There was a tendency for underpredicting the observed summer sulfate levels on the regions-scale. However, in St. Louis the sulfate performance was consistently good with low bias and error. This is an important result given

- Nitrate Underprediction Bias: NO_3 is routinely underpredicted during the summer and adjacent months throughout the St. Louis 12 km modeling region. This underprediction is due to modeled NO_3 concentrations near zero, when observed values are low, but above zero (typically < 1 μg/m^3). However, NO_3 is generally a very minor contributor to total $PM_{2.5}$ mass at FRM monitors in the St. Louis nonattainment region. Thus, the NO_3 performance issues are not a large concern in the $PM_{2.5}$ projections.

- OCM Underprediction Bias: The OCM under-prediction bias is a cause for concern since it is a major component of the $PM_{2.5}$ mass at St. Louis FRM monitoring sites with maximum contributions to the 2012 $PM_{2.5}$ Design Values of ~8 μg/m^3, minimum values of ~3 μg/m^3 and a mean value of ~4 μg/m^3. The reasons for the underestimation of OCM are unclear, but the fact that the underpredictions are higher in the urban than rural areas suggest that there may be missing anthropogenic emission sources, or possibly the urban OCM emissions are over diluted across the 12 km grid resolution used in the St. Louis modeling. The changes in projected OCM concentrations between the current and projected $PM_{2.5}$ Design Values are mostly less than 2% (i.e., $0.98 < RRF_{OCM} < 1.02$). Thus, the changes in OCM between the current and future year are having a minor influence on the projected $PM_{2.5}$ Design Values.

- Elemental Carbon (EC) Performance Issues: For the most part, both models performed well for EC at the urban sites and the slight over-prediction does not affect the relative changes in the model response to anthropogenic EC emissions changes. Therefore, any EC performance issues were not a cause for concern.

- Soil Performance Issues: The model performance for the soil species (aluminum, iron, titanium, calcium, and silicon) is quite poor. This soil component of the 2012 projected $PM_{2.5}$ Design Value ranges from 0.7 to 1.1 μg/m^3. The Relative Response Factors (RRFs) for SOIL indicate that it is mostly increasing, with summer (Q3) soil RRFs typically ranging from 1.1 to 1.2, which is relatively insignificant compared to SO_4 contributions. Therefore, the soil performance issues will not significantly affect the projected 2012 $PM_{2.5}$ Design Values.

- SO_4 reductions dominate the changes in $PM_{2.5}$ Design Values between 2002 and 2009/2012. SO_4 performance is good in the 2002 Base 5b simulation always achieving the PM performance goal at urban sites and achieving the PM performance criteria for rural sites. These factors provide confidence in the Design Value projections using the Base5b modeling results.

5.5 Future-Year Modeling and Modeled Attainment Demonstration

Future-year $PM_{2.5}$ modeling was performed with CMAQ and CAMx for 2009 originally. The 2009 $PM_{2.5}$ Design Value projections at the Granite City monitoring site using the CMAQ 2009 Base 5a modeling is 15.53 $\mu g/m^3$. Reducing the concentration at Granite City monitor to achieve compliance with the annual NAAQS will entail additional control measures targeting direct $PM_{2.5}$ sources. In accordance with section 172(a)(2)(A) of the CAA which states that EPA may grant an area an extension of the initial attainment date for a period of one to 5 years for an area showing that attaining the NAAQS by 2010 was impracticable, the States of Missouri and Illinois requested that the attainment date to be extended to 2012. This date extension was essential since more time was needed to implement the new RACT rules for SO_2 and NOx. Moreover, other important federal/states rules will not be effective until after 2010. For example, CAIR-Phase I SO_2 control from power utilities will cover the years 2010-2014 and IEPA's multi-pollutant utility NOx controls will be in place in 2011. Further, the 2007 publication of the $PM_{2.5}$ implementation rule by EPA did not allow for sufficient time to conduct the modeling analyses to evaluate additional local controls for development and implementation in 2009.

It is important to note that the primary regional modeling system for the development of the St. Louis annual $PM_{2.5}$ attainment demonstration was the CMAQ model. This is due to better overall model performance in the 2002 base year and a need to minimize the overall resources necessary to complete the modeling analyses. As noted elsewhere in the document, the CAMx modeling system was also utilized as an alternative modeling scheme.

The St. Louis future-year modeling used the 2002 MM5 meteorological conditions. That is, the meteorological conditions for the 2009 and 2012 future-years are assumed to be the same as 2002. This allowed for the comparison of the changes in $PM_{2.5}$ concentrations in the study area from the current (2002) to future-years due to changes in emissions. This means that the effects of climate change, land use variations and climatic variations were not accounted for in the future-year meteorological inputs. Boundary conditions along the lateral edges of the St. Louis 36 km domain (Figure 5-1) were based on VISTAS/ASIP CMAQ 36 km simulations for 2002, 2009 and 2018 emissions scenarios. The St. Louis BCs for the 2002 and 2009 simulations were based on the corresponding Atlanta SIP (ASIP) 2002/2009 CMAQ simulations, whereas the BCs for the St. Louis 2012 simulations were interpolated from the VISTAS/ASIP 2009 and 2018 CMAQ simulations

The 2012 Base 5b12 emissions scenario consists of emissions projected from 2002 to 2012 with on-the-books (OTB) control measures, some additional control measures and one ethanol plant in the NAA Permitted by IEPA. The 2012 Base 5b12 OTB controls include:

- CAIR;
- NOx SIP Call;
- MACT Standards;
- Tier 2 Rule – Light-Duty Vehicle Standards and Low-Sulfur Gasoline;
- Heavy-Duty Diesel Engine Standards and Low-Sulfur Diesel;
- Tier 4 Rule – Off-Road Mobile Engine Standards;
- Illinois' Multi-pollutant Utility Rule (pre-2012 requirements);
- Illinois Basic Inspection and Maintenance Program;
- Missouri Vehicle Emission Controls with 90% Inspection and Maintenance Program Control Efficiency; and
- Missouri SO_2 and NOx RACT requirements.

The modeling results were used to project future-year $PM_{2.5}$ Design Values. The procedures for performing the $PM_{2.5}$ Design Value projections are outlined in EPA's modeling guidance (EPA, 2007a). These procedures involve the use of the model in a relative sense to scale the observed current year $PM_{2.5}$ Design Value based on the relative changes in the modeled $PM_{2.5}$ species concentration between the current-year (2002) and future-years (2009 and 2012) using the Speciated Modeled Attainment Test (SMAT). Per the guidance, the current year "design value" is the average of the three design values that contain the base year (2000-02, 2001-03, and 2002-04).

The EPA has developed a Modeled Attainment Test Software (MATS) that codifies the SMAT procedures that was used with the CMAQ 2002/2012 Base 5b12 modeling results to projected 2012 $PM_{2.5}$ Design Values that are shown in Table 5-1. The CMAQ 2012 $PM_{2.5}$ Design Values for the Base 5b12 emissions scenario are all projected to be below the annual $PM_{2.5}$ NAAQS, with the exception of the Granite City FRM monitor that is (15.28 $\mu g/m^3$) above the annual $PM_{2.5}$ NAAQS (15.0 $\mu g/m^3$). Thus, the modeled attainment demonstration projects that the maximum modeled $PM_{2.5}$ Design Value in 2012 is well within the range (14.5-15.5 $\mu g/m^3$) where additional analysis can be used to perform a Weight of Evidence (WOE) attainment demonstration, which is discussed next.

Table 5-1. Projected 2009 & 2012 $PM_{2.5}$ Design Values using 2009 Base 5a & 2012 Base 5b12 12 km CMAQ modeling results.

FRM Site ID	Site Name		Excel	MATS v1.3.1
		(2002)* $PM_{2.5}$ DVC Observed	(2009) $PM_{2.5}$ DVF CMAQ Base 5a	(2012) $PM_{2.5}$ DVF CMAQ Base 5b12
17_119_0023	Washington Ave.	N/A	N/A	N/A
17_119_1007	Granite City	17.27	15.53	15.28
17_119_2009	Alton	14.58	12.99	12.29
17_119_3007	Wood River	14.70	13.09	12.51
17_157_0001	Tilden City	12.41	10.94	10.31
17_163_0010	East St. Louis	16.19	14.54	14.13
17_163_4001	Swansea	14.68	13.10	12.58
29_099_0012	Arnold	14.43	12.91	12.27
29_183_1002	West Alton	14.08	12.54	11.93

29_189_0004	Sunset Hills	12.52	11.36	10.76
29_189_2003	Clayton	14.02	12.70	12.02
29_189_5001	Ferguson	13.77	12.16	11.93
29_510_0007	S. Broadway	14.55	13.29	12.70
29_510_0085	Blair St.	14.93	13.42	13.12
29_510_0086	Margaretta	13.93	12.59	12.07
29_510_0087	2nd & Mound	15.16	13.62	13.10

* Average of the three design values containing 2002 (2000-02, 2001-03, and 2002-04)

5.6 Weight of Evidence (WOE) Attainment Demonstration

Guidance from EPA states that if there are future-year $PM_{2.5}$ Design Values between 14.5-15.5 µg/m^3 at one or more FRM sites, then "a weight of evidence demonstration should be conducted to determine if aggregate supplemental analyses support the modeled attainment test" (EPA 2007a). In fact, EPA suggests that a weight of evidence (WOE) always be performed to corroborate the modeled attainment demonstration test.

In a WOE determination, results from several types of air quality analyses are considered and the results reviewed for consistency with the conclusion of the modeled attainment test regarding the likelihood that the proposed control strategy will result in a NAA meeting the NAAQS. The credibility of each type of analysis used in the WOE determination must be assessed and finally, a conclusion reached regarding the likelihood of attainment.

For the St. Louis regional 36/12 km modeling, a WOE attainment demonstration is used because the maximum projected 2012 $PM_{2.5}$ Design Value at the Granite City site at 15.28 µg/m^3 is well within the WOE range (14.5-15.5 µg/m^3). The main facts supporting the WOE attainment demonstration are as follows:

- The 2012 projected $PM_{2.5}$ Design Value at Granite City (15.28 µg/m^3) is just (0.24 µg/m^3) above the level needed to for a modeled attainment demonstration;
- The Conceptual Model for $PM_{2.5}$ in the St. Louis area has identified local sources as contributing a significant fraction, 2 - 3 µg/m^3, of the annual $PM_{2.5}$ concentrations at the Granite City FRM monitor;
- The impact of sulfate and nitrate on the violating monitor is primarily composed on regionally transported pollution with a smaller component from sources within the nonattainment area. The control of nonattainment area SO_2 sources has some impact on the monitor and the overall reduction in the 2012 future year design value (2.0 µg/m^3) is directly related to the overall reduction in SO_2 and NOx emissions from the base-year;
- The Chemical Mass Balance Source Apportionment results for the Granite City Area and Urban Excess showed that local Granite City sources are the dominant influence on air quality impacts to the Granite City fire station site;

- As the local sources contributing to $PM_{2.5}$ at Granite City monitor are on the Illinois side of St. Louis, the IEPA is performing local-scale analysis using a hybrid of the CMAQ results presented here and AERMOD to identify the level of additional control on local sources needed to attain the annual $PM_{2.5}$ NAAQS; and
- As illustrated in Table 5-2, the design values for the St. Louis area have dropped considerably since the 2002 base year. An overall reduction of all the design values has occurred and that means that one or more control programs are impacting the overall area concentrations. This overall reduction is very encouraging and provides further evidence that the St. Louis area will be able to attain the NAAQS as the additional controls from this plan are implemented in the area. Nonetheless, as described previously, local control measures near the Granite City monitor and IEPA is pursuing a regulation to codify these controls with the Illinois Pollution Control Board.

Table 5-2. St. Louis Area $PM_{2.5}$ Annual Average Design Values

Monitor Site	$PM_{2.5}$ Annual Std = 15.0 µg/m^3									3-year average						
	2000	2001	2002	2003	2004	2005	2006	2007	2008	00-02	01-03	02-04	03-05	04-06	05-07	06-08
Missouri																
West Alton	14.8	15.0	14.0	14.0	11.9	15.2	11.6	13.2	Disc	14.6	14.3	13.3	13.7	12.9	13.3	n/a
Margaretta	15.2	14.2	14.3	13.5	12.1	15.3	12.5	Disc	Disc	14.6	14.0	13.3	13.6	13.3	Disc	Disc
Blair Street	16.4	15.2	15.4	14.1	13.2	16.1	13.4	13.9	12.9	15.7	14.9	14.2	14.5	14.2	14.5	13.4
Mound Street	16.0	15.4	15.8	14.7	13.6	15.9	13.7	14.3	12.7	15.7	15.2	14.7	14.7	14.4	14.6	13.5
South Broadway	15.3	14.8	15.3*	14.4	13.1	15.9	13.1	14.0	12.5	15.1**	14.8**	14.3**	14.5	14.0	14.3	13.2
Clayton	15.1	13.9	14.6	13.6	12.2	15.5	11.8	13.1	12.0	14.5	14.0	13.5	13.8	13.2	13.4	12.3
Arnold	15.2	14.5	15.1	13.9	12.6	15.4	12.6	13.8	11.4***	14.9	14.5	13.9	14.0	13.5	13.9	12.6
Illinois																
Alton	16.0	15.8	14.7	14.0	11.5	16	13.1	14.9	12.5	15.5	14.8	13.4	13.8	13.5	14.7	13.5
Wood River	15.9	15.0	15.1	14.0	13.2	16	13.1	14.2	12.2	15.3	14.7	14.1	14.4	14.1	14.4	13.2
Granite City	17.4	17.3	17.7	17.5	15.4	18.2	16.3	15.1	15.7	17.5	17.5	16.9	17.0	16.6	16.5	15.6
East St. Louis	17.4	17.0	16.7	16.6	14.7	17.1	14.5	15.6	12.6	17.0	16.8	16.0	16.1	15.4	15.7	14.2
Swansea	15.0	15.5	15.1	14.3	13.2	16	13.4	13.3	12.6	15.2	15.0	14.2	14.5	14.2	14.2	13.1

*Less than four full quarters
**Less than three full years
***Sampler moved to Arnold West

Based on all the analyses conducted for the annual $PM_{2.5}$ plan, the Department's Air Program has found that the St. Louis area will attain the air quality standard in 2012. This finding is based on the federal, state, and local controls outlined in this plan. Additional local control efforts are necessary

6.0 TRANSPORTATION CONFORMITY

This section establishes motor vehicle emissions budgets for transportation conformity analyses for the annual $PM_{2.5}$ standard for the milestone year of 2009 and the attainment demonstration year of 2012. Budgets are proposed for NOx and direct $PM_{2.5}$ emissions. As defined in 40 CFR 93.101, a motor vehicle emissions budget is:

"*...that portion of the total allowable emissions defined in the submitted or approved control strategy SIP revision or maintenance plan for a certain date for the purpose of meeting reasonable further progress milestones or demonstrating attainment or maintenance of the NAAQS, for any criteria pollutant or its precursors, allocated to highway and transit vehicle use and emissions.*"

The rules governing transportation conformity require certain transportation activities to be consistent with motor vehicle emissions budgets contained in the plan. To demonstrate conformity to the motor vehicle emissions budgets, emissions from the implementation of a transportation plan or a transportation improvement must be less than or equal to the budget level.

The May 6, 2005 final transportation conformity rule amendments require motor vehicle emissions budgets for each $PM_{2.5}$ precursor (NOx, SO_2, VOC, NH_3) determined through the plan development process to be a significant contributor to an area's $PM_{2.5}$ nonattainment problem. Based on the analyses, VOC and NH_3 were not considered for establishing motor vehicle budgets.

Although SO_2 contributes to the area's problem, motor vehicles are not a significant source of SO_2 emissions (0.7% of the total 2002 SO_2 emissions in the Missouri St. Louis nonattainment counties is from onroad mobile sources). In addition, SO_2 emissions from onroad mobile sources will decrease in the future due to federal controls on the sulfur content of diesel and gasoline. For these reasons, the Department's Air Program is not proposing to establish SO_2 mobile source budgets.

$PM_{2.5}$ areas must also include re-entrained road dust in conformity analyses if the EPA or the state air agency finds road dust to be significant. The Department's Air Program has determined that road dust is not a significant contributor to the area's annual $PM_{2.5}$ nonattainment problem.

The mobile source emissions budgets were calculated consistent with EPA's *Guidance for Creating Annual On-Road Mobile Source Emission Inventories for $PM_{2.5}$ Nonattainment Areas for Use in SIPs and Conformity*. In addition, the calculations incorporate the latest planning assumptions established by the Inter Agency Consultation Group coordinated by the East West Gateway Council of Governments.

Consistent with the Inter Agency Consultation Group's planning assumptions, a two-season approach was used to estimate annual motor vehicle emissions. This approach

uses winter and summer input conditions to develop inventories based on two sets of MOBILE6.2 runs. Each set of input conditions is assumed to represent six months of the year, and annual VMT is apportioned to the winter and summer seasons. The total annual inventory is the sum of the winter and summer inventories.

A growth rate of 1.5% per year was used to project 2002 VMT to 2009 and 2012 consistent with the average region-wide growth rate for the St. Louis nonattainment area counties used in the attainment demonstration modeling. Table 6-1 summarizes the 2012 and 2014 projected annual VMT by county.

Table 6-1. 2009 and 2012 Annual VMT by County

County	**2009 Annual VMT**	**2012 Annual VMT**
Franklin	1,532,966,936	1,595,395,454
Jefferson	1,981,191,285	2,061,873,284
St. Charles	2,696,060,245	2,805,854,554
St. Louis	11,497,351,040	11,965,568,956
St. Louis City	3,291,500,236	3,425,543,232
St. Louis NAA Totals	**20,999,069,743**	**21,854,235,479**

Winter and summer emission factors for 2009 and 2012 were generated using the EPA's MOBILE6.2 model. East West Gateway provided the winter and summer minimum and maximum temperature inputs and absolute humidity values. The local program specifications for the 2009 and 2012 runs included reformulated gasoline and the Gateway Vehicle Inspection Program that began October 1, 2007. Diesel sulfur contents of 43.0 ppm and 11.0 ppm for 2009 and 2012, respectively, were obtained from the EPA's National Mobile Inventory Model NMIM National County Database. In addition, the MOBILE6.2 model accounts for the impacts of the federal rules, such as the Tier 2 motor vehicle emission standards and the 2007 heavy-duty diesel standards.

Separate sets of inputs were created for Franklin County and the rest of the nonattainment area (Jefferson, St. Charles, and St. Louis Counties and City of St. Louis) in order to utilize the separate speed by VMT (SVMT) inputs for Franklin versus the rest of the nonattainment area and to be consistent with the way the 2002 VMT was prepared. The MOBILE6.2 input files are included in Appendix D.

The winter and summer MOBILE6.2 runs produced emission factors by pollutant (NOx, ECARBON, OCARBON, SO4, GASPM, BRAKE, TIRE), roadway type (freeway and arterial), and average speed (2.5 mph and 10 - 65 mph in 5 mph increments). The 2009 and 2012 onroad mobile emissions were calculated by multiplying the projected VMT for a given speed, road type, and nonattainment area subregion (Franklin County versus the rest of the nonattainment area) by the corresponding composite emission factor representing all vehicle types. Directly emitted $PM_{2.5}$ was calculated by summing diesel carbon emissions (ECARBON and OCARBON), gasoline carbon emissions (GASPM), sulfate particulate (SO4), and brake and tire wear. The results for each pollutant were

summed across all speeds, road types, and nonattainment area counties. The emissions totals for winter and summer were summed to generate annual estimates.

In the St. Louis nonattainment area, transportation conformity for the annual $PM_{2.5}$ standard will be based on these submitted motor vehicle budgets after the EPA determines that the budgets meet the adequacy criteria of the transportation conformity rule. Table 6-2 identifies the 2009 and 2012 motor vehicle emissions budgets for the St. Louis annual $PM_{2.5}$ nonattainment area for use in transportation conformity analyses.

Table 6-2. Motor Vehicle Emissions Budgets for the St. Louis Annual $PM_{2.5}$ Nonattainment Area

Pollutant	**2009 Budget (tpy)**	**2012 Budget (tpy)**
NOx	38,796.5	28,743.4
Direct $PM_{2.5}$	670.1	531.2

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7.0 CONTINGENCY MEASURES

Section 172(c)(9) of the Clean Air Act requires plan revisions to include specific contingency measures that can be implemented without further action by the state. Contingency measures are triggered if the state fails to meet a Reasonable Further Progress milestone or if monitoring shows that the standard has not been attained. Federal or local measures that provide emission reductions in excess of those needed to meet an RFP or attainment milestone may be used as a contingency measure.

The final $PM_{2.5}$ implementation rule requires that the contingency measures provide for emission reductions equivalent to about one year of reductions needed for RFP, based on the overall level of reductions needed to demonstrate attainment divided by the number of years from the 2002 base year to the attainment year. As shown in Table 7-1, the total reduction target is based on the difference between the Missouri portion of the base year and the attainment demonstration inventories. The contingency measure target for total reductions is 10,024 tons.

Table 7-1. Calculation of St. Louis Contingency Measure Emission Reduction Target for Annual $PM_{2.5}$ Standard

	NOx (tpy)	**SO_2 (tpy)**	**Direct $PM_{2.5}$ (tpy)**	**Total (tpy)**
2002 Baseline emissions inventory	137,907	205,329	16,245	359,481
2012 Attainment demonstration emissions inventory	82,696	160,298	16,291	259,285
Difference between 2002-2012 emissions	55,211	45,031	--	100,242
(Difference between 2002-2012)/10	5,521	4,503	--	**10,024**

The Department's Air Program has identified Doe Run Herculaneum smelter SO_2 reductions, federal motor vehicle controls, and the St. Louis heavy duty diesel vehicle idling reduction rule as contingency measures for the annual $PM_{2.5}$ standard.

As part of the RACT requirements for SO_2 emission sources in the St. Louis nonattainment area, the Department's Air Program revised a regulation to control SO_2 emissions from the Herculaneum primary lead smelter operated by the Doe Run Company (10 CSR 10-6.260). This regulation was modified to include new emission targets for the facility. These targets represent the on-going operation of the facility utilizing the existing sulfuric acid plant and are phased to include a zero emission target after 2016. The attainment demonstration analyses included the initial control level of 25,100 tons per year in 2012 from a base emission level of 41,840 tons per year. In addition to this level of emission reductions, the rule has an intermediate target level of

16,350 tons per year in 2014. The Department's Air Program is utilizing these additional emission reductions between the 2012 and 2014 targets (8,750 TPY) as a contingency measure for the annual $PM_{2.5}$ standard. These emission reductions will be required as part of the revised SO_2 control regulation and the plan and do not require additional action from the Department's Air Program, and were not included in the attainment demonstration modeling analyses for the St. Louis area.

The turnover of the onroad fleet of cars, trucks, and buses (i.e., the rate at which newer vehicles replace older ones in the fleet population) will result in direct $PM_{2.5}$ and NO_x emission benefits beyond 2012. This is because newer vehicles subject to federal motor vehicle programs are cleaner than the vehicles they are replacing. For contingency measure purposes, the emission reductions associated with federal motor vehicle control programs were calculated by subtracting 2014 onroad mobile emissions from 2012 mobile emissions. Appendix E provides more information on the methodology used to calculate reductions from federal motor vehicle controls.

Direct $PM_{2.5}$ and NO_x emission reductions are expected from the implementation of 10 CSR 10-5.385 Control of Heavy Duty Diesel Vehicle Idling Emissions. This rule requires that all commercial, public and institutional diesel vehicles with a gross vehicle weight rating (GVWR) over 10,000 pounds in the St. Louis nonattainment counties limit their idling to thirty (30) minutes while waiting to load or unload at a location. It also limits these vehicles from idling for more than five (5) minutes in any sixty (60) minute period, unless the vehicle meets one of the exemptions included in the rulemaking. The rule will become effective February 28, 2009. Appendix E provides more information on the methodology used to calculate reductions from the St. Louis heavy duty diesel idle reduction program.

Table 7-2 summarizes the emission reductions from federal motor vehicle controls and the heavy duty diesel idle reduction rule. Appendix E provides more information on the approaches used to estimate the benefits for these two contingency measures. The total emissions reduction level is estimated to be 14,813 tons/year, which exceeds the contingency measure target of 10,024 tons/year. Detailed information regarding the calculation of the mobile source measures is included in the TSD.

Table 7-2. Emission Reductions Expected from Contingency Measures for St. Louis Annual $PM_{2.5}$ Nonattainment Area

Contingency Measure	**NOx (tpy)**	**SO_2 (tpy)**	**Direct $PM_{2.5}$ (tpy)**	**Total (tpy)**
Doe Run-Herculaneum SO_2 emission reductions	--	8,750	--	8,750
Federal Motor Vehicle Controls (onroad fleet turnover)	5,542	--	68	5,609
Heavy Duty Diesel Idle Reduction Rule	448	--	6	454
Total	**5,990**	**8,750**	**74**	**14,813**

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8.0 CONCLUSION

The St. Louis area was designated as a nonattainment area for the annual $PM_{2.5}$ NAAQS in April 2005. This designation required the submittal of a plan by April 2008 with a comprehensive emission inventory, a reasonable further progress demonstration, RACT and RACM findings, an attainment demonstration, conformity findings, and contingency measures. This document has provided the necessary components of the St. Louis Annual $PM_{2.5}$ plan for Missouri. As part of the attainment demonstration analyses, there were three monitoring sites (Granite City, East St. Louis, & Mound Street) violating the annual $PM_{2.5}$ NAAQS (Table ES-1) using average design value data (2000-04). The combination of federal and state controls has reduced fine particle concentrations. Photochemical modeling using CMAQ with existing on-the-book controls shows that only one site (Granite City) is still in violation in 2009. This is consistent with the most recent air quality data which shows that both East St. Louis and Mound Street site will likely attain the NAAQS at the end of 2008.

In order to bring Granite City site into attainment, both Missouri and Illinois concluded that an attainment date of 2012 was necessary to bring the area into compliance. The state of Missouri is submitting an attainment date extension request as part of this plan submittal. The decision to use 2012 as the attainment year was based on time necessary to implement new RACT control measures along with the use of a portion of the Illinois multi-pollutant strategy and with other federal control measures being implemented after 2009. The Department's Air Program determined 2012 was the earliest possible date to accomplish the necessary reductions for Missouri and Illinois sources.

The Missouri $PM_{2.5}$ plan depends upon a number of federal, state, and local control measures to reduce fine particle emissions to assist in complying with the annual $PM_{2.5}$ standard in St. Louis. These control measures include the following:

- Clean Air Interstate Rule (CAIR) – Phase I;
- Heavy-Duty Diesel Engine Standards and Low-Sulfur Diesel;
- Illinois' Multi-pollutant Rule (pre-2012 requirements);
- Tier 2 Vehicle Standards;
- Tier 4 Rule – Off-Road Mobile Engine Standards;
- Reformulated Gasoline (RFG);
- Gateway Vehicle Inspection Program;
- NO_x SIP Call;
- Reasonably Available Control Technology (RACT) findings; and
- Local direct PM control measures near the Granite City, IL violating monitor.

Specifically for this plan, the Department's Air Program has implemented new RACT requirements that reduced SO_2 and NO_x emissions by 20,133 tons per year and 1,067 tons per year, respectively after 2011 at sources in the St. Louis PM nonattainment area. All these reductions showed some progress toward attainment but more reductions, particularly from nearby sources influencing the Granite City monitoring site, are needed

to attain the NAAQS of 15 $\mu g/m^3$. Based on the regional modeling attainment demonstration analyses conducted by the Department's Air Program, the resultant future year design value projected at Granite City without additional local control measures is 15.28 $\mu g/m^3$. This finding illustrates that additional local measures are necessary for sources in proximity to the monitor based on the impacts of the local industrial sources (2 - 3 $\mu g/m^3$).

Thus, IEPA is performing a hybrid modeling approach that integrates fine-scale Gaussian dispersion modeling results (AERMOD) with those of the grid-based CMAQ. Facilities whose direct $PM_{2.5}$ emissions were discretely modeled using AERMOD had these same $PM_{2.5}$ emissions "zeroed out" of the chemical transport model simulations. AERMOD, using base year (2002) and future year (2012) inventories of local sources potentially contributing to elevated $PM_{2.5}$ levels, predicted a concentration for the Granite City monitor and concentrations for a receptor grid with 100-meter spacing immediately surrounding the monitor. Model results were applied in a relative sense against a base year design value to develop a future year design value. Local speciated $PM_{2.5}$ monitoring data that has been evaluated for a "local" component and a "regional" component provides the necessary separation for applying the AERMOD results and the chemical transport model results. As with the regional modeling analyses, demonstrating modeled attainment of the annual $PM_{2.5}$ NAAQS is accomplished by implementing the Speciated Modeled Attainment Test (SMAT). The SMAT is a future year design value extrapolation from "local" and "regional" components of a base year design value. It integrates model-predicted relative changes, assesses quarterly contributions of individual $PM_{2.5}$ species, and ultimately reflects any control strategies needed to meet the annual $PM_{2.5}$ NAAQS. IEPA is near completion of the projections for Granite City and is also preparing a rule for submittal to the Illinois Pollution Control Board that will reduce emissions from culpable sources. Based on this rulemaking and the corresponding controls at these local sources and in conjunction with the other federal, state, and local measures described here, the Department's Air Program is confident that the St. Louis area will attain the annual $PM_{2.5}$ NAAQS.

Section 172(c)(9) of the Clean Air Act requires plan revisions to include specific contingency measures that can be implemented without further action by the state. Contingency measures are triggered if the state fails to meet a Reasonable Further Progress milestone or if monitoring shows that the standard has not been attained. The contingency measure target for total reductions is 10,024 tons. Per the PM implementation rule, this target was based on one-tenth of the difference in the Missouri portion of the total base year and attainment year inventories.

To fulfill the contingency measure target, the Department's Air Program has identified Doe Run Herculaneum smelter SO_2 reductions beyond RACT and the attainment demonstration requirements, federal motor vehicle controls, and the St. Louis heavy duty diesel vehicle idling reduction rule as contingency measures for the annual $PM_{2.5}$ standard. The total amount of emission reductions achieved by these contingency measures is 14,813 (nearly 5,000 tons more than required).

Ultimately, the Department's Air Program has determined that based upon existing federal and state controls promulgated and the implementation of RACT, along with the necessary control of local sources around the Granite City, Illinois monitor, that the St. Louis nonattainment area can achieve the NAAQS by 2012.

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