Commonwealth of Pennsylvania

STATE IMPLEMENTATION PLAN REVISION: ATTAINMENT DEMONSTRATION AND BASE YEAR INVENTORY PITTSBURGH-BEAVER VALLEY FINE PARTICULATE NONATTAINMENT AREA

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Executive Summary

Particulate matter is a mixture of microscopic solids and liquid droplets suspended in air that include: acids (such as nitrates and sulfates), organic chemicals, metals, soil or dust particles and allergens (such as fragments of pollen or mold spores). Fine particle pollution or $PM_{2.5}$ describes particulate matter that is less than or equal to 2.5 micrometers (μm) in diameter, approximately 1/30th the diameter of a human hair.

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. Individuals that may be particularly sensitive to fine particle exposure include people with heart or lung disease, older adults, and children.

The United States Environmental Protection Agency (EPA) issued fine particle ($PM_{2.5}$) national ambient air quality standards (NAAQS) in 1997 after evaluating hundreds of health studies and conducting an extensive peer review process. The EPA established an annual primary (health-based) and secondary (welfare-based) standard of 15.0 micrograms per cubic meter ($\mu g/m^3$), based on the 3-year average of annual mean $PM_{2.5}$ concentrations. The EPA also established a primary and secondary 24-hour standard of 65 $\mu g/m^3$ determined by the 3-year average of the 98th percentile of 24-hour concentrations.

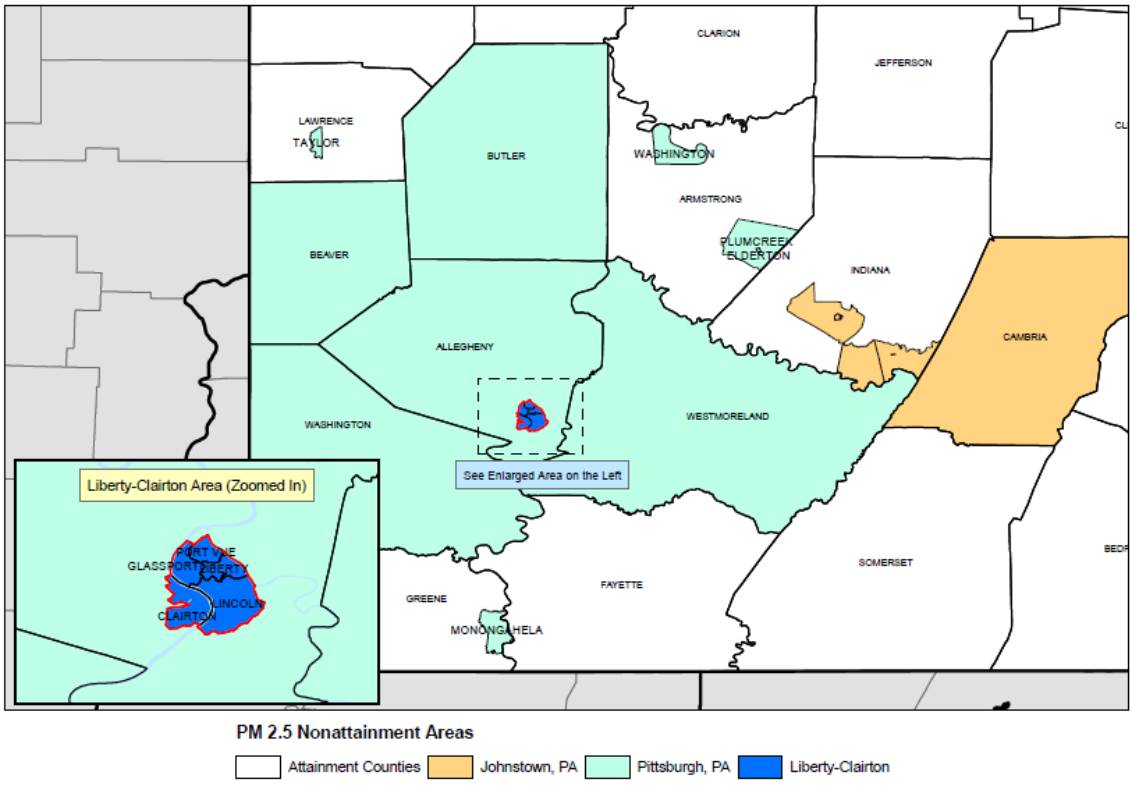
On December 17, 2004, the EPA issued air quality designations for the $PM_{2.5}$ standard based on air quality monitoring data from 2001-2003. The final designations were published in the *Federal Register* on January 5, 2005 (70 FR 944). The designations became effective on April 5, 2005. On April 5, 2005, the EPA issued a supplemental notice changing the designation of certain areas from nonattainment to attainment based on newly available air quality data (70 FR 19844; published in the *Federal Register* on April 14, 2005). The EPA designated eight areas in Pennsylvania as $PM_{2.5}$ nonattainment areas, comprising all or parts of 21 Pennsylvania counties.

The Pittsburgh-Beaver Valley $PM_{2.5}$ Nonattainment Area (Pittsburgh-Beaver Valley Area) is located in southwestern Pennsylvania and consists of Beaver, Butler, Washington, and Westmoreland counties and portions of Allegheny, Armstrong, Greene and Lawrence counties. The Pittsburgh-Beaver Valley Area is required to attain the $PM_{2.5}$ NAAQS no later than five years from the effective date of designation, or April 5, 2010.

As shown in Figure E-1, five municipalities near the Clairton Coke Works in Allegheny County are designated as a separate nonattainment area, the Liberty-Clairton $PM_{2.5}$ Nonattainment Area. The Liberty-Clairton $PM_{2.5}$ Nonattainment Area was designated as

a separate, distinctively local-source impacted, nonattainment area because the combination of emissions from the coke plant in a narrow river valley creates a local air quality problem uniquely different from the remainder of the Pittsburgh-Beaver Valley Area. The Liberty-Clairton $PM_{2.5}$ Nonattainment Area was also previously designated as a PM_{10} nonattainment area.

Figure E-1: Map of Southwestern Pennsylvania $PM_{2.5}$ Nonattainment Areas



This State Implementation Plan (SIP) revision contains information on $PM_{2.5}$ trends and emissions and demonstrates that the Pittsburgh-Beaver Valley Area meets all requirements necessary for an approvable SIP revision. This SIP revision also establishes motor vehicle budgets for purposes of transportation conformity. Once the EPA approves the budgets for purposes of conformity, the Pittsburgh-Beaver Valley Area's designated Metropolitan Planning Organization (MPO), the Southwestern Pennsylvania Commission, must use these budgets in its air quality analyses for transportation planning purposes.

$PM_{2.5}$ can be emitted directly or formed secondarily in the atmosphere by chemical reactions of gases in the atmosphere. Potential precursors of secondary $PM_{2.5}$ include sulfur dioxide (SO_2), nitrogen oxides (NOx), volatile organic compounds (VOC), and ammonia (NH_3).

While emissions of direct $PM_{2.5}$ are projected to increase from 2002 to 2009 in the Pittsburgh-Beaver Valley Area, emissions of the $PM_{2.5}$ precursors SO_2 and NOx are projected to decrease over the same time period. The emissions inventory shows this apparent increase in $PM_{2.5}$ emissions from stationary sources from 2002 to 2009 because the 2002 inventory was based on emissions reported to the Pennsylvania Department of Environmental Protection (DEP or Department) by facilities and did not include condensable PM for many facilities. The projected 2009 $PM_{2.5}$ emissions for electric generating units (EGUs) include condensable PM emissions which were calculated based on factors derived from defaults contained in AP 42 Fifth Edition, Compilation of Air Pollutant Emission Factors.

. The emission projections take into account both growth in economic activity that increases emissions and control measures implemented to reduce emissions. Based on speciated data from the Lawrenceville monitor, sulfates and nitrates account for 46% of the $PM_{2.5}$ mass in the Pittsburgh-Beaver Valley Area. Because sulfates and nitrates are formed from atmospheric reactions of SO_2 and NOx, the reduction of emissions of SO_2 and NOx is expected to result in attainment of the $PM_{2.5}$ air quality standard in the Pittsburgh-Beaver Valley Area.

Table E-1: Summary of Pittsburgh-Beaver Valley Area Direct $PM_{2.5}$ and Precursor Emissions

Pollutant	2002	2009
$PM_{2.5}$	14904	27969
PM_{10}	54879	69613
SO_2	476871	129074
NOx	198483	111897
VOC	80898	63230
NH_3	5303	6440

The permanent and enforceable control measures that enable the Pittsburgh-Beaver Valley Area to demonstrate attainment of the $PM_{2.5}$ NAAQS include:

- The Clean Air Interstate Rule (CAIR) and the NOx "SIP Call" reducing interstate pollution transport;
- State regulation of smaller sources of nitrogen oxides, cement kilns and large stationary internal combustion engines;
- The Pennsylvania and federal new motor vehicle emission control programs for passenger and light-duty trucks;
- The Pennsylvania and federal heavy-duty diesel emission control programs;
- Federal fuel programs for highway vehicles and nonroad mobile equipment; and
- Federal regulation of offroad diesel and gasoline-powered vehicles and equipment.

In addition, Pennsylvania's Diesel-Powered Motor Vehicle Idling Act of 2008 will assist the Pittsburgh-Beaver Valley Area in attaining and maintaining air quality.

Pennsylvania and other member states of the Ozone Transport Commission (OTC) and Mid-Atlantic/Northeast Visibility Union (MANE-VU) worked together to analyze potential control measures. The Pennsylvania Department of Environmental Protection (Department), based on this process that included stakeholders and the other OTC/MANE-VU states, concluded that there are no additional reasonable cost-effective measures that would advance the ability of the area to attain the standard by one year or more.

The OTC's modeling platform, the Community Multi-scale Air Quality (CMAQ) photochemical grid model (version 4.5), was used to estimate projected 2009 $PM_{2.5}$ concentrations within the Pittsburgh-Beaver Valley Area. CMAQ is an Eulerian grid model capable of simulating air pollutant concentrations in the atmosphere using mathematical equations to characterize chemical and physical properties.

A review of the base case (2002) run indicated the CMAQ model did a reasonable job reproducing actual concentrations. Based on this analysis, it is reasonable to assume the model can estimate the projected $PM_{2.5}$ concentrations within the Pittsburgh-Beaver Valley Area for 2009. The year 2009 will be the last complete year of annual emissions and ambient monitoring data that the EPA will use to determine whether the Pittsburgh-Beaver Valley Area achieves attainment in April 2010.

Projected $PM_{2.5}$ concentrations from CMAQ indicate the Pittsburgh-Beaver Valley Area will attain the annual and 24-hour $PM_{2.5}$ standards in 2009. Additional evidence supporting this conclusion includes recent lower concentrations at monitors within the Pittsburgh-Beaver Valley Area, significant SO_2 controls installed on large sources within and near the Pittsburgh-Beaver Valley Area and possible model under-predictions of the air quality benefits of emission reductions.

A number of potential emission control measures were developed during the OTC/ MANE-VU/Mid-Atlantic Regional Air Management Association (MARAMA) collaborative strategy development process. These measures are outlined in the technical support document titled: *Development of Emission Projections for 2009, 2012, and 2018 for NonEGU Point, Area, and Nonroad Sources in the MANE-VU Region*, developed by MARAMA. This document, which can be found in Appendix D-1, provides details on the specific factors, control assumptions, and implementation schedules used in the emission projection calculations for each source category.

This SIP revision contains a contingency plan that provides assurance that should the Pittsburgh-Beaver Valley Area fail to meet a milestone, fail to attain the NAAQS by the attainment date or violate the standard during the maintenance period, the area can be brought back into attainment as expeditiously as practicable.

I. INTRODUCTION AND OVERVIEW

A. Health and Environmental Effects of Fine Particulate Matter ($PM_{2.5}$)

Particulate matter (PM) includes both solid and liquid particles suspended in the air. PM is chemically and physically diverse and originates from a variety of human and natural activities. PM is composed of particles in a wide range of sizes. Particles less than 10 micrometers in diameter (PM_{10}) pose a health concern because they can be inhaled into and accumulate in the respiratory system. Particles less than 2.5 micrometers in diameter ($PM_{2.5}$) are referred to as fine particles and generally pose the largest health risks. Because of their small size, fine particles can penetrate deeply into the lungs.

Many scientific studies have linked exposure to elevated levels of $PM_{2.5}$ to premature death, aggravated respiratory disease, including asthma and chronic bronchitis, cardiovascular disease, changes in lung function and increased respiratory problems, such as coughing and painful breathing, as well as increased susceptibility to respiratory infections. Individuals particularly sensitive to $PM_{2.5}$ exposure include older adults, people with heart and lung disease and children.

The recent article, "Fine-Particulate Air Pollution and Life Expectancy in the United States" by C. Arden Pope, III, et al., was published in the New England Journal of Medicine on January 22, 2009. The authors of the article were able to demonstrate that decreased $PM_{2.5}$ concentrations contributed to a significant improvement in life expectancy. The study used statistical analyses to evaluate the role the $PM_{2.5}$ reductions that occurred in the 1980s and 1990s had on the increased life expectancy observed over that period. The study found that a reduction of 10 micrograms per cubic meter ($\mu g/m^3$) of $PM_{2.5}$ was associated with an average increase in life expectancy of 7.3 months.

$PM_{2.5}$ has significant environmental impacts, including acid rain and stream eutrophication. $PM_{2.5}$ also affects visibility (regional haze) through the scattering and absorption of light. Fine particles, similar in size to the wavelength of light, are most efficient, per unit of mass, at reducing visibility. Soiling and materials damage can also be caused by $PM_{2.5}$ in the air.

B. Sources of $PM_{2.5}$ and Implications for Reduction

Fine particle pollution can be emitted directly or formed secondarily in the atmosphere. $PM_{2.5}$ emitted directly into the air in a stable solid or liquid chemical form (including $PM_{2.5}$ that is formed near its source by condensation) is referred to as "primary" $PM_{2.5}$. $PM_{2.5}$ formed by chemical reactions of gases in the atmosphere is considered to be "secondary" $PM_{2.5}$. The chemical composition of $PM_{2.5}$ in an area depends on the mix of emissions, location, time of year, and weather. The chemical composition of $PM_{2.5}$ can include sulfate, nitrate, ammonium, particle-bound water, black (elemental) carbon, a great variety of organic compounds, and miscellaneous inorganic material, such as dust and metals.

Primary $PM_{2.5}$ includes soot from diesel engines, condensed organic material from incomplete combustion and compounds from condensation during combustion or smelting.

The atmospheric chemistry of $PM_{2.5}$ formation is complex. Formation of secondary $PM_{2.5}$ depends on numerous factors, including the relative concentration of precursors, atmospheric conditions and the interactions of precursors with each other and with other particles, clouds or fog. The contribution of different precursors will vary by location.

The principal forms of secondary $PM_{2.5}$ include:

- Sulfates, formed from emissions of sulfur dioxide from power plants and industrial facilities;
- Nitrates, formed from emissions of nitrogen oxides from power plants, vehicles, and other combustion sources;
- Ammonium, formed primarily from emissions of ammonia from animal operations; and
- Secondary organic aerosol, formed from emissions of volatile organic compounds (VOCs) from incomplete combustion and evaporation from a wide diversity of sources.

To protect public health and the environment, the United States Environmental Protection Agency (EPA) is required by the Clean Air Act (CAA) to set and periodically revise National Ambient Air Quality Standards (NAAQS) for six criteria pollutants. Particulate matter is one of the criteria pollutants. The EPA sets NAAQS based on its review of existing scientific knowledge about the adverse health and welfare effects of the pollutant. After the EPA sets or revises a NAAQS, states have the responsibility for devising strategies to attain and maintain the standard. Previous particulate matter standards were set for PM and PM_{10}. In 1997, after evaluating hundreds of health studies and conducting an extensive peer review process, the EPA promulgated NAAQS based on the level of particles smaller than 2.5 micrometers ($PM_{2.5}$). In setting the 1997 standards for $PM_{2.5}$, the EPA recognized that the smaller particles were most directly associated with adverse health effects.

The EPA set the annual health-based standard for $PM_{2.5}$ at 15.0 $\mu g/m^3$. This is determined by the 3-year average of annual mean $PM_{2.5}$ concentrations. The EPA set the 24-hour standard at a level of 65 ($\mu g/m^3$), as determined by the 3-year average of the 98th percentile of 24-hour concentrations. The EPA set levels to protect the environment at the same level as it set the health-based standards. While the EPA revised the 24-hour standard in 2006 to be more protective, designation of specific nonattainment areas for the 2006 revision to the standards were not yet effective at the time this plan was developed. Therefore, this document addresses attainment of the 1997 $PM_{2.5}$ NAAQS. Measures included in this document will continue to be in place to assist with attaining the more protective standard in the future.

The Pittsburgh-Beaver Valley $PM_{2.5}$ Nonattainment Area (Pittsburgh-Beaver Valley Area), located in southwestern Pennsylvania, consists of Beaver, Butler, Washington, and

Westmoreland counties and portions of Allegheny, Armstrong, Greene and Lawrence counties. Five municipalities near the Clairton Coke Works in Allegheny County are designated as a separate nonattainment area, the Liberty-Clairton $PM_{2.5}$ Nonattainment Area. The Liberty-Clairton $PM_{2.5}$ Nonattainment Area was designated as a separate, distinctively local-source impacted, nonattainment area because the combination of emissions from the coke plant in a narrow river valley creates a local air quality problem uniquely different from the remainder of the Pittsburgh-Beaver Valley Area. The Liberty-Clairton $PM_{2.5}$ Nonattainment Area was also previously designated as a PM_{10} nonattainment area.

The Pittsburgh-Beaver Valley Area was designated as nonattainment because it violated the 1997 annual standard of 15.0 $\mu g/m^3$ based on 2001-03 monitoring data. The Pittsburgh-Beaver Valley Area did not violate the 1997 24-hour standard of 65 $\mu g/m^3$.

Because of the complexity and variability of the process of particulate matter formation, the EPA recognizes that effective control measures for $PM_{2.5}$ will vary among nonattainment areas. In the EPA's Clean Air Fine Particle Implementation Rule (72 FR 20586, April 25, 2007) (the implementation rule), the EPA established general presumptive policies for assessing which $PM_{2.5}$ precursors should be evaluated for possible controls. The EPA requires states to evaluate control measures for sulfur dioxide (SO_2) and primary $PM_{2.5}$ in all locations. The EPA requires states to evaluate control measures for nitrogen oxides (NO_x) unless a technical demonstration is made to show NO_x does not significantly contribute to $PM_{2.5}$. The EPA requires states to evaluate measures for VOC and ammonia (NH_3) only if a technical demonstration is made to show they significantly contribute to $PM_{2.5}$ in that area. While this State Implementation Plan (SIP) revision provides emissions information for all pollutants (PM_{10}, $PM_{2.5}$, SO_2, NOx, VOC and NH_3), as required, it does not provide technical demonstrations pertaining to the level of contribution by NOx, VOC, or NH_3 to $PM_{2.5}$ concentrations. Therefore, the Commonwealth will consider SO_2 and NOx as $PM_{2.5}$ precursors for purposes of this attainment plan and reasonable further progress.[1] The EPA has indicated that virtually all nonattainment problems appear to result from a combination of local emissions and transported emissions from upwind areas.[2]

The CAA requires that an area's attainment date be the date by which attainment can be achieved as expeditiously as practicable, but no later than five years from the effective date of designation, or no later than April 5, 2010. If appropriate, the EPA could extend the attainment date up to but no later than 10 years after the date of designation. States are required to propose and justify an attainment date in their attainment plan. This SIP revision sets an April 2010 attainment date for the Pittsburgh-Beaver Valley Area. The analysis is based on modeling of projected emissions for 2009 because 2009 will be the last complete year of annual emissions and ambient monitoring data that the EPA will use to determine if the Pittsburgh-Beaver Valley Area attains the standard by April 2010.

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1 The EPA's definition of $PM_{2.5}$ attainment plan precursor can be found in 40 CFR Part 51, Subpart Z, section 51.1000.

2 Clean Air Fine Particle Implementation Rule, 72 FR 20587.

The EPA Administrator is authorized under Section 179(a) of the CAA to impose sanctions after making a finding or determination relating to a SIP revision, or after disapproving a SIP revision, in whole or in part. Mandatory sanctions would be imposed for (1) a state's failure to submit a plan or plan element, or to make a submission that satisfies the minimum criteria of section 110(k) of the CAA in relation to any element of the plan; (2) the EPA's disapproval of a plan in whole or in part; (3) the EPA's determination that a state has failed to make a required submission, including a required submission satisfying the minimum criteria of section 110(k); or (4) a state's failure to implement any requirement of an approved plan. If the state fails to correct any SIP deficiency within 18 months from the Administrator's finding, determination or disapproval, mandatory sanctions would be imposed. There are two mandatory sanctions for noncomplying states: (1) limitations on certain federal highway funding; and (2) "offset" limitations on certain developments in affected areas that require each new stationary emission source to be paired with a reduction in area emissions amounting to double the amount of increased emissions from the new source.

In addition, failure to submit a plan, failure to implement a plan, or the EPA disapproval of a plan can also affect the ability of transportation planning agencies to meet transportation conformity requirements, and thus the ability to implement transportation projects. The EPA may also impose discretionary sanctions under Section 110 of the CAA.

C. Purpose and Structure of this Document

In December 2004, after consultation with states and receipt of public input, the EPA designated eight areas in Pennsylvania comprised of all or parts of 21 Pennsylvania counties as $PM_{2.5}$ nonattainment areas based on air quality monitoring data from 2001-2003. Under Section 110 of the CAA, the Commonwealth of Pennsylvania (Commonwealth or Pennsylvania) is required to develop a revision to the SIP to demonstrate how the Pittsburgh-Beaver Valley Area will attain the standard by April 2010, meet emission reduction requirements in the CAA and ensure that in the event of a future violation or failure to meet emission reduction milestones, the area is brought back to attainment as quickly as possible.

This SIP revision is organized as follows:

Section I provides general information about $PM_{2.5}$ pollution, including information about the health and environmental impacts of $PM_{2.5}$ and sources of $PM_{2.5}$ and its precursors. Section I also provides an overview of the health-based $PM_{2.5}$ standard and Pennsylvania's responsibility to develop strategies to attain air quality standards.

Section II provides information characterizing the $PM_{2.5}$ problem in the Pittsburgh-Beaver Valley Area, examines current monitoring information, and analyzes trends.

Section III describes emission inventories for $PM_{2.5}$ and its precursors, SO_2 and NOx. Base year and projected emission inventories are also included as required for PM_{10}, VOC and NH_3. Section III describes how this SIP revision meets the requirement for "reasonable further progress" under Section 172 of the CAA[3]. Section III also contains the highway vehicle emission budgets for purposes of transportation conformity. Technical information on methodologies and inputs for point, area, highway and nonroad actual and projected emission inventories is contained in the Appendices B through F, relating to: (1) stationary point sources; (2) stationary area sources; (3) emissions projections; (4) highway vehicle sources inventory information; and (5) nonroad sources.

Section IV describes the control measures implemented in the Pittsburgh-Beaver Valley Area that produce emission reductions between 2002 and 2009 in order to attain the NAAQS in a timely fashion and how Pennsylvania meets the requirement for identifying Reasonably Available Control Measures (RACM) that could advance the attainment of the standard by one year or more. Appendix G, relating to Reasonably Available Control Measures, includes specific information and recommendations developed by the Ozone Transport Commission (OTC) and the Mid-Atlantic/Northeast Visibility Union (MANE-VU)states for additional controls to aid in reaching attainment.

Section V discusses the modeling that was done to evaluate attainment by April 2010 and the "weight of evidence" analysis. Together, these comprise the attainment demonstration. Based on modeling, statistical analyses and other evidence, the attainment demonstration indicates the Pittsburgh-Beaver Valley Area will attain the 1997 $PM_{2.5}$ standards by April 2010. Appendix H includes detailed technical information on the Community Multi-scale Air Quality (CMAQ) model performance, meteorological data, modeling emission inventories and modeling analysis used to project 2009 annual and 24-hour $PM_{2.5}$ design values.

Section VI is the contingency plan, meeting the requirement that the Commonwealth be able to address unanticipated failures to meet emission or air quality requirements in a timely fashion.

D. Public Participation

Requirements for a public comment process are set forth in Section 110(a)(2) of the CAA, 40 CFR Section 51.102(d) and 35 P.S. Section 4007.5 On September 5, 2009, the Pennsylvania Department of Environmental Protection (DEP or Department) published a notice of public hearing and commenced a 30-day written comment period on the proposed attainment demonstration and base year inventory for the Pittsburgh-Beaver Valley Area. 39 Pa.B. 5278. The Department held a public hearing in Pittsburgh on the proposed SIP revision on October 6, 2009. The public comment period closed on October 9, 2009. The Department has prepared a Comment and Response Document addressing comments received during the public participation process. Proof of public notice and a copy of the Comment and Response Document are included in the SIP submittal.

3 Clean Air Fine Particle Implementation Rule, 72 FR 20633.

II. NATURE OF THE PROBLEM IN THE PITTSBURGH-BEAVER VALLEY AREA

A. Background

The Pittsburgh-Beaver Valley Area, located in southwestern Pennsylvania, consists of Beaver, Butler, Washington, and Westmoreland counties and portions of Allegheny, Armstrong, Greene and Lawrence counties. Five municipalities near the Clairton Coke Works in Allegheny County are designated as a separate, local-source impacted nonattainment area, the Liberty-Clairton $PM_{2.5}$ Nonattainment Area. Other $PM_{2.5}$ nonattainment areas near the Pittsburgh-Beaver Valley Area include Morgantown, WV to the south, Stuebenville-Weirton, OH-WV to the west, Youngstown, OH to the northwest and Johnstown, PA to the east. Topographically, the Pittsburgh-Beaver Valley Area is bounded on the east by the high terrain of the Laurel and Chestnut Ridge Mountains. There are several major rivers that run through the region, including the Ohio, Allegheny, Monongahela, and Youghiogheny. These rivers, along with the rising terrain around them, create unique wind patterns.

Several types of $PM_{2.5}$ monitors operate within the Pittsburgh-Beaver Valley Area. These include eleven federal reference method (FRM) monitors. Five of these sites are operated by the Department, including Beaver Falls, Charleroi, Florence, Greensburg, and Washington. The additional six monitors, which include Coraopolis, Harrison, Lawrenceville, North Braddock, North Park, and South Fayette, are operated by the Allegheny County Health Department (ACHD). In addition to the FRMs, three speciation monitors (at Florence, Greensburg, and Lawrenceville) and four continuous monitors (at Beaver Falls, Charleroi, Kittanning, and Lawrenceville) are maintained within the region. FRM data has been collected since 1999 on a one in three day frequency (1/3). Speciated monitoring on a one in six day frequency (1/6) has occurred since April of 2002, while the Tempered Element Oscillating Microbalance (TEOM) monitor has operated almost continuously since August 2004.

B. Air Quality Monitoring Trends Analysis

A short summary of monitoring trends in the Pittsburgh-Beaver Valley Area is provided as follows:

1. Design Value Trend

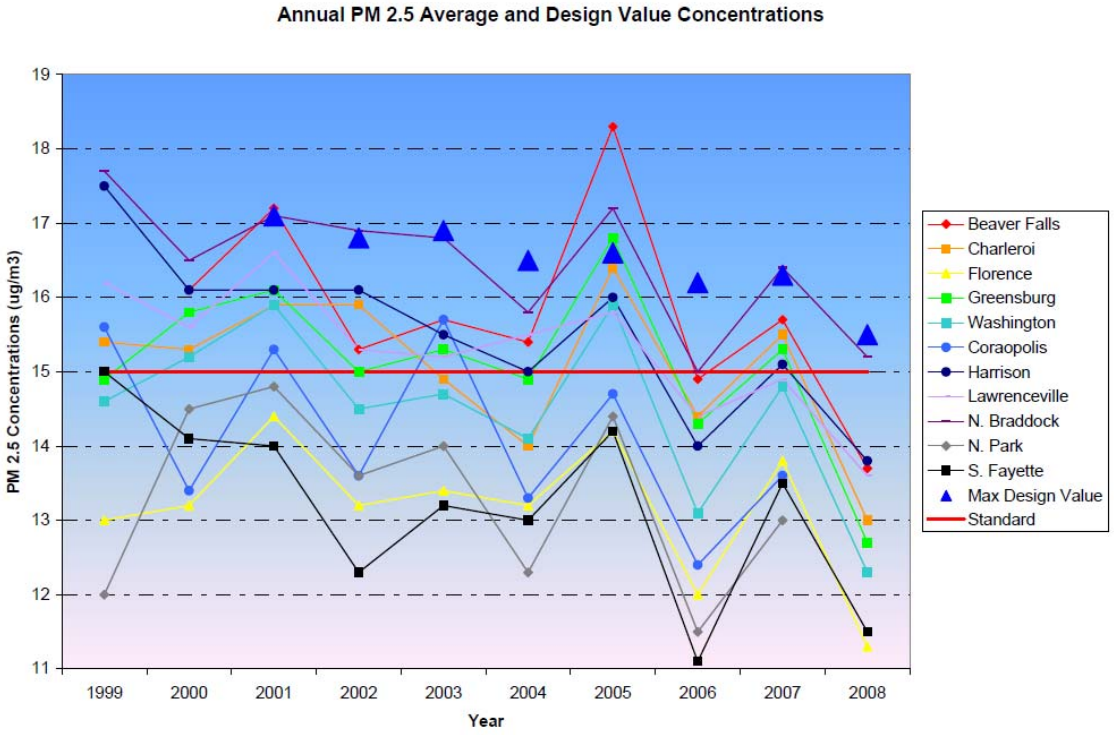
Table II-1: Pittsburgh-Beaver Valley Area Annual $PM_{2.5}$ Average and Design Value Trend (ug/m3)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Beaver Falls		16.14	17.19	15.26	15.67	15.38	18.30	14.87	15.72	13.69
Charleroi	15.44	15.27	15.90	15.88	14.89	13.99	16.36	14.42	15.51	13.03
Florence	12.98	13.20	14.43	13.21	13.40	13.21	14.23	11.94	13.79	11.30
Greensburg	14.90	15.78	16.11	14.96	15.32	14.92	16.81	14.32	15.26	12.67
Washington	14.58	15.16	15.85	14.49	14.74	14.14	15.88	13.08	14.83	12.27
Coraopolis *	15.63	13.38	15.33	13.63	15.71	13.26	14.67	12.38	13.64	
Harrison	17.45	16.09	16.11	16.09	15.50	15.02	15.95	14.03	15.06	13.39
Lawrenceville	16.23	15.63	16.58	15.33	15.20	15.46	15.82	14.40	14.89	12.87
N. Braddock	17.69	16.45	17.09	16.92	16.80	15.79	17.16	15.03	16.38	14.15
N. Park *	11.99	14.49	14.87	13.63	13.96	12.28	14.44	11.50	13.02	
S. Fayette	14.98	14.09	14.04	12.31	13.23	13.00	14.22	11.14	13.47	10.77
Max Annual Value			**17.19**	**16.92**	**16.80**	**15.79**	**18.30**	**15.03**	**16.38**	**14.15**

Source: Data extracted from Appendix A-1 (US EPA Air Quality System AMP 450 Report)

* The Coraopolis and N. Park monitor were shut down for 2008 due to limited staff at ACHD

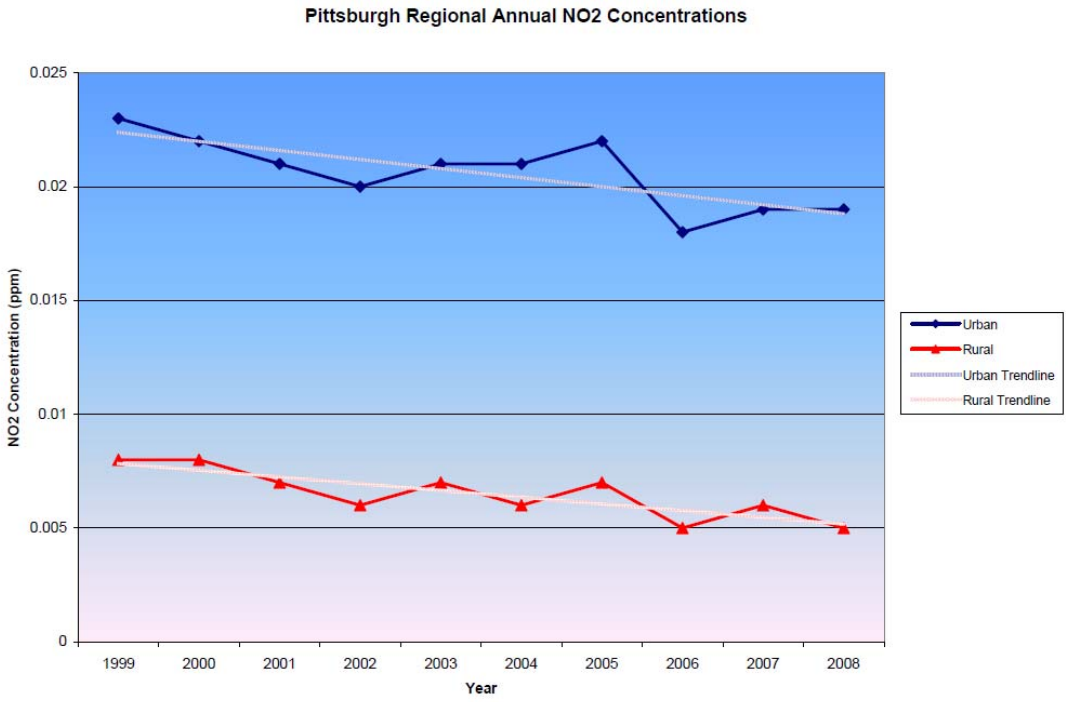
Figure 1: Pittsburgh-Beaver Valley Area Monitor Trend



2. NO_2 Monitoring Trend

Figure 2: NO_2 Monitoring Trend

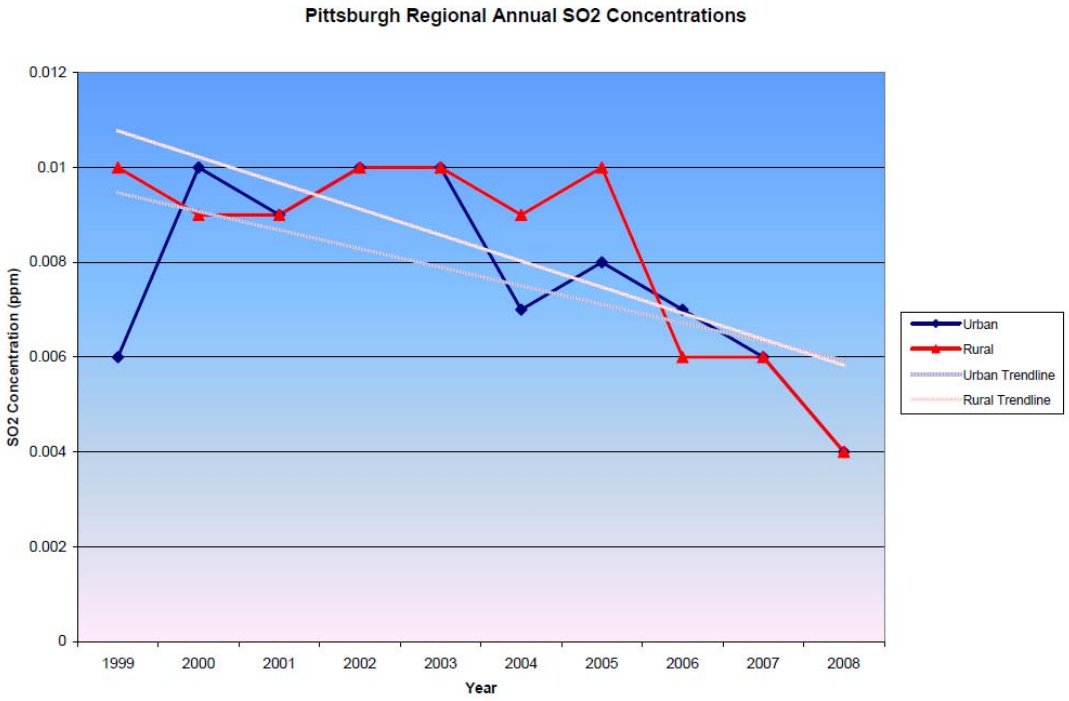
Figure 2 displays the rural vs. urban annual NO_2 concentration trend from 1999 to 2008. The rural monitor is adequately represented by the monitored values at Florence. The urban monitor is adequately represented by the Pittsburgh (Carnegie) monitor.



3. SO_2 Monitoring Trend

Figure 3: SO_2 Monitoring Trend

The following graph displays the rural vs. urban annual SO_2 concentration trend from 1999 to 2008. The rural monitor is adequately represented by the monitored values at Florence. The urban monitor is adequately represented by the Pittsburgh (Carnegie) monitor.



C. Seasonal Variability

1. FRM Monitoring Trends

Summary of seasonal variability in FRM data: There appears to be little variability in quarterly FRM values at monitors located in the Pittsburgh-Beaver Valley Area. In the more urbanized areas, monitored values during the 1st, 2nd and 3rd quarters tend to run higher than 4th quarter values. By contrast, the monitoring sites in rural areas (such as Florence and South Fayette) have substantially higher 2nd and 3rd quarter averages than 1st and 4th quarter averages.

2. Speciation Monitoring Trends

Summary of seasonal variability in speciated data: Raw speciation data for the Pittsburgh-Beaver Valley Area indicates some seasonal variability in the primary components. Sulfates have the largest variability with 1st quarter concentrations approximately half concentrations measured in the 3rd quarter. Nitrates vary in nearly the

opposite direction with 1st quarter measurements higher than 2nd, 3rd and 4th quarter measurements. Organic carbon, elemental carbon, ammonium and crustal mass do not appear to show much seasonal variability.

III. EMISSION INVENTORIES

Section 51.1008 of 40 CFR Part 51 requires an inventory of pollutants to meet the requirements of section 172(c)(3) of the CAA. As specified by the EPA, the pollutants inventoried by Pennsylvania include PM_{10}, $PM_{2.5}$, SO_2, NOx, VOC, and NH_3. In addition, projections of future emissions have been made for the milestone year 2009. Information on the manmade sources of direct PM and its potential precursors, SO_2, NOx, VOC, and NH_3 was compiled for:

- "Stationary sources" (or "point" sources), which are sources for which the Department collects individual emissions-related information. Generally, they represent major stationary sources but may be smaller.

- "Area sources," which are industrial, commercial, and residential sources too small or too numerous to be handled individually. These include but are not limited to commercial and residential open burning, architectural and industrial maintenance coatings application and clean-up, consumer product use, and vehicle refueling at service stations. Where there is overlap between stationary point sources and stationary area sources, the area source values are adjusted to remove any double counting.

- "Highway vehicles," which include passenger cars and light-duty trucks, other trucks, buses and motorcycles.

- "Nonroad sources," which encompass a diverse collection of engines, including but not limited to outdoor power equipment, recreational vehicles, farm and construction machinery, lawn and garden equipment, industrial equipment, recreational marine vessels, commercial marine vessels, locomotives, ships, and aircraft.

The inventory for the Pittsburgh-Beaver Valley Area was compiled for the following counties and partial counties that comprise the nonattainment area:

- Beaver, Butler, Washington, and Westmoreland counties
- Armstrong County (partial) – Elderton Borough, Plumcreek Township, and Washington Township
- Greene County (partial) – Monongahela Township
- Lawrence county (partial) – Township of Taylor south of New Castle City
- Allegheny County (partial) – entire county except Lincoln Borough, Clairton City, Glassport Borough, Liberty Borough, and Port Vue Borough which comprise the Liberty-Clairton $PM_{2.5}$ Nonattainment Area.

Emissions were estimated for the partial counties in the nonattainment area as follows. Point source emissions were included in the inventory if the point source is located in the nonattainment area. Area source and nonroad source emission estimates were apportioned

to the nonattainment area based on the percentage of county population in the nonattainment municipalities, using U.S. Census Bureau sub-county population data.

Mobile source VMT and emissions were estimated for the partial counties in the nonattainment area using the following methodology. The townships within each partial county were identified based on the nonattainment area designation description. Using GIS, township boundaries were overlaid on the PennDOT Roadway Management System (RMS) state roadway segments and used to identify which road segments fell within the nonattainment area. These state roadway segments were used for the analysis of VMT and emissions for non-local state-owned roadways.

The PennDOT RMS roadway data contains some local segments (those which are state-owned and function as local roads). Since the RMS database does not contain a comprehensive representation of local roads, local VMT is typically reconciled to the reported HPMS local VMT for each county in Pennsylvania. For the partial areas the following methods were used to estimate local VMT:

Three methods were analyzed for each partial county in the nonattainment area and the highest values were chosen to ensure that local VMT was not under-represented in the analysis. These values were used to estimate emissions for the partial counties in the nonattainment area. The methods are:

- Calculate local VMT based on local road segments in RMS database (as discussed this could underestimate local VMT)
- Using GIS, determine the portion of the Topologically Integrated Geographic Encoding and Referencing (TIGER)[4] roadway local mileage in the nonattainment municipalities vs. county total and apply this percentage to county HPMS local VMT.
- Determine the percentage of population in nonattainment municipalities versus the county population and apply this percentage to county HPMS local VMT.

A. Summary of 2002 Emissions

An emission inventory is an estimate of the emissions from sources in a particular area. The Department developed an emission inventory for 2002, which is the base year for attainment planning purposes with respect to 8-hour ozone and $PM_{2.5}$ SIPs, and for planning purposes with respect to the regional haze SIPs. The 2002 base year inventory includes the pollutants PM_{10}, $PM_{2.5}$, SO_2, NOx, VOC, and NH_3. The inventory consists of sources in four sectors: stationary point sources, stationary area sources, highway vehicle sources and nonroad sources. MANE-VU compiled a regional inventory from the

4 The Census Bureau's Geography Division maintains two databases used in this analysis. The MAF, or Master Address File, is a complete and current list of all addresses and locations where people live or work, covering an estimated 115 million residences, as well as 60 million businesses and other structures in the U.S. The TIGER® is a digital database that identifies the type, location and name of streets, rivers, railroads and other geographic features, and geospatially defines their relationships to each other, to the MAF addresses, and to numerous other entities. See http://www.census.gov/geo/www/tiger

emission inventories of the Northeastern and Mid-Atlantic states. This regional inventory was used to perform the regional modeling analysis used in Pennsylvania's air quality management planning efforts to attain the 8-hour ozone NAAQS and the $PM_{2.5}$ NAAQS, and to prepare the regional haze plan.

An emissions inventory for the base year, 2002, was developed in accordance with EPA guidance[5]. Table III-1 summarizes the emissions for 2002.

Table III-1: 2002 Annual Emissions (Tons per Year)

Pittsburgh-Beaver Valley Area 2002	**$PM_{2.5}$**	**PM_{10}**	**SO_2**	**NOx**	**VOC**	**NH_3**
Stationary Point Sources	4868	11149	463501	110618	5157	462
Area Sources	7916	41206	9905	8622	36683	2948
Highway Vehicle Sources	824	1164	1770	53268	25638	1884
Non-Road Sources	1297	1359	1694	25975	13421	8
Totals	14904	54879	476871	198483	80898	5303

B. Summary of Inventory Methodologies

Inventory development methodology is summarized below.

Stationary Point Sources. The Department requires owners and operators of larger facilities to submit annual production figures and emission calculations each year. Throughput data are multiplied by emission factors from Factor Information Retrieval (FIRE) Data System and the EPA's publication series AP-42 and are based on Source Classification Code (SCC). Each process has at least one SCC assigned to it. If the owners and operators of facilities provide more accurate emission data based upon other factors, these emission estimates supersede those calculated using SCC codes. Appendix B-1 includes information on stationary point source emission methodology, and Appendix B-2 is the data set for facility 2002 annual emissions. Appendix B-3 is a table documenting the banked emissions reduction credits for the Pittsburgh-Beaver Valley Area in the 2009 emission projection.

The 2002 inventory was based on emissions reported to the Department by facilities. In 2002, many facilities did not include condensable PM in their estimates of direct PM emissions. Condensable PM is a vapor or gas at stack temperature that condenses to a liquid or solid at stack exit.

Area Sources. Area source emissions are generally estimated by multiplying an emission factor by some known indicator or collective activity for each area source category at the

5 Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations – EPA-454/R-05-001. August, 2005. Updated November, 2005.

county level. Pennsylvania estimates emissions from area sources using emission factors and SCC codes in a method similar to that used for Stationary Point Sources. Emission factors may also be derived from research and guidance documents if those documents are more accurate than FIRE and AP-42 factors. Throughput estimates are derived from county-level activity data, by apportioning national or statewide activity data to counties, from census numbers, and from county employee numbers. County employee numbers are based upon North American Industry Classification System (NAICS) codes to establish that those numbers are specific to the industry covered. More specific information on the procedure used for each industry type is contained in Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods, (E.H. Pechan & Associates, Inc., February 2004) which is contained in Appendix C-1. Appendix C-2 is a table containing stationary area sources emissions data for the Pittsburgh-Beaver Valley Area.

Highway Vehicle Sources. The Department employs an emissions estimation methodology that uses the current EPA-approved highway vehicle emission model, MOBILE 6.2, to estimate highway vehicle emissions. In addition, Pennsylvania uses a MOBILE pre- and post-processing software package called PPSUITE to process and compile Pennsylvania's robust highway network and detailed highway vehicle data. The Pennsylvania Department of Transportation (PennDOT) provided estimates of vehicle miles traveled (VMT) by vehicle type and roadway type. The Pennsylvania methodology is consistent with the January 2002 guidance published by the EPA's Office of Transportation and Air Quality (OTAQ) entitled, *Technical Guidance on the Use of MOBILE6 for Emissions Inventory Preparation*.

More information on highway emission methodology is available in Appendix E. Appendix E-1 provides the 2002 base year and 2009 projections of mobile (highway) VMT and annual $PM_{2.5}$ direct and precursor emissions. The document summarizes the methodology and data inputs used to produce the mobile emissions inventory. Appendix E-2 is the table of 2009 Pittsburgh-Beaver Valley Area Annual Highway Emissions listed by SCC. Appendix E-3 describes the inputs to MOBILE6.2 used to generate emission factors for a specific area. Some examples of the inputs described in Appendix E-3 are the type and frequency of vehicle emission testing, the fuel types required in the area, temperatures by month, and fleet age. The summary in Appendix E-3 indicates when default information contained in the model is used rather than specific area information. Finally, Appendix E-4 is an electronic file that provides all of the input coding for a sample segment and scenario used in Pennsylvania's MOBILE6.2 modeling system.

Nonroad Sources. The 2002 emissions for the majority of nonroad emission source categories and pollutants were estimated using the EPA NONROAD 2005 model. The NONROAD model estimates emissions for diesel, gasoline, liquefied petroleum gasoline, and compressed natural gas-fueled nonroad equipment types and includes growth factors. The National Mobile Inventory Model (NMIM) was used to estimate emissions of ammonia from sources contained in the NONROAD model. The NONROAD model does not estimate emissions from aircraft, locomotives or commercial marine vessels. Emissions from aircraft, locomotives, and commercial marine vessels were estimated using EPA guidance and best available information. If specific local operational data was

available, that data was used to estimate emissions. State and national data was used if local data was unavailable.

Emissions from commercial aircraft operations for 2002 were estimated using the EPA-approved Emissions and Dispersion Modeling System (EDMS) 4.20, the latest version available at the time the inventory was developed. Pittsburgh International Airport (PIT) supports the vast majority of the commercial aircraft operations in the Pittsburgh-Beaver Valley Area. In addition, a military wing flies cargo aircraft out of PIT. The Department estimated emissions using operations data obtained from the United States Department of Transportation, Federal Aviation Administration's (FAA) Terminal Area Forecast for commercial aircraft operations and the Airnav.com website for military operations. Using this operations data, emissions were modeled directly using the EDMS.

Emissions produced by aircraft at small airports in the Pittsburgh-Beaver Valley Area were estimated by using airport operation statistics, which can be found at www.airnav.com and the Federal FAA's Terminal Area Forecast Detailed Report. An emissions factor for a typical general aviation single engine, multi-engine, and jet engine aircraft were derived by averaging the emissions factors from a basket of emission factors for common aircraft of each of the three types of aircraft. Emission factors and operational characteristics contained in EDMS were used. The proportion of operations among the three groups of aircraft was determined by examining the number of each aircraft type based at each airport. For military operations at small airports, the type of aircraft and its emission factors are sometimes identifiable. If not, emission factors calculated to represent an "average" military aircraft are used. Growth was estimated using estimates of future operations at Pittsburgh airports found in the FAA Terminal Area Forecast Detailed Report.

For 2002 locomotive emissions, the Department projected emissions from a 1999 survey when the Department obtained fuel use statistics from class II and III railroads. For class I railroads, which produce most of the emissions in the Commonwealth, the Department conducted a 2002 inventory because the 1999 fuel use data for class I railroads was skewed by gridlock caused by the acquisition of Conrail by CSX and Norfolk Southern. Emissions were generated using EPA emission factors. Emissions were grown using national railroad fuel use trends supplied by the Association of American Railroads.

All air emissions from commercial marine vessel (CMV) traffic in the seven county area of the Port of Pittsburgh were estimated using the methodology outlined in the EPA's publication *Commercial Marine Activity for Great Lakes and Inland River Ports in the United States, Final Report*. A comprehensive understanding of the methodology can be achieved by reviewing this document. Additional information was obtained from conversations with tug operators in the port. Emission estimates were based on number of CMV trips, trip durations, lock data, and the engine size of the tug fleet based in the Pittsburgh-Beaver Valley Area. Emissions were distributed to the county level based on the number of piers, wharves, and docks in each individual county. Relevant CMV operational data was obtained from the U.S. Army Corps of Engineers website.

Appendix F-1 is the technical document providing the methodology and description of the procedures used to generate 2002 and 2009 county-level pollutant emission estimates for nonroad mobile engines included in the EPA's NONROAD2005 model, locomotive engines, and aircraft operations. The table of the specific emissions data used to calculate the nonroad emissions sorted by source category is available as Appendix F-2.

C. Projected Inventories

1. Summary of 2009 Estimated Emissions

Table III-2 summarizes the emissions expected in 2009. These emissions take activity and emissions growth and/or controls from 2002 into account. Appendix D, relating to emissions projections, contains the technical support documents that describe the methodologies used to project the 2002 baseline emissions to 2009.

Table III-2: 2009 Projected Emissions (Tons per Year)

Pittsburgh-Beaver Valley Area 2009	**$PM_{2.5}$**	**PM_{10}**	**SO_2**	**NOx**	**VOC**	**NH_3**
Stationary Point Sources	18160	24710	114889	51361	4666	782
Area Sources	8127	42749	10452	9101	34042	3528
Highway Vehicle Sources	509	852	230	28739	14098	2121
Non-Road Sources	1142	1200	1385	21246	10055	9
Emission Reduction Credits Banked	31	102	2118	1450	368	0
Totals	27969	69613	129074	111897	63230	6440

Sulfur and nitrogen are the major contributors to the Pittsburgh-Beaver Valley Area's $PM_{2.5}$ nonattainment problem. Therefore, even though the direct $PM_{2.5}$ emissions are predicted to increase in 2009, the reductions of $PM_{2.5}$ precursors, SO_2 and NOx, will ensure that the Pittsburgh-Beaver Valley Area attains the $PM_{2.5}$ NAAQS by 2010. The emissions inventory shows this apparent increase in $PM_{2.5}$ emissions from stationary sources from 2002 to 2009 because the 2002 inventory was based on emissions reported to the Department by facilities and did not include condensable PM for many facilities. The projected 2009 $PM_{2.5}$ emissions for electric generating units (EGUs) include condensable PM emissions which were calculated based on factors derived from AP-42 defaults.

2. Growth Projection Methodologies

This section describes the data, methods, and assumptions utilized in developing estimates of emissions changes between 2002 and the milestone year 2009. Appendix D-1 contains the technical support document entitled, *Development of Emission Projections for 2009, 2012, and 2018 for Non-EGU Point, Area, and Nonroad Sources in the MANE-VU Region*, developed by Mid-Atlantic Regional Air Management Association

(MARAMA). The document provides details on the specific factors, control assumptions, and implementation schedules used in the emission projection calculations for each source category.

Stationary Point Sources. For EGUs, the Department used the EPA's Integrated Planning Model (IPM) modeling as adjusted by the Visibility Improvement State and Tribal Association of the Southeast (VISTAS), specifically VISTAS 2.1.9, to predict the results of the EPA's CAIR at affected facilities throughout the CAIR region. The emissions for 2009 resulting from application of the CAIR cap and trade program for annual NOx emissions, as predicted by IPM, were used. IPM estimates NOx and SO_2 emissions only. Operating parameters predicted by IPM for each EGU and emission factors were used to predict emissions of VOC, PM_{10}, $PM_{2.5}$, condensable PM, and NH_3. The technical support documents that describe the methodologies used to project the emissions from EGUs, *Documentation of 2018 Emissions from Electric Generating Units in the Eastern United States for MANE-VU's Regional Haze Modeling* (Alpine Geophysics, April 2008) and *Future Year Electricity Generating Sector Emission Inventory Development Using the Integrated Planning Model (IPM®) in Support of Fine Particulate Mass and Visibility Modeling in the VISTAS and Midwest RPO Regions* (ICF, April 2005) are included as Appendices D-2 and D-3, respectively.

For non-EGU point sources, the methodology for projecting emissions to 2009 is the same as the methodology described below for stationary area sources as documented in Appendix D-1, *Development of Emission Projections for 2009, 2012, and 2018 for Non-EGU Point, Area, and Nonroad Sources in the MANE-VU Region*. This report was prepared for MARAMA as part of an effort to assist states in developing attainment plans for ozone and fine particles, and in developing regional haze plans. It describes the data sources, methods, and results for emission forecasts for three years, three emission sectors, two emission control scenarios, seven pollutants, and 11 states plus the District of Columbia. MARAMA developed projections for 2009, 2012, and 2018.

The projected 2009 $PM_{2.5}$ emissions for EGUs include condensable PM. Emissions of condensable PM were calculated based on factors derived from AP-42 defaults. Because the 2002 inventory was based on emissions reported to the Department by facilities and did not include condensables for many facilities, the emissions inventory shows an apparent increase in $PM_{2.5}$ emissions from stationary sources from 2002 to 2009.

Area Sources. Area source emissions were projected from the 2002 inventory.

The factors used for the temporal allocation of projections to 2009 from the 2002 baseline inventory were provided by MARAMA, which is coordinating air quality technical projects for the Northeast and Mid-Atlantic states. The factors were in the form of Sparse Matrix Operator Kernel Emissions (SMOKE) v2.2 input files[6].

6 For additional information on the SMOKE file formats, please refer to the SMOKE v2.2 Users Manual, available from the Center for Environmental Modeling for Policy Development (CEMPD) at http://cf.unc.edu/cep/empd/products/smoke/index.cfm#Documentation.

A table of growth factors for 2009 was provided by MARAMA. For each state, county and SCC, this table includes state growth factors derived from the Energy Information Administration (EIA) Annual Energy Outlook, 2005; and/or factors extracted from the Economic Growth Analysis System (EGAS). Where more than one factor was available, the first choice was the EIA factor followed by the EGAS factor.

MARAMA also supplied tables of control factors, rule effectiveness factors, and rule penetration factors for any control measures applicable to these sources.

For the area sources, these factors were available by SCC and pollutant. There may be more than one generic control factor that applies to a given SCC and pollutant. In cases where there was more than one applicable factor, the following formula may have been applied recursively to generate reductions that are a composite of those factors.

$$Emissions_{Controlled} = Emissions - \left(\left(CF \times RE \times RP\right) \times Emissions\right)$$

Where

CF is the control factor
RE is the rule effectiveness factor
RP is the rule penetration factor

As described for stationary point sources above, Appendix D includes the MARAMA report, *Development of Emission Projections for 2009, 2012, and 2018 for NonEGU Point, Area, and Nonroad Sources in the MANE-VU Region,* which documents the methodology for projecting emissions to 2009.

Highway Vehicle Sources. The EPA's approved highway vehicle emission model, MOBILE 6.2, projects highway vehicle average fleet emission factors. State specific information was used where available and appropriate. Traffic forecasts were compiled using information from PennDOT's Traffic Information System and socioeconomic data. The Pennsylvania methodology for estimating highway vehicle emissions is consistent with the January 2002 guidance published by the EPA's Office of Transportation and Air Quality (OTAQ) entitled, *Technical Guidance on the Use of MOBILE6 for Emissions Inventory Preparation.* Appendices E-1 through E-5 include specific information on the highway emissions inventory methodology, data files of emissions estimates, MOBILE6.2 input parameters, a MOBILE6.2 sample input file, and the traffic growth forecasting system report.

As shown in Table III-3, VMT for the future analysis year increases 11% from 18.3 billion to 20.3 billion VMT within the nonattainment area. Despite the growth in VMT, emissions of the most significant vehicle-related precursor, NOx, are significantly lower in the future analysis year.

Table III-3: Regional Nonattainment Area VMT and Emissions

YEAR	VMT	Direct PM		VOC	NOx	SO_2	NH_3
		$PM_{2.5}$	PM_{10}				
2002	18,322,527,954	824	1,164	25,638	53,268	1,770	1,884
2009	20,266,112,739	509	852	14,098	28,739	230	2,121

Nonroad Sources. Projected emissions for the majority of nonroad emission source categories and pollutants were estimated using the EPA NONROAD 2005 model, which contains default assumptions for projected years. The NMIM estimated future ammonia emissions from source categories in the NONROAD model. The NONROAD model and NMIM estimate emissions for diesel, gasoline, liquefied petroleum gasoline, and compressed natural gas-fueled nonroad equipment types and include growth factors.

Future aircraft emissions from small and large airports were calculated by using future airport operation estimates, which can be found in the FAA's Terminal Area Forecast Detailed Report. Emission factors from aircraft and the aircraft mix remained unchanged in future years.

For locomotive emissions, the Department projected emissions from 2002 to 2009, using national fuel consumption data obtained from the Association of American Railroads and the EPA emission factors developed for the locomotive fleet in future years.

Commercial marine vessel emissions were grown using projected activity, fuel use and emission estimates from the EPA document, *Final Regulatory Analysis: Control of Emissions from Marine Diesel Engines, November 1999.*

Additional information about nonroad emission projection methodologies can also be found in Appendix F. Appendix F-1 is the technical document providing the methodology and description of the procedures used to generate 2002 and 2009 county-level pollutant emission estimates for nonroad mobile engines included in the EPA's NONROAD2005 model, locomotive engines and aircraft operations. The table of nonroad emissions data sorted by source category is available as Appendix F-2.

D. Reasonable Further Progress (RFP) Requirements

Section 172(c)(2) of the CAA requires that plans for nonattainment areas provide reasonable further progress. In accordance with 40 CFR 51.1009, if a state submits an attainment demonstration for an area which demonstrates that the area will attain the $PM_{2.5}$ NAAQS within five years of designation, the state is not required to submit a separate RFP plan. In that case, compliance with the emission reduction measures in the attainment demonstration and SIP will meet the requirements for achieving RFP for the area. This attainment demonstration and SIP revision demonstrate that the Pittsburgh-Beaver Valley Area will attain the $PM_{2.5}$ NAAQS by the area's attainment date of April 2010, which is

within five years of designation. Therefore, compliance with the emission reduction measures described in this plan meets the requirements for achieving RFP for the area.

E. Motor Vehicle Emission Budgets for Transportation Conformity

Section 176 of the CAA provides a mechanism by which federally funded or approved highway and transit plans, programs, and projects are determined not to produce new air quality violations, worsen existing violations, or delay timely attainment of the NAAQS. . EPA regulations issued to implement transportation conformity provide that motor vehicle emission "budgets" establish caps of these emissions that cannot be exceeded by the predicted transportation system emissions in the future. Transportation agencies in Pennsylvania are responsible for making timely transportation conformity determinations. The responsible agency in the Pittsburgh-Beaver Valley Area is the Southwestern Pennsylvania Commission, the designated Metropolitan Planning Organization (MPO) under federal transportation planning requirements.

Pennsylvania proposes to establish budgets for highway emissions for direct $PM_{2.5}$ and NOx in order to ensure that transportation emissions do not impede clean air goals in the next decade and beyond. The information in Table III-5, once the EPA approves it for purposes of conformity, will establish transportation conformity budgets for the Pittsburgh-Beaver Valley Area.

Amendments to the 40 CFR part 93 transportation conformity regulations to address the 1997 $PM_{2.5}$ standard were published in the *Federal Register* on May 6, 2005 (70 FR 24280) to account for $PM_{2.5}$ and its precursors. Section 93.102 requires conformity determinations to be applicable to direct emissions of $PM_{2.5}$ and NOx (unless a determination is made that transportation-related emissions are not significant contributors to $PM_{2.5}$), but to emissions of SOx, VOC, and NH_3 only if a finding is made that transportation-related emissions of these pollutants are significant contributors to $PM_{2.5}$.

Motor vehicle emissions of SOx, VOC, and NH_3 were analyzed to determine if motor vehicle budgets should be established for these pollutants. Table III-4 illustrates the on-road mobile source fraction of the total 2009 inventory for each of these pollutants. VOC and NH_3 account for a total of 22.30 % and 32.93 % of the total projected 2009 inventory for VOC and NH_3, respectively. Motor vehicle emissions of SOx account for 0.18 % of the total projected 2009 inventory.

Table III-4 Comparison of 2009 On-Road Mobile Precursor Emissions to the Total Projected 2009 Inventory

2009	SO_2	VOC	NH_3
On-Road Mobile Source Projected Inventory (Tons)	230	14098	2121
Total Projected 2009 Inventory (Tons)	129074	63230	6440
Percent of Total Projected 2009 Inventory (%)	0.18	22.30	32.93

Motor vehicle emissions budget for SOx, VOC, and NH_3 are needed only if the state air agency director or the EPA Regional Administrator makes a finding that motor vehicle emissions budgets must be established in order to attain the NAAQS for $PM_{2.5}$. Because the reactions that form particulate matter from emissions of VOC are complex and highly variable, there is considerable uncertainty regarding the contribution of VOC to particulate formation. Likewise, much uncertainty remains regarding the role of NH_3 in particulate formation. As discussed earlier in Section I, the Commonwealth is not considering VOC or NH_3 as $PM_{2.5}$ precursors for the purpose of the attainment plan because of the uncertainty surrounding their role in particulate formation. Therefore, this SIP revision is not establishing a motor vehicle emission budget for VOC or NH_3. As shown in Table III-4, motor vehicle emissions of SO_2 are a small percentage of the total inventory. Based on these facts and the fact that no applicable finding has been made for these pollutants, this SIP revision is only establishing motor vehicle emission budgets for direct $PM_{2.5}$ and NOx, as shown in Table III-5.

Table III-5: Motor Vehicle Emission Budgets

2009	$PM_{2.5}$	NOx
Tons/year	509	28739

The Department has included direct $PM_{2.5}$ re-entrained road dust emissions from paved and unpaved roads in the area source inventory. However, a number of fugitive dust studies have indicated that the $PM_{2.5}$ / PM_{10} ratios measured by EPA FRM samplers are significantly lower than predicted by AP-42 emission factors. As a result, the $PM_{2.5}$ emission estimates using AP-42 are biased high by as much as a factor of two, compared to FRM samplers. The Department believes that the emissions from paved and unpaved roads are significantly over-predicted and, therefore, has not included those emissions in the motor vehicle emission budgets at this time. Appendix C-2, relating to area source annual emissions, contains estimates of the $PM_{2.5}$ emissions attributable to paved and unpaved roads.

Transportation construction-related fugitive dust emissions are not a significant contributor to the air quality problem. At the Pittsburgh-Beaver Valley Area speciation monitor, the crustal component was found to be small compared to other components of $PM_{2.5}$ (see

Section V, Figure 5). Given that construction-related fugitive dust is one of many source categories contributing to the crustal material observed at the monitor, and transportation construction is a small subset of all construction, it is safe to conclude that transportation construction-related fugitive emissions are insignificant.

IV. CONTROL STRATEGIES

A. Permanent and Enforceable Control Measures

This section describes the federal and state measures that will provide the direct $PM_{2.5}$, SO_2 and NO_x emission reductions leading to emission reductions and attainment of the standard.

A summary of the quantity of emission reductions expected from 2002 to 2009 is included in Table IV-1. (Positive values indicate emission reductions, negative values indicate an increase in emissions.) The emission reduction estimates account for any anticipated growth in the activity of sources regulated by the strategy. For some pollutants and categories, emissions in 2009 are anticipated to be higher than they were in 2002. In those cases, projected growth in emissions is larger than anticipated emission reductions from control measures for that pollutant and source category. Each measure is explained in greater detail in the following sections.

Table IV-1: Summary of Emission Reductions 2002-2009 from Control Measures

2002-2009 Difference	$PM_{2.5}$	SO_2	NOx
Stationary Point Sources	-13292	348612	59257
Area Sources	-212	-547	-479
Highway Vehicle Sources	315	1540	24529
Nonroad Sources	155	309	4729

1. Stationary Point Sources

Clean Air Interstate Rule (CAIR). EPA's CAIR (70 FR 25162, May 12, 2005) was remanded to EPA for revisions by the United States Court of Appeals for the District of Columbia on December 23, 2008. The Court ordered the EPA to revise the CAIR consistent with the July 11, 2008 decision, but did not set a deadline. EPA intends to promulgate a replacement rule in 2011. In the meantime, CAIR is being implemented. Pennsylvania transitioned from the NOx SIP Call to the federal CAIR in 2009. The market-based CAIR was designed to reduce large electric generation unit (EGU) emissions of NOx and SO_2 below 2002 levels throughout the 28-state CAIR region. Pennsylvania and other nearby states were required to adopt a regulation implementing the requirements of the CAIR or an equivalent program. On April 28, 2006, the EPA promulgated Federal Implementation Plans (FIPs) to reduce the interstate transport of NOx and SO_2 that contribute significantly to nonattainment and interfere with maintenance of the 8-hour ozone and $PM_{2.5}$ NAAQS. The EGUs in Pennsylvania will be regulated under the FIP until the EPA approves a SIP revision for the implementation of CAIR for the affected EGUs, at which point the approved CAIR SIP revision will supersede the FIP requirements in Pennsylvania. The Pennsylvania CAIR regulation was published in the *Pennsylvania Bulletin* on April 12, 2008. (38 Pa.B. 1705). The Department submitted the SIP revision to

the EPA on May 23, 2008. EPA subsequently proposed approval of the Commonwealth's CAIR SIP Revision on September 24, 2009 (74 FR 48695).

Interstate Pollution Transport Reduction -- In response to the federal NOx SIP call rule, Pennsylvania and other covered states adopted NOx control regulations for large industrial boilers and internal combustion engines, EGUs, and cement plants. The regulation covering industrial boilers and electric generators required emission reductions to commence May 1, 2003, while the regulation covering large internal combustion engines and cement plants required emission reductions to commence May 1, 2005. The EPA approved these regulations, found in 25 Pa. Code Chapter 145, on August 21, 2001 (66 FR 43795) and September 29, 2006 (71 FR 57428).

New Source Review Programs. The federal New Source Review (NSR) programs are preconstruction review and permitting programs applicable to new or modified major stationary sources subject to Title I, Parts C and D of the federal CAA. The programs consist of the Prevention of Significant Deterioration (PSD) requirements, which are applicable in areas attaining the NAAQS, and the Nonattainment NSR requirements, which are applicable in geographic areas not attaining and maintaining the NAAQS.

The Department's PSD regulations, codified in 25 Pa.Code Chapter 127, Subchapter D, were approved by the EPA on August 21, 1984 and codified at 40 CFR § 52.2058 (49 FR 33128). The federal PSD regulations codified in 40 CFR Part 52 are incorporated by reference in their entirety in 25 Pa. Code § 127.83 (relating to adoption by reference). The PSD program requires any new source to implement Best Available Control Technology (BACT) and limits a new source's allowable impact on the environment.

The EPA granted "limited" approval of the Department's revised NSR regulations codified in 25 Pa.Code Chapter 127, Subchapter E, and published a final rule on December 7, 1997 (62 FR 64722). On October 19, 2001, the EPA converted the limited approval to a "full" approval for all areas of the Commonwealth except the five-county Philadelphia area (Bucks, Chester, Delaware, Montgomery, and Philadelphia counties) (66 FR 53904). Nonattainment NSR requirements include compliance with the lowest achievable emission rate and emission offsets.

These federally enforceable programs, incorporated in the Commonwealth's SIP, will also reduce emissions to provide continued improvements.

Federal Standards for Hazardous Air Pollutants. Federal standards to control hazardous air pollutants (HAPs) require Maximum Achievable Control Technology (MACT) at units located at major sources of HAPs. The EPA has issued a series of regulations that are applicable to sources in Pennsylvania. These MACT standards are adopted and incorporated by reference in Section 6.6 of Pennsylvania's Air Pollution Control Act and implementing regulations and are also included in federally enforceable permits issued by the Department for affected sources. Controls with a 2002 compliance date and earlier are included in the base year inventory for 2002, while controls with a

compliance date of 2003 and later are included in the projection inventories. A list of the categories for which federal MACT standards have been issued is contained in Appendix D-1.

Source Surveillance. Pursuant to 40 CFR Part 51, Subpart K (relating to source surveillance), the SIP revision is required to provide for monitoring of the status of compliance with any rules and regulations that set forth any portion of the control strategy. These include provisions, as applicable, for:

- emissions reports and recordkeeping for stationary sources;
- periodic testing and inspection of stationary sources;
- enforcement and complaint investigation of visible emission limitations;
- enforceable test methods for emission limits; and
- continuous emission monitoring for stationary sources.

Subpart K also requires monitoring of the implementation of transportation control measures (TCMs). There are no TCMs in this SIP.

After review, the Department finds that the rules and regulations for stationary sources, which are part of the control strategy for attaining the $PM_{2.5}$ standard, as well as the Department's comprehensive permitting program requirements in 25 Pa. Code Chapter 127 and the Commonwealth's SIP in 40 CFR 52.2020, meet the requirements of Subpart K.

2. Highway Vehicle Sources

Even with increases in VMT that occur from 2002 through 2009, highway vehicle emissions will continue to decrease. As more vehicles subject to cleaner new car standards replace older vehicles subject to less stringent new vehicle standards, the fleet as a whole emits fewer emissions, compensating for the increase in vehicle miles traveled. These decreases can be attributed to the programs described below.

Federal Motor Vehicle Control Programs (FMVCP) and Pennsylvania Clean Vehicle Program for passenger vehicles and light-duty trucks and cleaner gasoline.

Tier 1 tailpipe standards established by the CAA Amendments of 1990 include NOx and VOC limits for light-duty gasoline vehicles (LDGVs) and light-duty gasoline trucks (LDGTs). These standards began to be phased in 1994. Evaporative VOC emissions were reduced in gasoline-powered cars starting with Model Year (MY) 1998.

In 1998, under the authority of section 177 of the CAA, the Department adopted the Pennsylvania Clean Vehicles Program (28 Pa. B. 5873, Dec. 5, 1998). The Pennsylvania Clean Vehicles Program incorporates by reference certain California Low Emission Vehicle (CA LEV) emission standards for passenger cars and light-duty trucks. As required under Section 177 of the CAA, these provisions are identical to the low emission standards adopted by California. The regulation does not incorporate by reference the

California zero emissions vehicle (ZEV) or emissions control warranty systems statement provisions.

In the same rulemaking, the Department adopted the National Low Emission Vehicle (NLEV) program as a compliance alternative to the Pennsylvania Clean Vehicles Program. The NLEV program became effective in the Ozone Transport Region (OTR) in 1999. Pennsylvania's New Motor Vehicle Emissions Control Program regulations in 25 *Pa. Code* Sections 126.401-126.441 allowed automobile manufacturers to comply with NLEV instead of the CA LEV program through MY 2005. These regulations affected vehicles 6,000 pounds and less and were the regulations in effect for new motor vehicles in the baseline year, 2002.

In 1999, the EPA promulgated regulations more stringent than NLEV (Tier 2), starting with MY 2004. In order to participate in NLEV, Pennsylvania had been required to adopt language that extended its "commitment" to NLEV until MY 2006. In practical terms, the NLEV program was replaced for MY 2004 and later by the more stringent Federal "Tier 2" vehicle emissions regulations, 65 FR 6698 (Feb. 10, 2000), and vehicle manufacturers operating under the NLEV program became subject to the Tier 2 requirements.

Pennsylvania amended the former New Motor Vehicle Control Program (which included the Pennsylvania Clean Vehicles Program) in 2006. The Clean Vehicles Program continues to incorporate the California Low Emission Vehicle Program (CA LEV II) by reference. As amended, the program affects MY 2008 and newer passenger cars and light-duty trucks vehicles. 36 *Pa. B.* 7424 (Dec. 9, 2006).

Emissions for milestone years were estimated based on compliance with the Pennsylvania Clean Vehicles Program according to the methodology described in section 7.4.1 of the *Technical Guidance on the Use of MOBILE6.2 for Emissions Inventory Preparation* published by the EPA's OTAQ in January 2002. This methodology is further explained in Appendix E. The Department is assuming in its MOBILE modeling that the federal Tier 2 program applies to subject vehicles sold in Pennsylvania from MY 2004 through MY 2007 and the Pennsylvania Clean Vehicles Program applies to subject vehicles sold in MY 2008 and beyond.

Heavy-Duty Diesel Control Programs. The EPA promulgated more stringent national regulations for heavy-duty engines and vehicles (over 14,000 pounds) starting with MY 2004. In addition, consent decrees with seven of the largest heavy-duty engine manufacturers required, among other terms, that diesel engines made by these companies comply with these 2004 standards two model years early, in MY 2002. Pennsylvania includes these programs as provided in the MOBILE model.

In 2002, the Department adopted the Heavy-Duty Diesel Emissions Control Program for model years starting after May 2004. The program incorporates California standards by reference and requires MY 2005 and subsequent new heavy-duty diesel highway engines to be those certified by California. California standards were more stringent than federal standards for the two model years between expiration of the consent decrees discussed

above and the implementation of more stringent federal standards affecting MY 2007 and beyond. However, EPA's MOBILE model already assumes that the engines would comply with consent decree standards, even without an enforcement mechanism. The Department has used MOBILE defaults to calculate emissions from MY 2005 and 2006 highway engines.

The EPA adopted new emission standards for heavy-duty engines and vehicles for MY 2007 and subsequent. For diesel engines, the standards will be phased in from 2007 to 2010 for NOx and VOCs. For gasoline engines, the standards will be phased in during MY 2008 and 2009. Federal and California standards are virtually identical for MY 2007. For MY 2008, California adopted requirements for idling restriction engine programming and an optional "clean NOx idle" standard. However, there is no EPA-approved methodology to estimate emission reductions from this requirement. Therefore, the emission estimates use assumptions of the federal rule for MY 2007 through 2010.

Because the new engine standards are adversely affected by sulfur in fuel, the EPA also requires most highway diesel fuel to contain no more than 15 parts per million (ppm) of sulfur, beginning in the fall of 2006. There is a temporary compliance option allowing refiners to continue to produce up to 20 percent of their highway diesel fuel at 500 ppm fuel until 2010. The Department uses MOBILE defaults to estimate the effects of the phase-in provision.

Vehicle Emission Inspection/Maintenance Program. In early 2004, Pennsylvania revised the implementation of its Vehicle Emission Inspection/Maintenance (I/M) Program in the four applicable counties (Allegheny, Beaver, Washington, Westmoreland) in the Pittsburgh-Beaver Valley Area. The program applies to gasoline-powered vehicles 9,000 pounds and under, MY 1975 and newer. For vehicles MY 1996 and newer, the program consists of an annual on-board diagnostics test and a gas cap pressure test. For subject vehicles MY 1995 and older, the program consists of an annual two-speed idle test, visual inspection of pollution control devices to ensure they are present, connected and the proper type for the vehicle and a gas cap pressure test. For vehicles older than 25 years, the program is a visual inspection and gas cap test. These regulations can be found in 67 *Pa. Code* Chapter 177. Pennsylvania submitted the revised emissions program as a SIP revision on December 1, 2003. The EPA approved the SIP revision on October 6, 2005. (70 FR 58313).

Low sulfur gasoline. Simultaneously with the Tier 2 program, the EPA published a regulation requiring the reduction of sulfur in gasoline beginning in 2004, with full implementation in 2006. Sulfur levels are capped at 80 ppm per gallon and annual refinery averages must be no more than 30 ppm. The emission reduction analysis uses the default assumptions provided in MOBILE6 to account for the implementation of the federal sulfur standard rule.

Diesel Vehicle Idling Restrictions. On October 9, 2008, Governor Rendell signed the Diesel-Powered Commercial Motor Vehicle Idling Act (Act 124 of 2008). Act 124 of 2008 went into effect on February 6, 2009. This Act restricts subject drivers and owners

statewide from idling a diesel-powered motor vehicle engaged in commerce with a gross vehicle weight of 10,001 pounds or more for more than five minutes in any continuous 60-minute period. Also, no owner or operator of a location where the aforementioned vehicles load, unload or park may allow the vehicles to idle for more than 5 minutes in a 60-minute continuous period. Act 124 of 2008 specifically excludes some vehicles, such as motor homes and farm vehicles used in farm applications. Additional exemptions are allowed for certain vehicles being used in specific applications. Truck drivers may idle sleeper-berth equipped vehicles for the purposes of long duration travel rest if the temperature is extremely hot or cold. In May 2010, this temperature exemption expires. A properly labeled "low-NOx idle" engine may idle for an unlimited amount of time.

Act 124 of 2008 will be enforced by Department personnel, and by state and local law enforcement personnel. The law preempts and supersedes local ordinances, although rules in Allegheny County and Philadelphia County that are determined by those counties to be more stringent than the law may remain in effect. The Department estimates that 50 percent of all long duration idling for Class 8 trucks will be eliminated in 2010 when the temperature exemption for sleeper rest expires. Statewide emission reductions are estimated to be 1610 tons, 45 tons and 30 tons per year for NOx, VOC, and $PM_{2.5}$, respectively. Emission reductions expected from this strategy are not included in the projected emissions inventory for 2009 since a period of compliance assistance and education is expected during that year Act 124 of 2008 will be submitted to EPA for approval as a revision to the Commonwealth's SIP by the end of 2009.

3. Nonroad Sources

The EPA has adopted a series of regulations affecting new diesel-powered ("compression ignition") and gasoline-powered ("spark ignition") nonroad engines of various sizes (horsepower) and applications. Information on these federal rules, including their implementation dates, can be found at www.epa.gov/nonroad. The Department used the assumptions built into the nonroad model (NONROAD2005) to estimate emissions for all milestone years.

No new national or international regulations are expected to be applicable to aircraft by the attainment date. While the EPA has published a notice of proposed rulemaking for more stringent standards for locomotives and large commercial marine diesel engines, the agency has not finalized any new standards.

The EPA will also require diesel fuel used in most nonroad applications to contain less sulfur. The sulfur will prevent damage to the more advanced emission control systems needed to meet the engine standards; it will also reduce fine particulate emissions from diesel engines. In 2007, fuel sulfur levels were limited to 500 ppm for nonroad applications other than ocean-going marine vessels. In 2010, fuel sulfur levels will be reduced to the same sulfur concentration as in highway fuel, 15 ppm; this requirement applies in 2012 to locomotive and marine diesel fuel.

B. Reasonably Available Control Measures/Reasonably Available Control Technology Analysis

Section 172(c) of the CAA requires states to "provide for implementation of all reasonably available control measures (RACM) as expeditiously as practicable." The regulatory requirement for RACM and reasonably available control technology (RACT) for $PM_{2.5}$ SIP revisions is codified in 40 CFR 51.1010: "For each $PM_{2.5}$ nonattainment area, the state shall submit with the attainment demonstration a SIP revision demonstrating that it has adopted all reasonably available control measures (including RACT for stationary sources) necessary to demonstrate attainment as expeditiously as practicable and to meet any RFP requirements."

The EPA states in the Clean Air Fine Particle Implementation Rule preamble that it encourages states to conduct multi-pollutant analyses for $PM_{2.5}$ and ozone to cull out potential RACM:

"They can also try to use consistent meteorological fields and emissions inventories so that the same control strategies are relatively easy to evaluate for both ozone and $PM_{2.5}$. Modeling the same future year(s) for $PM_{2.5}$ and ozone can also make it easier to evaluate the impacts of controls on both pollutants. It should be noted that there are no specific modeling requirements other than the recommendation to try to harmonize the ozone, $PM_{2.5}$, and regional haze analyses whenever possible."[7]

The Commonwealth participated in two such collaborative processes with other states in the region. First, the OTC states formed a workgroup to identify and evaluate candidate control measures. Working from a preliminary list of approximately 1,000 potential control measures, the workgroup identified and analyzed 30 candidate control measures. Appendix G-1 contains the OTC report entitled, *Identification and Evaluation of Candidate Control Measures, Final Technical Support Document* (MACTEC, Feb. 2007). The initial list of control measures considered is available as Appendix G-2. Based on the OTC Workgroup analysis, the Commissioners recommended that States consider emission reductions from the following source categories:

- Consumer Products
- Portable Fuel Containers
- Adhesives and Sealants Application
- Diesel Engine Chip Reflash
- Cutback and Emulsified Asphalt Paving
- Asphalt Production Plants
- Cement Kilns
- Glass Furnaces
- Industrial, Commercial, and Institutional (ICI) Boilers
- Regional Fuels

7. 72 FR 20609.

• Electric Generating Units (EGUs)

The final report, included as Appendix G-1, contains more detailed information about the process and includes tables summarizing the emission reduction potential of each control measure by source category and projection year. There are five subsections discussing the control measure and emission reductions for the five source category sectors: non-EGU point sources, area sources, EGUs, onroad mobile sources, and nonroad mobile sources.

The Department also participated in an assessment of control measures for pollutants and sources affecting visibility through the MANE-VU regional haze planning process. As part of this effort, MANE-VU developed a list of possible control measures for consideration. The following categories were selected for analysis:

- Coal and oil-fired EGUs
- Point and area source industrial, commercial and institutional boilers
- Cement kilns
- Lime kilns
- The use of heating oil
- Residential wood combustion and open burning

Appendix G-3 contains the final report entitled, *Assessment of Reasonable Progress for Regional Haze in MANE-VU Class I Areas* (MACTEC, July 2007) from the MANE-VU control measure assessment project. This report presents the results of an analysis of the economic and environmental impacts of the potential control scenarios that could be implemented by MANE-VU states to reduce emissions from selected source categories in order to make reasonable progress toward meeting visibility improvement goals.

As required under 40 CFR 51.1010, a SIP revision for a $PM_{2.5}$ nonattainment area must demonstrate that all RACM, including RACT for stationary sources, necessary to demonstrate attainment as expeditiously as practicable have been adopted. The cumulative impact of implementing available measures must be considered in determining whether a particular emission reduction measure or set of measures is required to be adopted as RACM. Potential measures that are reasonably available considering technical and economic feasibility must be adopted as RACM if, considered collectively, they would advance the attainment date by one year or more. As discussed earlier in this document, the Pittsburgh-Beaver Valley Area expects to monitor attainment at the end of 2009. Therefore, any RACM measures would need to be in effect in 2008.

The Department determined that there were no additional control measures that could be adopted by January 1, 2008. In addition, existing measures and those planned for implementation by 2009 are expected to enable the Pittsburgh-Beaver Valley Area to attain the 1997 $PM_{2.5}$ NAAQS. Therefore, no further actions on RACM or RACT are warranted.

Although the measures explored by the OTC and MANE-VU workgroups are not required as RACM, many are worthwhile measures that Pennsylvania is currently pursuing. Others are measures that Pennsylvania may consider for the future.

C. Other Measures - VOC Control Measures

Although VOC is not a regulated $PM_{2.5}$ precursor for the Pittsburgh-Beaver Valley Area, several VOC control measures are discussed in this section because they are included in the modeling associated with this attainment demonstration.

Portable Fuel Containers. The Department adopted a portable fuel container regulation, 25 *Pa. Code* Chapter 130, Subchapter A, to address VOC loss resulting from permeation through portable gasoline containers, evaporative loss through container openings, and spillage during the filling of small tanks on machines such as lawn mowers, chain saws and jet skis. The regulation was submitted to the EPA as a SIP revision on March 26, 2003 and approved on December 8, 2004 (69 FR 70893).

Consumer Products. This regulation applies statewide to any person who sells, supplies, offers for sale, or manufactures certain consumer products on or after January 1, 2005, for use in the Commonwealth. The program is contained in 25 *Pa. Code* Chapter 130, Subchapter B. It was submitted to the EPA as a SIP revision on March 26, 2003 and approved on December 8, 2004 (69 FR 70895). Additional regulations were adopted on October 11, 2008 and submitted to the EPA as a SIP revision on April 14, 2009.

Architectural and Industrial Maintenance (AIM) Coatings. The Pennsylvania AIM Coatings regulation applies statewide to any person who supplies, sells, offers for sale, or manufactures, blends or repackages an AIM coating for use within the Commonwealth, as well as a person who applies or solicits the application of an AIM coating within the Commonwealth. The AIM coating program requirements are specified in 25 *Pa. Code* Chapter 130, Subchapter C. The regulation was submitted to the EPA as a SIP revision on December 3, 2003, with a supplement submitted on October 19, 2004. The EPA approved the provisions as an element of the SIP on November 23, 2004 (69 FR 69080).

V. ATTAINMENT DEMONSTRATION AND WEIGHT OF EVIDENCE (WOE)

A. Attainment Demonstration Background and Objectives

The EPA issued fine particle standards in 1997 after evaluating hundreds of health studies and conducting an extensive peer review process. The 1997 annual health-based standard for $PM_{2.5}$ is 15.0 μg/m^3, based on the 3-year average of annual mean $PM_{2.5}$ concentrations. The EPA also established a 24-hour health-based standard of 65 μg/m^3, determined by the 3-year average of the 98th percentile of 24-hour concentrations. The EPA set levels to protect the environment at the same levels as it set the health-based standards. Note that while the EPA has subsequently revised the 24-hour standard in 2006 to be more protective, EPA designated the Pittsburgh-Beaver Valley Area as nonattainment because it violated the 1997 annual standard of 15.0 μg/m3 based on 2001-03 monitoring data. Therefore, this SIP revision compares air quality data to the 1997 24-hour standard (65 μg/m^3).

On April 1, 2003, the EPA issued a memorandum, "Designations for the Fine Particle National Ambient Air Quality Standards" outlining the schedule for designating areas under the $PM_{2.5}$ standard and related guidance on nine factors to consider in identifying nonattainment areas. The CAA provides for states and tribes to submit designation recommendations to the EPA, and it requires the EPA to provide time for consultation in cases where the Administrator plans to promulgate a designation that modifies the state or tribal recommendation. On December 17, 2004, the EPA published its air quality designations and classifications for the 1997 $PM_{2.5}$ NAAQS. These designations became effective on April 5, 2005.

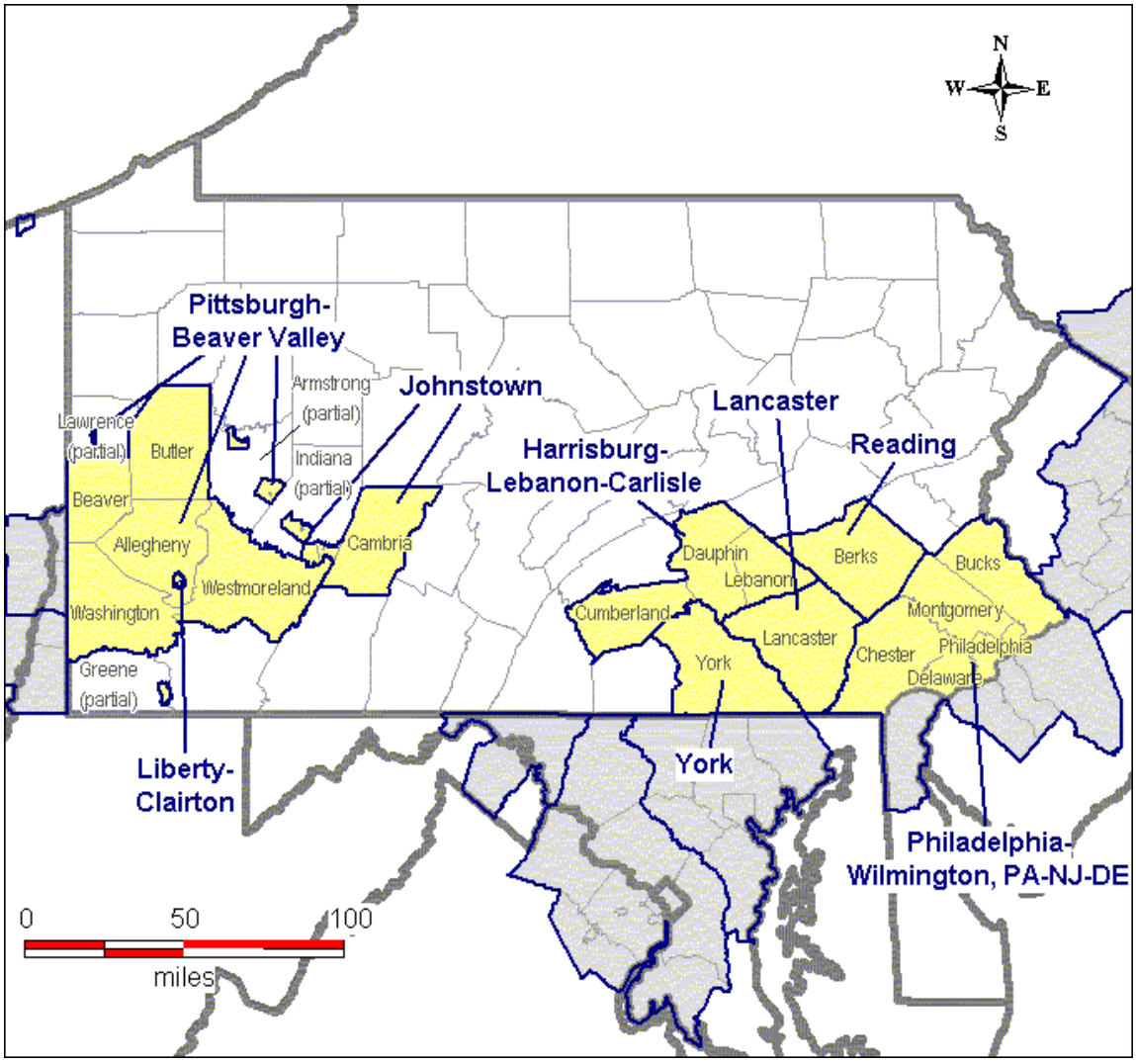
Figure 4 graphically depicts all of the $PM_{2.5}$ nonattainment areas within Pennsylvania. The Pittsburgh-Beaver Valley Area currently violates the EPA's annual $PM_{2.5}$ standard (15.0 μg/m^3). The maximum 2008 annual design value in the area is 15.5 μg/m^3. All monitors within the Pittsburgh-Beaver Valley Area are currently in attainment of the 1997 24-hour $PM_{2.5}$ standard (65 μg/m^3). The maximum 2008 24-hour design value in the area is 40 μg/m^3. The Pittsburgh-Beaver Valley Area is required to attain the $PM_{2.5}$ standard no later than five years from the effective date of designation of April 5, 2005 (April, 2010).

The purpose of the attainment demonstration is to ensure, through grid modeling, that projected emissions (with controls) will not cause the nonattainment area to exceed the 1997 $PM_{2.5}$ NAAQS. A complex grid model was run and processed over the entire Northeast to determine if the Pittsburgh-Beaver Valley Area would attain the $PM_{2.5}$ standard by April 5, 2010.

The procedures followed in this modeling analysis are in accordance with EPA's *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (EPA-454/B-07-002, April 2007). A brief summary of the modeling analysis used in this demonstration is included in the following sections. The Department submitted a modeling protocol to the EPA in October 2007 for

the Pittsburgh-Beaver Valley Area that includes a more thorough description of the modeling analysis.

Figure 4: Pennsylvania's $PM_{2.5}$ Nonattainment Areas



B. Pittsburgh-Beaver Valley Area Conceptual Model Description

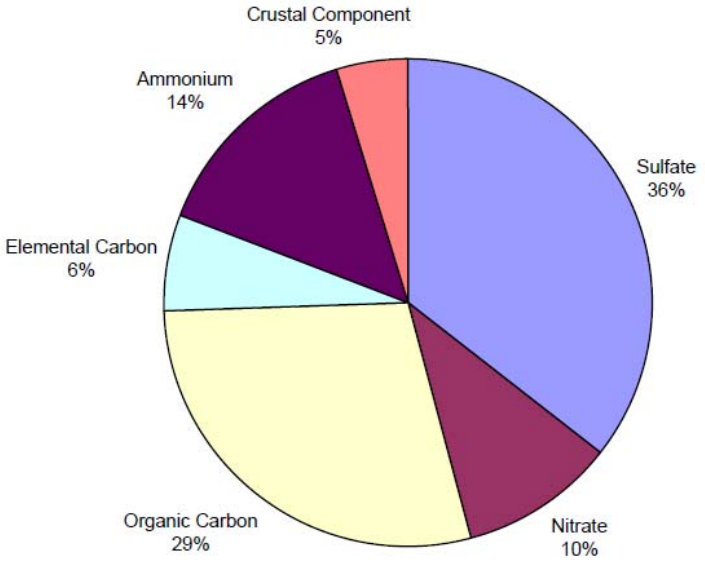
This section provides a brief description of the conceptual model for the Pittsburgh-Beaver Valley Area. The conceptual model was based on information from the Northeast States for Coordinated Air-Use Management (NESCAUM) final report entitled *The Nature of the Fine Particle and Regional Haze Air Quality Problems in the MANE-VU Region: A Conceptual Description* (2006) and the Department's modeling protocol documentation (October 2007).

Fine particulate formation in the eastern United States is a complex process involving local and regional meteorology, topography, chemistry and transport. Since a violation of an annual standard potentially involves a large range of conditions throughout the year, it is difficult to determine a direct cause-and-effect relationship for such a violation. Violations of the annual standard ensure a large range of conditions will contribute to nonattainment making direct cause-and-effect relationships difficult to determine. In general, the following statements can be used to provide a working conceptual model that describes the annual $PM_{2.5}$ nonattainment problem in the Pittsburgh-Beaver Valley Area:

- Secondary fine particulate formation is a major contributor to annual $PM_{2.5}$ nonattainment in the Pittsburgh-Beaver Valley Area. Sulfates, organic carbon and nitrates make up approximately 75% of the annual fine-particulate concentrations (see Figure 5).
- Fine-particulate chemistry favors sulfate formation during the warm summer months and nitrate formation during the colder winter months.
- In the summer time, large high pressure systems create favorable conditions for the oxidation of SO_2, which eventually forms sulfates. These sulfates then contribute to episodes of high particulate concentrations.
- In the winter time, local temperature inversions concentrate emissions near the surface leading to periods of elevated fine-particulate concentrations. This is especially apparent if significant terrain features are present.
- Continuous measurements in the Pittsburgh-Beaver Valley Area correlate well with the FRM data. This indicates measurements from the continuous monitor generally reflect actual concentrations in the nonattainment area.
- Average concentrations from the continuous monitor show a general diurnal pattern with higher concentrations in the overnight and early morning hours than during the day due to atmospheric conditions and possibly local mobile source emissions (peaks during rush hour traffic, etc).
- In addition to the diurnal signal noted in the continuous monitoring data there is a strong weekly pattern in the continuous monitoring data with higher $PM_{2.5}$ concentrations on weekdays than on weekends.

A range of control measures will be necessary to attain the $PM_{2.5}$ standard in the Pittsburgh-Beaver Valley Area due to the complex interaction between local and regional emissions and local meteorological conditions. Sulfates and nitrates are formed primarily through atmospheric reactions of precursor emissions of SO_2, NOx and NH_3. Organic carbon is a combination of secondary organic particles formed from emissions of VOC and the organic portion of primary $PM_{2.5}$ that is directly emitted or condenses near its source. Currently, our understanding of sulfate and nitrate chemistry and its impacts on $PM_{2.5}$ concentrations far exceeds our understanding of contributions from anthropogenic VOCs. This is important because sulfates, nitrates and organic carbon are major contributors to the fine particulate problem in the Pittsburgh-Beaver Valley Area. Therefore, it is reasonable to assume that a mixture of regional and local SO_2 and NOx controls in addition to VOC controls implemented for attainment of the 8-hour ozone standard will assist in attaining the $PM_{2.5}$ standard.

Figure 5: Pittsburgh-Beaver Valley Area Percentage of Total Mass
Based on Speciated $PM_{2.5}$ Data Collected at Lawrenceville
Averaged 2005 to 2007 Monitored Values



C. Modeling Domain and Photochemical Modeling System

The modeling demonstration for the Pittsburgh-Beaver Valley Area relies heavily on the OTC SIP quality-modeling platform. Ozone modeling was the primary focus of this effort. OTC's interaction with MANE-VU and NESCAUM allowed it, through the regional modeling centers, to do additional year-round modeling for $PM_{2.5}$ and Regional Haze.

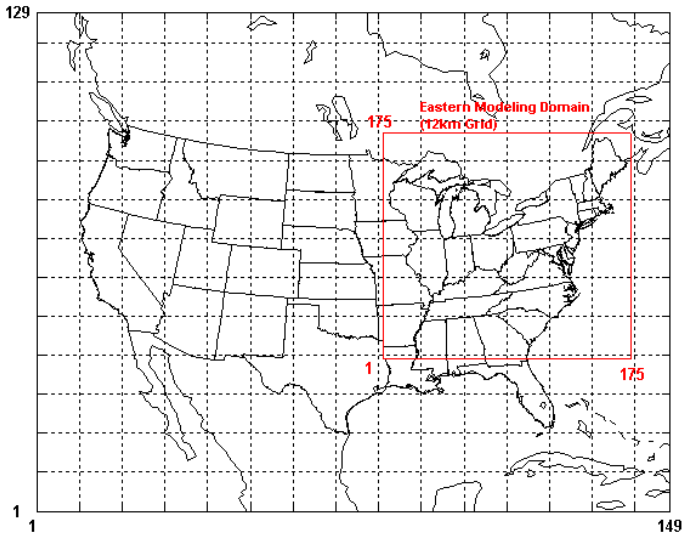
EPA's *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (EPA-454/B-07-002, April 2007) does not recommend a particular model or models for use in a SIP attainment demonstration. The OTC modeling committee used the CMAQ photochemical grid model (version 4.5) as part of its SIP modeling platform (OTC Final Modeling Protocol, 2006). CMAQ is an Eulerian grid model capable of simulating air pollutant concentrations in the atmosphere using mathematical equations to characterize chemical and physical properties.

Meteorological and emission input files must be prepared regardless of which photochemical grid model is used. The regional fine particulate modeling analysis encompassed an entire year of simulation for the year 2002. This approach provided a good variety of episodes to characterize the Pittsburgh-Beaver Valley Area's $PM_{2.5}$ nonattainment problem.

Figure 6 shows the modeling domain used by the OTC Modeling Workgroup. A nested-grid approach was used with the lower resolution outer grid providing boundary conditions

for a more refined grid covering the area of interest. The modeling domain was chosen to be large enough to properly simulate regional transport. The outer domain boundary is far enough from the inner grid's boundary so that clean-boundary condition assumptions along the outer domain's boundary are realistic and probably do not unduly influence concentrations within the inner domain.

Figure 6. OTC Modeling Study Domain



Outer grid at 36-kilometer resolution, inner grid at 12-kilometer resolution

The meteorological files used in CMAQ were produced using the Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) Mesoscale Model version 5 (MM5). MM5 is a limited-area, nonhydrostatic, terrain-following sigma-coordinate model designed to simulate or predict mesoscale atmospheric circulation. The model is publicly available and has been used for various air quality modeling studies in the past.

The OTC Modeling Committee also examined two emissions processors (EMS2001 and SMOKE, both using CB4 chemistry) in its prior work and concluded that there are differences between them that could be minimized by forcing the models to use a common speciation and surrogate database.

For areas with an attainment date of no later than April 5, 2010 for the $PM_{2.5}$ NAAQS, the emission reductions need to be implemented no later than the beginning of 2009. A determination of attainment will be based on air quality monitoring data collected in 2007, 2008, and 2009. Therefore, the year to project future emissions should be no later than the last year of the three-year monitoring period, which in this case is 2009.

The emissions inventory was developed for 2009 using standard emissions projection techniques. The 2009 inventories developed by MANE-VU were used in the attainment

demonstration. The most recently available inventories from other regional planning organizations (RPOs) in the modeling domain were also used.

Emission inventory guidance documents were followed for developing projection year inventories for point, area, mobile, and biogenic emissions. These procedures address projections of spatial, temporal, and chemical composition change between the base year and projection year.

The control strategies developed for evaluation in the attainment demonstration were selected by the OTC's Control Strategy Committee. These were selected from groups of strategies developed by the technical subcommittees responsible for identifying and developing the regulations and/or other control measures.

Consideration was given to maintaining consistency with control measures likely to be implemented by other modeling domains that may be involved in region-wide analysis. Also, technology-based emission reduction requirements mandated by the CAA are included in the future year model runs.

D. Model Performance Evaluation

A critical component of every air quality modeling study is the model performance evaluation where modeled estimates for the current year base case are compared against observed values to assess the model's accuracy and provide an indication of its reliability. The results presented here serve as an illustration of some of the model evaluation and assessment, as outlined in the EPA modeling guidance document entitled, *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (EPA-454/B-07-002, April 2007), performed on the Base Year 2002 CMAQ simulation.

The New York State Department of Environmental Conservation (DEC), Division of Air Resources, conducted a performance evaluation of the 2002 base case CMAQ simulation on behalf of the OTC member states. Model performance was evaluated over the entire year, except for the July 6-9, 2002 period which was excluded from this analysis since the observed $PM_{2.5}$ and organic mass (OM) data at many sites were greatly affected by Canadian forest fires. Appendix H, relating to Modeling Demonstration, provides comprehensive operational and diagnostic evaluation results. Highlights of this evaluation are provided in the following sections. The analysis examines model performance over a wide area, including the entire OTR plus the State of Virginia (OTR+).

1. Daily $PM_{2.5}$ Mass

Model performance over the entire OTR+ region was examined using several statistics. These included overall mean fractionalized bias (MFB) and mean fractional error (MFE). Equations for these diagnostics are summarized below and are included in the EPA modeling guidance document entitled, *Guidance on the Use of Models and Other Analyses*

for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze (EPA-454/B-07-002, April 2007).

Mean fractionalized bias (MFB), in %:

$$MFB = \frac{2}{N}\sum \left[\frac{P_i - O_i}{P_i + O_i}\right] \times 100\%$$

Mean fractional error (MFE), in %:

$$MFE = \frac{2}{N}\sum \left|\frac{P_i - O_i}{P_i + O_i}\right| \times 100\%$$

where P = Predicted (modeled) value, O = Observed value, and N = Number of observations

Figures 7 and 8 show MFE and MFB over the entire OTC+ region. The figures indicate the model is generally doing a reasonable job reproducing $PM_{2.5}$ across the entire domain with the exception of the New York City area and a few monitors in New England. Overall, the mean bias (predicted minus observed) was about 3.8 μg m^{-3}, ranging from -17.7 μg m^{-3} to +24.0 μg m^{-3}. The highest over-prediction tended to occur during the colder months, quarters 1 and 4, whereas the days on which the model tended to under-predict $PM_{2.5}$ were more likely to occur during the summer months.

Figure 7: Mean Fractional Error

MFE (%) at each FRM location over the entire year: blue, <30%; green, 30-45%; orange, 45-60%; red, 60-75%; pink, >75% (From NY DEQ report, 2007).

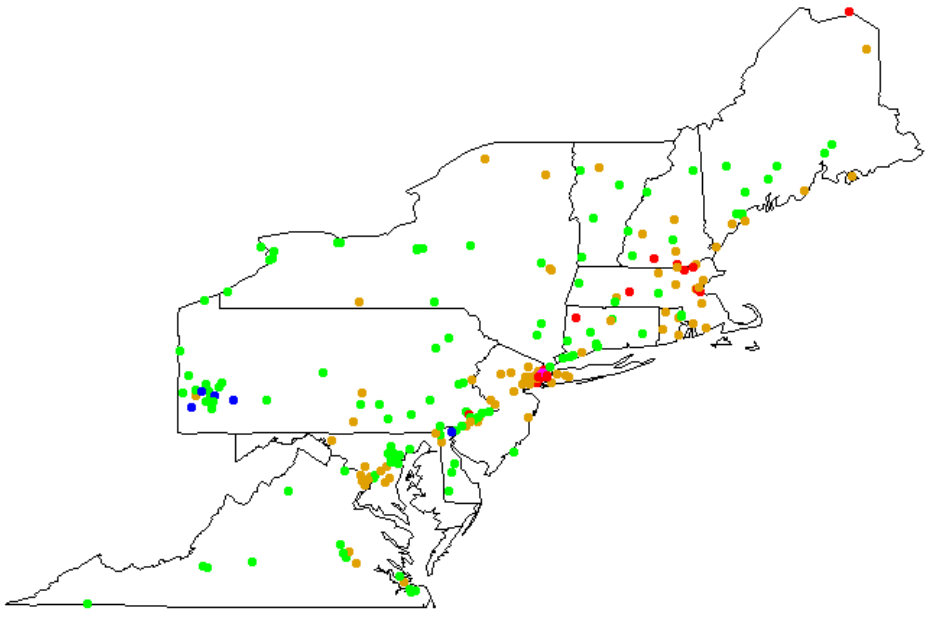
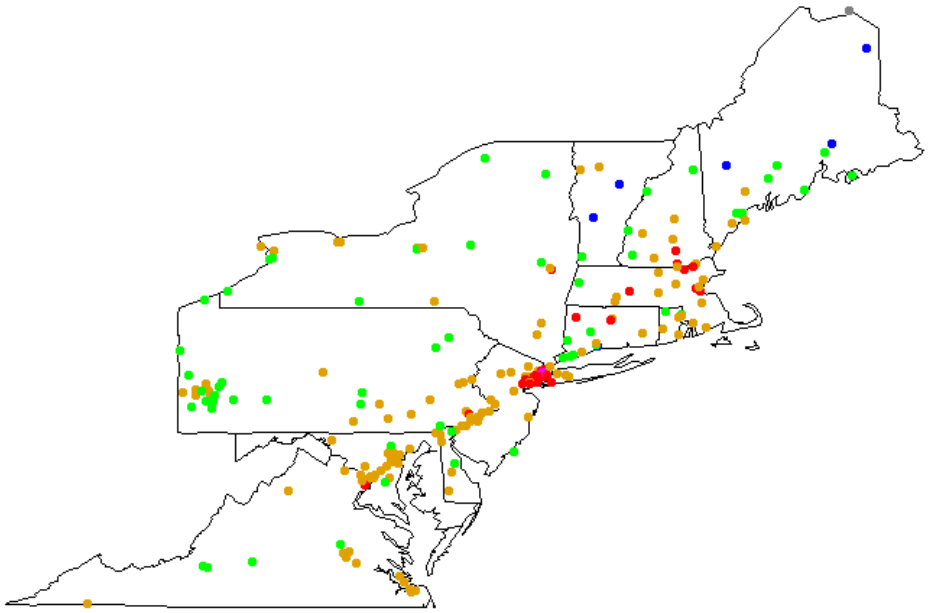


Figure 8: Mean Fractional Bias

MFB (%) at each FRM location over the entire year: gray, <-45%; blue, -45 to -15%; green, -15 to 15%; orange, 15-45%; red, 45-75%; pink, >75% (From NY DEQ report, 2007).



2. $PM_{2.5}$ Speciation

$PM_{2.5}$ is composed of several components. The primary components noted in the monitoring data include sulfates, nitrates and organic carbon; other components do not significantly contribute to $PM_{2.5}$ concentrations. For proper performance, CMAQ predictions for each individual component of $PM_{2.5}$ must also be examined.

Data from the various speciation networks in the OTR+ region were compared to model predicted values for the base case (2002). Again, data from the July 6-9, 2002 period was excluded from this analysis due to the Canadian forest fires.

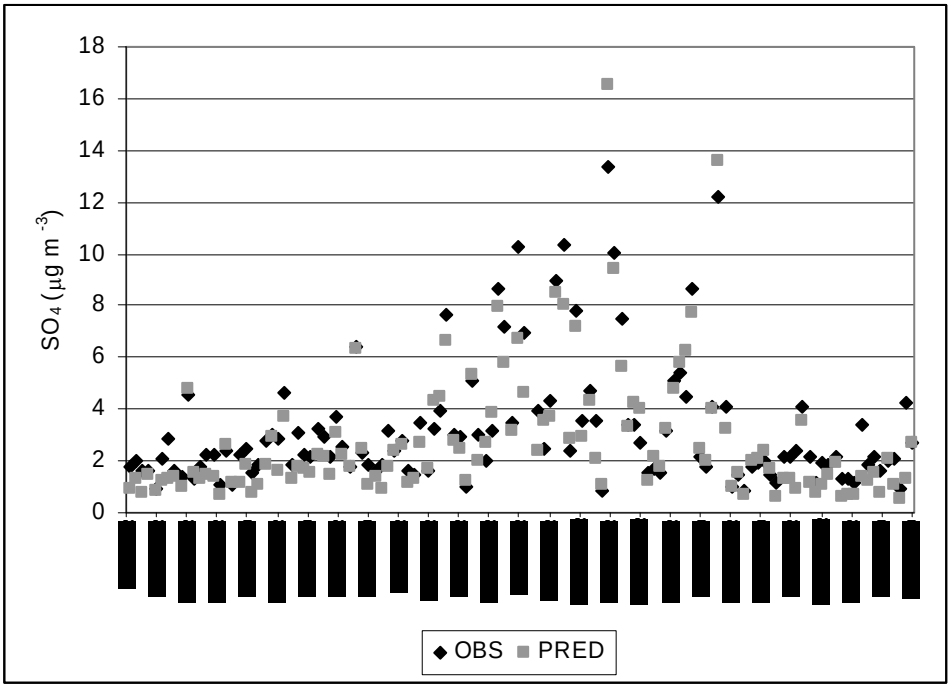
Sulfates (SO_4^-) are one of the primary contributors to the Pittsburgh-Beaver Valley Area's $PM_{2.5}$ nonattainment. Figure 11 depicts modeled and actual sulfate measurements in the OTR+ region. The CMAQ model appears to reproduce actual sulfate concentrations quite well along with its seasonal variability.

Nitrates (NO_3^-) are another important contributor to the Pittsburgh-Beaver Valley Area's $PM_{2.5}$ nonattainment. CMAQ does less well reproducing actual concentrations than it does for sulfates. Modeled concentrations appear to be less accurate during the colder months (1^{st} and 4^{th} quarters) than the warmer months.

OM is another important contributor to the Pittsburgh-Beaver Valley Area's $PM_{2.5}$ nonattainment. CMAQ does not do well reproducing the seasonal variability of OM though it does appear to do a better job reproducing observed winter values.

Figure 9: Time Series of SO_4 Mass

Time series of SO_4 mass based on the composite average of all 21 IMPROVE monitors across the OTR+ region. The observed values are denoted with the black diamonds, the model predictions are denoted with gray squares (From NY DEQ report, 2007).



NY DEQ's model performance included an analysis of the meteorological model used to drive CMAQ, as well as actual $PM_{2.5}$ values and $PM_{2.5}$'s speciated components. Appendix H-2 is a technical listing of the model inputs, as well as an assessment of the MM5 simulation to real-world data. The analysis shows that, in general, the performance of the MM5 is reasonable both at the surface and in the vertical, thereby providing confidence in the use of these data in the CMAQ simulations.

Both the MM5 and CMAQ runs appear to meet performance criteria over the entire OTR+ domain. Therefore, it can be assumed the modeling platform provides meaningful information in regard to projected 2009 $PM_{2.5}$ concentrations that will be used to assess the Pittsburgh-Beaver Valley Area's future attainment of the $PM_{2.5}$ standard.

E. Projected 2009 Design Values for the Pittsburgh –Beaver Valley Nonattainment Area

1. Overview

As mentioned previously, the Pittsburgh-Beaver Valley Area has an attainment date of April 5, 2010. The $PM_{2.5}$ NAAQS include an annual standard of 15.0 $\mu g/m^3$ based on the 3-year average of annual mean $PM_{2.5}$ concentrations, and a 24-hour standard of 65 $\mu g/m^3$ based on the 3-year average of the 98th percentile of 24-hour concentrations.

This section summarizes the procedures that are used to demonstrate attainment of the $PM_{2.5}$ NAAQS. As described in EPA's *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (EPA-454/B-07-002, April 2007), an attainment demonstration consists of (a) analyses that estimate whether selected emissions reductions will result in ambient concentrations that meet the NAAQS, and (b) an identified set of control measures that will result in the required emissions reductions. The necessary emission reductions for both of these attainment demonstration components may be determined by relying on results obtained with air quality models.

EPA's *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (EPA-454/B-07-002, April 2007) recommends applying a modeled attainment test to the air quality modeling results to determine if the $PM_{2.5}$ NAAQS will be met. Additional technical or corroboratory analyses may also be used as part of a "supplemental analysis" or a more stringent "weight of evidence" determination to supplement the modeled attainment test and to further support a demonstration of attainment of the NAAQS.

The modeled attainment test and additional corroborative analyses are described in further detail in the remaining portions of this section.

2. Modeled Attainment Test

The purpose of a modeling assessment is to determine if control strategies currently being implemented "on the books" (OTB) and proposed control strategies will lead to attainment of the NAAQS for $PM_{2.5}$ by the attainment year of 2009. The modeling is applied in a relative sense, similar to the 8-hour ozone attainment test: however, the $PM_{2.5}$ attainment test is more complicated and reflects the fact that $PM_{2.5}$ is a combination of many different species. In the test, ambient $PM_{2.5}$ is divided into major components. Then, a relative response factor (RRF) and future design value (DVF) is calculated for each of the $PM_{2.5}$ components. Since the attainment test is calculated on a per species basis, the attainment test for $PM_{2.5}$ is referred to as the Speciated Modeled Attainment Test (SMAT). The following sections outline the process to determine that 2009 projections of $PM_{2.5}$ will meet the NAAQS from regional modeling, as suggested in EPA's modeling guidance.

3. Determine Baseline Design Values

The first step in any attainment test process is to determine the baseline design value (DVB). The EPA guidance recommends using a DVB that is the average of the three design value periods that straddle the baseline inventory year (i.e., the average of the 2000-2002, 2001-2003, and 2002-2004 design value periods for a 2002 baseline inventory year). This results in a 5-year weighted average, with the baseline year having the heaviest weight (i.e., {[2000] + 2*[2001] + 3*[2002] + 2*[2003] + [2004]}/9).

For the SMAT process, a mean $PM_{2.5}$ DVB is determined, as well as component specific DVB, for each quarter. The following section will detail the calculation of baseline design values needed for the $PM_{2.5}$ attainment test.

Mean $PM_{2.5}$ Baseline Design Values

To begin the SMAT process, a mean $PM_{2.5}$ DVB is calculated on a quarterly basis for each FRM monitor in the $PM_{2.5}$ nonattainment areas. Concentrations are calculated based on calendar quarters (Q1: January - March; Q2: April - June; etc.) as the NAAQS is calculated for a calendar year, and the quarters need to fit evenly within a year. Calculating the attainment test on a quarterly basis also allows states to examine the differences in $PM_{2.5}$ composition that occur during the different seasons.

Speciated Baseline Conditions

The monitored attainment test for $PM_{2.5}$ utilizes both $PM_{2.5}$ and individual $PM_{2.5}$ component species. A separate RRF is calculated for each $PM_{2.5}$ species. In order to perform the recommended modeled attainment test, states should divide observed mass concentrations of $PM_{2.5}$ into seven components (plus passive mass):

1. Mass associated with sulfates (SO4)
2. Mass associated with nitrates (NO3)
3. Mass associated with ammonium (NH4)
4. Mass associated with organic carbon (OC)
5. Mass associated with elemental carbon (EC)
6. Mass associated with particle bound water (PBW)
7. Mass associated with "other" primary inorganic particulate matter (Crustal)
8. Passively collected mass or the mass of the blank filter (Passive)

This yields the following formula in order to calculate $PM_{2.5}$:

$$PM2.5_{FRM} = [SO4] + [NO3] + [OC] + [EC] + [NH4] + [PBW] + [Crustal] + [Passive]$$

The second part of the process is to use the quarterly mean $PM_{2.5}$ DVBs with speciated data to calculate the quarterly mean concentrations of these 7 components at the FRM sites. This need to speciate the FRM data presents two issues:

1. FRM measurements and speciated $PM_{2.5}$ measurements do not always measure the same mass.
2. Not all FRM monitoring sites have co-located Speciation Trends Network (STN) speciation monitors.

The following sections will explain how these issues are addressed to produce the speciated values needed for this attainment demonstration.

SANDWICH

As the EPA's *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (EPA-454/B-07-002, April 2007) notes, recent data analyses have noted that the FRM monitors do not measure the same components and do not retain all of the $PM_{2.5}$ that is measured by STN samplers. Therefore, measurements from FRM monitors cannot be directly compared to speciation measurements from the STN monitors. By design, the FRM mass measurement does not retain all ammonium nitrate and other semi-volatile materials (negative sampling artifacts) and includes particle bound water associated with sulfates, nitrates and other hygroscopic species (positive sampling artifacts). This results in concentrations (and percent contributions to $PM_{2.5}$ mass) that may be different from the ambient levels of some $PM_{2.5}$ chemical constituents.

To resolve the differences between FRM and STN total mass, EPA recommends using the "sulfate, adjusted nitrate, derived water, inferred carbonaceous" (SANDWICH) material balance approach. With the SANDWICH approach, nitrate mass is adjusted to account for volatilization based on hourly meteorology parameters. Subsequently, quarterly average nitrate, sulfate, elemental carbon, ammonium and crustal mass can be calculated, as well as the Degree of Neutralization (DON) of sulfates. Next, the mass of particle bound water can be calculated from the previously obtained DON, sulfate, nitrate, and ammonium values. (See more details on particle bound water calculations in the Annual SMAT Results section, below). Finally, organic carbon is calculated by taking the difference between the total $PM_{2.5}$ mass as measured at the FRM monitor, and the calculated component mass (i.e., OC from mass balance ([OCMmb] = $PM2.5_{FRM}$ - {[EC] + [SO4] + [NO3] + [NH4] + [PBW] + [Crustal] + [Passive]}), where the Passive (mass) is the FRM sampling artifact normally set equal to 0.5).

EPA Region 3 office provided SANDWICHed data for the Pittsburgh-Beaver Valley Area monitors. For a description and use of the SANDWICH method, see the *Definition of SANDWICHed STN Data* (EPA, 2006).

Speciated Profiles

While the SANDWICH method reconciles the differences between FRM and STN, a lingering issue is that not all FRM monitoring sites have co-located STN monitors to provide speciated data. EPA guidance suggests four measures that can be taken to resolve the lack of speciated data:

1. Use of concurrent data from a nearby speciated monitor
2. Use of representative data (from a different time period)
3. Use of interpolation techniques to create a spatial field using ambient speciation data
4. Use of interpolation techniques to create spatial fields, and gridded modeling outputs to adjust the species concentrations

Of the four methodologies, EPA recommends using one of the spatial interpolation techniques to estimate species concentrations at FRM sites that do not have speciation data (numbers 3 and 4, above). To assist in this task, EPA began developing a software tool called "Modeled Attainment Test Software" (or MATS) that would perform the spatial analysis of described options number 3 and 4. However, the MATS tool was not available at the time this analysis was completed. In trying to pursue the EPA recommended course of action, option 1 (use of concurrent data from a nearby speciated monitor) was utilized.

4. Relative Response Factor Calculations

The calculation of RRFs for this study was performed using the EPA recommended method for "nearby" grid cells for a 12-kilometer horizontal grid resolution, with a 3x3 grid cell array for 12-km resolution modeling. The relative response factor used in the modeled attainment test is computed by taking the ratio of the mean of the predictions in the future to the mean predictions with baseline emissions, over all relevant days.

For the 24-hour and annual $PM_{2.5}$ NAAQS, the spatially averaged value of the nearby predictions (mean value of the grid cell array) was used. Each component-specific RRF was used in the modeled attainment test by taking the ratio of the mean of the spatially averaged daily predictions in the future to the mean of the spatially averaged daily predictions with current emissions.

The basis for this approach is as follows:

1. Consequence of a control strategy may be "migration" of a predicted peak. If a state were to confine its attention only to the cell containing a monitor, it might underestimate the RRF (i.e., overestimate the effects of a control strategy).
2. Uncertainty in the formulation of the model and the model inputs is consistent with recognizing some leeway in the precision of the predicted location of concentrations.
3. Standard practice in defining a gridded modeling domain is to start in the southwest corner of the domain and determine grid cell location from there. Considering several cells "near" a monitor rather than the single cell containing the monitor diminishes the likelihood of inappropriate results that may occur from the geometry of the superimposed grid system.
4. The area does not exhibit strong spatial concentration gradients of observed primary $PM_{2.5}$.

5. Annual SMAT Results

A difficulty presented in estimating the future design values was missing STN data for 2000 and 2001at the Pittsburgh-Beaver Valley Area monitors. This limitation restricted the calculation of SANDWICH data to the period 2002–2004. Therefore, the 2009 projected design values are based on speciation profiles developed using 2002-2004 STN data. Appendix H-7 contains a sample Excel spreadsheet showing the calculations utilized to compute the 2009 DVF (displayed in Table V-2).

There are three FRM monitors in the Pittsburgh nonattainment area that are co-located with a speciated sampler: Florence, Greensburg, and Lawrenceville. However, since there are eleven FRM monitors within the Pittsburgh-Beaver Valley Area, the Department was able to determine that the three speciated monitors in the nonattainment area were representative of all FRM monitor locations in order to complete the SMAT analysis. RRFs were only calculated for the sulfates, nitrates, organic carbon, elemental carbon and crustal component of $PM_{2.5}$. Referencing the $PM_{2.5}$ FRM formula in section 3 above, the only components of $PM_{2.5}$ that were not included in the RRF calculation were ammonium and water. Base and future case ammonium was calculated based on the DON value and the following formula presented in EPA's *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze*:

$$NH4 = 0.29 * NO3 + DON * SO4.$$

The particle bound water was then calculated using the particle bound water formula estimated from the Aerosol Inorganic Model. Due to the hygroscopic nature of ammonium sulfate and ammonium nitrate, retained sulfate, nitrate and ammonium will all contain water. Therefore, the final polynomial equation (seen below and referenced (EPA, 2006 (2))) contains sulfates, nitrates and ammonium within its calculation. The equation utilized was that for low acidity.

$$\begin{aligned} PBW = [&202049.0 - 391494.6 * S - 390912.1 * N + 442.4 * (S^{1.5}) - 155.3 * (N^{1.5}) \\ &- 293406.8 * (A^{1.5}) + 189277.5 * (S^2) + 377992.6 * N * S + 188636.8 * (N^2) \\ &- 447.1 * (S^{2.5}) - 507.2 * (S^{1.5}) * N - 12.8 * (S^3) + 146.2 * (N^{1.5}) * S \\ &+ 217.2 * (N^{2.5}) + 30.0 * (N^{1.5}) * (S^{1.5}) - 18.6 * (N^3) + 216267.0 * (A^{1.5}) * S \\ &+ 215419.9 * (A^{1.5}) * N - 621.8 * (A^{1.5}) * (S^{1.5}) + 239.1 * (A^{1.5}) * (N^{1.5}) \\ &+ 35413.1 * (A^3)] * (SO4 + NO3 + NH4) \end{aligned}$$

where

$$S = SO4 / (SO4 + NO3 + NH4)$$
$$N = NO3 / (SO4 + NO3 + NH4)$$
$$A = NH4 / (SO4 + NO3 + NH4)$$

Table V-1 displays the calculated quarterly RRFs for the design monitor of the Pittsburgh-Beaver Valley Area, North Braddock. Based on the results of the RRF calculations, all

$PM_{2.5}$ constituents either remain the same or undergo a downward trend, except for the crustal portion.

Table V-1: Annual $PM_{2.5}$ Quarterly RRF Values

Quarter	Sulfates	Nitrates	OC	EC	Crustal
1st	0.9485	0.9806	0.9564	0.8426	1.1254
2nd	0.7098	0.9081	1.0036	0.8456	1.2194
3rd	0.6593	0.9179	0.9867	0.8405	1.2318
4th	0.8942	0.9626	0.9966	0.8496	1.1628

Table V-2 presents the results of the annual SMAT results for all of the monitors in the Pittsburgh-Beaver Valley Area. The SMAT results demonstrate that the projected average annual arithmetic mean $PM_{2.5}$ concentration calculated at each FRM monitor attains the annual $PM_{2.5}$ NAAQS. Specifically, all DVF calculations are less than 15.0 $\mu g/m^3$. Table V-2 presents the results of the annual SMAT results for a suite of regional modeling runs conducted by OTC, with each modeling run representing "On the Books, On the Way" (OTB/OTW) control measures. All runs demonstrate compliance with the annual NAAQS.

Table V-2: Annual SMAT Results for the Pittsburgh-Beaver Valley Area 2009 On-The-Books-On-The-Way Control Measures

AIRS ID	Site Name	County	State	2000-2004 DVB				2009
				Q1	Q2	Q3	Q4	DVF
420030008	Lawrenceville	Allegheny	PA	13.75	15.71	19.53	13.52	13.3
420030067	South Fayette	Allegheny	PA	10.89	13.27	17.34	11.20	11.3
420030093	N. Park	Allegheny	PA	11.90	14.74	18.00	11.07	11.8
420030095	Coraopolis	Allegheny	PA	12.41	15.63	17.83	11.74	12.2
420031008	Harrison	Allegheny	PA	14.25	16.60	19.51	13.02	13.5
420031301	N. Braddock	Allegheny	PA	15.07	16.64	20.49	14.81	14.3
420070014	Beaver Falls	Beaver	PA	14.50	14.93	20.32	13.82	13.6
421250005	Charleroi	Washington	PA	12.59	16.60	20.32	12.03	13.0
421250200	Washington	Washington	PA	12.42	15.12	19.90	12.08	12.7
421255001	Florence	Washington	PA	10.90	14.54	17.82	10.84	11.6
421290008	Greensburg	Westmoreland	PA	13.53	15.46	20.04	12.50	13.0

Source: 2000-2004 DVB quarterly concentrations calculated from data in Appendix A-2.

6. 24-Hour SMAT Results

As with obtaining the annual SMAT Results, a difficulty presented in estimating the future design values was missing STN data for 2000 and 2001 at all of the Pittsburgh monitors. This limitation restricted the calculation of SANDWICH data to the period 2002–2004. Therefore, the 2009 projected design values are based on speciation profiles developed using 2002-2004 STN data. Appendix H-7 contains a sample Excel spreadsheet showing the calculations utilized to compute the 2009 DVF (displayed in Table V-4).

The RRF calculations were very similar to those that were computed in the annual SMAT analysis, except that all modeled RRFs were compared with each monitoring year's 24-hour 98th percentile design value. A quarterly analysis was completed consistent with the procedure outlined in EPA's *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (EPA-454/B-07-002, April 2007).

The procedure that was completed was as follows. The top 25% of the days of the speciation and the modeling data were computed on a quarterly basis. The speciation data was compared with the quarterly $PM_{2.5}$ FRM data to compute a speciated composition of the FRM data. Then after the RRFs were calculated (the RRF values for North Braddock, are shown below in Table V-3), these RRF values were applied to the speciated composition data to compute a 2009 speciated composition data. Once this was completed, a future year design value was reconstructed.

Table V-3: 24-hour $PM_{2.5}$ Quarterly RRF Values

Quarter	Sulfates	Nitrates	OC	EC	Crustal
1st	0.9755	0.9843	0.9408	0.8291	1.0992
2nd	0.6295	1.0926	0.9893	0.8471	1.2694
3rd	0.6182	0.9962	0.9902	0.8429	1.2801
4th	0.9090	0.9839	0.9965	0.8503	1.1666

Table V-4 displays the 24-hour $PM_{2.5}$ SMAT results for all of the monitors within the Pittsburgh-Beaver Valley Area. The SMAT results demonstrate that the projected 24-hour 98th percentile $PM_{2.5}$ concentration calculated at the FRM monitor attains the 24-hour $PM_{2.5}$ NAAQS. Specifically, all DVF calculations are less than 65 $\mu g/m^3$. Table V-4 presents the results of the 24-hour SMAT results for a suite of regional modeling runs conducted by OTC each representing OTB/OTW control measures. All runs demonstrate compliance with the 24-hour $PM_{2.5}$ NAAQS.

Table V-4: 24-hour SMAT Results for the Pittsburgh-Beaver Valley Area 2009 On-The-Books-On-The-Way Control Measures

AIRS ID	Site Name	County	State	24-Hour 98th Percentile DVB					2009
				2000	2001	2002	2003	2004	DVF
420030008	Lawrenceville	Allegheny	PA	34.1	41.7	41.4	35.9	38.3	31.5
420030067	South Fayette	Allegheny	PA	32.0	37.0	47.6	42.1	42.2	31.3
420030093	N. Park	Allegheny	PA	33.9	37.9	52.5	56.6	47.2	38.1
420030095	Coraopolis	Allegheny	PA	31.1	38.4	46.2	38.6	46.6	33.1
420031008	Harrison	Allegheny	PA	41.6	48.1	46.2	41.9	45.4	35.0
420031301	N. Braddock	Allegheny	PA	39.7	51.7	41.9	50.4	38.3	33.6
420070014	Beaver Falls	Beaver	PA	43.6	49.3	37.7	33.8	43.0	31.9
421250005	Charleroi	Washington	PA	36.0	44.4	45.4	35.6	35.4	30.7
421250200	Washington	Washington	PA	33.3	38.9	37.2	33.4	34.0	28.8
421255001	Florence	Washington	PA	30.5	37.6	36.7	33.9	36.0	26.4
421290008	Greensburg	Westmoreland	PA	37.2	44.1	40.0	34.8	39.0	30.6

Source: 24-Hour 98th percentile DVB concentrations calculated from data in Appendix A-1.

F. Unmonitored Area Analysis

Following EPA's *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (EPA-454/B-07-002, April 2007), an unmonitored area analysis "…is intended to ensure that a control strategy leads to reductions in ozone or $PM_{2.5}$ at other locations which could have baseline (and future) design values exceeding the NAAQS were a monitor deployed."

Projected annual $PM_{2.5}$ concentrations surrounding the Pittsburgh-Beaver Valley Area indicate most areas in the Commonwealth, including the Pennsylvania nonattainment areas immediately surrounding the Pittsburgh-Beaver Valley Area, are projected to attain the standard by 2009. This indicates there should be no areas where concentrations could reasonably be expected to exceed the annual $PM_{2.5}$ NAAQS within the nonattainment area.

The fact that the Liberty-Clairton $PM_{2.5}$ nonattainment area is a subsection of the Pittsburgh-Beaver Valley $PM_{2.5}$ nonattainment area was also evaluated. The five (5) municipalities that make up the Liberty-Clairton $PM_{2.5}$ nonattainment area were originally designated as nonattainment for PM_{10}. At the time, the five (5) municipalities were tied together due to the extent at which the local source was believed to impact (due to local topographical and meteorological issues). In the time since the original PM_{10}

nonattainment designation, the ACHD has monitored $PM_{2.5}$ in municipalities surrounding the Liberty-Clairton $PM_{2.5}$ nonattainment area. The monitoring data has confirmed the boundaries of the original PM_{10} nonattainment area, showing that the impacts of the local source within the region did not extend further than the five (5) municipality region.

The Air Quality Modeling Group (EPA Research Triangle Park) has developed the MATS, described on p. 39, above. MATS is a PC-based software tool that can perform the modeled attainment tests for $PM_{2.5}$ and ozone (O_3), and perform the uniform rate of progress analysis for regional haze (visibility). When this analysis was conducted, MATS was still in development and therefore was not utilized within this analysis.

G. Local Area Analysis

EPA's *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (2007) suggests that it may be necessary to evaluate the impact of local primary PM sources for contributions to both the 24-hour and annual NAAQS. Evaluation of local PM sources and their effects on monitor concentrations could be evaluated using a near-scale model such as AERMOD or CALPUFF.

Since the end of 2008, there are a total of nine (9) FRM monitors within the Pittsburgh-Beaver Valley Area; five (5) FRM monitors run by the Department and four (4) FRM monitors run by the ACHD. In addition, there are three (3) speciation monitors and at least four (4) continuous $PM_{2.5}$ monitors located within the Pittsburgh-Beaver Valley Area.

Pennsylvania has noted local source interference at Allegheny County's North Braddock monitor (PA DEP, September 2004). North Braddock has the highest annual $PM_{2.5}$ design value (15.5 $\mu g/m^3$) and the highest 24-hour design value (40 $\mu g/m^3$) in the Pittsburgh-Beaver Valley Area in 2008. The 24-hour design value is below the (1997) 24-hour standard indicating compliance with the NAAQS even with significant local effects.

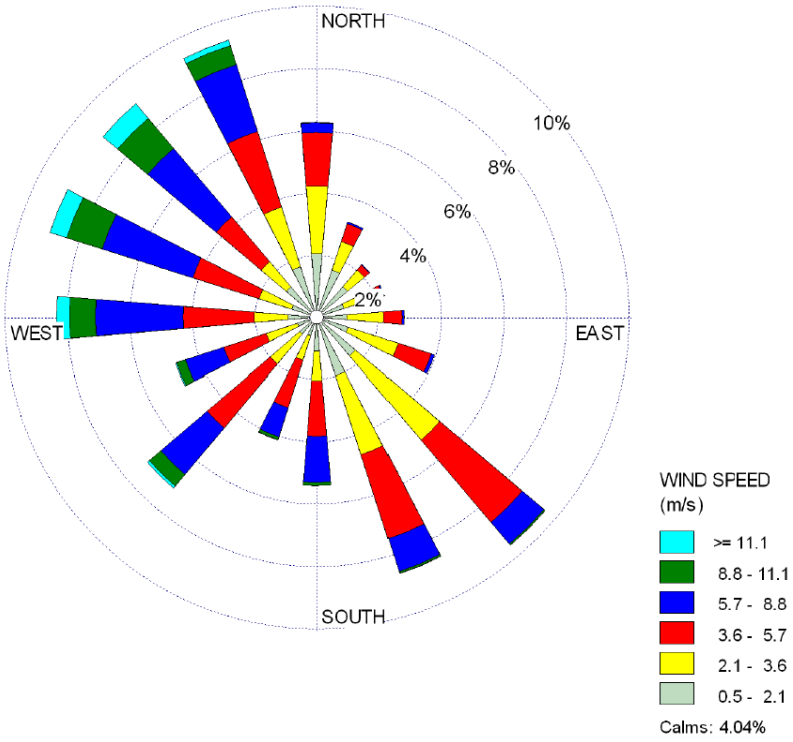
A review of the Commonwealth's and Allegheny County's 2002 emissions from the NEI database indicates ten (10) large sources with greater than 50 tons per year (TPY) of direct $PM_{2.5}$ emissions within 50 kilometers of the North Braddock $PM_{2.5}$ monitor. These sources are listed in Table V-5. Each source's $PM_{2.5}$ emissions, distance from the North Braddock monitor, direction from the North Braddock monitor, county and emission to distance ratio (Q/d) are included in the table.

Table V-5: Summary of Large $PM_{2.5}$ Sources near the North Braddock Monitor

Source	Emissions (TPY)	Distance (km)	Direction	County	Q/d
US Steel – Edgar Thompson	472.0	1.2	S	Allegheny	**380.5**
US Steel – Irvin	63.5	8.4	SE	Allegheny	7.6
US Steel – Clairton Coke	394.0	11.1	SSE	Allegheny	**35.6**
Glenshaw Glass Co.	58.8	15.2	NW	Allegheny	3.9
Reliant – Cheswick	591.0	16.0	NE	Allegheny	**37.0**
Reliant – Elrama	556.0	17.5	SSE	Washington	**31.8**
Shenango Inc.	70.2	21.1	WNW	Allegheny	3.3
Allegheny Energy – Mitchell	181.0	22.6	SE	Washington	8.0
Alleg. Ludlum – Brackenridge	271.0	25.5	NE	Allegheny	10.6
AK Steel – Butler Works	58.8	47.9	NNW	Butler	1.2

The ratio of emissions to distance (Q/d) is often used as a screening tool to determine if a source could cause a significant model concentration. If a source's Q/d ratio is larger than twenty (20) it usually warrants an analysis using a dispersion model. Table V-5 indicates four (4) sources exceed this Q/d ratio and probably warrant an analysis with a dispersion model to gauge their effects on the North Braddock monitor. A quick survey of local wind patterns utilizing meteorological data collected from 1998 to 2000 at the North Braddock monitor indicates the flow around the North Braddock area is influenced by the Monongahela River valley the monitor sits in. Therefore, as shown in Figure 10 below, the North Braddock area generally experiences a strong west, northwest flow or southeast flow. Based on the results from the wind rose analysis, three of the identified sources (US Steel – Edgar Thompson, US Steel – Clairton Coke, and Reliant - Elrama) lie upwind of the North Braddock monitor, while the other source (Reliant - Cheswick) lies in less favorable wind directions to transport direct $PM_{2.5}$ emissions to the North Braddock monitor.

Figure 10. Wind Rose: North Braddock Monitoring Location (1998-2000)



As noted earlier, the Department has observed enhancement of $PM_{2.5}$ concentrations at the North Braddock monitor by local sources. Using emissions to distance ratios (Q/d) and local predominant wind directions; four (4) sources were identified for possible analysis with a dispersion model to gauge the effect of local direct $PM_{2.5}$ emissions on the North Braddock monitor. A local area analysis using a dispersion model, however, was not conducted since the modeled concentrations for the North Braddock monitor currently would attain the $PM_{2.5}$ NAAQS. This does not preclude the Department from conducting a dispersion modeling analysis as part of a local area analysis in the future for the EPA's revised 24-hour $PM_{2.5}$ standard.

The 2002 inventory was based on emissions reported to the Department by facilities and did not include condensables for many facilities. If a local area analysis is needed in the future to address the 2006 $PM_{2.5}$ NAAQS, the analysis would likely be based on inventory data from a more recent baseline year. At that point, the Department could evaluate whether the baseline inventory includes $PM_{2.5}$ condensables, as appropriate.

H. Weight of Evidence and Other Documentation Supporting Attainment

The EPA's *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (2007) encourages the use of corroboratory analyses to support the modeled attainment demonstration. These

analyses, collectively referred to as "weight of evidence" (WOE), help bolster the assertions that an area will achieve attainment in the allotted time.

Table V-6 outlines the types of supplemental information that EPA suggests will satisfy a weight of evidence demonstration. Generally, the analyses become more complicated as the projected modeled values increase. The projected 2009 design value for the annual standard in the Pittsburgh-Beaver Valley Area, 14.3 $\mu g/m^3$, is below the lower bounds of the range of 14.5 $\mu g/m^3$ to 15.5 $\mu g/m^3$ for which EPA's *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (2007) requires a formal weight of evidence demonstration.

According to the EPA's *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze* (2007), areas, such as the Pittsburgh-Beaver Valley Area, that have a projected design value lower than 14.5 $\mu g/m^3$ are recommended to provide basic supplemental analyses to support the result of the modeling demonstration. The basic supplemental analyses can include additional modeling, analysis of trends in the monitoring data or emissions and/or observational models and diagnostic analyses. The Department's supporting evidence includes a brief summary of the modeling demonstration, recent trends in the Pittsburgh-Beaver Valley Area's monitoring data and a brief analysis of some of the largest SO_2 sources within the nonattainment area.

Table V-6: Summary of $PM_{2.5}$ Weight of Evidence Guidelines (EPA Guidance)

Results of Modeled Attainment Test		**Supplemental Analyses**
Annual $PM_{2.5}$	**24-Hour $PM_{2.5}$**	
Future Design Value < 14.5 $\mu g/m^3$, all sites	**Future Design Value < 62 $\mu g/m^3$, all sites**	**Basic supplemental analyses should be completed to confirm the outcome of the modeled attainment test**
Future Design Value 14.5 – 15.5 $\mu g/m^3$, all sites	**Future Design Value 62 – 67 $\mu g/m^3$, all sites**	**A weight of evidence demonstration should be conducted to determine if aggregate supplemental analyses support the modeled attainment test**
Future Design Value ≥ 15.5 $\mu g/m^3$, all sites	**Future Design Value ≥ 68 $\mu g/m^3$, all sites**	**More qualitative results are less likely to support conclusion differing from the outcome of the modeled attainment test**

2009 Projected Modeling Concentration: The Department's attainment demonstration relies on results from the OTB/OTW CMAQ runs completed by the Virginia Department of Environmental Quality. Emissions for the base case (2002) and projected (2009) time

frames were developed by MARAMA with input from all states that are part of the OTR plus the District of Columbia. Base-case and projected emissions within the Pittsburgh-Beaver Valley Area appear to be reasonable; therefore, the projected design value for 2009 should reflect what will actually be monitored.

Recent analyses of projected CMAQ ozone design values suggest the model may actually underestimate the impact of emission reductions on actual concentrations. This modeled underestimation of changes in ozone concentrations may be due to the model's inability to adequately reproduce changes in ozone concentrations due to large emission reductions. If CMAQ has the same shortfall with fine particulate concentrations, then it may also overestimate the projected 2009 $PM_{2.5}$ design values for the Pittsburgh-Beaver Valley Area. Since the calculated design value is already well below 15.0 $\mu g/m^3$, any overestimation of the projected 2009 annual $PM_{2.5}$ design value provides a further cushion bolstering the argument that the Pittsburgh-Beaver Valley Area will reach attainment.

In addition, the 2002 inventory was based on emissions reported to the Department by facilities. In 2002, many facilities did not include condensables in their estimates of direct $PM_{2.5}$. The projected 2009 $PM_{2.5}$ emissions for EGUs include condensable PM. For EGUs, emissions of condensable PM were calculated based on 2009 operating parameters predicted by IPM and emission factors derived from AP-42 defaults. Because the 2002 inventory was based on emissions reported to the Department by facilities and did not include condensables for many facilities, the emissions inventory shows an apparent increase in $PM_{2.5}$ emissions from stationary sources from 2002 to 2009.

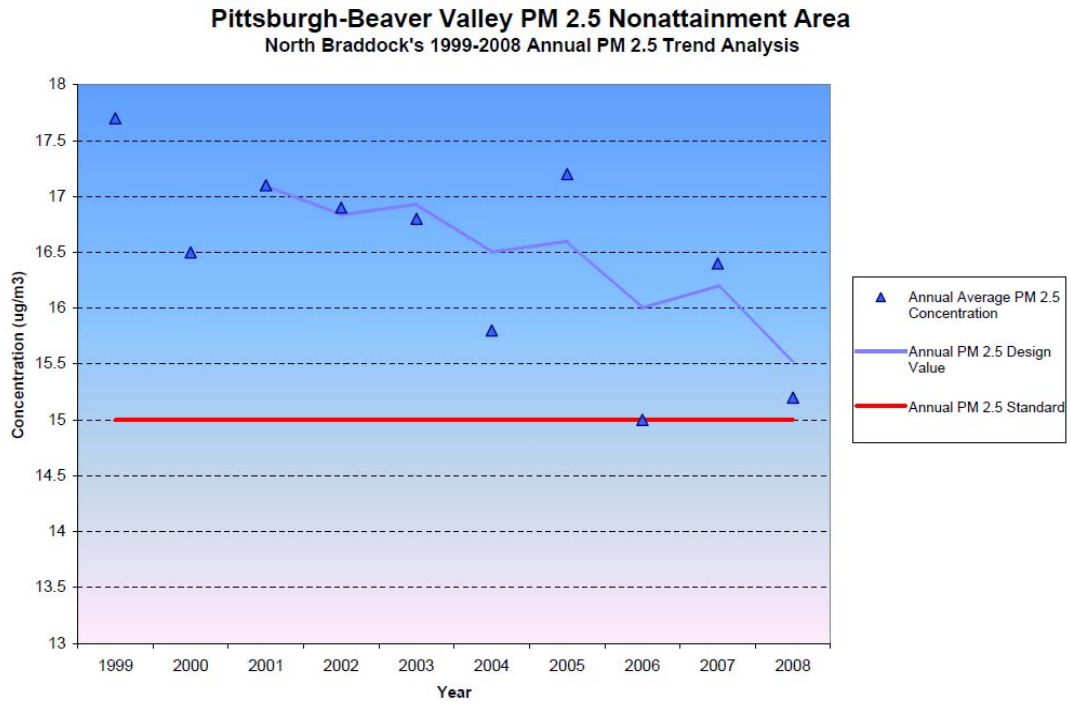
If the 2002 emissions inventory were corrected to account for the unreported condensable emissions, the modeled 2009 $PM_{2.5}$ concentrations would be lower, i.e., the Pittsburgh-Beaver Valley Area would be predicted to attain the standard by a larger margin. If the 2002 emissions inventory were corrected to account for the unreported condensable emissions, 2002 would have higher total $PM_{2.5}$ emissions in the inventory. Within the modeling, a concentration was calculated for 2002 and 2009 (based on their respective inventories). Then, in order to calculate the anticipated 2009 monitored concentration, DEP utilized the speciated pollutants (such as sulfates, nitrates, elemental carbon, organic carbon, etc.) constructed from the 2002 and 2009 modeling runs. Then a ratio (known as a relative reduction factor (RRF)) was applied, using the results of the 2002 and 2009 modeling. The RRF is calculated by dividing the 2009 modeled results by the 2002 modeled results. Therefore, if the 2002 emissions inventory had higher total $PM_{2.5}$ emissions, the RRF calculated would have been lower (with a larger number being the denominator of the RRF calculation). With a lower RRF, the calculated speciated component attributable to the direct $PM_{2.5}$ emissions would have been lower, lowering the overall 2009 $PM_{2.5}$ predicted concentration.

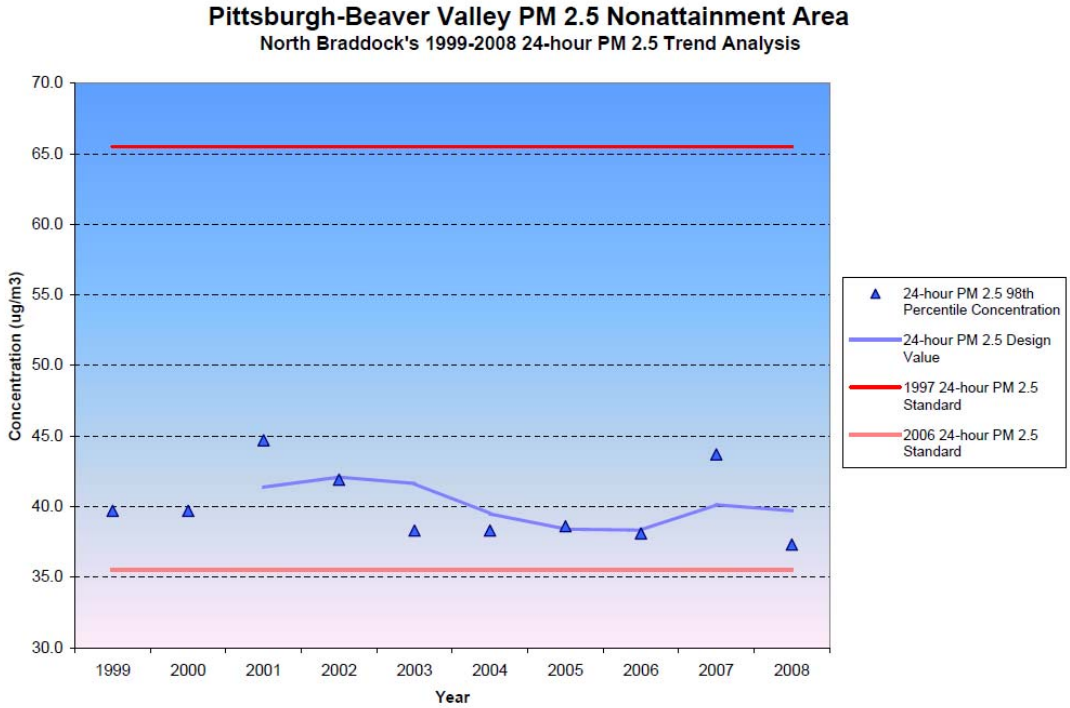
$PM_{2.5}$ and Emission Trends: Long-term trends were analyzed for all $PM_{2.5}$ monitors in Pennsylvania, using $PM_{2.5}$ modeling protocols. No statistically significant trends in the 2001-08 design values were noted for the Pittsburgh-Beaver Valley Area monitors. This finding was not unexpected, since it appears that many monitors within the region are

heavily influenced by the mobile-source sector, which has recently had significant controls imposed on it.

Figure 11 shows the values for the monitor (North Braddock) displaying the highest annual and 24-hour $PM_{2.5}$ concentration in the Pittsburgh-Beaver Valley Area from 1999 through 2008. Over the last two years, annual $PM_{2.5}$ averages appear to have declined slightly. In fact, all $PM_{2.5}$ monitors, excluding North Braddock, in the Pittsburgh-Beaver Valley Area are now in compliance with the annual $PM_{2.5}$ standard. This may be due to a combination of weather conditions and emission decreases in the mobile source sector. While this is probably not a statistically significant trend, it may be indicative of lower future $PM_{2.5}$ design values more in line with the annual $PM_{2.5}$ standard.

Figure 11: Pittsburgh-Beaver Valley Area $PM_{2.5}$ Trends





Controls on the largest SO_2 sources in the Pittsburgh-Beaver Valley Area, including Allegheny Energy – Hatfield's Ferry, Reliant – Keystone, and Reliant – Cheswick facilities, are scheduled to be operational in 2009. The projected SO_2 emission rates for these three (3) sources should provide a substantial reduction in sulfate levels within the Pittsburgh-Beaver Valley Area. As seen in Figure 5 (in this Section V), sulfate is a major contributor to the Pittsburgh-Beaver Valley Area's $PM_{2.5}$ nonattainment problem. This reduction in $PM_{2.5}$ precursors coupled with somewhat lower recent annual $PM_{2.5}$ concentrations bolsters the Commonwealth's assertion that the Pittsburgh-Beaver Valley Area will soon be in compliance with the $PM_{2.5}$ NAAQS.

I. Conclusions

The Pittsburgh-Beaver Valley Area's projected 2009 annual $PM_{2.5}$ concentration was estimated using the OTC's modeling platform. A review of the base case (2002) run indicated the CMAQ model did a reasonable job reproducing actual concentrations. Based on this analysis, it is reasonable to assume the model can estimate the projected $PM_{2.5}$ concentrations within the Pittsburgh-Beaver Valley Area for 2009. The Department understands that the EPA anticipates using 2009 data to determine whether the Pittsburgh-Beaver Valley Area attains the $PM_{2.5}$ standard by its April 2010 attainment date.

Projected $PM_{2.5}$ concentrations from CMAQ indicate the Pittsburgh-Beaver Valley Area will attain the annual standard by 2009. Additional evidence supporting this conclusion includes lower concentrations at all of the $PM_{2.5}$ monitors within the Pittsburgh-Beaver Valley Area the last couple of years, significant SO_2 controls installed on some of the largest sources within the nonattainment area and possible model under-predictions of the air quality benefits of emission reductions.

VI. CONTINGENCY MEASURES FOR THE ATTAINMENT DEMONSTRATION

A. Contingency Measure Requirement

Pursuant to 40 CFR 51.1012, the attainment plan for the Pittsburgh-Beaver Valley Area must include a contingency plan that contains measures that qualify as contingency measures for the attainment demonstration. This section fulfills the contingency measures requirement for the attainment demonstration. The contingency plan must provide for one year of reductions needed for attainment.

By 2009, emissions of SO_2 and NOx in the Pittsburgh-Beaver Valley Area are projected to decrease by 347,796 tons and 86,586 tons, respectively. Based on modeling of the projected 2009 emissions, the Pittsburgh-Beaver Valley Area is predicted to have a 2009 design value of 14.3 ug/m^3. This is lower than the 15 ug/m^3 required for attainment of the $PM_{2.5}$ standard. Calculations were made to estimate the portion of the emission reduction that is necessary to reach the attainment concentration of 15 ug/m^3 and the portion of the emission reduction that reduces the design value below 15 ug/m^3 and is, therefore, excess.

Table VI-1 contains information about the changes in design value and emissions expected by 2009 in the Pittsburgh-Beaver Valley Area. Table VI-1 displays the 2002 actual and 2009 modeled design values and the 2002 actual and 2009 projected emissions of $PM_{2.5}$, SO_2 and NOx.

Table VI-1: Changes in Design Value and Emissions Expected by 2009

Pittsburgh-Beaver Valley Area	Design Value (ug/m^3)	$PM_{2.5}$ (tons/year)	SO_2 (tons/year)	NOx (tons/year)
2002	16.8	14904	476871	198483
2009 (Modeled/Projected)	14.3	27969	129074	111897
Predicted Change from 2002-2009	2.5	-13066	347796	86586

As shown in Table VI-2, for each pollutant, the change in pollutant emissions was divided by the predicted change in design value to yield the design value reduction rate. Next, the change in design value necessary to attain the standard (16.8 ug/m^3 – 15 ug/m^3 = 1.8 ug/m^3) was multiplied by the design value reduction rate to estimate the target emissions reduction. This represents the portion of emissions reduction necessary to attain the standard. The rest of the emissions reduction is beyond what is necessary for attainment and is, therefore, considered to be "excess" reduction.

Table VI-2: Calculation of Required and Excess Emissions Reductions

Pittsburgh-Beaver Valley Area	Design Value (ug/m^3)	$PM_{2.5}$ (tons/year)	SO_2 (tons/year)	NOx (tons/year)
Predicted Change from 2002-2009	2.5	-13066	347796	86586
Design Value Reduction Rate ($tons/ug/m^3$)		N/A	139119	34634
Target Reductions for Attainment	1.8	N/A	250413	62342
Calculated Excess Reductions	0.7	N/A	97383	24244

The contingency requirement is calculated by dividing the target emissions reduction by seven which is the number of years between 2002 and 2009. Table VI-3 shows the calculation of the contingency requirement reduction and demonstrates that the calculated excess reduction exceeds the amount of reduction necessary for the contingency plan.

Table VI-3: Calculation of Required Contingency Plan Reductions

Pittsburgh-Beaver Valley Area	$PM_{2.5}$ (tons/year)	SO_2 (tons/year)	NOx (tons/year)
Target Reductions for Attainment	N/A	250413	62342
Calculated Excess Reductions	N/A	97383	24244
Contingency Requirement	N/A	35773	8906
Excess Reductions Satisfy Contingency Requirement	N/A	Yes	Yes

B. Identified Contingency Measures

In addition to the calculated excess reductions shown in Tables VI-2 and VI-3 above, the Department has identified additional control measures. EPA guidance encourages early implementation of contingency measures to guard against failure either to meet a milestone or attain the standard. EPA's guidance on early implementation of control measures encourages the early implementation of required control measures and of contingency measures as a means of guarding against failures to meet a

milestone or to attain. The EPA states that any implemented measures (that are not needed for the rate-of-progress requirements or for the attainment requirements) would need to be "backfilled", meaning replaced with another measure, only to the extent they are used to meet a milestone.[8]

The reductions from the designated contingency measures are surplus vis-à-vis the attainment demonstration contained in this SIP. As a result, the Department will not be required to replace any contingency measures that it chooses to implement in advance of the contingency plan requirement.

The following describes specific control measures that are anticipated to be in place in order to bring the area back into attainment should a violation occur.

On October 9, 2008, Governor Rendell signed Senate Bill 295, which became Act 124 of 2008, the Diesel-Powered Commercial Motor Vehicle Idling Act (Act 124). Act 124 went into effect on February 6, 2009. The Department estimates that 50 percent of all long duration idling for Class 8 trucks will be eliminated in 2010 when the temperature exemption for sleeper truck rest expires. Statewide emission reductions are estimated to be 1610 tons, 45 tons and 30 tons per year for NOx, VOC, and $PM_{2.5}$, respectively. The Department may also utilize enhanced enforcement to obtain additional emission reductions.

Significant additional reductions in NOx, direct $PM_{2.5}$ and, to a limited extent, SO_2 emissions will occur in emissions from highway and nonroad mobile sources after 2009. NOx emissions from mobile sources are more than one-third of the emissions in 2009.

In addition, the following regulations are in development and are anticipated to be adopted in the relatively near future:

- NOx controls for cement kilns
- NOx controls for glass furnaces
- PM controls for outdoor wood furnaces

Regulations to reduce VOC emissions are also in development, including controls on the manufacture and use of adhesives, primers and sealants and regulations incorporating the Control Techniques Guidelines issued by the EPA in 2006, 2007 and 2008.

Once the Department's Bureau of Air Quality has obtained an approved request to initiate a rulemaking, the rulemaking may proceed as follows:

8 EPA, "Guidance on the Post-1996 Rate-of-Progress Plan and the Attainment Demonstration," Corrected Version as of February 18, 1994, p. 50.

Within 2 months: Review by Air Quality Technical Advisory Committee (AQTAC), Citizens Advisory Council and other advisory committees,[9] as appropriate.
Within 5 months: Environmental Quality Board (EQB) meeting/action.
Within 7 months: Publication in the *Pennsylvania Bulletin* for comment as proposed rulemaking.
Within 9 months: Public hearing takes place and comment period on proposed rule closes.
Within 10 months: House and Senate Standing Committees and Independent Regulatory Review Commission (IRRC) comment on proposed rule.
Within 12 months: AQTAC, Citizens Advisory Council and other committees, as appropriate, review responses to comments and draft final rulemaking.
Within 15 months: EQB meeting/action.
Within 16 months: IRRC action on final rulemaking.
Within 17 months: Attorney General review/action.
Within 18 months: Publication in the *Pennsylvania Bulletin* as final rulemaking and submission to the EPA as a SIP revision. The regulation would become effective upon publication in the *Pennsylvania Bulletin*.

9 Other committees could include the Small Business Compliance Advisory Committee and Agriculture Advisory Committee.

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ACRONYMS AND ABBREVIATIONS

ACHD	Allegheny County Health Department
AIM	Architectural and Industrial Maintenance Coatings
AQTAC	Air Quality Technical Advisory Committee
BACT	Best Available Control Technology
CAA	Clean Air Act
CAIR	Clean Air Interstate Rule
CA LEV	California Low Emission Vehicle (program)
CF	Control Factor
CFR	Code of Federal Regulations
CMAQ	Community Multi-scale Air-Quality Model
CMV	Commercial Marine Vessel
DON	Degree of Neutralization
DVB	Baseline Design Value
DVF	Future Design Value
EC	Elemental Carbon
EDMS	Emissions and Dispersion Modeling System
EGAS	Economic Growth Analysis System
EGU	Electric Generating Unit
EIA	Energy Information Administration
EPA	The United States Environmental Protection Agency
EQB	Environmental Quality Board
FAA	Federal Aviation Administration
FIP	Federal Implementation Plan
FIRE	Factor Information Retrieval
FMVCP	Federal Motor Vehicle Control Program
FR	Federal Register
FRM	Federal Reference Method
HAP	Hazardous Air Pollutant
ICI	Industrial, Commercial, Institutional
I/M	Inspection and Maintenance
IPM	Integrated Planning Model
IRRC	Independent Regulatory Review Commission
LDGV	Light Duty Gasoline Vehicles
LDGT	Light Duty Gasoline Trucks
MACT	Maximum Achievable Control Technology
MANE-VU	Mid-Atlantic/Northeast Visibility Union
MARAMA	Mid-Atlantic Regional Air Management Association
MATS	Modeled Attainment Test Software
MM5	Mesoscale Model Version 5
MPO	Metropolitan Planning Organization
MY	Model Year
NAAQS	National Ambient Air Quality Standard
NAICS	North American Industry Classification System
NBP	NOx Budget Program
NESCAUM	Northeast States for Coordinated Air-Use Management

NH_3	Ammonia
NH_4^+	Ammonium
NLEV	National Low Emission Vehicle (program)
NMIM	National Mobile Inventory Model
NOx	Oxides of Nitrogen
NO_2	Nitrogen Dioxide
NO_3^-	Nitrates
NSR	New Source Review
OC	Organic Carbon
OM	Organic Mass
OTAQ	Office of Transportation and Air Quality
OTB	On the Books
OTC	Ozone Transport Commission
OTW	On-the-Way
OTR	Ozone Transport Region
PBW	Particle Bound Water
PennDOT	Pennsylvania Department of Transportation
PIT	Pittsburgh International Airport
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter less than 2.5 microns in diameter or Fine Particulates
PM_{10}	Particulate Matter less than 10 microns in diameter
ppm	parts per million
PSD	Prevention of Significant Deterioration
PSU/NCAR	Pennsylvania State University National Center for Atmospheric Research
RACM	Reasonably Available Control Measure
RACT	Reasonably Available Control Technology
RE	Rule Effectiveness
RFP	Reasonable Further Progress
RP	Rule Penetration
RPO	Regional Planning Organization
RRF	Relative Response Factor
RVP	Reid Vapor Pressure
SANDWICH	Sulfate, Adjusted Nitrate, Derived Water, Inferred Carbonaceous Material Balance Approach
SCC	Source Classification Code
SCR	Selective Catalytic Reduction
SIP	State Implementation Plan
SMAT	Speciated Modeled Attainment Test
SMOKE	Sparse Matrix Operator Kernel Emissions
SO_2	Sulfur Dioxide
SO_4^-	Sulfates
STN	Speciation Trends Network
TCM	Transportation Control Measures
TEOM	Tampered Element Oscillating Microbalance Monitor
TSD	Technical Support Document
$\mu g/m^3$	Microgram per cubic meter

µm	Micrometer
VISTAS	Visibility Improvement State and Tribal Association of the Southeast
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compound
WOE	Weight of Evidence
ZEV	Zero Emissions Vehicle