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PROTECTION**

**FINAL**

**Volume I**

**State Implementation Plan Revision: NO<sub>x</sub> and VOC  
Motor Vehicle Emission Budget Revisions Based on  
the MOVES2010a Model**

**Lancaster Eight-Hour Ozone Maintenance Area**

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# **1. Introduction and Overview of Ground-Level Ozone**

Maintaining concentrations of ground-level ozone below the health-based 8-hour ozone national ambient air quality standards (NAAQS) is important because ozone is a serious human health threat and can cause damage to important food crops, forests, and wildlife.

Repeated exposure to ozone pollution may cause a variety of adverse health effects for both healthy people and those with existing conditions including: difficulty breathing, chest pains, coughing, nausea, throat irritation, and congestion. Ozone exposure can exacerbate bronchitis, heart disease, emphysema, and asthma, and reduce lung capacity. Asthma is a significant and growing threat to children and adults. Ozone can aggravate asthma, causing more asthma attacks, increased use of medication, more medical treatment and more frequent visits to hospital emergency clinics. Because ozone pollution usually forms in hot weather, anyone who spends time outdoors in the summer may be affected, particularly children, the elderly, outdoor workers and people exercising. Children are most at risk from exposure to ozone because they are active outside during the summertime when ozone levels are highest.

Ozone is one of the most pervasive and detrimental pollutants known to affect vegetation, causing more injury to trees and crops than any other air pollutant in the United States. Ozone interferes with photosynthesis, the process by which plants convert water and sunlight to food. Ozone makes plants more susceptible to disease, insects, other pollutants and harsh weather. It damages the foliage of trees and other plants, ruining the landscapes of cities, parks, forests, and recreation areas. Research has shown that current ozone concentrations result in reductions in wood growth of over 10 percent in forests of the Northeast United States. There is strong scientific evidence showing that current levels of ozone are reducing crop yields, particularly in sensitive species such as soybean, cotton, and peanuts. Annual crop loss alone from ozone-affected soybeans in Illinois, Indiana and Ohio has been calculated to fall between \$199 million and \$346 million. The U.S. Environmental Protection Agency (EPA) has estimated national crop yield losses due to ozone in excess of \$1 billion annually. One of the key components of ozone, oxides of nitrogen, contributes to fish kills and algae blooms in sensitive waterways, such as the Chesapeake Bay.

Ozone is not emitted directly to the atmosphere, but is formed by photochemical reactions between volatile organic compounds (VOCs) and oxides of nitrogen (NO<sub>x</sub>) in the presence of sunlight. The long, hot, humid days of summer are particularly conducive to ozone formation, so ozone levels are of concern primarily during the months of May through September. The primary sources of man-made VOCs and NO<sub>x</sub>, the ozone precursors, are the evaporation of fuels and solvents (gasoline and consumer products), combustion of fuels (motor vehicles, power plants and non-road engines), and industrial processes.

## ***1.1. 8-Hour Ozone National Ambient Air Quality Standards***

In July 1997, the EPA established identical primary and secondary 8-hour ozone NAAQS at a concentration of 0.08 parts per million (ppm), based on the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentrations measured in the ambient air at each monitored location. Implementation of the standards was delayed due to litigation. In June 2004, EPA designated the Lancaster Area, which consists of all of Lancaster County, as

nonattainment for the 1997 8-hour ozone standard, based on ambient air quality monitoring data collected from 2001-2003. The Lancaster Area was one of seventeen areas in Pennsylvania designated as an 8-hour ozone nonattainment area for the 1997 ozone NAAQS.

The Lancaster Area was initially classified as a “moderate” 8-hour ozone nonattainment area. In July 2004, Pennsylvania requested that the EPA reclassify the Lancaster Area to a “marginal” 8-hour ozone nonattainment area in accordance with Section 181(a)(4) of the Clean Air Act (CAA). A state may request reclassification if the design value in the nonattainment area is five percent greater or five percent less than the level on which the classification is based. The EPA approved the reclassification request for the Lancaster Area on September 22, 2004 (69 FR 56697).

On March 12, 2008, the EPA revised the NAAQS for ozone to 0.075 ppm averaged over 8 hours to provide even greater protection for children, other at-risk populations and the environment against the array of ozone-induced adverse health and welfare effects. See 73 FR 16436 (March 27, 2008). The EPA had begun a voluntary reconsideration of the 2008 ozone NAAQS in January 2010 to set a more protective 8-hour ozone standard (75 FR 2938), but withdrew that reconsideration at the request of the President of the United States on September 2, 2011, leaving the 2008 ozone standard in place. On May 21, 2012, the EPA published a final rule for the 2008 8-hour ozone NAAQS, implementing the nonattainment area classification approach, attainment deadlines, and revoking the 1997 ozone NAAQS for the purpose of transportation conformity (77 FR 30160). The EPA will be promulgating an additional implementation rule for the 2008 ozone NAAQS, which is scheduled to be proposed during 2013, that will address State Implementation Plan (SIP) requirements for the 2008 ozone NAAQS and other issues. The ozone standard is currently undergoing its statutory five year review and it is anticipated that EPA will promulgate an ozone standard between 0.060 and 0.070 ppm in the near future. Pennsylvania could have additional areas that do not meet this anticipated revised ozone standard.

States will need to submit SIP revisions to demonstrate how they will bring the nonattainment areas into attainment of the 2008 ozone NAAQS. Nevertheless, the promulgation of the new ozone standard does not affect the need for this revision to the approved maintenance plan for the Lancaster Area (Lancaster Ozone Maintenance Plan) under the 1997 ozone NAAQS.

## ***1.2. Lancaster Area and Ozone SIP Revisions***

On September 20, 2006, the Department submitted a SIP revision to the EPA requesting redesignation of the Lancaster Area to attainment of the 1997 ozone NAAQS. The Department concurrently submitted a SIP revision (2006 Lancaster SIP revision) to the EPA that included a maintenance plan based on the attainment and continued long-term attainment of the 1997 ozone NAAQS for the Lancaster Area (Lancaster Ozone Maintenance Plan), the 2002 baseline inventory, and motor vehicle emission budgets (MVEBs) to be used for purposes of transportation conformity. The Department submitted supplemental inventory material to the EPA on November 8, 2006. The EPA’s transportation conformity regulation, found at 40 CFR Part 93, Subpart A, requires that the transportation plan, transportation improvement program (TIP), and projects not from a conforming transportation plan and TIP must be consistent with the MVEBs in the applicable air quality SIP. This criterion is satisfied if the state can demonstrate that emissions of the pollutants or pollutant precursors for which the area is in

nonattainment or maintenance, and for which the applicable SIP contains MVEBs approved or deemed adequate by the EPA, are less than or equal to the MVEBs established in the applicable SIP or SIP submission. The metropolitan planning organization for the area, the Lancaster County Transportation Coordinating Committee, ensures that emissions resulting from its TIP are less than the MVEBs in the SIP by completing periodic conformity determinations, which are subject to public comment. The EPA approved all of the components of the 2006 Lancaster SIP revision, including the MVEB, on July 6, 2007 (72 FR 36889) and redesignated the Lancaster Area to attainment.

The approved MVEBs included in the approved Lancaster Ozone Maintenance Plan were estimated using the EPA-approved highway emissions model in effect at that time, the Highway Mobile Source Emission Factor Model version 6.2 (Mobile6.2). The MVEBs in the Lancaster Ozone Maintenance Plan included emission budgets for both NO<sub>x</sub> and VOC. On March 2, 2010, the EPA released a new mobile source emissions model called the Motor Vehicles Emissions Simulator 2010 (MOVES2010). The EPA provided a two-year grace period to transportation planning organizations, ending March 2, 2012, during which the older Mobile6.2 emissions model could be used to model emissions for transportation projects in order to meet the requirements of transportation conformity (75 FR 9411 (March 2, 2010)). In September 2010, EPA approved a revised version of the MOVES2010 model. On October 13, 2011, the EPA proposed a one-year extension to the two-year grace period because states and localities needed more time to transition to using MOVES2010a and to develop the technical capacity to use MOVES2010a (76 FR 63575). The EPA finalized the extension on February 27, 2012 (77 FR 11394). The extension allows states and localities to better evaluate whether SIPs and MVEBs, or transportation plans and TIPs, should be revised for future conformity determinations. The 1-year extension provides additional time that may be critical for nonattainment and maintenance areas to learn and apply MOVES2010a for regional conformity analyses. Any new transportation conformity analysis started after March 2, 2013, must use the most up-to-date version of MOVES.

EPA issued the MOVES2010b version of the model and its associated guidance in April 2012. EPA considers both MOVES2010a and MOVES2010b to be minor revisions to MOVES2010 that do not significantly affect the results of modeling criteria pollutant estimates for highway vehicles. References to “MOVES” in the remainder of this document relate to all of the approved versions of the model. The highway vehicle emissions modeling for this SIP revision was already developed significantly using MOVES 2010a. By the time that version 2010b was issued, using MOVES2010b would have been impractical.

Compared to Mobile6.2, the MOVES model estimates higher NO<sub>x</sub> emissions and in some areas higher VOC emissions being produced by highway vehicles, depending on the model’s inputs. Emissions estimated using MOVES will always be greater for transportation planning than the emissions accounted for in the MVEBs, which were estimated using Mobile6.2. As a result, comparing emissions from the MOVES model to the MVEB included in approved maintenance plan would not allow local and regional transportation planning agencies to meet the requirements of transportation conformity; the emissions budget in the maintenance plan would be exceeded and transportation planning could be adversely affected. This is why the

Department is updating the MVEBs for the Lancaster Area using the newer EPA-approved emissions model, MOVES2010a.

It is important to mention that higher emission estimates calculated by MOVES2010a do not mean that emissions from vehicles actually increased. The MOVES model better estimates emissions that are already being produced by vehicles. Consequently, the ability of the area to maintain the standard will not be affected by using estimates produced by the new model.

### ***1.3. EPA Requirements for Developing and Revising Maintenance Plans***

The 2006 Lancaster SIP revision redesignation request is consistent with the September 4, 1992, EPA memorandum written by John Calcagni, Director, Air Quality Management Division, entitled, *Procedures for Processing Requests to Redesignate Areas to Attainment*. For the Lancaster Ozone Maintenance Plan, the Department produced an emissions inventory for NO<sub>x</sub>, VOC, and carbon monoxide (CO) for 2004, the attainment year, which included ambient air quality monitoring data that showed emissions that met the 1997 ozone NAAQS in the Lancaster Area. The inventory was based on a “typical summer day,” as required by the EPA. The Department developed an emissions inventory for 2018 that demonstrated that the area would meet the 1997 ozone NAAQS for a 10-year period following redesignation of the area to attainment. The emissions inventory for 2018, a maintenance year, showed that emissions of NO<sub>x</sub>, VOC, and CO in the Lancaster Area would not exceed emissions that occurred in 2004. The maintenance year is a year at least 10 years in the future that a state chooses to demonstrate that emissions over a 10-year period of analysis will not lead to an exceedance of the standard. A state does this by showing that emissions in the maintenance year are less than emissions in the attainment year.

An emissions inventory in the 2006 Lancaster SIP revision showed that emissions in 2009, the interim year, did not exceed emissions in 2004, the attainment year. The 2009 and 2018 inventories both considered future growth projected from a 2002 baseline year, and included emission reductions from permanent and enforceable control measures.

This SIP revision updates highway emissions estimates using the newer MOVES2010a model. The Department need not update emissions estimates for area and nonroad sources for several reasons. For one, the growth assumptions for emissions from area and nonroad sources in the 2006 Lancaster SIP revision for the year 2009 were greater than the documented growth that occurred from 2002 to 2009. Additionally, newer, updated emission growth projections to 2018 for area and nonroad sources are less than emission growth projections for these sources in the 2006 Lancaster SIP revision. Company-reported point source emissions are used in this SIP revision to revise the projected 2009 emissions in the 2006 Lancaster SIP revision. Also in this SIP revision, linearly interpolated 2018 point source emission estimates derived from the Mid-Atlantic Regional Air Management Association (MARAMA) 2011 effort for modeling ambient particulate matter concentrations are used to revise 2018 projected emissions in the Lancaster Ozone Maintenance Plan.

Recent ambient air quality monitoring results for the Lancaster Area demonstrate continued attainment of the 1997 ozone NAAQS (0.08 parts per million, with rounding 84 parts per billion), as shown in Table 1.



**Table 1: Lancaster Area 2011 Design Values**

<b>Monitor</b>	<b>2009 4<sup>th</sup> highest</b>	<b>2010 4<sup>th</sup> highest</b>	<b>2011 4<sup>th</sup> highest</b>	<b>3-Year Average or Design Value<sup>1</sup></b>
<b>Lancaster 42-071-0007</b>	69 ppb	82 ppb	78 ppb	76 ppb
<b>Lancaster Downwind 42-071-0012</b>	66 ppb	82 ppb	85 ppb	77 ppb

<sup>1</sup> A “design value” is the annual fourth highest daily maximum 8-hour ozone concentration, averaged over three years.

The EPA Office of Transportation and Air Quality developed guidance titled, *Policy Guidance on the Use of MOVES2010 and Subsequent Minor Revisions for State Implementation Plan Development, Transportation Conformity, and Other Purposes*, (MOVES2010 guidance) EPA 420-B-12-010, April 2012. This guidance describes requirements for SIP revisions. For maintenance demonstrations, areas can have a revised motor vehicle emissions inventory and budget using MOVES without revising emissions for other sectors included in the applicable SIP or completing additional modeling if:

- The SIP continues to meet applicable requirements when the previous motor vehicle emissions inventories are replaced with inventories generated by MOVES2010a; and,
- The state can document that growth and control strategy assumptions for non-motor vehicle sources continue to be valid and minor updates do not change the overall conclusions of the SIP.

The EPA further states that if both of the criteria are met, the state can simply re-submit the original maintenance plan with the revised motor vehicle emissions inventories, using the most current version of the MOVES model. However, if either criterion is not met, the emissions categories in the maintenance plan that have changed must be brought up to date.

Since one of the criteria listed above is not met for point source emissions, this SIP revision includes information addressing the recommendations described in the MOVES2010 policy guidance, listed here:

- Demonstration that the 1997 ozone NAAQS approved maintenance plans continue to meet applicable requirements with the revised motor vehicle emissions inventories, as calculated by the most recently approved MOVES model, and recalculation of the attainment year, interim year and maintenance year MVEBs with the latest planning assumptions, including documentation of the updated assumptions;
- Review of the point, area, and nonroad emissions inventories for the interim year and maintenance year to determine if growth and control strategy assumptions have changed and, if so, development of an analysis to determine if these changes affect the conclusion

of the maintenance plan that air quality will remain compliant with the 1997 ozone NAAQS; and

- Assessment to confirm excess emissions exist and the quantification of these excess emissions for use in the safety margin applied to the MVEBs.

#### ***1.4. Maintenance Plan Demonstration and Motor Vehicle Emissions Budgets***

Table 2 shows the revised 2004, 2009 and 2018 NO<sub>x</sub> and VOC MVEBs calculated using the latest planning assumptions for the Lancaster Area using MOVES2010a. Assumptions used in the MOVES2010a modeling, including model inputs, growth assumptions and modeling methodology, are provided in Appendix C. Highway vehicle emissions show a clear, downward trend.

**Table 2: Motor Vehicle Emissions Budgets Calculated with MOVES2010a**

<b>Year</b>	<b>NO<sub>x</sub> Emissions (tons/day)</b>	<b>VOC Emissions (tons/day)</b>
<b>2004 Attainment Year</b>	42.10	16.41
<b>2009 Modeled Emissions</b>	33.18	14.29
<b>Conformity Portion of Safety Margins<sup>1</sup></b>	2.00	0.00
<b>2009 Interim Year Budget</b>	35.18	14.29
<b>2018 Modeled Emissions</b>	18.57	8.14
<b>Conformity Portion of Safety Margins</b>	2.00	2.00
<b>2018 Maintenance Year Budgets</b>	20.57	10.14

#### ***1.5. Non-Mobile Source Inventory Review***

The EPA states, in its MOVES2010 guidance, that revisions to existing SIPs and budgets must continue to meet applicable requirements under the Clean Air Act. A maintenance plan revised to take into account new emission estimates due to an update in the highway model must demonstrate that attainment of the standard continues, even with updated control measures and

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<sup>1</sup> A “safety margin” is the amount of emissions by which the total projected emissions from all sources of a given pollutant are less than the total emissions that would satisfy the applicable requirement for reasonable further progress, attainment, or maintenance (40 CFR §93.101). The state may designate a portion of these emissions for use by the Metropolitan Planning Organization (MPO) or Department of Transportation (DOT) as a safety margin to be used for transportation projects. See 40 CFR §93.124(a) for application of a safety margin.

growth estimates. The basis for this SIP revision includes increases in the maintenance plan's NO<sub>x</sub> and VOC emission estimates for the attainment, interim and maintenance years resulting from revising highway emissions using MOVES instead of the Mobile6.2 model, and accounting for emissions of point, area, and nonroad sources using the latest planning assumptions and growth estimates. Total emissions in the years 2009 and 2018 cannot exceed the emissions in the 2004 attainment year inventory. The Department concludes that the Lancaster Area will continue to demonstrate attainment of the 1997 ozone NAAQS because total emissions of NO<sub>x</sub> and VOC in the interim year and maintenance year will be less than the 2004 attainment year inventory for those two pollutants. Developing a revised highway inventory for carbon monoxide (CO) is unnecessary for this SIP revision because CO emissions decrease using MOVES in place of the Mobile6.2 model.

Growth and control strategy assumptions have changed for all of the emission categories since the Lancaster Ozone Maintenance Plan was approved. The changes in these assumptions have generally decreased forecasted emissions in future years. A severe economic recession occurred since the maintenance plan was approved and employment was greatly depressed, falling short of the employment projections in the maintenance plan for the year 2009. More controls of source categories have been implemented at both the federal and state level. Area and nonroad NO<sub>x</sub> and VOC emission inventories are not being revised for the interim and maintenance year in this SIP revision. The point source emission inventory is being updated. The Department compared updated growth estimates with growth assumptions and growth estimates in the Lancaster Ozone Maintenance Plan. That analysis is included below. More detailed information can be found in Volume II: Technical Support Document.

Some SIP revisions for certain areas in the Commonwealth will require the Department to update growth and strategy assumptions of non-motor vehicle sources. A number of areas in the Commonwealth are home to newly built point sources, such as electric generating units (EGUs). Some areas have experienced Marcellus Shale gas development, which has increased area source emissions. The EPA developed a rule in 2011 to limit the transport of NO<sub>x</sub> and sulfur dioxide, which could change projected emissions of point sources. See, 76 FR 48208 (Aug. 8, 2011), and later revisions. Some owners and operators of EGUs have responded to new economic and regulatory developments by closing coal-fired electric generation units or by switching fuels (to natural gas) at their facilities. The Department has considered these developments and concluded that these changes do not apply to the Lancaster Area.

Tables 3 and 4 show that emissions in the future interim and maintenance years will not exceed overall emissions from all sources in 2004, the attainment year, even though highway emissions are greater in the Lancaster Area when modeled by MOVES than when the emissions were estimated by Mobile6.2 in the Lancaster Ozone Maintenance Plan. Actual emissions for the 2009 point sources and updated 2018 projected point source emissions were included in the SIP revision inventory. Projected area and nonroad category emissions from the Lancaster Ozone Maintenance Plan are used for 2009 and 2018 in this SIP revision. Projected area and nonroad sources do not need to be updated because emissions from these categories have not increased appreciably since the Lancaster Ozone Maintenance Plan was submitted to EPA. Attainment of the 1997 ozone standard is maintained by showing revised actual and projected growth for 2009 and 2018 does not increase overall future emissions of the Lancaster Ozone Maintenance Plan. This SIP revision demonstrates that growth assumptions in the Lancaster Ozone Maintenance

Plan forecast greater growth than what actually occurred or will occur in the major source category segments.

A small portion of the difference between attainment and maintenance emissions has been set aside as a transportation conformity safety margin to accommodate unanticipated growth in highway vehicles (See Table 2). The highway vehicle emissions reflect inclusion of that safety margin.

**Table 3: Revised Lancaster Area NO<sub>x</sub> Emissions from 2004 to 2018**

<b>NO<sub>x</sub> in tons/day</b>					
<b>Year</b>	<b>Point</b>	<b>Area</b>	<b>Nonroad</b>	<b>Mobile</b>	<b>Total</b>
<b>2004</b>	3.89	2.60	13.20	42.10	61.79
<b>2009</b>	3.20	2.80	10.80	33.18	49.98
<b>Δ(2004-2009)</b>	-0.79	0.20	-2.40	-8.92	-11.91
<b>2018</b>	3.60	2.90	6.80	18.57	31.87
<b>Δ(2004-2018)</b>	-0.29	0.30	-6.40	-23.53	-29.92

**Table 4: Revised Lancaster Area VOC Emissions from 2004 to 2018**

<b>VOC in tons/day</b>					
<b>Year</b>	<b>Point</b>	<b>Area</b>	<b>Nonroad</b>	<b>Mobile</b>	<b>Total</b>
<b>2004</b>	8.10	24.40	17.30	16.41	66.21
<b>2009</b>	5.50	24.20	15.00	14.29	58.99
<b>Δ(2004-2009)</b>	-2.60	-0.20	-2.30	-2.12	-7.22
<b>2018</b>	7.74	27.20	11.90	8.14	54.98
<b>Δ(2004-2018)</b>	-0.36	2.80	-5.40	-8.27	-11.23

## **2. Source Category Emissions**

### ***2.1. Point Source Category Emissions***

#### **2.1.1. CONTROL MEASURES**

At the time of the development of the Lancaster Ozone Maintenance Plan, many large sources were affected by the requirements of the federal Clean Air Interstate Rule (CAIR). Pennsylvania implemented NO<sub>x</sub> control programs, including implementation of CAIR, which control NO<sub>x</sub> from large industrial boilers, internal combustion engines, electric generating units, and cement kilns. None of the sources subject to these regulations are located in the Lancaster Area.

#### **2.1.2. GROWTH ESTIMATES IN THE LANCASTER OZONE MAINTENANCE PLAN**

Two annual point source inventories using historical emissions data reported to the Department by point source facilities were included in the Lancaster Ozone Maintenance Plan. The Department developed an emissions inventory of point sources for calendar years 2002 and 2004. The 2002 point source emissions inventory represents a time when the Lancaster Area did not meet the 1997 ozone NAAQS. The 2004 point source inventory showed emissions that occurred during 2004, the attainment year for the 1997 ozone NAAQS.

Emission projections for the point source sector for 11 states, including Pennsylvania, and the District of Columbia, were prepared for MARAMA by MACTEC Federal Programs, Inc. (MACTEC). Future year projections were developed by MACTEC so that states could use the point source inventories in their SIPs. Emission projections were prepared for years 2009 and 2018.

For the purpose of projecting emissions into the future, the point source inventory is divided into two subsectors – the EGU sector and the non-EGU sector. Different projection methods were used for those two sectors. For the EGU sector, the Mid-Atlantic/Northeast Visibility Union (MANE-VU) effort used the Integrating Planning Model (IPM) to project future electric generation, as well as to calculate the impact of control programs on future emission levels. As stated above, the Lancaster Area has no EGU emission sources. For the non-EGU sector, growth factors were developed by using the EPA's Economic Growth Analysis System Version 5.0 (EGAS 5.0). The U.S. Department of Energy fuel consumption forecasts were used to replace default values in EGAS 5.0. Also, state-supplied population, employment, and other emission projection data were used to update and enhance the EGAS 5.0 default values.

#### **2.1.3. POINT SOURCE CATEGORY CONCLUSION**

Projected NO<sub>x</sub> and VOC emissions for 2009 in the Lancaster Ozone Maintenance Plan are being revised with actual emissions for point sources in 2009, because the actual emissions are readily available and allow easy comparison between the projected emissions in the maintenance plan and the actual emissions. The Department assessed point source emissions by comparing the actual emissions inventory data submitted to the Department by owners of point sources for 2009 to the estimated 2009 NO<sub>x</sub> emissions from point sources in the Lancaster Ozone Maintenance Plan. The Lancaster Ozone Maintenance Plan overestimated point source emissions for 2009. Table 5 shows that the projected point source emissions of NO<sub>x</sub> in the maintenance plan were 0.9 tons per day more than actual 2009 point source emissions and the projected point source

emissions of VOC in the maintenance plan were 3.2 tons per day more than actual 2009 point source emissions. Actual emissions of NO<sub>x</sub> and VOC declined significantly from 2004 to 2009, even when compared to the slow growth in emissions forecasted in the Lancaster Ozone Maintenance Plan.

**Table 5: 2009 Point Source Emissions –  
Maintenance Plan Estimates Versus Actual Emissions**

<b>2009 Emissions</b>	<b>NO<sub>x</sub> (tons/day)</b>	<b>VOC (tons/day)</b>
<b>Maintenance Plan Estimate</b>	4.1	8.7
<b>Actual</b>	3.2	5.5

The Department will revise the 2018 inventory in the Lancaster Ozone Maintenance Plan by using emissions from the inventory developed by MARAMA. Because the updated inventory produced by MARAMA uses different years for the baseline and projected inventories, and different surrogates to estimate growth than what was used in the Lancaster Ozone Maintenance Plan, comparison between growth factors used to produce the two inventories is difficult. The MARAMA projected inventory estimated emissions for the years 2017 and 2020 from a baseline 2007 emissions inventory. In order to obtain emission estimates for the 2018 maintenance year, a straight line interpolation between 2007 and 2020 was used. Projected NO<sub>x</sub> and VOC emissions in 2018 using the MARAMA estimates are still well below the 2018 projected emissions in the Lancaster Ozone Maintenance Plan, as shown in Table 6, and thus show that projected emissions in 2018 will fall below the 2004 (attainment year) emission levels.

**Table 6: 2018 Point Source Emissions -  
Maintenance Plan Estimate Versus Revised 2018 Emissions**

<b>2018 Emissions</b>	<b>NO<sub>x</sub> (tons/day)</b>	<b>VOC (tons/day)</b>
<b>2018 Maintenance Plan Estimate</b>	4.6	11.0
<b>2018 Revised Estimate (MARAMA Inventory)</b>	3.6	7.7

## **2.2. AREA SOURCE CATEGORY EMISSIONS**

### **2.2.1. CONTROL MEASURES**

The area sector includes, but is not limited to, such diverse emissions source categories as: surface coating; commercial and consumer solvent use; residential heating; open burning; traffic line painting; and landfill gases. Emissions are produced from a wide number of sources for which actual emissions or direct indicators of emissions are not available. The Lancaster Ozone Maintenance Plan relied upon many different types of socioeconomic indicators that served as surrogates to actual sales data to estimate emissions from the area source sector when actual sales data was not available. Population, employment, fuel use and housing data are some of the surrogates used to estimate emissions. Methodologies for estimating some emissions from some area sources were updated by the EPA in the time since EPA approved the Lancaster Ozone Maintenance Plan but, because the emissions change similarly for the attainment, interim and maintenance years, the changes will not result in a significant difference between the attainment year's emissions and the maintenance year's emissions. As can be seen from Table 7, with the exception of commercial boilers using natural gas, emissions would decrease from area sources, since actual growth rates from 2002 to 2009 and projected growth rates from 2009 to 2018 are lower or nearly the same when compared to the growth rates used in the Lancaster Ozone Maintenance Plan. The metrics presented in Table 7 serve as growth surrogates for most source classification codes (SCCs) in the area source category in the maintenance plan, which account for a large majority of the emissions in the area source inventory.

**Table 7: Comparison of Growth Factors Used in Maintenance Plan and Inventory Updates from 2002 to 2009**

<b>Metric</b>	<b>Actual Growth (Census Data)</b>	<b>Maintenance Plan Surrogate Estimates (2006)</b>
2009 Population *	1.0621	1.0918
2009 Total Employment	0.9868	1.1321
2009 Commercial Boilers Natural Gas	1.0456	1.0106
2009 Commercial Boilers, Distillate	0.9807	1.0731
2009 Commercial Boilers, Coal	0.7488	1.0481

\*Growth for the year 2009 is computed from 2002 to 2009.

**Table 8: Comparison of Growth Factors Used in Maintenance Plan and Inventory Updates from 2009 to 2018**

<b>Metric</b>	<b>Revised Growth from MARAMA Inventory (2009-2018)*</b>	<b>Maintenance Plan Growth (2009-2018)*</b>
Population	1.0509	1.1081
Employees	1.0113	1.1499
Anthracite Coal, Industrial	0.9799	0.9988
Anthracite, Commercial	1.0055	0.9865
All Combuster Types, Distillate Oil, Residential	0.9615	0.9598
Boilers and Internal Combustion Engines, Natural Gas, Commercial	1.0154	1.0521
Combustor Types, Natural Gas, Residential	1.0034	1.0181

**\*Growth for the year 2018 is given as a factor estimating growth from 2009 to 2018. Due to different time ranges used for growth estimates in the maintenance plan and more recent inventory data, growth based on 2002 was impossible to estimate. This method allows for a direct comparison.**

**2.2.2. GROWTH ESTIMATES IN THE LANCASTER OZONE MAINTENANCE PLAN**

Area source emission growth factors were developed by using the default configuration in EGAS 5.0. EGAS 5.0 used the Department of Energy Annual Energy Outlook 2004 (AEO2004) fuel use projections. In this SIP revision, the AEO2005 fuel consumption forecasts were used to replace AEO2004 forecasts. State-supplied population and employment data were used to replace default data, when the state-specific data was available. Growth estimates were represented by growth factors for each area SCC for each county.

County-level population data for 2000, and projections for 2010 and 2020 from the Pennsylvania State Data Center, <http://pasdc.hbg.psu.edu/>, were provided to derive growth factors. This data were interpolated to obtain growth factors for projecting emissions from 2002 to 2009 for SCCs that are population based. General employment data for 21 counties or areas for 2000, and projections to 2010 and 2020, were used. This data were also interpolated to estimate growth factors for projecting from 2002 to 2009 and 2018 for nine area source categories. For all other area source categories, AEO2005 forecasts were used for projecting emissions from area source fuel combustion, when available. If AEO2005 forecasts are not available, EGAS 5.0 default factors were used.

**2.2.3. GROWTH ESTIMATES IN MARAMA 2011 REGIONAL MODELING EFFORT**

The development of growth factors for the MARAMA 2011 regional modeling effort for area sources used one or a combination of the following as surrogates for growth: AEO2010, population data, or employment data. A direct comparison cannot be made between the growth



factors based on AEO2005 or population in the original maintenance plan and this SIP revision which uses growth factors from MARAMA's 2011 regional modeling effort. As years pass, different inventory methodologies are developed. This SIP revision uses the best possible method to compare emissions inventories that use differing methodologies. (See Volume II: Technical Support Document). The MARAMA 2011 regional modeling effort developed growth factors for most SCCs using AEO2010 or county level population. Employment data was derived from North American Industry Classification System to the state level. Since employment data to the county level was not available from the MARAMA 2011 modeling, state employment data was applied for all SCCs and counties in this SIP revision. The recession reduced employment which fell short of the projections in the maintenance plan for the year 2009. Starting from depressed employment levels in 2009, it is unlikely that employment projections in the maintenance plan will be exceeded in reality in 2018, even if employment growth recovers to normal levels in the near future. Revised growth estimates show this to be the likely case.

#### **2.2.4. MARCELLUS SHALE EMISSIONS**

Significant infrastructure development to extract Marcellus Shale natural gas in some Pennsylvania counties has occurred since the 2006 Lancaster Area Ozone Maintenance Plan was submitted to the EPA by the Department. Area source emissions result from the placement of drilling equipment, gathering lines and compressor stations. The Lancaster Area has not experienced any Marcellus Shale development and is not expected to experience any of this development in the future.

#### **2.2.5. AREA SOURCE CATEGORY CONCLUSION**

The Department demonstrated (See Table 8) that it is reasonable to assume that emissions growth for area sources that has and is occurring is less than the growth forecasted in the Lancaster Ozone Maintenance Plan for both NO<sub>x</sub> and VOC for maintenance years 2009 and 2018. The Department compared growth estimates used in the Lancaster Ozone Maintenance Plan and the MARAMA 2011 regional modeling effort. Emissions of NO<sub>x</sub> and VOC from the area source sector have not increased as a result of any new activity or update in methodology, or by using a new data source to estimate emissions. Therefore, no revisions to the area source sector for NO<sub>x</sub> or VOC emissions are necessary.

### ***2.3. Nonroad Source Category Emissions***

#### **2.3.1. CONTROL MEASURES**

The nonroad category contains many different types of equipment. The Department used NONROAD2005 for the Lancaster Ozone Maintenance Plan. All versions of the EPA's NONROAD Model estimate emissions for over 200 types of engines and vehicles. Nonroad engines and vehicles can be used for such applications as construction, lawn and garden care, farming, and industrial applications. In addition, emissions from three types of activities, including aircraft, locomotive, and commercial marine vessel activities, are not estimated in the NONROAD Model but are in the nonroad category. In the Lancaster Ozone Maintenance Plan, the NONROAD2005 model was used to estimate emissions of nonroad vehicles and engines. The model went through one major revision since it was used for the Lancaster Ozone Maintenance Plan. NONROAD2008a is the latest version of this model. This new version of

the model incorporates two reduction strategies that affect engines and vehicles in the nonroad sector:

- Diesel recreational marine standards in the 2008 final rule on locomotive and marine engines (See *Control of Emissions of Air Pollution From Locomotive Engines and Marine Compression-Ignition Engines Less Than 30 Liters per Cylinder*, 73 FR 25098, May 6, 2008); and
- The October 2008 small spark ignition and spark ignition and recreational marine rule (See *Control of Emissions From Nonroad Spark-Ignition Engines and Equipment*, 73 FR 59034, October 8, 2008).

For the Lancaster Ozone Maintenance Plan, the Department modified files in the NONROAD Model, when state specific data was available, that affect emission categories such as residential lawn and garden and recreational marine vessels.

### **2.3.2. GROWTH ESTIMATES**

Emissions from nonroad sources have decreased since the submittal of the Lancaster Ozone Maintenance Plan as a result of additional controls mentioned above, and other tier level controls that have been phased in since 2004 for engines used in the nonroad sector. The fleet turnover that occurs as older, more polluting nonroad equipment and vehicles are replaced by newer equipment and vehicles that meet more stringent emission standards has continued to lower emissions in the nonroad sector since the late 1990s, and will continue to do so for the next 10 years. Emission reductions occurred across all segments of the nonroad category, including construction equipment, farming equipment, locomotives, and lawn and garden equipment. Furthermore, the recession significantly lowered construction, railroad, aircraft, and industrial activity, and, consequently, lowered emissions. Even if growth returns to pre-recession levels, overall growth will likely remain lower than what was predicted in the maintenance plan up to the 2018 maintenance year.

### **2.3.3. NONROAD SOURCE CATEGORY CONCLUSION**

The Department demonstrated that it is reasonable to assume that emissions growth for nonroad sources that has and is occurring is less than the growth forecasted in the Lancaster Ozone Maintenance Plan for both NO<sub>x</sub> and VOC for maintenance years 2009 and 2018. The Department compared growth estimates between what was used in NONROAD2005 and NONROAD2008a, and took into account fleet turnover and the effects of the recession. Emissions of NO<sub>x</sub> and VOC from the nonroad source sector have not increased as a result of any new activity or update in methodology. Therefore, no revisions to the nonroad source sector for NO<sub>x</sub> or VOC emissions are necessary.

## ***2.4. Highway Source Category Emissions***

### **2.4.1. CONTROL MEASURES**

Assumptions for vehicle emissions standards have not changed significantly from when the Lancaster Ozone Maintenance Plan was submitted to EPA. In 2008, Pennsylvania began implementation of California emission standards, which are incorporated by reference in

Pennsylvania regulations, for passenger cars, light-duty trucks, and diesel-powered heavy-duty trucks. In January 2012, the California Air Resources Board (CARB) approved significant revisions to its regulations for criteria pollutant and greenhouse gas emissions from passenger cars, light-duty trucks and medium-duty vehicles. The amendments, referred to as LEV III, will become effective in model year 2015 for criteria pollutants and in model year 2017 for greenhouse gases, once the amendments are approved by California’s Office of Administrative Law (OAL). Once the CARB LEV III amendments are approved by the California OAL, the requirements will be automatically incorporated by reference as part of the Pennsylvania Clean Vehicles Program, to the extent the amendments apply to Pennsylvania’s program. EPA is preparing to propose revisions to its regulations for criteria pollutant and greenhouse gas emissions from on-road vehicles, but has not yet published a proposed rulemaking. When EPA publishes a proposed rulemaking relating to new vehicle emission standards, the proposed rule will be analyzed as to its effect on future year emission estimates of NO<sub>x</sub> or VOC.

**2.4.2. GROWTH ESTIMATES**

Overall emissions from highway vehicles will continue to decrease as new vehicles take the place of older vehicles during normal fleet turnover. Fleet turnover is the greatest driver in lowering emissions from highway vehicles. Fleet turnover has been slower than forecast in the Lancaster Ozone Maintenance Plan. This is, in part, a result of the recent recession and its lingering effects. Other factors have some impact on emissions from the highway source category such as changes in fleet age, vehicle miles traveled, and the fleet mix of vehicles. The fleet age is also increasing as people operate their vehicles for a longer period of time. This will reduce the rate of fleet turnover and the reductions expected in emissions. It is difficult to compare vehicle miles traveled (VMT) in Pennsylvania between the Lancaster Ozone Maintenance Plan and this SIP revision because the method for estimating VMT has changed. Nationally, there was a slight decline in VMT during the recession. The percentage of vehicles in Pennsylvania that are light-duty trucks is also shrinking. Consumers are purchasing more passenger cars than light-duty trucks. Passenger cars tend to have lower emissions.

Both VOC and NO<sub>x</sub> emission estimates were developed using MOVES2010a and the latest planning assumptions. Emissions have been estimated for the 2004 attainment year, as well as the 2009 and 2018 maintenance years. The MOBILE6.2 emission estimates from the original maintenance plan have been included in Table 9 to illustrate relative changes in emissions.

**Table 9: Revised Motor Vehicle Emissions Using MOVES2010a**

Pollutant	Original MOBILE6.2 Emissions			Revised MOVES2010a Emissions		
	2004	2009	2018	2004	2009	2018
VOC	19.75	14.33	7.77	16.41	14.29	8.14
NO <sub>x</sub>	32.33	22.32	8.99	42.10	33.18	18.57

Table 9 shows the MOVES model estimates NO<sub>x</sub> emissions in 2009 and NO<sub>x</sub> and VOC emissions in 2018 that exceed the MOBILE6.2-derived emissions in the Lancaster Ozone Maintenance Plan. This would cause transportation planning emissions estimates using MOVES to exceed the MVEBs. The updated NO<sub>x</sub> and VOC MVEBs provided in Table 2 will help ensure that the Lancaster Area can demonstrate transportation conformity using MOVES2010a, once

the conformity grace period expires, while the emissions estimates still demonstrate that the Lancaster Area demonstrates attainment with the 1997 ozone NAAQS.

### **2.4.3. MOBILE SOURCE CATEGORY CONCLUSION**

The SIP revision includes revised MVEBs for Lancaster County using updated highway vehicle emissions estimates derived from MOVES. Appendix C of this SIP revision replaces the corresponding sections of the original Appendix C in the Lancaster Ozone Maintenance Plan. Appendix C of this SIP revision describes the highway modeling methodology necessary to produce accurate emission estimates from the MOVES model.

## **3. Safety Margins**

Tables 3 and 4 show that the emissions in the maintenance years, even when using conservative estimates in the Lancaster Ozone Maintenance Plan, for point, area and nonroad sectors, provide a significant safety margin for continued maintenance.

Therefore, a portion of those safety margins is being allocated to transportation projects to help ensure that any future planning assumption updates will not negatively impact the area's ability to demonstrate transportation conformity. Adequate safety margins will also defer the need for future SIP revisions, where the purpose of the SIP revision is only to update numbers and not to document any actual emissions reductions to the atmosphere.

To help ensure that the transportation conformity process is not needlessly delayed, a 2.0 ton/day safety margin for NO<sub>x</sub> has been applied to the MVEBs in 2009 and a 2.0 ton/day safety margin for NO<sub>x</sub> and VOC has been applied to the MVEBs in 2018. All indications are that the 2009 and 2018 emission estimates made for point, area and nonroad sources in the Lancaster Ozone Maintenance Plan are higher than any actual emissions for 2009 and revised estimates for 2018 in this SIP revision. Table 2 quantitatively shows that these safety margins will continue to allow the area to remain well below the 2004 attainment year emissions inventory cap, thereby ensuring that future air quality will continue to meet the 1997 ozone NAAQS.

## **4. Motor Vehicle Emission Budget for Transportation Conformity**

The Department proposes to establish budgets for highway emissions in order to ensure that transportation emissions do not impede clean air goals for almost the next decade. The information in Table 10, once EPA approves this SIP revision for the purposes of transportation conformity, will establish MVEBs for Lancaster County.

**Table 10: Motor Vehicle Emissions Budgets**

Calendar Year	Pollutant	
	NO <sub>x</sub>	VOC
2009	31,914.8 kilograms/summer day 35.18 tons/summer day	12,963.7 kilograms/summer day 14.29 tons/summer day
2018	18,660.8 kilograms/summer day 20.57 tons/summer day	9,198.9 kilograms/summer day 10.14 tons/summer day

## 5. Conclusion

By examining actual and projected emissions, increased controls for all emissions categories, and evidence that actual emissions growth for point source, area source, and nonroad source categories has been less than the projected emissions growth in the approved Lancaster Ozone Maintenance Plan, the Department has shown that the conclusion in the Lancaster Ozone Maintenance Plan that the Lancaster Area will continue to maintain attainment of the 1997 ozone NAAQS remains valid, even after updating the highway emissions using the new EPA-approved MOVES model. Updating NO<sub>x</sub> or VOC emissions in the MVEBs will not negatively affect the Lancaster Area's ability to maintain attainment of the 1997 ozone NAAQS. In this revision, the Department has updated emissions of NO<sub>x</sub> and VOC that were included in the Lancaster Ozone Maintenance Plan for point and highway sources. Emissions of area and nonroad sources were not updated from the Lancaster Ozone Maintenance Plan because it was shown that growth in emissions for those sources decreased or were unaffected.