

## **4.0 The 2009 Projected Uncontrolled and Controlled Inventories**

Projected uncontrolled and controlled inventories for the attainment year 2009 are required for the region to calculate benefits from various control measures. Comparison of the base year 2002 and the attainment year 2009 controlled inventories provides a trend in emissions between these two milestone years. Also, the base year 2002 and the attainment year 2009 controlled inventories are required for emissions reduction calculation to meet attainment contingency requirements. The 2002 Base Year Inventory is described in Chapter 3. This chapter presents the 2009 projected uncontrolled and controlled inventories, the estimation of the levels of emissions in that year before and after the consideration of emissions controls respectively.

### **4.1 The 2009 Projected Uncontrolled Inventories**

The 2009 projected uncontrolled inventory was derived by applying the appropriate growth factors to the 2002 base year emissions inventory. EPA guidance describes four typical indicators of growth. In order of priority, these are product output, value added, earnings, and employment. Surrogate indicators of activity, for example population growth, household growth, etc. are also acceptable methods.

Round 7.0a Cooperative Forecasts (population, household and employment projections) and Vehicle Miles Traveled (VMT) projections for 2009 were used to project area sources emissions. Round 7.0a Cooperative Forecasts were prepared by the Metropolitan Washington Council of Governments (MWCOCG) staff and officially adopted by its Board of Directors on October 11, 2006.

Vehicle Miles Traveled (VMT) projections were developed by COG Department of Transportation Planning staff as part of the report on 2005 Constrained Long Range Plan (CLRP) & 2006-2011 Transportation Improvement Program (TIP) for the National Capital Region Transportation Planning Board. Projections for onroad emissions were developed using MOBILE6.2 (January 2003) model and the Travel Demand Model ver. 2.1d #50 developed by the National Capitol Region Transportation Planning Board. The travel demand modeling process also used Round 7.0a Cooperative Forecasts.

EPA's nonroad model, NONROAD2005, was used for developing uncontrolled 2009 nonroad inventory. The Economic Growth Analysis System (EGAS) model was used by all three jurisdictions to project growth in point source emissions.

#### **4.1.1 Growth Projection Methodology**

The following sections describe the methods followed to develop the projected uncontrolled inventories for 2009 for point, area, nonroad, and onroad sources.

##### **4.1.1.1 Growth Projection Methodology for Point Sources: EGAS**

The growth in point source emissions is projected using EGAS version 5.0. Point source emissions for 2002 are provided from the state data sources and the model is run with the

following options selected: Source Classification Code; the Bureau of Labor Statistics national economic forecast; and the baseline regional economic forecast. Point source emission projections using EGAS for 2009 are contained in Appendix C.

#### 4.1.1.2 Growth Projection Methodology: Area Sources

Base year 2002 area source emissions were calculated using the year 2002 population, household, and employment data. Growth factors for the periods 2002 through 2009 were derived by dividing Cooperative Round 7.0a population, household, and employment forecasts and Vehicle Miles Traveled (VMT) data provided by COG Department of Transportation Planning for 2009 by the year 2002 population, household, employment, and VMT data for the region respectively. Cooperative Round 7.0a Forecasts and VMT data are provided in Appendix D1 and E1 respectively. Projected uncontrolled area source inventories for 2009 are contained in Appendix D1. Growth factors used for the 2009 projection years are presented in Tables 4-1.

**Table 4-1  
2002-2009 Growth Factors**

<b>Jurisdiction</b>	<b>Employment<sup>a</sup></b>	<b>Population<sup>a</sup></b>	<b>Household<sup>a</sup></b>	<b>VMT<sup>b</sup></b>
District of Columbia	1.043	1.049	1.051	1.038
Charles County	1.291	1.141	1.160	1.159
Frederick County	1.297	1.162	1.165	1.175
Montgomery County	1.106	1.097	1.095	1.057
Prince George's County	1.108	1.052	1.076	1.062
City of Alexandria	1.166	1.083	1.101	1.083
Arlington County	1.137	1.082	1.102	1.023
Fairfax County	1.138	1.117	1.120	1.074
Fairfax City	1.066	1.071	1.070	1.074
Falls Church City	1.194	1.141	1.172	1.074
Loudoun County	1.427	1.515	1.517	1.331
Prince William County	1.235	1.304	1.312	1.189
Manassas City	1.067	1.064	1.089	1.189
Manassas Park City	1.489	1.286	1.322	1.189

<sup>a</sup> Growth factors based on COG Final Round 7.0a Cooperative Forecasts.

<sup>b</sup> Growth factors based on VMT estimates from 2005 CLRP & 2006-2011 TIP provided by COG Department of Transportation Planning.

Uncontrolled 2009 emissions for area sources were calculated by multiplying the 2002 base year area emissions by the above growth factors for 2009 for each jurisdiction. Each area source category was matched to an appropriate growth surrogate based on the activity used to generate the base year emission estimates. Surrogates were chosen as follows:

**Residential Fuel Combustion** - Household was chosen as the growth surrogate, except for residential coal combustion, where no growth was assumed.

**Industrial/Commercial/Institutional Fuel Combustion** - Population was chosen as the growth surrogate except for the commercial/institutional coal combustion category, where no growth was assumed.

**Open Burning** - Population was chosen as the growth surrogate as yard wastes, land debris, etc. increase with population.

**Structural Fires, Motor Vehicle Fires** – Population was chosen as the growth surrogate.

**Forest Fires, Prescribed Burning** - No growth was assumed.

**Municipal Landfills** - Base-year emissions are estimated using data on total refuse deposited. Population was chosen as a surrogate since deposited waste is from the general population rather than industrial facilities.

**Commercial Cooking** - Population growth was used as the surrogate.

**Forest Fires, Slash Burning, Prescribed Burning** – Zero growth was applied to this category.

**Incineration**– Zero growth was applied to this category.

**Agricultural production (Crop Tilling, Dust Kicked-up by Animal Hooves)** – Zero growth was applied to this category.

**Fugitive Dust** – VMT growth was applied to this category.

**Construction** – Household growth was applied to residential category. Industrial/Commercial/Institutional construction was grown based on the employment growth. Road construction was grown using VMT projections. Mining emissions were not grown.

#### **4.1.1.3 Growth Projection Methodology: Nonroad Sources**

Uncontrolled nonroad source inventory for the year 2009 was developed using the NONROAD model, except for locomotives, aircrafts, and aircraft auxiliary power units, which were either grown from the base year 2002 using appropriate surrogates or were

projected using the EDMS model by the Metropolitan Washington Airports Authority (MWAA).

### NONROAD Model Sources

The 2009 projected uncontrolled nonroad source inventory was created through the use of EPA's NONROAD2005 model version 2005a (February 8, 2006), except for locomotives, aircrafts, and aircraft auxiliary power units. This model was run with its associated graphic user interface NONROAD2005.1.0 (June 12, 2006), reporting utility version. 2005c (March 21, 2006), and all geographical allocation data files updated until February 1, 2006. The base year 2002 nonroad source inventory was also created using the same model, reporting utility, geographical allocation data files, and graphic user interface versions.

Four season approach was adapted for developing annual emissions. The NONROAD2005 model was run for the metropolitan Washington region for the four seasons (winter, spring, summer, and autumn) and then seasonal emissions were summed up to get the annual emissions. Four seasons considered were Winter (December, January, and February), Spring, (March, April, and May), Summer (June, July, and August), and Autumn (September, October, and November).

Model inputs (temperature, fuel, and other parameters) were prepared for the four seasons used for annual model runs and are provided in the Appendix B along with the details of methodology used to develop those inputs. For projected 2009 uncontrolled inventory, all nonroad model inputs valid for the base year 2002 were used, the technology limiter was set at the 2002 and the growth assumptions valid for the year 2009 were used.

### Ground Support Equipment Emissions

MWAA only provided projected controlled 2009 ground support equipment (GSE) emissions for Dulles (Arlington) and Reagan National (Fairfax and Loudoun) airports in their report (see Appendix B4). NONROAD2005 model generated GSE emissions for Arlington and Loudoun counties were replaced by MWAA emissions. Since Dulles airport is spread across Fairfax and Loudoun counties, MWAA emission from Dulles airport were divide equally between Fairfax and Loudoun counties.

### Non-NONROAD Model Sources

#### Aircraft & Auxiliary Power Units

MWAA only provided projected controlled 2009 commercial aircraft and auxiliary power unit emissions for Dulles (Arlington) and Reagan National (Fairfax and Loudoun) airports in their report (see Appendix B4). Base year 2002 military aircraft emissions were provided by Virginia Department of Environmental Quality, which were not grown to 2009. General aviation and Air taxi emissions were grown using population as the surrogate.

### Railroad

Railroad or locomotive emissions were provided by all three states and were grown using employment as the surrogate.

Projected uncontrolled nonroad source inventory for 2009 are contained in Appendix D1. Detailed NONROAD2005 model output files are being provided separately in electronic format as Appendix D2 of this document.

#### **4.1.1.4 Growth Projection Methodology: Onroad Sources**

The projected uncontrolled 2009 mobile source inventory was created through the use of transportation and emissions modeling techniques. This involved use of the MOBILE6.2.03 emissions factor model and the Version 2.1d #50 Travel Demand Model with 2009 planned highway network. For projected 2009 uncontrolled inventory, all mobile model fuel inputs, Inspection & Maintenance Programs and technology controls valid for the base year 2002 were used. Registration Distribution, Diesel Sales Fraction, and Vehicle Miles Traveled (VMT) valid for the year 2009 were used. Full documentation of the development of the uncontrolled 2009 mobile inventory is included in Appendix E1. Detailed Mob6.2.03 model input, output, and external output files are being provided separately in electronic format as Appendix E2 of this document. Appropriate population, household, and employment growth are input through the Round 7.0a Cooperative Forecasting techniques.

#### **4.1.1.5 Biogenic Emission Projections**

2002 base year emissions were estimated by EPA using BEIS3.12 model. Biogenic emission inventories for 2009 are the same as those used for the 2002 base year for Washington, DC-VA-MD ozone nonattainment region. Year specific biogenic inventory for 2009 was not estimated.

#### 4.1.2 2009 Projected Uncontrolled Inventory – Summary of Emissions

The 2009 PM2.5-Pri, NOx, and SO2 projection year emission inventory results with no control measures applied are summarized by component of the inventory in Tables 4-4 through 4-6 below.

**Table 4-4  
2009 Projected Uncontrolled PM2.5-Pri Emissions (tons/day)  
Washington, DC-MD-VA Annual PM2.5 Nonattainment Area**

<b>Emission Source</b>	<b>District of Columbia</b>	<b>Maryland<sup>a</sup></b>	<b>Virginia</b>	<b>Total<sup>b</sup></b>
Point	159.35	3,992.83	498.38	4,650.55
Area	519.29	8,203.50	9,883.06	18,605.85
Non-road	278.87	1,004.19	1,336.39	2,619.46
Mobile	113.19	634.31	564.48	1311.98
<b>Total<sup>b</sup></b>	<b>1,070.70</b>	<b>13,834.82</b>	<b>12,282.32</b>	<b>27,187.84</b>

Notes:

<sup>a</sup> Maryland point source emissions include 16.66 tpy of quasi- point source emissions from Andrews Air Force Base (AFB).

<sup>b</sup> Small discrepancies may result due to rounding.

**Table 4-5  
2009 Projected Uncontrolled NOx Emissions (tons/day)  
Washington, DC-MD-VA Annual PM2.5 Nonattainment Area**

<b>Emission Source</b>	<b>District of Columbia</b>	<b>Maryland<sup>a</sup></b>	<b>Virginia</b>	<b>Total<sup>b</sup></b>
Point	1,895.35	52,747.80	14,028.67	68,671.82
Area	1,778.14	5,569.68	8,301.43	15,649.25
Non-road	3,630.08	10,651.04	14,710.05	28,991.17
Mobile	7,336.95	38,798.34	34,836.73	80,972.02
<b>Total<sup>b</sup></b>	<b>14,640.51</b>	<b>107,766.86</b>	<b>71,876.88</b>	<b>194,284.25</b>

Notes:

<sup>a</sup> Maryland point source emissions include 822.84 tpy of quasi- point source emissions from Andrews AFB.

<sup>b</sup> Small discrepancies may result due to rounding.

**Table 4-6**  
**2009 Projected Uncontrolled SO<sub>2</sub> Emissions (tons/day)**  
**Washington, DC-MD-VA Annual PM<sub>2.5</sub> Nonattainment Area**

<b>Emission Source</b>	<b>District of Columbia</b>	<b>Maryland<sup>a</sup></b>	<b>Virginia</b>	<b>Total<sup>b</sup></b>
Point	3,724.49	193,276.64	36,792.91	233,794.03
Area	480.63	2,585.56	11,167.43	14,233.62
Non-road	443.81	1,051.20	1,939.89	3,434.90
Mobile	308.60	1,952.39	1,753.04	4,014.03
<b>Total<sup>b</sup></b>	<b>4,957.52</b>	<b>198,865.79</b>	<b>51,653.27</b>	<b>255,476.58</b>

Notes:

<sup>a</sup> Maryland point source emissions include 55.43 tpy of quasi- point source emissions from Andrews AFB.

<sup>b</sup> Small discrepancies may result due to rounding.

## 4.2 Emission Reductions from Control Measures

Chapter 6 of this SIP describes the control measures that have either already been implemented or will be implemented by 2009 that will reduce emissions in that year. Most control measures are required by federal or state regulations. Local governments and state agencies have voluntarily committed to other measures, as described in Section 6.5. Projected controlled inventory for 2009 assume a number of control measures to be in place by that year.

Tables 4-7 through 4-9 present the projected controlled emissions for the 2009 attainment year resulting from implementation of the control measures. Below is a list of the measures implemented by the year 2002 in the Washington region. Chapter 6 presents detailed information on the measures and the projected reductions from each.

### Point

- NO<sub>x</sub> RACT for Major Sources
- NO<sub>x</sub> OTC Phase II Budget Rules (DC only)
- NO<sub>x</sub> SIP Call (MD only)
- Visible Emissions & Fugitive Dust/Emissions Standards for Existing Sources (VA)
- Standards of Performance for Visible Emissions & Fugitive Dust/Emissions for New and Modified Stationary Sources (VA)

### Area

- Seasonal Open Burning Restrictions

### Nonroad

- 1994 EPA Non-Road Diesel Engines Rule
- 1995 EPA Non-Road Small Gasoline Engines Rule, Phase 1 and Phase 2 (handheld and non handheld)
- 1996 EPA Emissions standards for spark ignition marine engines
- 2002 EPA Emissions standards for large spark ignition engines
- Reformulated Gasoline (off-road)

### Onroad

- High-Tech Inspection/Maintenance (I&M)
- Reformulated Gasoline (on-road)
- Federal "Tier I" Vehicle Standards and New Car Evaporative Standards
- National Low Emission Vehicle Program

Below is a list of the measures with phased-in implementations between 2002 and 2009 in the Washington region.

Point

NO<sub>x</sub> SIP Call  
Clean Air Interstate Rule (CAIR) (VA and DC)  
Maryland Healthy Air Act (MD)  
Utility Reductions (Possum Point Fuel Conversion) (VA)

Area

Additional phase-in of reductions from National Locomotives Rule

Nonroad

2004 Nonroad Heavy Duty Diesel Rule (negligible benefits by 2009)  
Additional phase-in of technology rules implemented by 2002.

Onroad

Heavy-Duty Diesel Engine Rule (2004)  
Heavy-Duty Diesel Engine Rule (2007)  
Tier 2 Motor Vehicle Emission Standards  
I&M Program with Final Cutpoints  
Transportation Control Measures (TCMs)  
Vehicle Technology, Maintenance, or Fuel-Based Measures

### **4.3 The 2009 Projected Controlled Inventories**

The projection of 2009 controlled emissions is simply the 2009 uncontrolled emissions minus the emission reductions achieved from the federal control measures and attainment strategies implemented by states for the annual PM2.5 plan. This information is presented in Tables 4-7 through 4-9.

#### **4.3.1 2009 Projected Controlled Inventory: Point Sources**

2009 projected controlled inventories for point sources were developed by subtracting the emission reductions due to federal and state control measures (see Section 4.6) in 2009 from the projected uncontrolled 2009 inventories.

#### **4.3.2 2009 Projected Controlled Inventory: Area Sources**

2009 projected uncontrolled and controlled inventories for area sources were the same as there was no control measure available.

#### **4.3.3 2009 Projected Controlled Inventory: Nonroad Sources**

2009 projected controlled inventory for nonroad sources was developed using the NONROAD model, except for locomotives, aircrafts, and aircraft auxiliary power units, which were either developed by subtracting emissions benefits in 2009 due to federal rules (see Section 4.6) or were developed using the EDMS model by the MWAA. The Nonroad model also used all control measures described in the Section 4.6.

##### NONROAD Model Sources

The 2009 projected controlled nonroad source inventory was created through the use of EPA's NONROAD2005 model, which is described in detail in the Section 4.2.3. The same methodology, which was used to develop the base year 2002 and uncontrolled 2009 inventories, was also used to develop controlled 2009 inventory. This methodology is described in detail in the Appendix B.

Detailed model inputs are provided below in the two tables. Details of methodology for preparing temperature inputs are provided in the Appendix B. Methodology to develop RVP, sulfur, and oxygen content of fuel and Stage II control is being described below. While fuel Reid Vapor Pressure (RVP) varied by jurisdiction and season, rest other inputs were the same for all jurisdictions and seasons. For projected 2009 controlled inventory, all nonroad model inputs valid for the year 2009 were used.

##### *Development of Fuel Inputs*

Monthly fuel RVP data were provided by the state air agencies. These data were averaged for each of the four seasons to get season average RVP. Mobile6.2 model default for the year 2009 was used for gasoline sulfur percent. Nonroad diesel/marine diesel/CNG/LPG sulfur percent are Nonroad model defaults for the year 2009. Fuel

oxygen content (3.5 % by weight) is based on the Energy Policy Act, 2005. Since this Act removed the requirement of oxygenate in the fuel since Spring of 2006, Ether (MTBE) is no longer used as an oxygenate. The only oxygenate remaining in the fuel is Ethanol, which has an oxygen content of 35%. Based on 10% Ethanol content in gasoline (by vol.) used in Washington, DC area, Ethanol-blended fuel oxygen content of 3.5% was used for 2009. Stage II control data (zero %) is suggested by the EPA (Nonroad Model User Guide pp. 3-7) and agreed to by states.

**Fuel Reid Vapor Pressure**

	<b>Values</b>			
	<b>Winter</b>	<b>Spring</b>	<b>Summer</b>	<b>Autumn</b>
District of Columbia	12.2	8.0	6.8	8.0
Virginia	12.9	10.9	6.8	10.9
Maryland	12.4	10.0	6.8	9.7

**Other NONROAD Model Inputs (District of Columbia, Virginia, Maryland)**

	<b>Values</b>			
<b>Parameters</b>	<b>Winter</b>	<b>Spring</b>	<b>Summer</b>	<b>Autumn</b>
Min. Temperature	27.1	45.7	66.7	49.5
Max. Temperature	44.0	66.2	84.7	67.5
Avg. Temperature	35.6	56.0	75.7	58.5
Gas Sulfur (%)	0.003	0.003	0.003	0.003
Nonroad Diesel Sulfur (%)	0.0348	0.0348	0.0348	0.0348
Marine Diesel Sulfur (%)	0.0408	0.0408	0.0408	0.0408
CNG/LPG Sulfur (%)	0.003	0.003	0.003	0.003
Oxygen Weight (%)	3.5	3.5	3.5	3.5
Stage II Control (%)	0	0	0	0

**Non-NONROAD Model Sources**

Aircraft & Auxiliary Power Units

MWAA provided projected controlled 2009 commercial aircraft and auxiliary power unit emissions for Dulles (Arlington) and Reagan National (Fairfax and Loudoun) airports in their report (see Appendix B4). Base year 2002 military aircraft emissions were provided by Virginia Department of Environmental Quality, which were also used for 2009.

Railroad

Controlled 2009 railroad or locomotive emissions were developed by applying 2009 PM2.5 and NOx controls (15.15% and 32.36% respectively) to the 2009 uncontrolled inventory:

Projected controlled nonroad source inventory for 2009 are contained in Appendix D1. Detailed NONROAD2005 model output files are being provided separately in electronic format as Appendix D2 of this document.

#### 4.3.4 2009 Projected Controlled Inventory: Onroad Sources

The projected controlled 2009 mobile source inventory was created through the use of transportation and emissions modeling techniques. This involved use of the MOBILE6.2.03 emissions factor model and the Version 2.1d #50 Travel Demand Model with 2009 planned highway network. For projected 2009 controlled inventory, all mobile model fuel inputs, Inspection & Maintenance Programs and technology controls valid for the year 2009 were used. Registration Distribution, Diesel Sales Fraction, and Vehicle Miles Traveled (VMT) used were also valid for the year 2009. Full documentation of the development of the controlled 2009 mobile inventory is included in Appendix E1. Detailed Mob6.2.03 model input, output, and external output files are being provided separately in electronic format as Appendix E2 of this document. Appropriate population, household, and employment growth are input through the Round 7.0a Cooperative Forecasting techniques.

#### 4.3.5 2009 Projected Controlled Inventory – Summary of Emissions

The 2009 PM2.5-Pri, NOx, and SO2 projection year emission inventory results with control measures applied are summarized by component of the inventory in Tables 4-7 through 4-9 below.

**Table 4-7**  
**2009 Projected Controlled PM2.5-Pri Emissions (tons/day)**  
**Washington, DC-MD-VA Annual PM2.5 Nonattainment Area**

<b>Emission Source</b>	<b>District of Columbia</b>	<b>Maryland<sup>a</sup></b>	<b>Virginia</b>	<b>Total<sup>b</sup></b>
Point	159.35	3,992.83	498.38	4,650.55
Area	519.29	8,203.50	9,883.06	18,605.85
Non-road	226.84	853.20	1,146.53	2,226.56
Mobile	97.93	534.21	475.82	1,107.96
Total <sup>c</sup>	1,003.40	13,583.74	12,003.79	26,590.93

Notes:

<sup>a</sup> Maryland point source emissions include 16.66 tpy of quasi- point source emissions from Andrews AFB.

<sup>b</sup> Small discrepancies may result due to rounding

**Table 4-8**  
**2009 Projected Controlled NOx Emissions (tons/day)**  
**Washington, DC-MD-VA Annual PM2.5 Nonattainment Area**

<b>Emission Source</b>	<b>District of Columbia</b>	<b>Maryland<sup>a</sup></b>	<b>Virginia</b>	<b>Total<sup>b</sup></b>
Point	1,173.10	16,300.71	8,085.59	25,559.41
Area	1,778.14	5,569.68	8,301.43	15,649.25
Non-road	2,921.89	8,486.17	12,262.88	23,670.94
Mobile	5,059.75	24,945.31	22,196.88	52,201.94
<b>Total<sup>c</sup></b>	<b>10,932.88</b>	<b>55,301.87</b>	<b>50,846.78</b>	<b>117,081.53</b>

Notes:

<sup>a</sup> Maryland point source emissions include 822.84 tpy of quasi- point source emissions from Andrews AFB.

<sup>b</sup> Small discrepancies may result due to rounding

**Table 4-9**  
**2009 Projected Controlled SO2 Emissions (tons/day)**  
**Washington, DC-MD-VA Annual PM2.5 Nonattainment Area**

<b>Emission Source</b>	<b>District of Columbia</b>	<b>Maryland<sup>a</sup></b>	<b>Virginia</b>	<b>Total<sup>b</sup></b>
Point	3,724.49	193,276.64	18,825.70	215,826.82
Area	480.63	2,585.56	11,167.43	14,233.62
Non-road	93.03	237.05	952.89	1,282.97
Mobile	43.89	246.52	227.95	518.36
<b>Total<sup>c</sup></b>	<b>4,342.02</b>	<b>196,345.77</b>	<b>31,173.97</b>	<b>231,861.76</b>

Notes:

<sup>a</sup> Maryland point source emissions include 55.43 tpy of quasi- point source emissions from Andrews AFB.

<sup>b</sup> Small discrepancies may result due to rounding