
***Revision to the Motor Vehicle Emission Budgets
for the
Washington DC-MD-VA
1997 Annual Primary PM_{2.5} NAAQS Maintenance Plan***

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for the
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**on behalf of the
Metropolitan Washington Air Quality Committee**

xxx, xx, 2016

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1. STATE IMPLEMENTATION PLAN REVISION OVERVIEW

The District of Columbia, the State of Maryland, and the Commonwealth of Virginia request that the United States Environmental Protection Agency (USEPA) approve revisions to the 1997 annual primary fine particulate (PM_{2.5}) maintenance plan (PM_{2.5} maintenance plan) for the Washington DC-MD-VA 1997 Annual Primary PM_{2.5} NAAQS Maintenance Area (PM_{2.5} maintenance area). These revisions include changes to on-road motor vehicle emissions budgets (MVEBs) for PM_{2.5} and nitrogen oxides (NO_x) based on the USEPA approved MOVES2014 model.

The three jurisdictions are revising the MVEBs to meet the commitments in Appendix D of the maintenance plan, which USEPA approved on October 6, 2014 (79 FR 60081). The PM_{2.5} maintenance plan relied upon MOVES2010a to generate on-road estimates and projections since MOVES2010a was the most recent, federally approved tool for such applications at the time of the development of the PM_{2.5} maintenance plan. The MOVES2010a estimates were also the basis for the MVEBs contained within the plan. The three jurisdictions within the PM_{2.5} maintenance area voluntarily committed to submitting updated PM_{2.5} and NO_x MVEBs developed using MOVES2014 after that tool became approved and available. MOVES2014 is an USEPA approved on-road vehicle emissions model and includes the effects of new federal control measures that MOVES2010a did not consider, such as the Tier 3 light duty vehicle emission standards. MOVES2014 also has other technical improvements over previous versions of the on-road model. Due to these updates, emission estimates developed using MOVES2014 differ from those developed using MOVES2010a.

2. REVISIONS TO THE MVEBS

This submittal updates the 2007, 2017, and 2025 MVEBs using MOVES2014 and updated planning assumptions.

Table 2-1 and Table 2-2 provide the previous MVEBs, which are based on MOVES2010a and were included in the Washington DC-MD-VA maintenance plan approved on October 6, 2014. Table 2-x (and Table 2-x) provide(s) the revised MVEBs, which are based on MOVES2014 outputs.

This section is not complete yet. Details of the MOVES2014 based updated MVEBs and “transportation buffers” would be added here once the decision has been made.

The District of Columbia, the State of Maryland, and the Commonwealth of Virginia developed the previous and revised MVEBs in consultation with the National Capital Region Transportation Planning Board (TPB), which is responsible for transportation planning in the Washington DC-MD-VA PM_{2.5} maintenance area.

Table 2-1: Washington DC-MD-VA Maintenance Plan Tier 1 On-Road Mobile Source Emissions Budgets based on MOVES2010a*

Year	NO _x On-Road Emissions (tpy)	PM _{2.5} On-Road Emissions (tpy)
2007 Attainment Year	91,639	3,452
2017 Interim Budget	41,709	1,787
2025 Predicted Emissions	27,400	1,322
Transportation Buffer	---	28
2025 Final Budget	27,400	1,350

* October 6, 2014 (79 FR 60081)

Table 2-2: Washington DC-MD-VA Maintenance Plan Tier 2 On-Road Mobile Source Emissions Budgets based on MOVES2010a*

Year	NO _x On-Road Emissions (tpy)	PM _{2.5} On-Road Emissions (tpy)
2007 Attainment Year	91,639	3,452
2017 Predicted Emissions	41,709	1,787
Transportation Buffer	8,342	357
2017 Interim Budget	50,051	2,144
2025 Predicted Emissions	27,400	1,322
Transportation Buffer	5,480	264
2025 Final Budget	32,880	1,586

* October 6, 2014 (79 FR 60081)

Appendix A and Appendix B contain information on the development of the 2007, 2017, and 2025 on-road emissions inventories and MVEBs.

3. REVISIONS TO THE MAINTENANCE DEMONSTRATION

This submittal revises the maintenance demonstration included in the PM_{2.5} maintenance plan and provides updated estimates of PM_{2.5}, NO_x, sulfur dioxide (SO₂), volatile organic compounds (VOCs), and ammonia (NH₃) for the 2007 attainment year and for the 2017 and 2025 plan projection years. The maintenance demonstration must show that emissions of PM_{2.5} and its precursors do not increase in future years beyond the actual estimated emissions in the attainment year, in this case 2007. The continued downward trend in projected emissions from within the PM_{2.5} maintenance area ensures the area will maintain compliance with the 1997 PM_{2.5} NAAQS.

The following sections describe the revisions to the attainment year, the interim year, and the out year inventories, which reflect changes to the on-road sector.

3.1. Revisions to the 2007 Attainment Year Inventory

Table 3-1 provides the revised 2007 attainment year inventory summary. Other than the on-road

emissions estimates, this inventory is identical to the 2007 attainment year inventory summary provided in Table 4-1 of the PM_{2.5} maintenance plan, approved by USEPA on October 6, 2014 (79 FR 60081). The on-road data provided in Table 3-1 include on-road estimates created using MOVES2014. The emissions estimates from all other sectors continue to be valid and need no further updating.

Table 3-1: Revised 2007 Attainment Year Inventory

Pollutant	Point	Area	Nonroad	On-Road	Total
District of Columbia, Emissions in tpy					
SO ₂	612	1,241	234	43	2,130
NO _x	789	1,547	3,300	5,724	11,360
PM _{2.5}	53	1,120	246	216	1,635
VOC	0	183	3	2,809	2,995
NH ₃	59	5,516	1,357	171	7,103
Maryland, Emissions in tpy					
SO ₂	176,880	1,078	550	317	178,825
NO _x	30,365	3,222	10,407	42,477	86,471
PM _{2.5}	5,048	4,385	899	1,549	11,881
VOC	4	3,079	10	17,493	20,586
NH ₃	719	21,928	9,877	924	33,448
Virginia, Emissions in tpy					
SO ₂	5,956	3,414	867	211	10,448
NO _x	6,701	4,166	13,111	32,800	56,778
PM _{2.5}	446	4,022	1,053	1,237	6,758
VOC	52	962	11	14,138	15,163
NH ₃	596	26,501	10,167	767	38,031
Washington DC-MD-VA PM_{2.5} Maintenance Area, Emissions in tpy					
SO ₂	183,449	5,733	1,652	570	191,404
NO _x	37,855	8,936	26,817	81,001	154,609
PM _{2.5}	5,547	9,528	2,198	3,002	20,274
VOC	1,375	53,944	20,275	34,441	110,035
NH ₃	56	4,224	23	1,862	6,165

3.2. Revisions to the 2017 Interim Year and the 2025 Out Year Projection Inventories

Table 3-2 summarizes the 2007, 2017, and 2025 emissions inventories for this revision to the Washington DC-MD-VA PM_{2.5} maintenance plan. Revisions to emissions inventories for the attainment year 2007 and projection years 2017 and 2025 include updated on-road emissions estimates based on MOVES2014. There are no updates to the District, Virginia, and Maryland point, area, and nonroad source emissions projections.

Though Maryland has not made any changes to emissions inventors for point sources for projection years 2017 and 2025 for this revision, it has developed and instituted new regulations addressing emissions from the electric generating industry. The regulation is designed to address the ozone NAAQS(s) and limit NO_x emissions from coal-fired electric generating units. All of the coal-fired electric generating units in Maryland are equipped with post combustion NO_x controls such as Selective Catalytic Reduction (SCR), Selective Non-Catalytic Reduction (SNCR) or Selective Auto-Catalytic Reduction (SACR). The regulation limits NO_x emissions during the ozone season by:

- Establishing system-wide 30-day rolling average NO_x emission rates for all coal-fired units
- Mandating the optimization of NO_x controls for each coal-fire unit

- Instituting a system-wide daily NO_x emission rate cap or system-wide daily tonnage cap

The intent of the system-wide NO_x emission rate caps on the coal-fired units is to compel the systems to run the units with the lowest NO_x rates first and foremost. This allows the system the flexibility to operate the units with higher NO_x rates on higher demand days or peak days.

MDE expects these regulations to drive down peak day NO_x emissions. Quantifying the effects of an ozone season regulation with both unit-specific requirements and system-wide requirements on an annual basis is extremely difficult especially when combining the regulation with Maryland's Healthy Air Act. As such, Maryland has not included the regulation in projected emission inventories for the PM_{2.5} maintenance plan update.

Table 3-2: Washington DC-MD-VA 1997 Annual Primary PM_{2.5} NAAQS Maintenance Area

SO ₂ Emissions in tpy					
Year	Point	Area	Nonroad	On-Road	Total (tpy)
2007	183,449	5,733	1,652	570	191,404
2017	28,183	4,139	433	162	32,917
Δ (2017–2007)	-155,266	-1,594	-1,219	-408	-158,487
2025	28,377	3,862	517	142	32,898
Δ (2025–2007)	-155,072	-1,871	-1,135	-428	-158,506
NO _x Emissions in tpy					
Year	Point	Area	Nonroad	On-Road ¹	Total (tpy)
2007	37,855	8,936	26,817	81,001	154,609
2017	22,481	9,009	17,600	32,790	81,880
Δ (2017–2007)	-15,374	73	-9,217	-48,211	-72,729
2025	23,044	9,342	14,719	15,434	62,539
Δ (2025–2007)	-14,811	406	-12,098	-65,567	-92,070
Primary PM _{2.5} in tpy					
Year	Point	Area	Nonroad	On-Road ¹	Total (tpy)
2007	5,547	9,528	2,198	3,002	20,274
2017	5,656	9,632	1,579	1,523	18,390
Δ (2017–2007)	109	104	-619	-1,479	-1,884
2025	5,693	9,725	1,269	926	17,613
Δ (2025–2007)	146	197	-929	-2,076	-2,661
VOC in tpy					
Year	Point	Area	Nonroad	On-Road	Total (tpy)
2007	1,375	53,944	20,275	34,441	110,035
2017	1,623	52,333	13,758	16,768	84,482
Δ (2017–2007)	248	-1,611	-6,517	-17,673	-25,553
2025	1,659	54,536	14,592	11,765	82,552
Δ (2025–2007)	284	592	-5,683	-22,676	-27,483
NH ₃ in tpy					
Year	Point	Area	Nonroad	On-Road	Total (tpy)
2007	56	4,224	23	1,862	6,165
2017	100	4,255	28	1,229	5,612
Δ (2017–2007)	44	31	5	-633	-553
2025	101	4,285	34	1,181	5,601
Δ (2025–2007)	45	61	11	-681	-564

¹On-road values include transportation buffers for NO_x and PM_{2.5} in 2017 and 2025.

3.3. Inventory and Emissions Trend Analysis

As described in the sections above, the maintenance planning process relies upon emission trends to ensure good air quality into the future. Emission inventories consider four distinct inventory sectors: area (small, widely distributed sources); nonroad (off road equipment, marine vessels and airplanes); on-road (highway motor vehicles) and point (large individual sources such as power plants, manufacturing facilities, etc.). Each has unique methodologies for gathering and estimating both actual emissions and projected emissions.

The point source inventory contains fewer individual entities than do the other sectors. State air agencies have quantitative, quality-assured data for the period 2007 (maintenance plan base) through 2014, obtained from certified emissions reporting for most point sources. Table 3-3 summarizes the point source emissions for each jurisdiction in the region for each pollutant.

Table 3-3: Maintenance Area Point Source Actual Annual Emissions

Pollutant/Jurisdiction	Inventory Year Emissions in TPY		
	2007	2011	2014*
PM_{2.5}			
District of Columbia	53	55	
Maryland	5,048	1,345	
Virginia	446	269	
Region Total	5,547	1,670	
NO_x			
District of Columbia	789	703	
Maryland	30,365	9,187	
Virginia	6,701	4,244	
Region Total	37,855	14,134	
SO₂			
District of Columbia	612	570	
Maryland	176,880	12,815	
Virginia	5,956	1009	
Region Total	183,449	14,394	
VOC			
District of Columbia	60	71	
Maryland	720	472	
Virginia	596	680	
Region Total	1,375	1,223	
NH₃			
District of Columbia	0	0	
Maryland	4	4	
Virginia	52	49	
Region Total	56	53	

* 2014 Point source emissions need to be added in Table 3-3.

Source: 2007 – 1997 PM_{2.5} Maintenance Plan approved on October 6, 2014 (79 FR 60081)
 2011 – Base Year Emissions Inventory approved on May 13, 2015 (80 FR 27276) and July 23, 2015 (80 FR 43625)
 2014 – Emissions databases submitted as part of the National Emissions Inventory 2014 effort by the District, Maryland, and Virginia

Table 3-3 shows that point source emissions generally have a declining trend for PM_{2.5} and its precursors within the region. The decreases of SO₂ are particularly important for this region since SO₂ forms sulfates in the atmosphere, a major component of PM_{2.5} in this area of the country.

Area sources also contribute a significant portion of the NH₃, VOC, and PM_{2.5} inventories in the Washington DC-MD-VA PM_{2.5} maintenance area. Activity levels associated with various area source sub-categories are functions of a number of surrogate parameters that originate with the area’s socioeconomic data such as population and employment projections. The Annual Energy Outlook (AEO) fuel consumption forecasts, federal residential wood combustion estimates, vehicle miles travelled (VMT), as well as other state and county data estimates also inform the area source projection data. Between the previous PM_{2.5} maintenance plan submittal and this submittal, some of these data have not changed. For example, USEPA has not updated the residential wood combustion methodology in this time period. For sectors that show change, many of the changes reflect lower growth, which is typical of such projections. Projections for a greater difference in years are generally more conservative than projections for years not as far into the future. Table 3-4 compares AEO growth factor surrogates for 2007-2017 and 2007-2025 for sectors where the projections change. In nearly all cases, updated projections show smaller growth than predicted during the development of the PM_{2.5} maintenance plan.

Table 3-4: Growth Factors and Projection Data from AEO

Category	2007-2017 Growth Factor		2007-2025 Growth Factor	
	Initial PM _{2.5} Maintenance Plan ⁽¹⁾	Updated Growth Factor	Initial PM _{2.5} Maintenance Plan ⁽¹⁾	Updated Growth Factor
Transportation, Motor Gasoline	0.95	0.92	1.01	0.86
All Sectors, Motor Gasoline	0.95	0.93	1.01	0.87
Industrial; Distillate	0.94	0.86	0.93	0.83
Industrial; LPG	1.09	0.65	1.14	0.78
Comm/Inst; Natural Gas	1.10	1.07	1.19	1.11
Comm/Inst; Kerosene	1.56	0.18	1.67	0.38
Residential; Distillate	0.78	0.47	0.64	0.38
Residential; Natural Gas	1.06	0.99	1.11	1.00
Residential; LPG	0.84	0.66	0.83	0.63

⁽¹⁾The initial PM_{2.5} maintenance plan used AEO2010 projections, and the above comparison is to the most recent AEO2015 projections.

For housing and population projection data, the PM_{2.5} maintenance plan relied upon information from the COG Cooperative Forecast, Round 7.2a. VMT estimates within recent air quality conformity analyses are the basis for such activity data within the area source calculations. For employment projection data, the PM_{2.5} maintenance plan relied upon information from the state department of labor (DOL) projections. Table 3-5 compares the housing and population estimates for 2030 from the PM_{2.5} maintenance area jurisdictions based on Round 7.2a with the same data from Round 8.4, which is the most

recent update to this forecast. Table 3-5 also compares the VMT estimates for 2030 from the Air Quality Conformity Analyses for 2009 and 2015 and the employment projections from state DOLs for the periods 2006-16 (2008-18 in case of the District) and 2012-22. The more recent forecasts are similar to the forecasts used in the PM_{2.5} maintenance plan and show a slightly lower projection for households, VMT, and employment and only slightly higher projection for population.

Table 3-5: Housing, Employment, Population, and VMT Data Comparison

Category	Initial PM _{2.5} Maintenance Plan	PM _{2.5} Maintenance Plan Update
	2030 Projections	2030 Projections
Households	2,398,843 ¹	2,369,668 ²
Population	6,118,224 ¹	6,209,988 ²
VMT	197,574,487 ³	193,913,410 ⁴
Employment	Annual Growth Rate	Annual Growth Rate
DC	1.01% ⁵	0.74% ⁶
MD	1.00% ⁷	0.64% ⁸
VA	1.45% ⁹	1.27% ¹⁰

¹Round 7.2a Cooperative Forestry: Population and Household Forecasts to 2040 by Traffic Analysis Zone, Department of Community Planning and Services, Metropolitan Washington Council of Governments, 2009

²Round 8.4 Cooperative Forecasting: Population and Household Forecasts to 2040 by Traffic Analysis Zone

³Air Quality Conformity Analysis of the 2009 Constrained Long-Range Transportation Plan and the FY2010-2015 Transportation Improvement Program for the Washington Metropolitan Region, Page 24, Exhibit 12, "2009 CLRP/FY2010-2015 TIP Air Quality Conformity Modeled Area Trips and Vehicle Miles Traveled Average (000's) Weekday Traffic"

⁴Air Quality Conformity Analysis of the 2015 Constrained Long-Range Plan Amendment and the FY2015-2020 Transportation Improvement Program for the Washington Metropolitan Region, Page 13, Exhibit 8, "2015 CLRP/FY2015-2020 TIP Air Quality Conformity Modeled Area Trips and Vehicle Miles Traveled (000's) Average Weekday Traffic"

⁵District of Columbia: Industry and Occupational Projections 2008 – 2018, Table 1: District of Columbia Employment by Major Sector, 2008 – 2018

⁶District of Columbia Industry Projections, 2012-2022

⁷Maryland Industry Projections, 2006-2016, Table 1: Employment by major industry sector, 1996, 2006, and projected 2016

⁸Maryland Industry Projections, 2012-2022

⁹Virginia Industry Projections, 2006-2016

¹⁰Virginia Industry Projections, 2012-2022

Table 3-4 and Table 3-5 show that reevaluating the area source emissions based upon the most current socioeconomic data would result in emission projections that are less than those included in the approved PM_{2.5} maintenance plan. Additionally, marine, rail and aircraft emissions projections as well as nonroad model projections would not change as activity and methodologies have not changed since the development of the PM_{2.5} maintenance plan. Therefore, projections for these categories do not require updating in order to ensure that the maintenance demonstration supplied in Table 3-2 is valid. Emissions are below, and will continue to remain below, maintenance levels in the Washington region. What is also

clear from this data is that total emissions of PM_{2.5} and its precursors are declining and will continue to decline into the future, ensuring further PM_{2.5} air quality improvements.

3.4. Air Quality

The Washington DC-MD-VA region has been attaining the 1997 PM_{2.5} NAAQS since 2005, and PM_{2.5} levels have been continually decreasing over the last decade. The trends in the PM_{2.5} design values in Figure 3-1 and Figure 3-2 reflect the effect of the declining emissions trends on PM_{2.5} levels in the region.

Figure 3-1: Annual PM_{2.5} Design Value

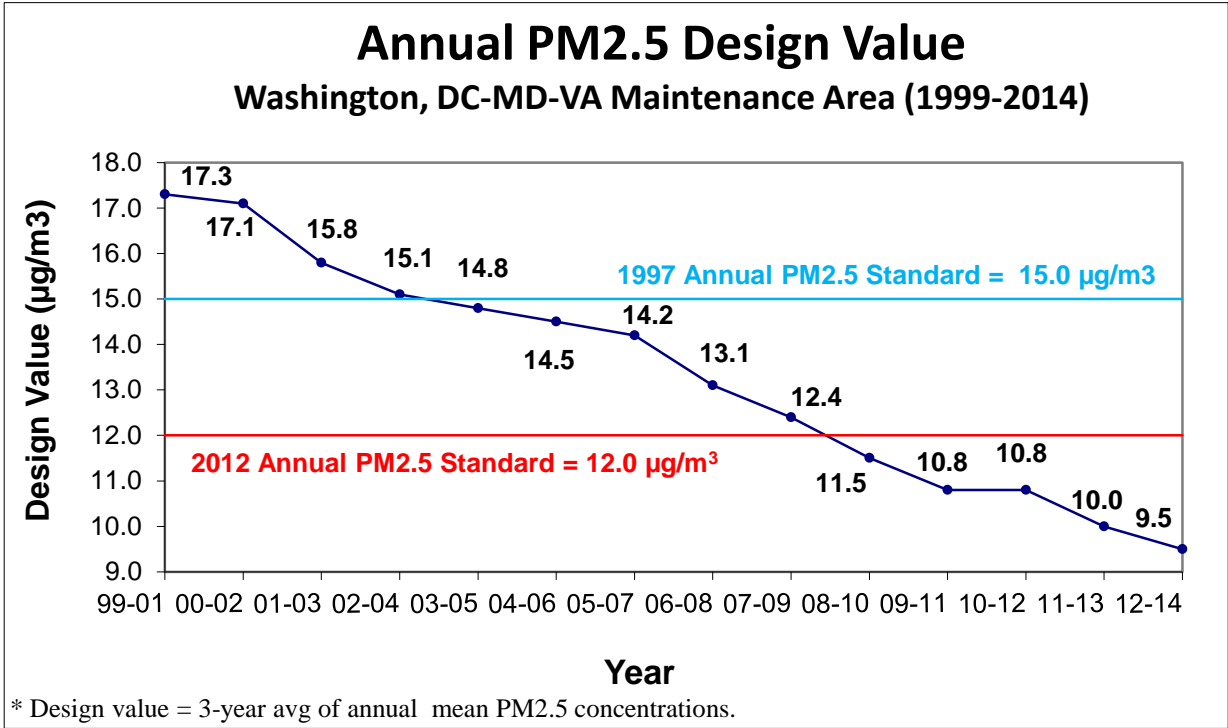
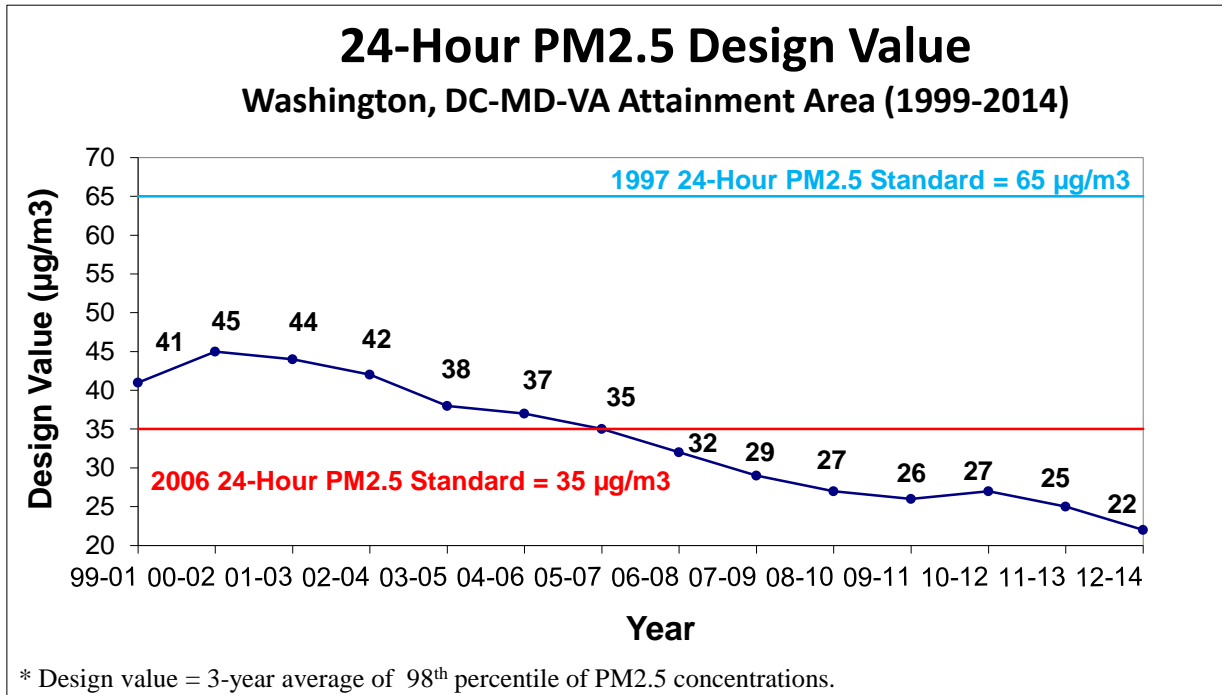
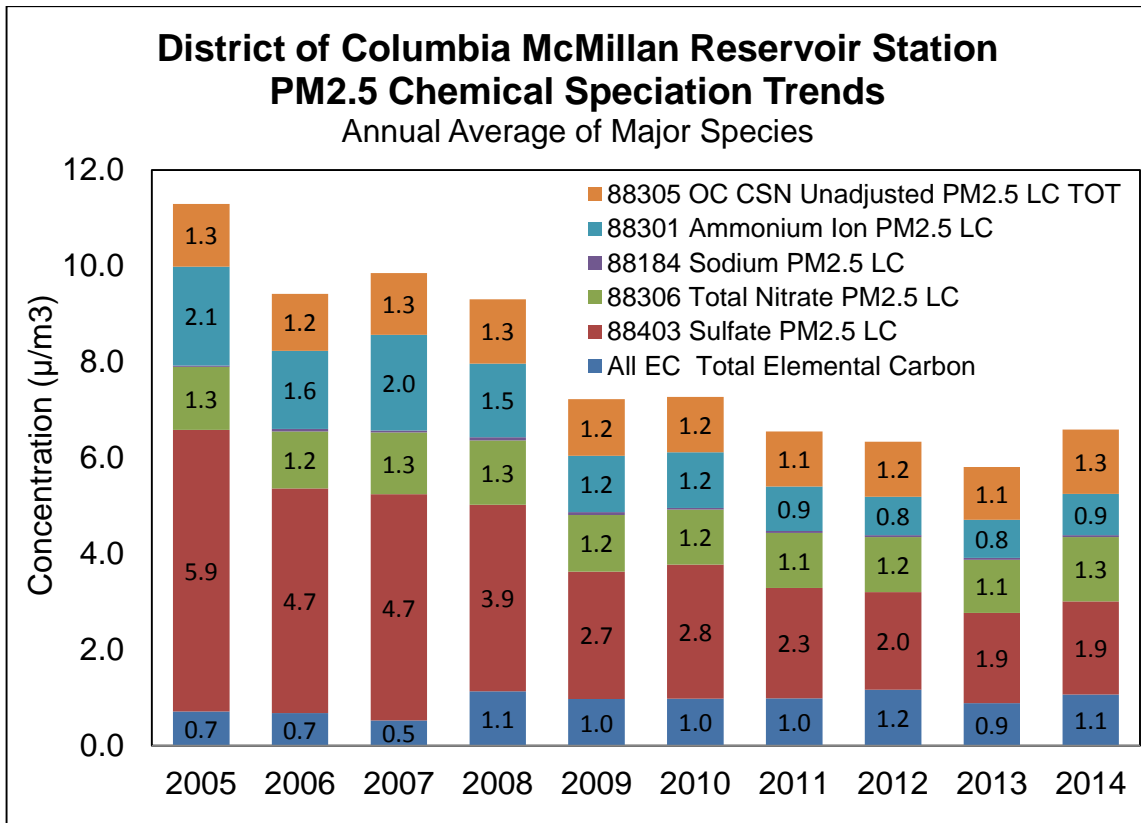


Figure 3-2: 24-Hour PM_{2.5} Design Value



The trends in the PM_{2.5} speciation data in Figure 3-3 reflect the effect of the declining emissions of SO₂ over the years on PM_{2.5} levels in the region.

Figure 3-3: PM_{2.5} Chemical Speciation (District of Columbia)



4. CONCLUSION

The District of Columbia, the State of Maryland, and the Commonwealth of Virginia request that USEPA approve these revisions to the PM_{2.5} maintenance plan for the Washington DC-MD-VA 1997 NAAQS PM_{2.5} Maintenance Area. These revisions establish updated MVEBs for highway vehicles using the latest federally approved on-road source emissions estimation model, MOVES2014. The revised MVEBs reflect expected reductions in emissions from newly finalized programs such as the Tier 3 Vehicle Emission and Fuel Standards Program and the Corporate Average Fuel Economy Standards. Future transportation conformity determinations, which already utilize MOVES2014, will use these revised MVEBs once they are deemed adequate by USEPA.

Appendix A

Methodology to develop On-Road Mobile Emissions and Motor Vehicle Emissions Budgets

Appendix B:

Input, RunSpec, and Output Files for On-Road Mobile Emissions by Source Classification Code

Appendix C

Washington DC-MD-VA State Compromise Overview: PM_{2.5} Maintenance Plan Motor Vehicle Emissions Budgets (Appendix D, PM_{2.5} Maintenance Plan; approved on October 6, 2014 (79 FR 60081))