



National Capital Region
Transportation Planning Board

MEMORANDUM

TO: Files
FROM: Ronald Milone, Jinchul Park, and Jane Posey, COG, DTP
SUBJECT: Mobile On-Road Emission Inventories for the PM_{2.5} Maintenance Plan Update
DATE: December 30, 2015
CC: Kanti Srikanth, Dusan Vuksan, Sunil Kumar, Steve Walz

Introduction

In 2005, the Metropolitan Washington, DC, (DC-MD-VA) region was designated by the EPA as nonattainment for the 1997 Fine Particles (PM_{2.5}) National Ambient Air Quality Standard (NAAQS).¹ In 2009, the EPA announced that the monitors in the Washington region showed compliance with the 1997 PM_{2.5} NAAQS.² In 2013, MWAQC approved a PM_{2.5} Maintenance Plan³ and the states requested that EPA redesignate the region as being in attainment. In 2014, EPA approved the Maintenance Plan.⁴ The Plan included a provision (Appendix D) that committed the state air agencies to update the PM_{2.5} Plan by revisiting the development of mobile on-road inventories and budgets. This memorandum documents DTP staff's recent efforts to update the PM_{2.5} SIP inventory and includes: 1) a summary of the methods and assumptions used in developing updated inventories, 2) a comparison of original (2013) and updated (2015/16) emissions inventory results, and 3) a formulation of updated PM_{2.5} budgets in light of the updated PM_{2.5} SIP inventories. A listing of MOVES-related files is also included.

The PM_{2.5} SIP inventory focuses on emission tonnage associated with five (5) pollutants:

- Fine Particles (PM_{2.5});
- Precursor NO_x;
- Sulfur Dioxide (SO₂);
- Volatile Organic Compounds (VOC); and
- Ammonia (NH₃).

Inventories of the above pollutants were prepared for three (3) analysis years:

- 2007;
- 2017; and
- 2025.

¹ 70 FR 944

² 74 FR 1146

³ Washington DC-MD-VA 1997 PM_{2.5} Maintenance Plan, MWAQC, May 22, 2013
https://www.mwacog.org/environment/air/downloads/PM/PM2.5%20MP_Final%20Version.pdf

⁴ 79 FR 193

The emissions inventories were prepared for the Washington, D.C. PM2.5 Air Quality Planning Area which comprises ten jurisdictions:

- District of Columbia
- Arlington County, VA
- City of Alexandria, VA
- Fairfax County (and cities), VA
- Montgomery County, MD
- Prince George’s County, MD
- Charles County, MD
- Prince William County (and cities), VA
- Loudoun County, VA
- Frederick County, MD

Methods and Assumptions

The key planning assumptions and methods underlying the original (2013) and updated (2015/16) PM2.5 emissions inventories are listed in Table 1.

Table 1. Assumptions and Methods Used in the 2013 and 2015/16 SIP Inventories

	2013 PM SIP Inventory	2015/16 PM SIP Inventory
CLRP	2011	2015
Land Activity	8.0a	8.4
Travel Demand Model	Version 2.3.36	Version 2.3.57a
Emissions Model	MOVES2010a	MOVES2014
Vehicle Registration Data	2008 VIN/2011 VIN	2008 VIN/2014 VIN
PM 2.5 Study Area	10 Jurisdictions	10 Jurisdictions
Years Analyzed	2002, 2007, 2017, 2025, 2040	2007, 2017, 2025

The updated 2015/16 SIP inventories were prepared using the technical methods and inputs used in the air quality conformity determination of the 2015 CLRP.⁵ The methods included the use of the TPB’s currently adopted travel demand model, Version 2.3.57a and the EPA MOVES2014 emissions model. These modeling tools are more refined than those used in the 2013 Maintenance Plan. The Version2.3.57a travel model includes updates implemented as a result of a model validation effort⁶ using observed 2010 data. The MOVES2014 emissions model incorporates the impact of new federal programs not considered in MOVES2010a and also considers more recent mobile emission research.

The non-travel related inputs to the MOVES2014 model, relating to meteorology, inspection and maintenance programs and fuel formulation and supply, were provided by state air agencies in coordination with COG’s Department of Environmental Programs. For the year 2007, the non-travel inputs used in the original 2013 SIP analysis were used as is, however, some reformatting of

⁵ Air Quality Conformity Analysis of the 2015 Constrained Long Range Plan Amendment and the FY2015-2020 Transportation Improvement Program for the Washington Metropolitan Region, MWCOG/TPB, October 25, 2015

⁶ 2010 Validation of the Version 2.3 Travel Demand Model, Memorandum to Files, June 30, 2013

the data was necessary when moving from MOVES2010a to MOVES2014. The 2017 and 2025 inputs were already compiled as part of the recent conformity analysis of the 2015 CLRP Amendments. The non-travel related assumptions and methods underlying the original (2013) and updated (2015/16) PM_{2.5} emissions inventories are listed in Table 2.

Table 2. Non-Travel Related Assumptions and Methods Used in the 2013 and 2015/16 SIP Inventories

	2013 PM SIP Inventory	2015/16 PM SIP Inventory
Inspection & Maintenance (I/M) Programs	Year-Specific I/M Programs (MOVES2010a Format)	Year-Specific I/M Programs (MOVES2014 Format)
Fuel Programs	Year-Specific Fuel Data (MOVES2010a Format)	Year-Specific Fuel Data (Includes Tier 3 Low Sulfur Gasoline) (MOVES2014 Format)
Meteorology	Historical 2007 Met Data (EPA's Default NMIM Model Database)	Historical 2007 Met Data (EPA's Default NMIM Model Database)

Results and Analysis

A comparison of the updated (2015/16) and original (2013) SIP inventories is shown on Table 3. The 2015/16 inventory is generally less than the original inventory for all of the pollutants and years analyzed. These differences are not surprising given that the new MOVES2014 model reflects federal fuel and vehicle technology (Tier 3) programs and the “improved science” methods that were not accounted for in MOVES2010a. Further, while the new federal programs do not exist in the 2007 scenario, emissions decreases still result due to the “improved science” considered in the MOVES2014 model. These findings are consistent with earlier sensitivity work conducted by TPB staff and with research conducted at other agencies.

Table 3. Comparison of 2013 and 2015/16 Annual On-Road Emission Inventories (in Short Tons)

Analysis Year/Pollutant	2013 PM SIP	2015/16 PM SIP	Δ	% Δ
Year 2007				
Ammonia (NH3)	1,901	1,862	-39	-2%
Precursor NOx	91,639	81,001	-10,638	-12%
PM _{2.5}	3,452	3,002	-450	-13%
Sulfur Dioxide (SO ₂)	607	570	-37	-6%
Volatile Organic Compounds (VOC)	37,514	34,441	-3,074	-8%
Year 2017				
Ammonia (NH3)	1,249	1,229	-21	-2%
Precursor NOx	41,709	32,790	-8,919	-21%
PM _{2.5}	1,787	1,523	-264	-15%
Sulfur Dioxide (SO ₂)	560	162	-398	-71%
Volatile Organic Compounds (VOC)	18,730	16,768	-1,962	-10%
Year 2025				
Ammonia (NH3)	1,227	1,181	-46	-4%
Precursor NOx	27,400	15,434	-11,966	-44%
PM _{2.5}	1,322	926	-396	-30%
Sulfur Dioxide (SO ₂)	531	142	-389	-73%
Volatile Organic Compounds (VOC)	14,269	11,765	-2,504	-18%

Background

The 2013 PM_{2.5} Fine Particles Maintenance Plan includes forecast year motor vehicle emissions budgets (MVEBs; mobile budgets) for PM_{2.5} direct and PM_{2.5} Precursor NOx for 2017 and 2025, which the TPB is required to use to demonstrate conformity of the region’s Constrained Long Range Plan (CLRP) and Transportation Improvement Program (TIP). This means that in order for transit and highway improvements supported by the region to move forward, the TPB will be required to show that projected motor vehicle emissions for 2007 through 2016 are less than or equal to the 2007 mobile budgets; emissions for 2017 through 2024 are less than or equal to the 2017 mobile budgets; and emissions for 2025 through 2040 are less than or equal to the 2025 mobile budgets. Typically, once established, these mobile budgets can remain in place for years.

The development of the original (2013) Maintenance Plan mobile budgets was a lengthy process, involving the formation of a Mobile Budget Task Force, which included representatives from state and local transportation and air quality agencies. In order to address technical uncertainties due to model changes or to vehicle fleet turnover, which may affect future motor vehicle emissions inventories, the TPB recommended that the budgets allow for safety margins of 20 percent and 30 percent into out-year mobile emissions budgets, for 2017 and 2025 respectively. These recommended levels were based in part on VIN data sensitivity tests run in 2012, which were designed to assess the potential impact of changes in the mix and age of the vehicle fleet. They were also based on TPB’s previous experience with changes in EPA’s mandated emissions estimating procedures, which had typically resulted in significantly higher estimates from the same set of local inputs. The sensitivity tests and recommended safety margin levels are documented in a June 1, 2012

letter from Ron Kirby to the MWAQC chair. The use of safety margins is common practice for maintenance plans around the country, and is explicitly provided for in the US EPA Conformity Regulations.

The Mobile Budget Task Force agreed to a 20 percent safety margin for both PM_{2.5} Direct and PM_{2.5} precursor NO_x for setting mobile budgets as part of the Maintenance Plan.

The state air and transportation agencies agreed to group the mobile budgets into two Tiers in the Maintenance Plan. “Tier 1” mobile budgets were set at the mobile emission inventory levels for 2017 and 2025. “Tier 2” mobile budgets were developed by adding a 20% buffer to the mobile emission inventory projections for 2017 and 2025. Regional transportation conformity analysis would first be tested against the Tier 1 mobile budgets, once the EPA found them adequate. The Tier 2 mobile budgets would become effective if it is determined that lead to motor vehicle emissions estimates above the Tier 1 budgets. The regional air quality conformity analysis for the past three CLRP and TIPs have been conducted and approved by the FHWA and the FTA using the Tier 1 PM_{2.5} mobile budgets. The region has not had to use the Tier 2 mobile budgets to date, in spite of changes to the travel demand model and emissions model and other technical inputs to the regional conformity analysis.

At the time of the development of the original (2013) Maintenance Plan, the Environmental and Transportation agencies of Maryland, Virginia, and the District of Columbia agreed to update the PM_{2.5} mobile budgets in 2015, and submit them as a revision to the 2013 PM_{2.5} Maintenance Plan (as included in Appendix D of the Maintenance Plan). In accordance with this agreement, TPB staff has now developed the updated mobile inventories. The changes in the inputs used in developing the updated on-road emissions inventories are listed in Tables 1 and 2, and the changes in the estimated on-road emissions inventories are listed in Table 3.

Recommendation

Consistent with the provisions of the US EPA Conformity Regulations and the TPB's recommendations for the 2014 PM_{2.5} Maintenance Plan, and as agreed to and implemented in the 2013 PM_{2.5} Maintenance Plan, it is recommended that mobile emissions budgets in the revised PM_{2.5} Maintenance Plan provide the same 20% safety margin to address inherent uncertainties attributed to future travel/emissions modeling refinements or other technical inputs, such as vehicle fleet mix changes over time.

MOVES FILES

The MOVES files developed for the PM_{2.5} SIP Update reside in a subdirectory on the LAN, named:

H:\2015CLRP_PMSIP

The above subdirectory contains three subdirectories pertaining to MOVES inputs, outputs and “Runspec” files. Files are provided for each analysis year. Maryland jurisdictions include two sets of files corresponding to separate alternative vehicle fuel technology (AVFT) scenarios.

A listing of files is shown in Table 4.

Table 4. Input, Output and “Runspec” MOVES2014 Files for Years 2007, 2017 and 2025

Year 2007

Input	Output	Runspec
Annual_DC_2007_Base_In	Annual_DC_2007_Base_Out	Annual_DC_2007_Base.MRS
Annual_NoAVFT_CHL_2007_Base_In	Annual_NoAVFT_CHL_2007_Base_Out	Annual_NoAVFT_CHL_2007_Base.MRS
Annual_AVFT_CHL_2007_Base_In	Annual_AVFT_CHL_2007_Base_Out	Annual_AVFT_CHL_2007_Base.MRS
Annual_NoAVFT_FRD_2007_Base_In	Annual_NoAVFT_FRD_2007_Base_Out	Annual_NoAVFT_FRD_2007_Base.MRS
Annual_AVFT_FRD_2007_Base_In	Annual_AVFT_FRD_2007_Base_Out	Annual_AVFT_FRD_2007_Base.MRS
Annual_NoAVFT_MTG_2007_Base_In	Annual_NoAVFT_MTG_2007_Base_Out	Annual_NoAVFT_MTG_2007_Base.MRS
Annual_AVFT_MTG_2007_Base_In	Annual_AVFT_MTG_2007_Base_Out	Annual_AVFT_MTG_2007_Base.MRS
Annual_NoAVFT_PG_2007_Base_In	Annual_NoAVFT_PG_2007_Base_Out	Annual_NoAVFT_PG_2007_Base.MRS
Annual_AVFT_PG_2007_Base_In	Annual_AVFT_PG_2007_Base_Out	Annual_AVFT_PG_2007_Base.MRS
Annual_ARL_2007_Base_In	Annual_ARL_2007_Base_Out	Annual_ARL_2007_Base.MRS
Annual_ALX_2007_Base_In	Annual_ALX_2007_Base_Out	Annual_ALX_2007_Base.MRS
Annual_FFX_2007_Base_In	Annual_FFX_2007_Base_Out	Annual_FFX_2007_Base.MRS
Annual_LDN_2007_Base_In	Annual_LDN_2007_Base_Out	Annual_LDN_2007_Base.MRS
Annual_PW_2007_Base_In	Annual_PW_2007_Base_Out	Annual_PW_2007_Base.MRS

Year 2017

Annual_DC_2017_Base_In	Annual_DC_2017_Base_Out	Annual_DC_2017_Base.MRS
Annual_NoAVFT_CHL_2017_Base_In	Annual_NoAVFT_CHL_2017_Base_Out	Annual_NoAVFT_CHL_2017_Base.MRS
Annual_AVFT_CHL_2017_Base_In	Annual_AVFT_CHL_2017_Base_Out	Annual_AVFT_CHL_2017_Base.MRS
Annual_NoAVFT_FRD_2017_Base_In	Annual_NoAVFT_FRD_2017_Base_Out	Annual_NoAVFT_FRD_2017_Base.MRS
Annual_AVFT_FRD_2017_Base_In	Annual_AVFT_FRD_2017_Base_Out	Annual_AVFT_FRD_2017_Base.MRS
Annual_NoAVFT_MTG_2017_Base_In	Annual_NoAVFT_MTG_2017_Base_Out	Annual_NoAVFT_MTG_2017_Base.MRS
Annual_AVFT_MTG_2017_Base_In	Annual_AVFT_MTG_2017_Base_Out	Annual_AVFT_MTG_2017_Base.MRS
Annual_NoAVFT_PG_2017_Base_In	Annual_NoAVFT_PG_2017_Base_Out	Annual_NoAVFT_PG_2017_Base.MRS
Annual_AVFT_PG_2017_Base_In	Annual_AVFT_PG_2017_Base_Out	Annual_AVFT_PG_2017_Base.MRS
Annual_ARL_2017_Base_In	Annual_ARL_2017_Base_Out	Annual_ARL_2017_Base.MRS
Annual_ALX_2017_Base_In	Annual_ALX_2017_Base_Out	Annual_ALX_2017_Base.MRS
Annual_FFX_2017_Base_In	Annual_FFX_2017_Base_Out	Annual_FFX_2017_Base.MRS
Annual_LDN_2017_Base_In	Annual_LDN_2017_Base_Out	Annual_LDN_2017_Base.MRS
Annual_PW_2017_Base_In	Annual_PW_2017_Base_Out	Annual_PW_2017_Base.MRS

Table 4. Input, Output and “Runspec” MOVES2014 Files for Years 2007, 2017 and 2025 (continued)

Year 2025

Annual_DC_2025_ALT_B_In	Annual_DC_2025_ALT_B_Out	Annual_DC_2025_ALT_B.MRS
Annual_NoAVFT_CHL_2025_ALT_B_In	Annual_NoAVFT_CHL_2025_ALT_B_Out	Annual_NoAVFT_CHL_2025_ALT_B.MRS
Annual_AVFT_CHL_2025_ALT_B_In	Annual_AVFT_CHL_2025_ALT_B_Out	Annual_AVFT_CHL_2025_ALT_B.MRS
Annual_NoAVFT_FRD_2025_ALT_B_In	Annual_NoAVFT_FRD_2025_ALT_B_Out	Annual_NoAVFT_FRD_2025_ALT_B.MRS
Annual_AVFT_FRD_2025_ALT_B_In	Annual_AVFT_FRD_2025_ALT_B_Out	Annual_AVFT_FRD_2025_ALT_B.MRS
Annual_NoAVFT_MTG_2025_ALT_B_In	Annual_NoAVFT_MTG_2025_ALT_B_Out	Annual_NoAVFT_MTG_2025_ALT_B.MRS
Annual_AVFT_MTG_2025_ALT_B_In	Annual_AVFT_MTG_2025_ALT_B_Out	Annual_AVFT_MTG_2025_ALT_B.MRS
Annual_NoAVFT_PG_2025_ALT_B_In	Annual_NoAVFT_PG_2025_ALT_B_Out	Annual_NoAVFT_PG_2025_ALT_B.MRS
Annual_AVFT_PG_2025_ALT_B_In	Annual_AVFT_PG_2025_ALT_B_Out	Annual_AVFT_PG_2025_ALT_B.MRS
Annual_ARL_2025_ALT_B_In	Annual_ARL_2025_ALT_B_Out	Annual_ARL_2025_ALT_B.MRS
Annual_ALX_2025_ALT_B_In	Annual_ALX_2025_ALT_B_Out	Annual_ALX_2025_ALT_B.MRS
Annual_FFX_2025_ALT_B_In	Annual_FFX_2025_ALT_B_Out	Annual_FFX_2025_ALT_B.MRS
Annual_LDN_2025_ALT_B_In	Annual_LDN_2025_ALT_B_Out	Annual_LDN_2025_ALT_B.MRS
Annual_PW_2025_ALT_B_In	Annual_PW_2025_ALT_B_Out	Annual_PW_2025_ALT_B.MRS

Location: The files are located under H:\2015CLRP_PMSIP\; and data of each analysis year are copied under input, output and Runspec directories.