MEMORANDUM

To:	Michael Clifford
From:	Jinchul (JC) Park, DTP/MWCOG
Date:	May 17, 2010
Re:	2005 Annual Emission Results: Direct PM2.5, Precursor NOx, and CO2

This memo documents the MOVES modeling method applied to 2005 annual emission calculations and the modeling results of direct PM2.5, NOx and CO2 for COG/TPB's non-attainment areas. All local data are used for MOVES model inputs except average speed distribution and ramp fraction. Local data were partially applied to the MOVES models in calculating the annual emissions presented at the April Task Force meeting. The annual emission results in this memo, however, are the results of applying more local data and new modeling methods EPA recommends (specified below in Section 1). Thus, the modeling results and comparisons to the Mobile emission results are more up-to-date and realistic than the comparison results presented at the previous meeting.

1. Modeling Methods and Data

The modeling methods applied in the 2005 annual emission calculations didn't follow the EPA's technical guidance that recommends that the annual emission calculations be conducted by selecting 'hour' as both the input and output aggregation levels. I found out that the EPA's recommendation produced unreasonable outputs. I conducted a sensitivity analysis, in which combinations of available input and output time aggregations were carefully evaluated one at a time. I used hour and month as the input and output time aggregations based on the results found from the sensitivity analysis (see Table 1). I think that internal multipliers for calculating three output time aggregations (e.g., hour, 24-hour day and portion of week) are not correctly specified in MOVES. I reported the issue to EPA, and am waiting for the EPA's response

The MOVES modeling incorporated the early National Low Emitting Vehicle (NLEV) inputs in the MOVES specification. This input helps adjust emissions from the vehicles manufactured with new emission standards in 1999 and 2000. MOVES 2010 only adjusts the effects of the NLEV standards beginning with the 2001 model year. In summary the results introduced in this memo were produced from two new MOVES model specifications: 'Hour' and 'Month' for the input and output time aggregations, and adjustment of early NLEV.

The MOVES modeling conducted in May incorporated more local data than in April. COG/DTP staff created transportation related data using data converters, and received local environmental data from VDEQ and MDE. These local data, described in Siva's May 14, 2010 memo, were applied to the MOVES modeling. Average speed distribution and ramp fraction are only default data used in the modeling (see Table 2).

2.   Modeling Results: 2005 Annual Emissions

The 2005 MOVES' annual emissions for non-attainment areas (see Map 1) were compared to the Mobile 6.2's by pollutant: direct PM2.5, NOx, and CO2 (see Figures 1 to 3). The MOVES' annual emissions are increased in comparison to the Mobile's for all three pollutants: 1,900 tons, 23,000 tons, and about 1

million tons for direct PM 2.5, NOx and CO2, respectively. MOVES estimated direct PM 2.5 at more than double than the Mobile estimates, a 130 % increase. Annual NOx emissions are considerably increased in MOVES in comparison to Mobile, 29%. However, annual CO2 emissions show a good match with Mobile' with only an increase of 4.3% for the CO2 reporting area (the 8 hour ozone non-attainment area).

3. Next Steps

Local data applied in May produced more accurate and realistic emission results than the April local data. COG/DTP staff need to develop local average speed distribution and ramp fraction, and recalculate the 2005 annual emissions. This would be a full application of local data to MOVES. COG/DTP staff will apply the same MOVES modeling routine performed for the 2005 emission calculations to upcoming 2030 annual emission calculations.

Attachment:
Tables 1-2
Figures 1-3
Map 1

Table 1. Sensitivity Analysis: 2005 Annual Emissions for Montgomery County with April Local Inputs

Sensitivity Run	Time Aggregation Levels		Direct PM2.5 (tons)	Annual NOX (tons)	Annual CO2 (tons)	Annual Distance (VMT)	Run Time (min)
	Input	Output					
1	Hour	Hour	0	982	281,439	500,256,809	157
2	Hour	24-Hour Day	27	1,009	281,441	500,256,984	159
3	Hour	Portion of Week	100	3,661	1,022,046	1,815,004,728	158
4	Hour	Monthly	439	15,907	4,440,568	7,885,328,928	157
5	Hour	Yearly	439	15,907	4,440,569	7,885,328,896	155
6	Month	Monthly	443	15,893	4,443,513	7,885,329,952	14
7	Month	Yearly	442	15,892	4,443,519	7,885,328,896	13
8	Year	Yearly	410	15,289	4,340,293	7,885,328,896	11
	Mobile 6.2		265	14,879	4,517,969	7,853,637,397	Not Recorded
	Difference		174	1,028	(77,401)		
	% Difference		65.7%	6.9%	-1.7%		

Note: MOVES outputs are summarized by 'SummaryReport' in MOVES.

Table 2. Inputs used in the 2005 Annual Emission Calculations

No.	Input Data	DC	VA	MD
1	Average Speed Distribution	Default data		
2	Fuel Formulation	Default data	VDEQ	MDE
3	Fuel Supply			
4	I/M Programs			
5	Ramp Fraction	Default data		
6	Meteorology Data	Local data		
7	Road Type Distribution	Local data prepared by COG/DTP		
8	Age Distribution			
9	Source Type Population			
10	Vehicle Type VMT_Yearly			
11	Vehicle Type VMT_Monthly			
12	Vehicle Type VMT_Daily			
13	Vehicle Type VMT_Hourly			

Figure 1. 2005 Direct PM2.5 Emissions for Non-Attainment Area (Annual)

+1,902 Tons (130% increase)

3,343

1,441

Emissions (in tons)

- Mobile6.2
- MOVES_Local_May

Direct PM2.5

Figure 2. 2005 NOx Emissions for Non-Attainment Area (Annual)

+23,068 Tons (29% increase)

103,661

80,593
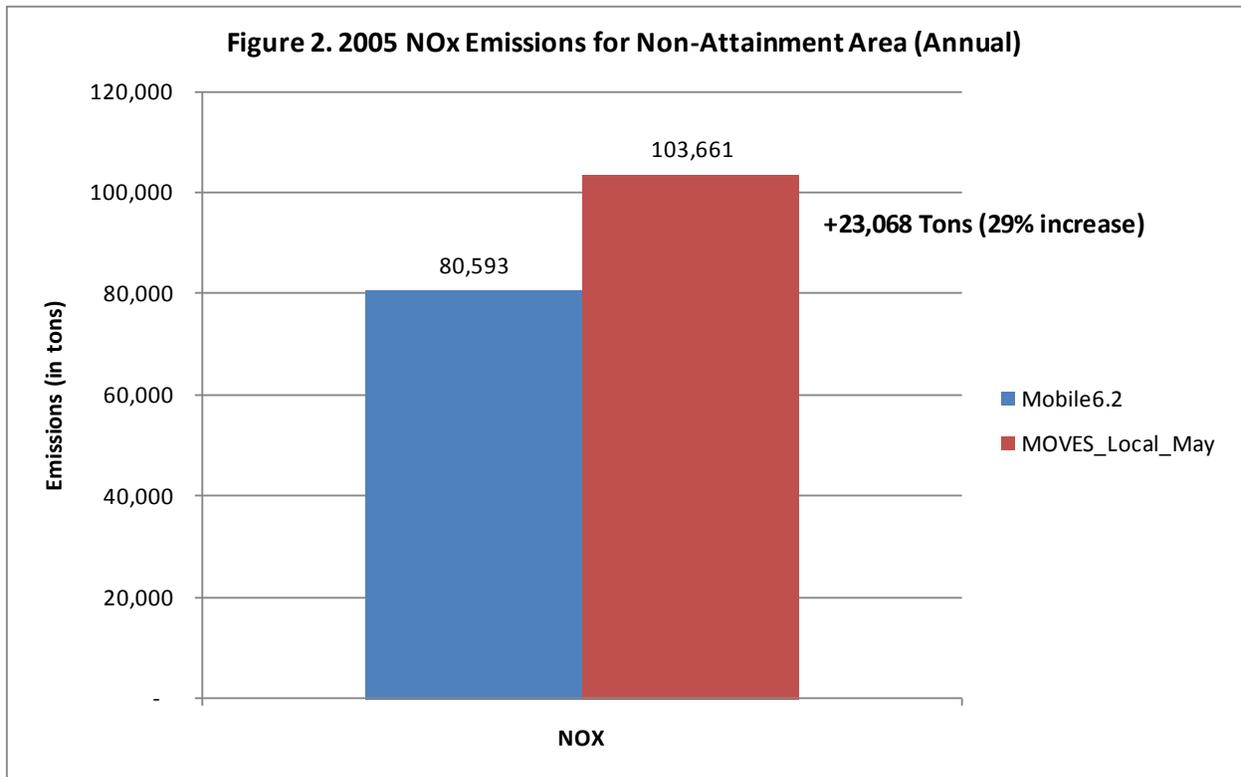
Emissions (in tons)

- Mobile6.2
- MOVES_Local_May

NOX
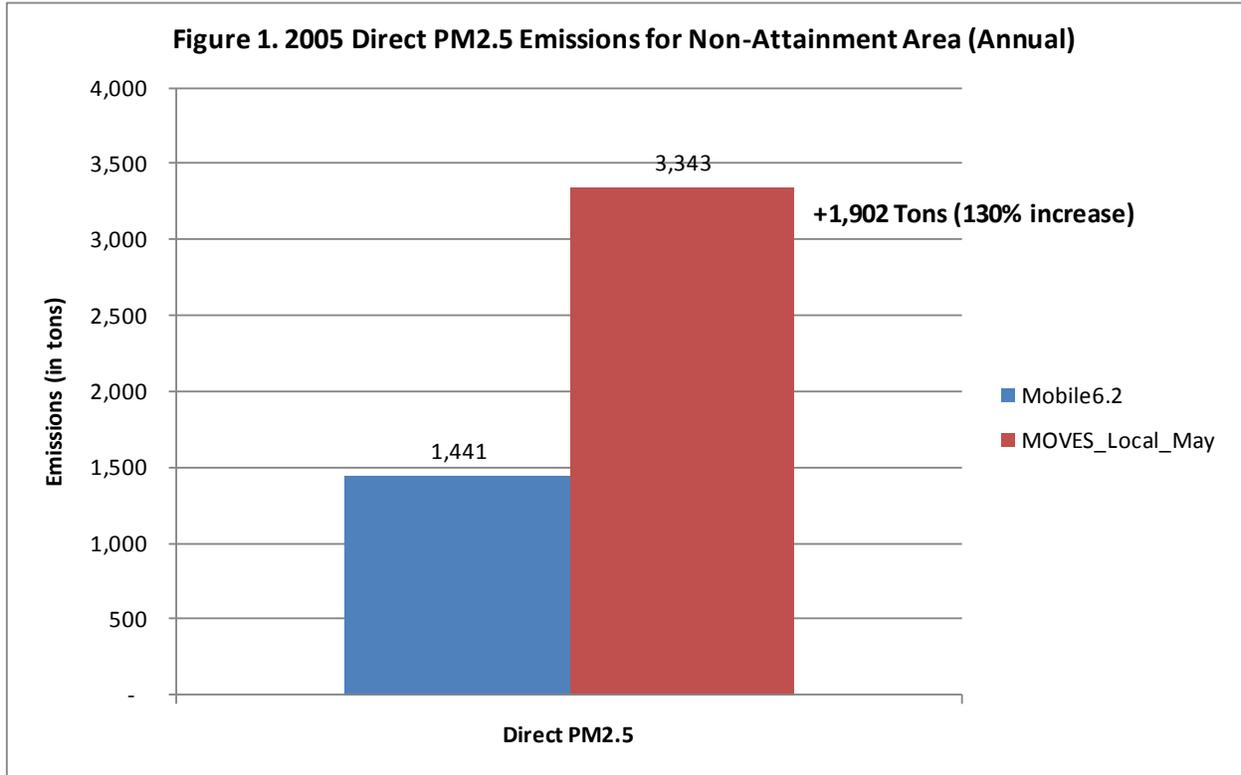
Figure 3. 2005 CO2 Emissions for Reporting Area (Annual)
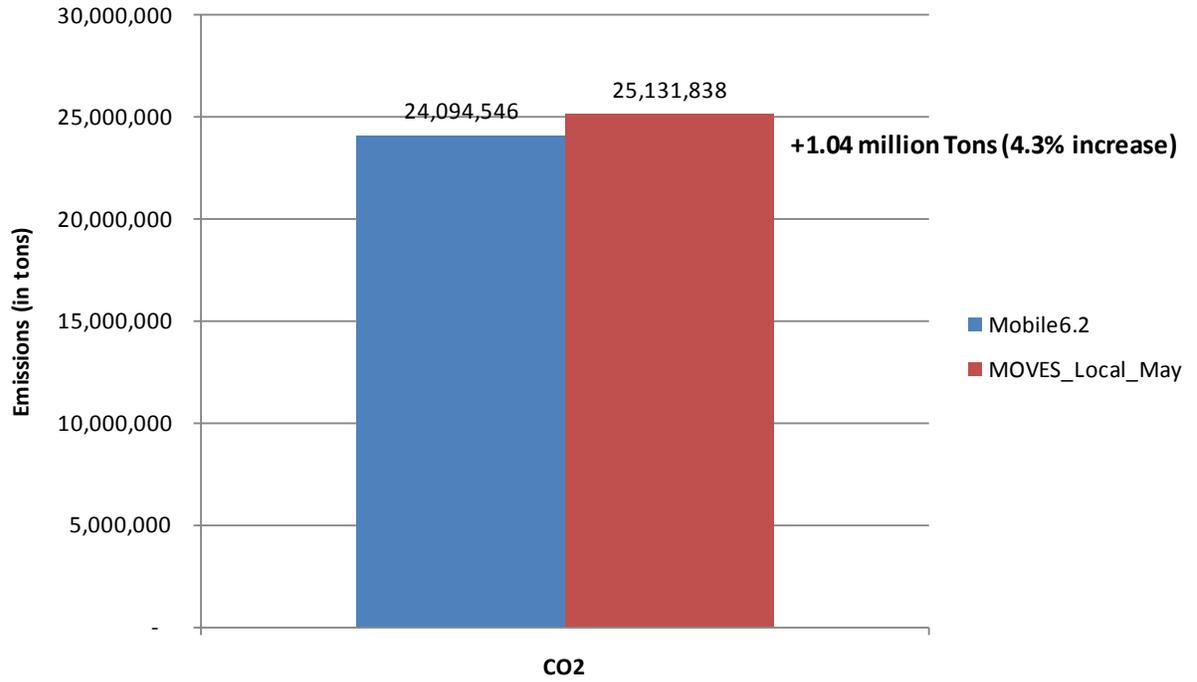
EXHIBIT 2
Washington, D.C. - Maryland - Virginia Planning Areas

Legend:
- Model Area
- 1-Hour Ozone Nonattainment Area
- 8-Hour Ozone Nonattainment Area
- $PM_{2.5}$ Nonattainment Area
- Winter CO Maintenance Area

12
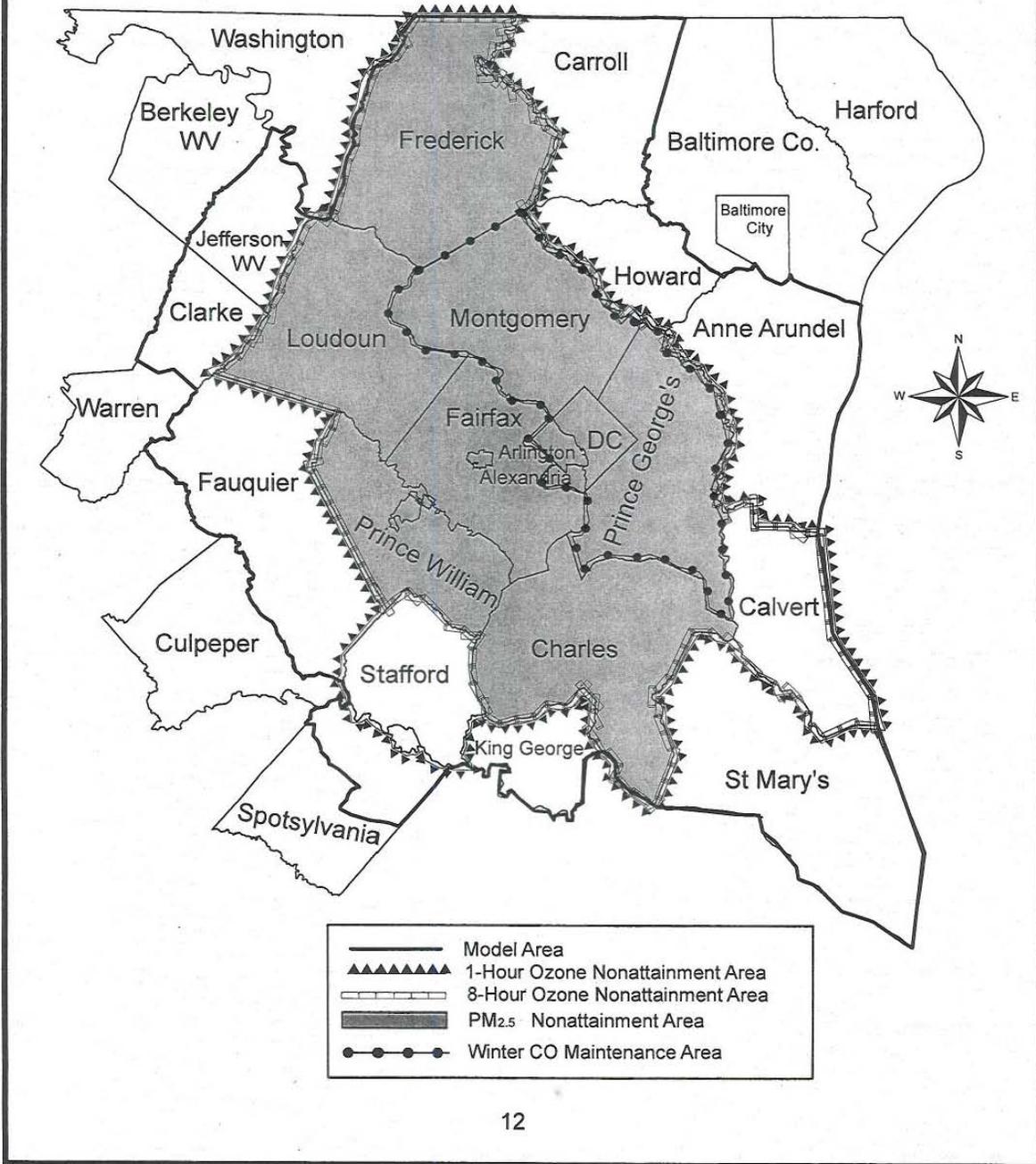
Map 1. Washington D.C., Maryland and Virginia Planning Areas