

National Capital Region Transportation Planning Board

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Memorandum

February 3, 2006

To: TPB Technical Committee

From: Michael J. Clifford

Subject: Development of Emissions Inventories for Air Quality Planning Needs

Introduction

This memo provides a brief overview of some ongoing work program activities relating to emissions inventory development for state air quality implementation plan (SIP)s and subsequent conformity assessments. This summary is designed to inform the Committee of current activities and discussion and to obtain guidance regarding recommended next steps in proceeding with work program requirements.

Background

COG/DTP and DEP staff are working to develop mobile source emissions inventories for use in preparing: base year and forecast year conditions, scenarios for 'reasonable further progress' (RFP), and an attainment plan for the 8-hour ozone standards in the Washington area. Refined technical methods and planning assumptions are continuously being incorporated into SIP and air quality conformity analyses as improvements become available. For example, in the latest conformity assessment (for fine particles or PM_{2.5}), staff developed new methods including the use of traffic and emissions factors for each season (Spring, Summer, Fall and Winter) in order to prepare inventories for the entire year, instead of the daily totals previously required. In that work staff initially tried a monthly approach for inventory construction, but, after interagency consultation, opted for seasonal factors since there was little difference in average emissions rates by month within each season, and the computer processing time required to execute the emissions factor software interface approached 30 hours for a single run (compared with less than eight hours for a computer run using the seasonal approach).

Current Work

In preparing to develop the emissions inventories required for the 8-hour ozone SIP, the air agencies have requested a number of additional refinements, e.g., the use of temperature by hour of the day (instead of the use of average minimum and maximum values for the day), hourly relative humidity, and explicit values for barometric pressure and 'NO_x rebuild effects' (percentages relating to the

compliance rate with a consent decree governing faulty heavy duty truck engines). While these updates were expected, the request also included test application to the monthly, as well as the seasonal, software interface. Given the past experience with the monthly approach, we concurred with the need to construct base year emissions inventories using both monthly and seasonal approaches to assess whether significant differences would be obtained between the two methods before making a decision. Attachment A presents an overview write-up of this work as of January 12, 2006, and Attachment B presents the results of the comparison. In Attachment B, there appears to be no significant difference between the two methods for either direct PM_{2.5} emissions (0.04%) or for precursor NO_x emissions (0.41%).

In discussing these results at the January 19, 2006 conference call of the MWAQC TAC's Emissions Inventory Work Group, one air agency representative questioned whether a repeat of this comparison, after applying updated technical methods which reflected the hourly temperatures, etc., might yield greater differences in emissions results. Staff agreed to perform such a test (once both software interface platforms were revised by COG's consultant to institute the upgrades) and prepare the same emissions inventory comparisons. This work is underway. Updated software has now been received from the consultant and tested. Inventory results should be available in the next week.

Recommended Next Steps

In terms of general observations between the two emissions calculations methods applied to date, there do not appear to be any real differences in results obtained from the monthly versus seasonal approaches. Nor are greater differences expected to result from the latest test being executed to incorporate hourly temperatures and other refinements. The level of precision associated with most any model input, e.g., land use, observed traffic counts, vehicle speed flow relationships, or with model outputs, e.g., VMT, hourly traffic volumes, will exceed the differences in results seen between the two methods. Further, overall trends in mobile source emissions consist of steady and significant reductions through time, with direct PM_{2.5} and precursor NO_x emissions showing declines from 2002 to the attainment year 2010 of over 40% and 50%, respectively. So, a more intensive analysis in this area does not appear to be an effective use of resources. Attachment C contains a staff memo outlining the 'production' emissions inventory requirements associated with SIP planning activities. Given the immediate deliverables and overall schedule for this work, this emphasizes the need to complete the investigation into technical methods and proceed with the requested inventories.

In summary, barring any surprise results from the latest requested comparison, DTP staff recommends, and asks for TPB Technical Committee concurrence, that the 'seasonal' emissions factor approach be advanced for the SIP developmental work (which will also set a precedent for subsequent air quality conformity assessment methods).

Attachments: A - C

Memorandum

January 12, 2006

To: MWAQC Technical Advisory Committee
From: Mike Clifford, COG/DTP
Subject: January 19, 2006 Emissions Inventory Working Group conference call

Brian, Joan, et al,

As follow-up to this morning's TAC conference call, which led to the scheduling of a meeting / conference call for the Emissions Inventory Working Group for next Thursday, I am providing a brief overview of some items that I would like to discuss at that meeting. I am sending it to the TAC since there was not much chance for discussion this morning, and some TAC members may also wish to participate in next week's meeting.

Background

Over the course of this past Summer and Fall, MWAQC and TPB staff and committees developed a mobile source emissions estimation process for PM2.5 analysis which was used in the air quality conformity assessment of the 2005 CLRP and FY2006 – 11 TIP. This involves the major steps of: travel demand forecasting; emissions factor development (using a software interface to develop the factors in specific file formats necessary for subsequent emissions calculation software); and the emissions calculation 'postprocessor'. This process was established and successfully executed yielding inventories for 2002, 2010, 2020 and 2030.

Since yearly emissions inventories were required for direct PM2.5 and precursor NOx, the process was developed, pivoting from existing methods which focused on an average ozone season day (for VOC and NOx) and an average Winter day (for Carbon Monoxide), to also address the yearly emissions requirement. This process is called the 'seasonal approach' since it is based on an average day in each of the four seasons (Winter, Spring, Summer and Fall). Those work efforts initially involved development and testing of a 'monthly approach', but was abandoned since there was very little difference in the resulting monthly vs. seasonal emissions factors, and the computer time required for execution approached 30 hours (vs. less than 8 hours for a computer run using the seasonal approach). Both daily and yearly inventories of ozone precursors will be required, so consistent methods applicable to each condition need to be finalized.

Current Work

While the above-referenced base year 2002 inventories exist for daily VOC and NOx ozone season conditions (and for yearly PM2.5 conditions), and could be utilized for

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required 8-hour ozone SIP analyses, MWAQC staff and agencies have requested sensitivity tests of the current mobile source emissions estimation process. These tests include: (1) revisiting the monthly emissions approach, and (2) also incorporating more disaggregate Mobile6.2 model inputs, e.g., hourly temperatures (instead of the existing average daily minimum / maximum temperatures), and associated hourly relative humidity, and barometric pressure, and a 'NOx rebuild' parameter.

Staff is currently proceeding with testing the first proposal by executing the full monthly process to compare results against the inventories already prepared using the seasonal approach. This work is well along and we hope to have results before next week's working group meeting.

The second set of proposed refinements, involving the use of hourly temperatures, etc., will be performed following the conclusion of the first test. Staff will apply the new parameters to the selected software platform (monthly or seasonal) and continue the sensitivity tests.

Process Design

As staff who are required to prepare several mobile emissions inventories for SIP and conformity assessments throughout the year, we are concerned regarding the computer time required for overall execution of the 'monthly approach' emissions factor software interface, but will endeavor to incorporate all appropriate stratification into the emissions calculation process. Should the results of the monthly vs. seasonal approach indicate that the monthly emissions factor process provides refined emissions estimates, given the 30 hour machine time requirements to address a single year or scenario we would therefore look to streamline other components of the current process to try and keep overall process execution time to manageable levels. Possible examples of this include aggregation of VMT into 5 mph speed bins (instead of the current 1 mph bins), or aggregation of registered vehicle data by jurisdiction.

Next Steps

As Joan mentioned at today's TAC call, a number of important decisions regarding mobile source emissions calculation procedures must be made in the near future in order to stay on schedule for preparation of 8-hour ozone SIP planning materials. TPB staff is proceeding with 2008 and 2009 network analysis and travel demand forecasting work for use in RFP and attainment year inventories, but the critical path will be decisions regarding the emissions calculation methods.

There are tradeoffs to consider between the work to test reconfiguration of the emissions calculation process and adherence to schedule using existing methods. I encourage those of you who are interested in these mobile source applications, and are available next week, to participate in next week's conference call.

Draft

19-Jan-06

Table 1 Direct PM 2.5 Results
2002 Non-Attainment Area Network Monthly Emissions vs Seasonal Emissions

Season	Month	Total Trip Cycle		Absolute Difference	Percent Difference
		Tons per month	Tons per season		
Winter	Dec	120.34			
	Jan	124.12			
	Feb	115.92			
	Sub-Total	360.38	369.00	-8.63	-2.34%
Spring	Mar	124.44			
	Apr	120.57			
	May	126.98			
	Sub-Total	371.98	368.64	3.34	0.91%
Summer	Jun	126.39			
	Jul	129.58			
	Aug	129.58			
	Sub-Total	385.55	385.20	0.35	0.09%
Fall	Sep	128.07			
	Oct	125.40			
	Nov	116.76			
	Sub-Total	370.23	364.64	5.58	1.53%
Annual		1488.14	1487.49	0.65	0.04%

Table 2: Precursor NOx
2002 Non-Attainment Area Network Monthly Emissions vs Seasonal Emissions

Season	Month	Total Trip Cycle		Absolute Difference	Percent Difference
		Tons per month	Tons per season		
Winter	Dec	7527.479			
	Jan	7744.33			
	Feb	7121.80			
	Sub-Total	22393.61	22757.94	-364.33	-1.60%
Spring	Mar	7431.42			
	Apr	7044.60			
	May	7296.29			
	Sub-Total	21772.30	21567.29	205.02	0.95%
Summer	Jun	7194.33			
	Jul	7418.70			
	Aug	7419.57			
	Sub-Total	22032.60	21984.04	48.56	0.22%
Fall	Sep	7415.16			
	Oct	7367.43			
	Nov	7036.80			
	Sub-Total	21819.39	21351.15	468.24	2.19%
Annual		88017.90	87660.414	357.49	0.41%

These emissions are based on the following:

1. Monthly and Seasonal VMT consistent with the 2005 CLRP and FY 2006-2011 TIP
2. Min/Max monthly temperatures were used for monthly rates
3. Does not include school or transit bus or auto access to transit emissions
4. Seasonal emissions are from the 2005 CLRP and FY 2006-2011 TIP

Memorandum

Date: January 23, 2006

To: Michael Clifford, COG/TPB

From: Joan Rohlf, COG/DEP
Sunil Kumar, COG/DEP

Subject: Priority list of MOBILE6 inventories for 8-hour ozone SIP

The purpose of this memorandum is to inform COG/TPB staff of MOBILE6 inventories that will be needed for base case, Reasonable Further Progress (RFP), and attainment years for the 8-hour ozone SIP. A description of the MOBILE6 inventories in the order of priority for SIP planning purposes is provided below.

Following a consultation on January 19, 2006, with the state air agencies about the priority needs for 8-hour ozone SIP planning, we wish to revise a previous memo sent to you on December 5, 2005. Based on the current schedule for 8-hour ozone SIP Planning, the final 2002 mobile emissions inventories need to be finalized by February 2006, and completion of the Reasonable Further Progress (RFP) and Attainment year inventories is needed by March 2006.

The annual inventories that are now required for both the 8-hour ozone SIP and the fine particle SIP will be needed later this spring, no later than April. VOC, NO_x, and CO emissions both on annual and typical summer weekday basis will be need to be submitted to EPA in NIF3.0 format by June 15, 2006 for the base year 2002 as per new EPA emissions inventory guidance.

MWAQC staff will provide MOBILE6 emission factors for these runs, and TPB staff will generate total emissions after applying these emission factors to the Travel Demand Model. TPB staff will also provide total emissions broken down by vehicle classes, HPMS facility types, and emission types for the base year 2002 only for the purpose of reporting these emissions to the EPA Region III in NIF3.0 format required by them by June 2006. Description of Mob6 runs are being provided below.

Description of Mobile6 Runs:

- Run #1: Base year 2002 Mob6 run (Typical summer day) for VOC, NO_x, & CO*
- All 2002 control programs, 2002 Registration data/Diesel sales fraction/VMT mix, and 2002 total VMT
- Run #2: Adjusted year 2002 Mob6 run (For RFP; typical summer day) for VOC & NO_x
- No post-1990 Clean Air Act measures, 1990 I&M programs, RVP set at 7.8, 2002 Registration data/Diesel sales fraction/VMT mix, and 2002 total VMT
- Run #3: Adjusted year 2008 Mob6 run (For RFP; typical summer day) for VOC & NO_x
- No post-1990 Clean Air Act measures, 1990 I&M programs, RVP set at 7.8, 2002 Registration data/Diesel sales fraction/VMT mix, and 2002 total VMT,

Model year in Mob6 input file set at 2008

- Run #4: Target year 2008 Mob6 run (For RFP; typical summer day) for VOC & NO_x
- All 2008 control programs, Registration data/Diesel sales fraction/VMT mix valid for 2008, and 2008 total VMT
- Run #5: Attainment year 2009 Mob6 run (Typical summer day) for VOC & NO_x
- All 2009 control programs, Registration data/Diesel sales fraction/VMT mix valid for 2009, and 2009 total VMT
- Run #6: Base year 2002 Mob6 run (Actual Annual) for VOC, NO_x, & CO, PM_{2.5}, PM₁₀, SO₂, and NH₃
- All 2002 control programs, 2002 Registration data/Diesel sales fraction/VMT mix, and 2002 total VMT