METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENTS

Local governments working together for a better metropolitan region

ITEM # 4

DATE: March 21, 2006 DRAFT

To: Travel Management Subcommittee

From: Anant Choudhary
Transportation Engineer

Subject: Simplified methodology to estimate PM2.5 emissions and NOx emissions as PM2.5 precursor emissions reduction benefits

This memorandum describes a simplified methodology to estimate PM 2.5 emissions and NOx emissions as a PM2.5 precursor emissions reduction benefits for use in analyzing Potential TERMs and adopted TERMS for Air Quality Conformity Assessment and State Implementation Plans (SIPs).

The EPA guidance on fine particulate matter (PM 2.5) emissions requires the region to estimate direct PM 2.5 and NOx emissions as a PM2.5 precursor. In addition these emissions estimations are required on an annual basis and not on a daily basis as in the case of ozone precursors.

The simplified methodology to estimate annual PM2.5 and NOx emissions as a PM2.5 precursor is to use an average annual emission rates and apply these average rates to annual VT and VMT to estimate the annual PM2.5 and NOx emissions. The emission estimation involves following steps.

- Convert daily weekday average VT & VMT to 7day average
- Convert 7-day average VT & VMT to annual VT & VMT by multiplying 365 days
- Apply appropriate emissions factors and estimate PM2.5 and NOX emissions benefits.

It may be noted that the Direct PM2.5 emission rates are constant for all speeds and are expressed in grams/mile. Direct PM 2.5 has no start-up, soak or other evaporative emissions associated with them. NOx as a precursor to PM 2.5 is similar to NOx as a precursor to ozone, and has start-up emissions in addition to running emissions. Emissions rates for PM2.5 & NOx as a precursor to PM 2.5 for years 2010, 2020 and 2030 are shown in TERM section of the '*Call for Projects*' document' (Tables 12 through 15)

An example of a commuter TERM analysis with PM2.5 and NOx emissions as a PM2.5 precursor is attached.

EXAMPLE OF A COMMUTING VEHICLE TRIP TERM ANALYSIS

Construction of 1300 additional Parking Spaces at a Metro Station

Description: 1,300 parking spaces will be constructed at Grosvenor Metro station. The garages at Metrorail stations are currently experiencing full utilization of all existing parking capacity on a daily basis.

Analysis Tool: Sketch Planning

Assumptions:

- Montgomery County will build 1,300 additional parking spaces at Grosvenor Metro station to increase capacity at the station. Funding is estimated at $2.117 million dollars. Life span: 30 years
- New trips generated due to additional parking spaces will be 2/3 of new spaces.
- Average one-way trip length reduced will be 15.5 miles.
- No cold start benefit, as autos will drive to station.
- NOx & VOC estimation using Mobile 6 Emissions factors.

Summary Impacts (2010):

Daily VT Reduction:	-	VT
Daily VMT Reduction:	26,846	VMT
Daily NOx Reductions:	0.0113	tons/day
Daily VOC Reductions:	0.0048	tons/day
PM Reductions (per year):	0.0866	tons/year

Emission Impacts for (2010):

1,300 additional spaces

Trip length: 15.5 mile x 2 = 31 mi round trip

2/3 new trips: 2/3 x 1300 = 866 trips

866 x 31 miles = 26,846 VMT

Daily NOx & VOC emission reductions (2010):

NOx								
Cold Start	0	x	0.5818 grams / 1 trip	x	1 ton / 907,185 grams	=	0.00000	tons
Running	26,846	x	0.3833 grams / 1 mi	x	1 ton / 907,185	=	0.0113	tons
					Total NOx		0.0113	tons
VOC								
Cold Start + Hot Soak	0	x	1.536 grams / 1 trip	x	1 ton / 907,185 grams	=	0.0000	tons
Running	26,846	x	0.1631 grams / 1 mi	x	1 ton / 907,185	=	0.0048	tons
					Total VOC		0.0048	tons

Methodology for PM2.5 emissions estimation:

Direct PM2.5

Direct PM2.5 emissions factors are available for winter, spring, summer and fall seasons. Estimation of direct PM2.5 emissions can be carried out on a seasonal or an annual basis. As PM2.5 seasonal emission factors do not vary significantly, the average of these four seasonal factors is used to estimate annual PM emissions. Please refer Table -12.

The travel demand model and postprocessor use average annual weekday traffic (AAWDT) for analysis. Hence for the analysis of TERMs which are effective 7-days a week, VT and VMT for such TERMs need to be adjusted to reflect average daily traffic (AADT). A factor of 0.95 is used to convert AAWDT volume to AADT volume. For the TERMs that affect only commuter traffic (effective only on weekdays) no adjustment is needed as the VT and VMT reflect average weekday traffic. The formulae for annual direct PM2.5 estimation for these TERMs are shown as below.

For the TERMs effective 365 days:

Direct PM2.5 Emissions = VMT x average of seasonal emissions factors x weekday VMT adjustment factor x days/year.

Running 26,846 x $\frac{0.0117 \text{ grams}}{1 \text{ mi}}$ x $\frac{1 \text{ ton}}{907{,}185 \text{ grams}}$ x 0.95 x 365 days = 0.1201 tons

For the TERMs effective only on weekdays:

Direct PM2.5 Emissions = VMT x average of seasonal emissions factors x days/year.

Running 26,846 x $\frac{0.0117 \text{ grams}}{1 \text{ mi}}$ x $\frac{1 \text{ ton}}{907{,}185 \text{ grams}}$ x 250 days = 0.0866 tons

NOx precursor emissions estimation:

As conformity assessment criteria for the PM2.5 standards include NOx precursor emissions, we are also required to estimate NOx precursor emissions on seasonal/annual basis. For TERM analysis we follow the annual approach similar to the PM2.5 emission estimation as described above. Emission factors corresponding to speed 40 mph are used to estimate cold start and running NOx precursor emissions. Tables 13-15 show the average of the NOx precursor seasonal emissions factors for years 2010, 2020 and 2030.

For the TERMs effective 365 days:

Cold Start	0	x	0.6132 grams / 1 trip	x	1 ton / 907,185 grams	x	365			=	0.0000	tons
Running	26,846	x	0.3825 grams / 1 mi	x	1 ton / 907,185	x	0.95	x	365	=	3.9249	tons
					Total						3.9249	tons

For the TERMs effective only on weekdays:

Cold Start	0	x	0.6132 grams / 1 trip	x	1 ton / 907,185 grams	x	250	=	0.0000	tons
Running	26,846	x	0.3825 grams / 1 mi	x	1 ton / 907,185	x	250	=	2.8298	tons
					Total				2.8298	tons

Cost Effectiveness (2010):

Garage cost (given): $2.177 million

$$\text{NOx} = \frac{\$2.177 \text{ million}}{250 \text{ days} \times 30 \text{ yr} \times 0.0113 \text{ t/d}} = \$25{,}700/\text{ ton}$$

$$\text{VOC} = \frac{\$2.177 \text{ million}}{250 \text{ days} \times 30 \text{ yr} \times 0.005 \text{ t/d}} = \$60{,}500/\text{ ton}$$

$$\text{PM2.5} = \frac{\$2.177 \text{ million}}{30 \text{ yr} \times 0.1201 \text{ t/yr}} = \$750{,}000/\text{ ton}$$