ENVIRONMENTAL DEFENSE
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January 22, 2002

Mr. Ron Kirby
Director, Department of Transportation Planning
Metropolitan Washington Council of Governments
777 N. Capitol St. NE #300
Washington, DC 20002

Re: Response to November 20, 2002 letter from Ron Kirby to Michael Replogle regarding deficiencies in TPB Version 2 Transportation Model

Dear Mr. Kirby:

This letter responds to your letter of November 20, 2002 to me concerning comments on the TPB Version 2 Transportation Model which were conveyed in a presentation by Norm Marshall and myself to the TPB Travel Forecasting Subcommittee meeting on November 15, 2002, in a technical report by Smart Mobility, Inc., that accompanied the study, *More Sprawl, More Traffic, No Relief: An Analysis of Proposed Potomac River Crossings*, October 2002, and in a letter from various environmental and civic groups to TPB and MWAQC, dated November 4, 2002.

Adequacy of TPB Version 2 Model to Meet Planning Requirements

After considering your response to our comments, we continue to believe that use of the Version 2 model to support SIP air quality planning or transportation conformity analysis without addressing the problems identified will lead to serious mis-estimation of mobile source emissions and traffic conditions. This is likely to contribute to years of additional unhealthy air quality (with attendant injury and premature death for many individuals), potential legal challenges to the region's transportation planning process, and unwise decisions about billions in transportation investments on the basis of faulty analysis.

We urge you to take decisive, timely steps to assure that TPB and MWAQC will rapidly develop analysis tools with adequate integrity so the public can trust your accounting. This means setting a standard of excellence that strives for state-of-the-art, rather than business-as-usual, state-of-the-practice transportation and impact analysis tools. Corporate boards and audit committees must assure sound accounting methods and honest reporting on corporate activities or face a

devaluation of corporate integrity and public or shareholder trust and value. So too must TPB and MWAQC insist on sound accounting for transportation impacts.

We urge you to take immediate steps to fix serious accounting problems in TPB's transportation and emissions analysis models by assuring that the TPB Version 2 model will upgraded to appropriately reflect induced traffic effects so it can be used to fairly appraise the impacts of alternative transportation and land use policies in our region.

Model Validation

TBP staff and some members of the Travel Forecasting Subcommittee have been quick to dismiss the suggestion that the time-of-day-of-travel performance of the TPB model be evaluated using permanent traffic count station data that has been collected for decades by area transportation agencies as well as the many other sources of hourly traffic count data available across the region. Yet these data sets provide a statistically robust sample of major facilities around the region.

We suspect the reason that there is no interest in such evaluation is that the preliminary evidence shows pervasive and very serious problems in the performance of the TPB model. If PM and AM period traffic is seriously overestimated, the estimates of speeds, congestion delay, diversion of travelers to transit and other modes, and a host of other key indicators and outputs of travel behavior, transportation system performance, and motor vehicle emissions will be seriously mis-estimated. It is the daily peak flows of traffic that cause traffic congestion to become a political issue. No one in our region experiences "average 24-hour traffic flows." Instead, we experience troubling congestion and lack of adequate travel choices at particular times of day. It is unacceptable for TPB staff to continue to hide behind HPMS daily traffic data and business-as-usual modeling approaches when to do so blocks the way to getting better models, cleaner air, and sound evaluation of cost effective transportation strategies and decisions that might better satisfy community, environmental, business, and traveler interests. Smart Mobility, Inc., has looked at a variety of performance measures comparing the TPB Version 2 model with observed data and found serious problems. Available evidence also points up serious concerns about the performance of Version 2.0 and 2.1 relative to the Enhanced Model.

You state in your letter that we should investigate the performance of the Enhanced Model for a much greater array of measures than the ones reported in our report before reaching any conclusions about its performance relative to Version 2.0 or Version 2.1. Our budget does not permit more exhaustive documentation. We have asked Smart Mobility, Inc. to provide you with a CD ROM containing further details of the Enhanced Model, which will be forthcoming shortly.

Despite numerous adjustment ("K") factors, the TPB model still over-predicts 1994 total daily base year Potomac River crossing vehicle trips and total traffic volumes, by 22 percent and 14 percent respectively for Version 2.1 (which is even worse than for Version 2.0). From the latest documentation available,[1] it appears that the Version 2.1 model overestimates 1994 and 2000 AM and PM peak period traffic volumes – by 14 to 29 percent *across an average of all*

[1] Metropolitan Washington Council of Governments, *Version 2.1/TP+ Travel Model Calibration Report*, Draft October 4, 2002, Washington, DC. Page 9-8

permanent count stations. The overestimation is particularly acute for vehicles entering or leaving the Metro Core, where PM peak trips are overestimated by 52 percent in 1994 and by 40 percent in 2000. This is yet one more reflection of consequences of the failure of the TPB Version 1 and Version 2 models to properly incorporate congestion feedback in the modeling process as required by federal planning regulations (CFR Title 40 Section 93.122).

Traffic Assignment Feedback into Trip Distribution

The Smart Mobility, Inc. report stated that the Transportation Planning Board's Version 2 travel model for the metropolitan DC region, which we will hereafter call the "TPB DCV2" model, applies a trip distribution feedback mechanism only to home-based work trips. As the attached November 19, 2002 memorandum to me from Norm Marshall indicates, rather than stating that the TPB DCV2 model includes *no* feedback for non-work trips, SMI's report should have stated that the TPB DC V2 model includes only *weak* distribution feedback for such trips.

This misstatement does not in any way change the underlying finding of the analysis, which is that *the TPB DC V2 traffic model substantially underestimates the effects of traffic congestion on trip length and other travel behaviors.* Non-work trips make up the majority of trips during all three time periods – AM peak, PM peak, and off-peak. But the TPB DCV2 model uses travel times from generally non-congested off-peak times as the determinant of non-work trip length for all times of day. This contributes to a serious overestimation of traffic in the peak periods, especially the PM peak period, when non-work trips constitute 77% of all trips, and when traffic delays are longest. In the AM peak period, non-work trips constitute 59% of all trips.

Indeed, as we stated in our November 4th letter to the TPB and MWAQC, the latest documentation available from TPB shows that the Version 2.1 model overestimates 1994 and 2000 AM and PM peak period traffic volumes by 14 to 29 percent across an average of all permanent count stations[2]. The overestimation is particularly acute for vehicles entering or leaving the Metro Core, where PM peak trips are overestimated by 52 percent in 1994 and by 40 percent in 2000. This is a consequence of the failure of the TPB Version 1 and Version 2 models to properly incorporate congestion feedback in the modeling process as required by federal planning regulations (CFR Title 40 Section 93.122).

Relationship Between Vehicle Travel Demand and Mobile Source Emissions

You request in your letter of November 20th an explanation of two separate statements taken out of context from our November 4th letter, where one states that "Version 2 will overestimate motor vehicle travel demand in the future and overestimate the benefits of proposed highway investments," and the other states that Version 2 threatens to lead to "serious underestimation of mobile source emissions." I stand by these statements, which you call, "apparently inconsistent," and will explain the logic behind them. These statements are not inconsistent but refer to the complex dynamics of how travel and emission models interact in real world applications.

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[2] Metropolitan Washington Council of Governments, *Version 2.1/TP+ Travel Model Calibration Report*, Draft October 4, 2002, Washington, DC. Page 9-8

First, Version 2 does not properly reflect the induced traffic effects of expanded highway capacity or the travel-dampening feedback effects of highway capacity constraints, such as the ways that traffic spreads out across the hours of the day as congestion gets worse over time. Thus, in future scenarios as congestion builds on the regional road network, Version 2 is likely to overestimate the motor vehicle travel demand especially *in the peak hour peak direction on congested highways*. Indeed, this is observed in both 1994 and 2000 at all permanent count stations in the region. This problem is likely to become more pronounced over time for future year scenarios. The Enhanced Model or other models that better capture induced traffic effects would, in contrast, show for future growth scenarios that more of this peak period traffic will shift to non-peak hours, or shift from more distant destinations to closer destinations, thus predicting less overall traffic growth, especially in peak hours, compared to Version 2.

Second, Version 2 for the most part is insensitive to shifts in the time-of-day-of-travel in response to congestion and changes in land use patterns. Version 2 focuses on 24-hour travel, rather than directional travel flows by time-of-day. This leads to observed and reported errors, for example, of 40 percent or more in the amount of traffic entering or leaving the DC Metro Core in both 1994 and 2000. This leads to large errors in the speeds of traffic on area highways, which in turn leads to significant errors in estimation of emissions, which are dependent in part on vehicle speeds.

NOx emissions, in particular, are higher for high speed traffic than for traffic that operates in a mid-speed range. Smart Mobility analyzed this phenomena in the travel model in metropolitan Atlanta by comparing observed traffic speeds and modeled traffic speeds at a number of locations on area freeways and found that underestimated traffic speeds in the model produced a likely underestimate of NOx emissions by 40 tons per day in a region with a 214 ton per day emission budget for NOx. The Atlanta traffic model most notably underestimated the traffic speeds associated with the substantial traffic operating in the non-peak direction during peak periods. A subsequent speed study by the Georgia Regional Transportation Authority confirmed that this modeled error in traffic speeds accounted for a very significant underestimation of motor vehicle emissions, which was accounted for in the next conformity analysis.

Attention to the directionality of traffic flows by time-of-day is essential to estimating travel times, travel behavior responses, traffic speeds, and emissions. As TPB's own documentation shows, the Version 2 models falls short of addressing these issues satisfactorily.

Use of Data from the National Personal Transportation Survey

As the attached memo from Norm Marshall of Smart Mobility indicates, the size of the survey sample available and used for calibration of the Enhanced Model represents over 500 households from the Washington/Baltimore metropolitan area. NPTS data has been widely used in travel demand analysis and model development and validation and is an acceptable source of such information when the limitations of the data are appropriately recognized. There are a variety of issues that can be raised to question the utility of nearly any travel data set, including the TPB household travel survey and the Census. Professional judgement is key in any model development exercise. As a transportation modeler with over 25 years of experience, it is my judgment that SMI's use of NPTS data is appropriate and reasonable in the current application.

We look forward to working with you to improve the metropolitan area's transportation and emissions analysis tools in coming months and years.

Sincerely,

Michael Replogle, Transportation Director
Environmental Defense

cc: Dolores Milmoe, Solutions Not Sprawl
Neal Fitzpatrick, Audubon Naturalist Society of the Central Atlantic States
Lee Epstein, Chesapeake Bay Foundation
Chris Miller, Piedmont Environmental Council
Stewart Schwartz, Coalition for Smarter Growth
Phil Mendelson, Chair, MWAQC
Peter Shapiro, Chair, TPB
Kanathur Srikanth, Chair, TPB Technical Committee
Bill Mann, Chair, TPB Travel Forecasting Subcommittee
Phil Andrews, Chair, MWAQC Technical Advisory Committee
Julie Pastor, Chair, COG Planning Director's Technical Advisory Committee
Jane M. Kenny, Regional Administrator, EPA Region 2
Nelson Castellanos, Division Administrator, FHWA Maryland Office
Roberto Fonseca-Martinez, Division Administrator, FHWA Virginia Office
Cary Henderson, Division Administrator, FHWA DC Office
Susan E. Schruth, Regional Administrator, FTA
Rep. Frank Woolf
Rep.Chris Van Hollen
Sen. Milkulski
Sen. Sarbanes
Sen. Warner
Sen. Allen

Memorandum

To: Michael Replogle
From: Norm Marshall and Brian Grady
Subject: Issues Raised at 11/15 TPB Travel Forecasting Subcommittee
Date: November 19, 2002

Feedback for Non-Work Trips

In the TPB Version 2.0 travel demand model, distribution feedback is performed for home-based work (HBW) trips using travel speeds from the AM time period. Feedback is performed for the home-based shopping (HBS), home-based other (HBO), and nonhome-based (NHB) trips using travel speeds from the off-peak time period. The AM time period represents the hours from 6:00 – 9:00 AM. The PM time period represents the hours from 4:00 – 7:00 PM. The off-peak time period includes all other hours of the day or 9:00 AM – 4:00 PM and 7:00 PM – 6:00AM. The off-peak time period is a relatively uncongested period. As such, travel times and speeds are much faster in the off-peak period than corresponding trips in either the AM or PM time periods, and the effects of feeding back these off-peak travel times are minimal.

The following two figures show total system-wide vehicle hours of travel (VHT) for the AM and PM peak periods in the 1994 TPB Version 2.0 model. In addition, we calculated system-wide VHT using the off-peak travel times used in the TPB feedback.

Figure 1: 1994 TPB Version 2.0 AM Peak Period VHT Compared to Calculated VHT using Off-Peak Speeds

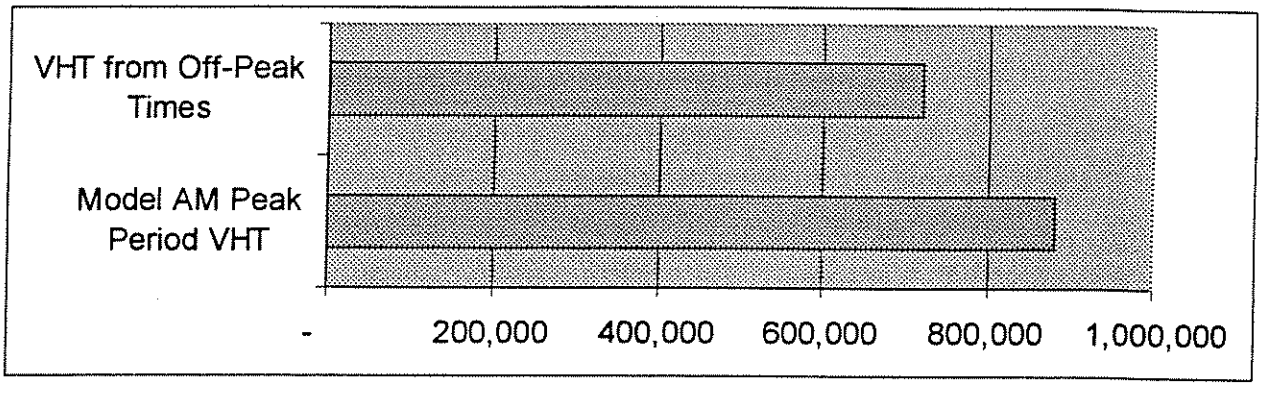
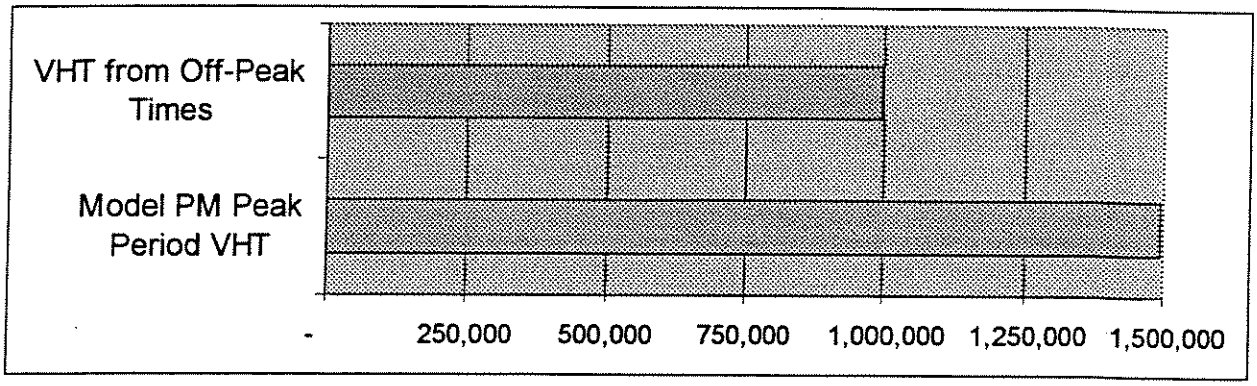


Figure 2: 1994 TPB Version 2.0 PM Peak Period VHT Compared to Calculated VHT using Off-Peak Speeds



In the AM peak period, the modeled VHT is 23 percent greater than that calculated with off-peak travel times. In the PM peak period, modeled VHT is 50 percent higher. Non-work travelers during the peak periods would experience much longer travel times than the off-peak times assumed in the TPB model.

In both periods, VHT calculated with off-peak travel times is only 14 percent higher than VHT calculated with free-flow travel times, i.e. as if there were no other vehicles on the road. In both peak time periods, the off-peak feedback is closer to the no feedback free-flow speed case than it is to the actual modeled travel times during this periods.

In our earlier report, we demonstrated that non-work vehicle trips make up the majority of trips in all three periods. Table 1 shows the fraction of vehicle trips by purpose by time of day.

Table 1: Percent of Vehicle Trips by Purpose and Time of Day

Time Period	HBW	HBS	HBO	NHB	Total
AM Peak	41%	6%	34%	20%	100%
PM Peak	23%	13%	31%	34%	100%
Off-Peak	11%	15%	36%	38%	100%

Non-work trips represent the majority of trips in both the AM and PM peak period. These trips are not receiving an appropriate feedback message and are being over-assigned to congested links during peak periods. As shown in Figure 1, even using the AM peak times underestimates the affects of congestion during the more congested PM peak period.

In the modeling in *More Sprawl, More Traffic, No Relief: An Analysis of Potomac River Crossings*, the AM travel times were fed back for all trip types. This represents a middle course between using the uncongested off-peak travel times and the most congested PM-peak travel times. Applying the AM travel times within the off-peak period means that the feedback will be somewhat too strong (16 percent longer times), but this is balanced because the AM travel time feedback is too weak in the PM peak travel period (25 percent lower travel times). Therefore, this approach is more accurate than using the off-peak travel times with feedback that is too weak during both peak periods.

As the peak periods account for most of the modeled delay and have the strongest influence on project development, modeling these time periods correctly is critical.

National Personal Transportation Study (NPTS) Data

The NPTS survey data are coded for Metropolitan Statistical Area (MSA) and Consolidated Metropolitan Statistical area (CMSA). None of the areas match the TPB model area exactly. MSA 8840 is the Washington D.C. region. CMSA 8872 is the consolidate Washington/Baltimore region. As Baltimore is internal to the TPB model, the larger region was considered most applicable, and also gave a larger sample size.

In our report, we reported that the CMSA 8872 sample included 798 households. However, as TPB staff pointed out, some of the households were surveyed on weekends. Therefore, the effective sample for estimating weekday trips is smaller.[3]

Trips were considered only if they were made on weekdays. The NPTS weights were used in all calculations per recommendations in the NPTS documentation. These calculations give the total number of trips per year. These totals were scaled first to the average weekday, and then were adjusted for the difference in population between the CMSA and the TPB model area.

[3] The NPTS public use database includes the day of the week only in the trip file and not in the household or person files. Because some households made no trips on their travel day, we were unable to determinate exactly how many households traveled were surveyed on weekdays. The number reporting trips on weekdays was 514; but the total number surveyed is somewhat higher – approximately 560.