Highlights of the TPB Travel Forecasting Subcommittee Meeting
Held on November 21, 2008

Item 1: Approval of September 19, 2008 Meeting Highlights

The highlights were approved as written.

Item 2: TPB Models Development Status Report

Mr. Milone distributed a handout entitled "TPB Models Development Status Report." The status report consisted of three discussion topics: 1) the development schedule for the Version 2.3 travel model, 2) recent updates to the Version 2.2 travel model, and 3) sensitivity testing of the Version 2.3 model, focusing on transit fare elasticity testing and an effort to incorporate transit fare subsidies into the model (as conceptually discussed at the last meeting).

The Version 2.3 model, featuring updated truck models and a nested logit (NL) mode choice model, currently remains in development. Based on the progress made in recent months, TPB staff feels confident that the model will be successfully adopted for production use. At this juncture, the key questions are: what remains to be done to Version 2.3 and when should the model be adopted? TPB staff is currently anticipating the Long Range Plan update beginning in January 2010 and has established the objective of using the Version 2.3 model to support this important activity. Timely completion of this objective could be challenging, given the complexity of coordinating a large number of disparate activities that must come together: New travel data will be arriving in the next few months; a new and more detailed TAZ system (almost doubling the matrix size of the existing zone system) is nearing completion; and methods for improving network development using GIS technology are also in motion. Mr. Milone presented a timeline indicating staff's expected phasing plan for adopting Version 2.3 over the next 13 months.

TPB staff plans to resolve three vital activities over the next three months. First, the updated TAZ system will be finalized. The geographic extent of the TPB's existing TAZ system will not change, but the level of detail of the zone system will be increased by 90%, from 1,972 to 3,741 internal zones. Consequently, the highway and transit network node numbering scheme will need to be revisited and various program dimensions will be modified. Second, over the next three months, several surveys will be released for evaluation and use. These include the 2007 Metrorail Survey, the 2007/2008 Household Travel Survey, and the 2008 Bus On-Board Survey. Preliminary findings suggest that improved data collection techniques will reduce the time expected to geocode and clean surveyed information, and so the data sets will be available for evaluation during the beginning of 2009. Third, a consultant-supported project to exploit GIS-based technology to improve the way highway and transit networks are developed and managed has been underway for the past 16 months. Testing of this application will begin in December, and is anticipated to be ready for production by February. TPB staff plan to

use this new network coding application to code the new 3,700-zone highway and transit networks that will be needed for model calibration and validation.

Mr. Milone stated that COG's Metropolitan Development Policy Committee is expected to approve a new set of land activity forecasts (Round 7.2) in January, but the forecasts will not initially be prepared for the updated TAZ system mentioned above. By contrast, the next round of land activity forecasts (Round 8.0) will be developed for the updated TAZ system, but it will not be ready for at least another year. Therefore, model development work will be supported with Round 7.2 land activity files that will be converted from the existing TAZ system to the updated TAZ system using the best available information to make such a conversion. Model calibration and validation activities are envisioned to proceed during the remainder of 2009.

Mr. Milone then reviewed the latest improvements made to the currently adopted Version 2.2 travel model during the course of recently conformity work. These improvements relate to the traffic assignment step. As a result of these updates, TPB now assigns HOV 3+ trips in a separate traffic assignment step after non-HOV3+ trips are assigned (in the AM and PM peak periods only; the off-peak assignment has not been changed). The assignment approach loads HOV 3+ trips to an already congested highway network, which better guarantees that HOV3+ vehicles will maximize the use of (uncongested) preferential facilities, as one would expect. This technique was developed, in large part, to improve HOT lane forecasts. He added that the improved assignment technique requires added running time to a given model execution, but the added time is marginal.

The section of the presentation entitled "Sensitivity testing of the Version 2.3 travel model: Fare elasticities" was presented by Mark Moran. The sensitivity testing included over 20 model runs, but Mr. Moran's presentation focused on the several runs dealing with changes in fares. The baseline year for the fare sensitivity tests was 2002. Tests included a 20% increase and a 20% decrease in fares. Model response was recorded and fare elasticities were calculated. Two methods were tried for changing fares: via the input files and via changes to statements in the mode choice model control files. Both methods resulted in a similar response from the model, though the second method (changes to the control files) is generally preferred because it is more versatile and is easier to implement. Mr. Moran pointed out that the famous Simpson & Curtain formula, which would generally predict a fare (arc) elasticity of about -0.39, tends to overstate fare elasticities in cities with heavy rail transit (HRT), such as Washington, D.C., since it was derived from data from cities without HRT. Next, Mr. Moran pointed out two comprehensive, though less well known, fare elasticity studies done in the 1980s, based on cities both with and without HRT (Webster & Bly; and Mayworm, Lago, & McEnroe). According to these two studies, one should expect fare elasticity values to range between -0.1 and -0.6 (Webster) and/or between -0.12 and -0.44 (Mayworm). As for the Ver. 2.3 travel model, we calculated a fare elasticity for total transit of -0.11, which is approximately within the ranges found for the two 1980s studies, though at the low end of both ranges. As a reasonableness check, TPB staff presented implied value-of-time (VOT) values, based on the time and cost coefficients in the mode choice model, and compared these to general rules of thumb, e.g., that the work VOT should be between

25% and 50% of the prevailing wage rate. According to this comparison, the calculated VOTs appeared to be on the high side, which could indicate that the cost coefficients used in the model are too low (since VOT is proportional to the time coefficient divided by the cost coefficient).

Due to the structure of the nested-logit mode choice (NL MC) model, we were able to calculate fare elasticities by household income group (1, 2, 3, and 4) and by transit sub-mode (commuter rail, bus only, Metrorail only, and bus combined with Metrorail). The model generally showed an "income effect," namely that lower income households have higher fare elasticities, since they are more sensitive to price. A case was shown where the "income effect" was not present, but, by zeroing out the income constants in the model, the income effect was restored. A priori, one would expect a "transit sub-mode effect," namely that that bus would show the largest fare elasticity, rail would show the lowest elasticity, and any other mode, such as bus/Metrorail combined, would fall somewhere between these two. In our case, the transit sub-mode effect was somewhat counterintuitive: the bus/Metrorail sub-mode had the highest fare elasticity, not the bus-only sub-mode. Mr. Moran pointed out that, although these results seemed counterintuitive, at first, they may actually be correct, given two facts: 1) bus/Metrorail includes, by definition, at least one (forced) transfer, whereas the other three transit-sub modes do not necessarily include a forced transfer; 2) bus/Metrorail trips are likely longer than those of bus only or Metrorail only, which would result in higher fares, and could thus result in larger fare elasticities.

A member of the audience asked what was the year of the data used to calibrate the model. TPB staff responded that the mode choice model was calibrated using the 2002 WMATA rail survey and the 2000 regional bus survey, factored to 2002 conditions. However, other parts of the model we calibrated to the 1994 Household Travel Survey and validated to the 2000 Census. The member had a follow-up question: Do you know what proportion of transit users was receiving a transit subsidy in the year 1994? TPB staff indicated that the federal transit subsidy program began in 1998, but did not know the proportion of riders receiving a transit subsidy in 1994. Staff indicated that the next section of the presentation would discuss transit subsidies in more detail.

Finally, Mr. Milone discussed staff's work on incorporating transit subsidies (such as the SmartBenefit and Metrochek programs) into the Version 2.3 model. Specifically, he presented some background on the history of employer-based transit subsidy programs in the Washington, D.C. area, a proposed method for reflecting transit subsidies, and results of applying the method for the year 2002. As discussed at the September TFS meeting, the level of transit subsidy participation in the Washington D.C. area is substantial. According to the 2007 Metrorail Survey, approximately 60% of commuting trips on Metrorail utilize some type of employer-provided transit subsidy. TPB's interest in this particular topic stems from a desire to improve the accuracy of the real-world fare inputs to the Version 2.3 model, as opposed to the use of adjustments to the model, to account for what is obviously a growing phenomenon in the Washington, D.C. region.

Mr. Milone cautioned that the method used to reflect transit subsidies affected only HBW Metrorail travel: the existing subsidy programs target all commuter travel, but the Metrorail survey data was the only available source of information for gauging participation levels in subsidy programs. He added that the anticipated 2008 Bus On-Board survey and available commuter rail surveys would be consulted to address non-Metrorail related subsidies as part of future work. The specific method was essentially an approach to reduce the average standard Metrorail fare between stations to reflect the fact that a portion of riders pay a reduced fare. The application of the tested method for 2002 resulted in an increase of about 6,500 trips.

Mr. Milone felt that the proposed method for incorporating fare subsidies was a reasonable improvement to the model, and that TPB staff should proceed with incorporating non-Metrorail- related subsidies as well. This type of fare adjustment would need to be considered in the next calibration of the NL mode choice model (in conjunction with Mark Moran's potential changes to the model specification vis-à-vis his work on fare elasticity). Mr. Milone also wondered how other MPOs are addressing such subsidies (if at all).

The next steps in the TPB's Models Development program will be to explore any/all methods to speed up the running time of the Version 2.3 model, given that a more detailed zone system is about to be released. These methods will include: 1) testing the distributed processing capability in Cube (Cube Cluster), 2) investigating the potential reduction in speed feedback iterations currently executed in Version 2.3, and 3) testing improved traffic assignment algorithms that are emerging from Citilabs, Inc. research. Staff will also complete documentation of additional sensitivity tests using Version 2.3 and will carry on with further refinements to the fare subsidy method.

An audience member commented that the Metrorail survey indicates only whether or not a subsidy is available to the passenger, and does not provide the specific subsidy amount. One might expect differences in the amount of subsidy granted by the employer. For example, public sector employees might be granted the maximum allowable monthly benefit while private sector employees may be granted only a portion of the maximum benefit. WMATA or the COG Commuter Connections staff may be able to provide insight on this question. TPB staff may potentially use this information to fine-tune the computed average subsidy.

A comment was made that the substantial level of transit subsidy use shown in the Metrorail survey is rather unique to the Washington, D.C. area, due to the large presence of the federal government, and that the TPB should reflect this type of policy irrespective of what other MPOs are doing in this area. Another audience member speculated that other MPOs may be dealing with this type of phenomenon by adjusting the model (via the modal constants), which is not desirable in the TPB's view. Another member commented that it is vital for TPB to reflect transit subsidies for both non-Metrorail related trips as well as Metrorail trips to avoid a potential bias in the model. The 2008 Bus On-Board Survey data will be an important source of information in this regard, as well as available commuter rail survey data.

Item 3: FY2009 Task Order Contract

Mr. Hogan reviewed the history of models development task order contracting at TPB, indicating that Cambridge Systematics, Inc. had won the competitive bid to perform these services in FY2009. To date staff had given three task orders to CSI covering the following topics:

- Fuel Prices in Travel Models,
- Recommended Approach to Near-Term Model Enhancements, and
- Framework for Before-and-After Study of HOV Network Effects Due to New HOT Lanes.

(The slides from their presentations are available on the COG website, and the accompanying technical memoranda were still being developed as of the date of the meeting.)

Fuel Prices in Travel Models

Mr. Goldfarb reported that fuel prices have remained fairly constant with small seasonal variations for the most part of the last decade, but since early 2003 they have more than doubled. Media and other recent reports have been suggesting that increased fuel prices started to affect travel demand, and consumers were changing their travel behavior to adapt to the higher fuel price regime. Drawing on the common sense hypothesis that fuel prices have a direct impact on travel demand, it was deemed a useful exercise to investigate the effects of fuel prices on travel demand.

While the fuel price increases in the 1970s resulted in considerable changes in travel behavior and improvements in fuel efficiency, such dramatic changes have not been observed during the current price increases. The highly volatile nature of fuel prices makes data collection efforts to gauge the magnitude of travel behavior changes in response to fuel price changes difficult. Given the current situation (declining fuel prices amidst a weak economic environment), it is more difficult to analyze the effects of the price spike experienced earlier this year. Such an exercise would require sufficient time lag to get meaningful data and results. Observing short-term adjustments provides useful insights, but for travel forecasting purposes, long-term effects are more important. Forecasting these is a difficult task in the absence of clear historical trends and given the unpredictable nature of the influencing factors.

In view of the data constraints and volatility of fuel prices, any changes in existing modeling practice may not be rewarding enough to justify the required efforts and investment. The primary recommendation has been to use the current models in place to conduct sensitivity analyses with respect to a wide range of automobile operating cost scenarios to help provide key insights on the effects of fuel price changes. Given the constraints, employing a multi-scenario analysis to predict a spectrum of possible future

scenarios while using reasonably robust model structures and relying on professional judgment is probably the best way forward.

Questions and Comments:

Staff observed that the uncertainties in this area are enormous and make this a challenging area to model. Staff asked if the assumption was still valid that base year fuel cost will rise with inflation. Mr. Goldfarb responded that it would be interesting to do a sensitivity run on that issue. Staff observed the slope is negative on the price over time, so it could move in a manner different from inflation. Staff observed that OPEC may have more (or less) influence over price than inflation. Mr. Goldfarb observed that fuel type could change over time. Staff observed that technology is evolving and could significantly impact fuel economy (and importance of fuel price).

A meeting participant observed that fuel prices in the 1994 household travel survey would be what is accounted for in the current model calibration and trip patterns and that it is hard to know how to account for changes such as increased shopping from home and home entertainment that reduce trip making and which might be impacted with fuel price increases to 2030. Staff commented that the new household survey will update our understanding of some of these behavioral changes (although not how they might be further impacted by fuel price changes).

Another observation from the committee was that it would be interesting to explore fuel price change impacts on freight or truck traffic as distinct from total traffic, including trip distribution.

Finally, another participant observed that the current discussion is similar to discussions being had in 1978 and stated that looking at cost per mile may be a way of looking at this topic rather than strictly framing in terms of fuel price.

Recommended Approach to Near-Term Model Enhancements

Mr. Evans provided a presentation for this topic area, focused on exploring possible directions for near-term model enhancements while keeping an eye towards the next steps in long-term model development. The current state-of–the-practice travel demand forecast models, follow a four-step sequential process that tracks trips at an aggregated level through the transportation decision process. While the four-step process performs reasonably well in representing and forecasting aggregate system- and corridor-level travel demand, the process is unable to respond to policies that are of increasing interest today. In particular, he expressed the view that the four-step models cannot adequately address the following: road and congestion pricing; time-specific policies; improvements in traffic operations and ITS deployment; freight and goods movement; peak spreading; and highly congested networks. In response to the need to model these complex policy alternatives and traffic operation scenarios, techniques have been developed and are starting to be implemented that focus on a more disaggregate level of choice and

incorporate greater behavioral realism. Four-step models using tours as the unit of analysis and more disaggregate activity-based models are becoming more applicable. However, four-step tour-based models applied at the zonal level, but allowing for multiple purposes and multiple stops within each trip, are limited in their ability to address today's policy concerns.

Consequently, several Metropolitan Planning Organizations (MPOs) have moved toward more advanced modeling systems and have chosen to implement an activity-based model. Activity-based models treat travel as a demand derived from the desire and need to participate in activities. Therefore, the activity-based approach attempts to capture the behavioral basis behind households' and individuals' decisions to participate in specific activities at certain times and places. By modeling individual participation in activities, and incorporating the sequences of activity throughout the course of the day, such an approach can address complex issues. It is for this reason that many major MPOs are moving to these new frameworks and/or currently developing work programs to move to these frameworks.

Mr. Evans suggested that activity-based models have a number of analytical advantages over conventional trip based models including:

- Activity-based models provide a more accurate representation of travel behavior.
- Activity-based models are applied at a disaggregate level to individuals, whose personal activities and travel are simulated. This greatly reduces aggregation error.
- The logic and output of activity-based models can be easier to understand for decision-makers and the public, who may find the four-step modeling process hard to understand.
- Activity-based models provide the ability to perform certain types of analyses, such as road pricing, environmental justice, and peak spreading.

However, he also noted that there are disadvantages of activity-based modeling, relative to trip-based modeling, which include the following:

- Activity-based models are more complex;
- Activity-based models are more expensive to implement, validate, update, and maintain;
- Activity-based models often require more consultant assistance to develop;
- Activity-based model run times can be longer;
- Managing simulation error in activity-based models can result in the need for multiple model runs for each scenario;
- Hardware requirements can be greater; and
- Custom software can be required for activity-based models (although adapting some software from existing models is possible).

For an MPO such as TPB, the benefits of activity-based models may outweigh the disadvantages. Because activity-based models are more complex, more expensive, and take significant time to develop, implementing an activity-based model should be

included in long-term model development plans. At the same time, updating and improving the current four-step model is a valid option for near-term model enhancements, although the potential priority for development of a new activity-based model may influence the timing or deferment of such improvements.

Questions and Comments:

Mr. Evans was asked by Staff for a breakdown of costs and budget requirements to move in the direction of activity based models. In particular there is interest in breaking out costs among the categories of data collection, consultant costs, and agency costs. Mr. Evans replied that to the extent the data is available, it will be included in the forthcoming memorandum. Staff observed that this is an area of great interest not only to TPB but also to other MPOs.

Staff also expressed concern that a lot of new data would be required to estimate the special purpose components discussed, such as for time-of-day models.

A question was raised from the committee about the value that is added by having an activity-based model rather than the traditional model -- what are the benefits and differences? Mr. Evans responded that the main benefit area current users are finding is in its ability to address pricing policy testing. Mr. Evans observed that at the TRB Innovations in Modeling conference, this was a primary application area discussed. Mr. Evans also observed that activity based models offer the ability to ask "drill-down" type questions on model results to a much finer level of detail (e.g., special population impacts). He further noted though that a good understanding of the level of uncertainty in forecasts (particularly at finer levels of detail) was important to have (as with traditional models).

A follow up question was asked regarding with which assignments can the activity based model be used. Mr. Evans replied that it is currently standard practice to use stochastic user equilibrium assignment with activity based models, but it is hoped that in the future simulation based techniques will be used. Staff then asked whether error checking was more difficult in a stochastic environment such as when using activity based models (e.g., totals may be different from one run to another). Mr. Evans observed that there are still things that can be checked along the way when running these models to help assure oneself that they are functioning properly. Mr. Evans also cited the use of scenario management tools and other quality assurance techniques as ways of managing this risk.

<u>Framework for Before-and-After Study of HOV Network Effects Due to New HOT Lanes</u>

Mr. Evans provided an abbreviated presentation for this topic area due to the time limitations. The next several years offer a unique opportunity to observe changes in traveler behavior in response to the gradual introduction of a more expansive high-occupancy vehicle (HOV) network as the planned high-occupancy toll (HOT) lane projects are completed in sequence in Northern Virginia. The purpose of this exploration

was to develop a framework for a before-and-after study of the HOV network effects of these transportation system changes. Primary among the recommendations is that a hypothesis driven approach be employed in first identifying hypotheses surrounding the potential network effects and then to use these hypotheses to identify the data requirements for testing them. Data requirements may be met through traditional data sources or through new data sources developed to support the study. Several previous studies offered lessons learned in both developing a framework and for development of an actual before-and-after study.

Questions and Comments:

No time was available for a question and answer period pertaining to this presentation. Mr. Hogan noted that after staff have reviewed and commented on the reports being prepared under these task orders, presentation of these could occur at a future TFS meeting.

Item 4: Additional Routes for Enhancing the Arterial Highway Congestion Monitoring Program in the Washington Region

Mr. Sivasailam and Ms. Morrow presented a memorandum on the potential route additions to the arterial highway congestion monitoring program. The proposal will increase the coverage over a three year period by an additional 65 miles. In response to a question as to why I-66 is not part of the routes studied, Mr. Sivasailam replied that this part of the congestion monitoring program addresses arterial roads, and there is a separate program that monitors the entire freeway system once every three years. A request was made to extend the limit for US 29 in Montgomery County to the county line, and Mr. Sivasailam agreed to look into the feasibility of extending the northern limit.

Item 5: Travel Surveys Update

Consistency edit checks currently are being run on survey trip data – adding local knowledge to some aspects of the survey data, correcting some respondent response interpretation errors, and correcting one or two egregious random errors (.e.g. – An airplane trip to a 7-11). Overall, though, the trip data generally look very good.

Some of our checks include verifying “No Trips” Made on Travel Day (6% for Households/11% for persons) are legitimate, verify Person Travel that was “Out-of-Region” for entire travel day was really out of the region, and verify trips made in region on travel day. For trips in the region, staff are verifying that trip times plus activities for each person add up to a total of 24-hours. (They do!) Staff are geocoding a few missing trip ends to TAZs and approximate X-Y coordinates. This work amounts to approximately 3,000 out of a total of 132,000 trips ends that were missing geocodes and about half of these were origins or destinations that were outside of the TPB modeled area.

Additionally staff are checking the consistency of the geocodes with the travel of other household members. An analysis is being conducted of "Quick Stops", particularly looking at gas station stops versus other quick stops. Staff anticipate recoding some quick stops to other trip purposes (eg. quick stops for fast food meals).

Checks are being conducted within the various modes respondents used on their travel day. Staff are analyzing the use of commuter rail and commuter bus trips in order to standardize commuter rail station names, verify commuter rail trips travel between commuter rail stations. As needed, some recoding of commuter rail trips to Metrorail (respondent errors) will occur, as well as recoding of some commuter bus trips to local bus (respondent errors). Additionally, staff will add some missing mode of access segments where required. In looking at Metrorail related trips, staff will standardize Metrorail station names, verify Metrorail trips travel between Metrorail stations, and recode some Metrorail trips to commuter rail (respondent errors). Again, staff will add some missing mode of access segments as necessary. For the analysis of local bus only trips, verification that these trips are bus only is being undertaken and any missing mode of access segments are being added, as necessary. For the analysis of carpool and auto passenger trips, staff are verifying that each auto passenger has a corresponding auto driver and running consistency checks with other household members.

The trip linking and survey weighting will occur after consistency edit checks are complete. Staff will verify estimated modal shares and person trip totals with other data sources such as the Metrorail and Metrobus surveys and ACS Commuting Data. The final trip edit checks will occur after trip linking and will include time/distance/speed checks by mode and check trip length frequency distributions by trip purpose.

Staff will be working closely with the models development team on this review of the survey data and want to especially acknowledge Hamid Humeida's work and assistance on this review. Much work still remains to be done over the next month, but good progress is being made and major problems with the survey data have not developed. Staff are continuing to work toward a December 31st deadline to get the edited, weighted survey to the models development team.

Questions and Comments:

How are telecommuters handled? One of the options on the Work Activities section of the activity list is 'Work at home/telecommute (for pay)." If a respondent is at home and indicates they worked at home for pay, then staff will classify them as a telecommuter.

How much of an issue is imputation? It has not been a huge issue. The interviewing staff makes every effort to contact and obtain all information from every member of the household. However, in some cases that is not always possible. In these instances staff do try to impute the missing information. More importantly are the households who are never recruited into the survey in the first place. It is important to know how they differ

from the recruited households. A non-response follow-up survey was conducted to learn how these households differ.

Item 6: Adjourn

The meeting was adjourned at 11:57 A.M.

COG/TPB Travel Forecasting Subcommittee
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Meeting of November 21, 2008

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