September 21, 2007 TFS Highlights

Item 1: Approval of July 20, 2007 Meeting Highlights

The highlights were approved as written.

Item 2: Version 2.2 Travel Demand Model Update

Mr. Milone distributed a handout describing the current status of the Version 2.2 model. He briefly reviewed the development history and the key features of the model. The most recent refinement to the model was an increased number of user equilibrium iterations (UEIs) in the Version 2.2 traffic assignment process, from 20 to 60. He stated that the increased number of UEIs is desirable because it ensures that highway paths are closer to a theoretical condition where system-wide delay is minimized. A traffic assignment with near optimal paths is sometimes referred to as 'highly converged'. The benefit of a highly converged traffic assignment is realized when comparing two highway alternatives in an already congested network. The use of non-converged highway assignments typically results in system changes that include a substantial amount of random error. The use of more highly converged traffic assignments reduces the degree of random error. Mr. Milone stated that 60 iterations appeared to yield the best trade-off between a reduction in random error and an increase in running time based on TPB's testing.

Mr. Milone presented some background on the ground counts used to validate the Version 2.2 model. Ground counts are provided to TPB by the state transportation agencies (MD SHA, VDOT, and DC DOT) and are coded on highway network links by direction. The counts are collected at a limited number of permanent count stations or at more numerous short-term (program) counting locations, reflecting 24-hour/48-hour tube counts. Program counts consist of either data that have been collected during a particular analysis year or previously collected data that have been adjusted to account for the time-period difference. TPB has populated the highway network with year 2000 and year 2005 ground counts. There are approximately 3,400 directional links for which both 2000 and 2005 count figures exist, about 17% of all highway network links in the regional highway network. TPB has spent some time analyzing these particular counts for logic and reasonability. The analysis indicated that 45% of the ground count sample showed either no change, or a small negative change, between 2000 and 2005. In contrast, HPMS summaries for the Washington, D.C. MSA, from 2002 to 2005, indicate steady VMT growth of about 1% to 2% *per year*. Mr. Milone provided a network plot indicating the locations of the ground count decreases, some of which were on major facilities (the Capital Beltway, I-66, and I-95 in Maryland, for example). Mr. Milone could not offer any explanation regarding the decreasing count volumes between 2000 and 2005, and he suggested that varying levels of count quality and/or count factoring between the two years may contribute to such a decrease. He asked state representatives to review the map with him after the meeting, to investigate these findings further.

Mr. Milone presented Version 2.2 model performance summaries relating to area-wide VMT, Root Mean Square Error (RMSE) statistics, and screenline crossings. He

explained that each of the performances measures were generally within reasonable tolerances. He added that some of the screenline level comparisons were based on a very limited number of observed counts. He also presented global demographic and travel statistics relating to base and future years. One of the distinguishing features of the Version 2.2 model, relative to prior models, is that the rate of VMT growth between 2005 and 2030 is smaller than that of household and employment growth. While households and employment are expected to grow by 36% and 39%, respectively, the Version 2.2-based forecast reflects a 30% increase in VMT.

Mr. Milone stated that the Version 2.2 model is currently being applied to support air quality conformity work. Version 2.2 will be adopted as the official regional model, along with the Round 7.1 Cooperative Forecasts, when the TPB approves the air quality conformity analysis. He added that TPB staff has also begun work on what will ultimately be known as the Version 2.3 model. The key features of Version 2.3 will include a nested logit model mode choice model (replacing the existing multinomial logit mode choice model) and updated medium and heavy truck models.

Comments and Questions:

Mr. Jamei observed that the number of links associated with some screenlines varied between 2000 and 2005 (as shown on slide 20) and he asked for staff comment. Staff explained that there are a few instances where the delineation of screenline codes in the highway network varies by year. Inconsistency exists because screenline codes are manually adjusted to address highway network updates over time. Inconsistency in screenline delineation is clearly not desirable, and TPB is currently working on automated procedures (via GIS) to improve screenline coding consistency.

Mr. Clifford observed that even though the total number of network links with ground counts was greater in 2005 than in 2000 (5,600 compared to 3,900), the number of screenline links with ground counts in 2005 was less than that of 2000 (448 compared to 675). Mr. Milone agreed with the observation and commented that one would expect greater screenline coverage with a larger count sample, but, in this case, the larger sample did not happen to coincide on links designated with screenline codes.

Mr. Mann commented that the growth in VMT per household (shown on slide 19) is forecast to decline for the region between the years 2005 and 2030. He suggested that VMT growth rates in the suburbs may, in fact, be growing for that same period and he asked staff to summarize the VMT growth in greater detail. Staff agreed to pursue this investigation.

Ms. Qi asked if there are any practical standards regarding the number of user equilibrium iterations that should be used in a traffic assignment. Mr. Milone stated that there is no strict guidance regarding the number of iterations that an MPO should use in traffic assignments. He suggested that the TPB's approach of analyzing the traffic assignment changes between highway alternatives, using a varying number of iterations, is a reasonable approach for honing in on an optimal number of iterations. The objective

is to reduce random noise as much as possible when comparing alternatives. Mr. Kirby said that staff tested as many as 200 iterations and determined that the marginal benefit (i.e., reduced noise), was decidedly not large enough to justify the added running time.

Item 3: FY-2007 VHB Task Order Report, Part II

Chairman Rawlings introduced Phil Shapiro and Rich Roisman of VHB. Mr. Roisman reminded the subcommittee that today's presentation was the first of two detailed presentations covering three of the six FY07 research topics, following the summary presentation at the July 20th TFS meeting. Today's presentation will cover cutlines for model validation, traffic count database and peak spreading, and microsimulation and dynamic traffic assignment (DTA). The remaining three topics will be covered at the November 16th TFS meeting. Subcommittee members and others in attendance received a hard copy of VHB's PowerPoint slides.

Mr. Roisman reviewed the information on screenlines. Screenline is a generic term often used for three distinct types of lines: cutlines capture major flows through a corridor, screenlines capture cross-regional flows, and cordons are polygons enclosing a study area. The primary guidance for the placement and use of screenlines is NCHRP #255, which is followed by most MPOs. The actual number of screenlines used by an MPO varies based on MPO size and professional practice. The current TPB system contains 38 screenlines plus the external cordon. Several examples of the number and type of screenlines used by other MPOs were included in the presentation.

NCHRP #255 guidance on selecting cutlines states that a cutline should capture traffic on all alternative roadways in a corridor; that a cutline should cross between three and seven facilities, with ten being the practical maximum; that the recommended length for a cutline is between two and five miles, depending on the density of the study area, and that cutlines should be placed between major roadway interchanges to capture the intervening travel. When performing base year data checks during model validation, NCHRP #255 recommends comparing estimated (modeled) and observed volumes by screenline. The report includes curves for determining the maximum desirable deviation between estimated and observed volumes for both individual count locations and screenlines. There is an inverse relationship between the screenline volume and the maximum desirable deviation; that is, as traffic volumes crossing the screenline increase, there should be less deviation between estimated and observed volumes.

If problems are discovered during the validation tests, NCHRP #255 recommends performing quality assurance / quality control on the model itself and then re-running the model. Another recommended solution is to extend the screenline, but the modeler needs to be sure that the new roads added to the extended screenline serve the same travel market as those already captured. The modeler may also factor the screenline volumes or adjust the forecast volumes if needed, as long as the results produced are reasonable.

As part of the research, VHB recommended new screenlines for use with the TPB model. The methodology for recommendation was to review the existing screenlines, consider

changes in travel markets, overlay the existing screenline system on the CLRP, and check the new screenlines against the NCHRP 255 guidelines. A map and tables showing the 22 proposed new screenlines were shown. VHB also performed some validation tests for the new screenlines in the I-270 and I-66 corridors by comparing 2005 observed volumes (taken from 2005 traffic counts) with estimated volumes taken from a 2005 model run using the TPB Version 2.1D#50 model set and using the NCHRP #255 maximum desirable deviation curves. Most of the results of this analysis were within acceptable deviation levels. Mr. Roisman suggested that TPB consider placement of the new recommended screenlines. While there are still issues with observed data in some of the new locations, there are still data yet to be mined that could support this effort. A phased approach may be needed. Both the new and existing screenlines should be multimodal – there is a need to gather more observed transit data. Ultimately, TPB must balance its needs between regional screenlines and project level cutlines. The validation procedures presented may be used for model sensitivity testing. Finally, TPB may want to consider placement of local area cordons (similar to BMC) for areas such as Tysons Corner, Bethesda, and others.

Comments and Questions:

Mr. Hogan asked if the observed data for the BMC local area cordons came from a special count (like TPB's Beltway or Metro Core cordon counts) or from other sources. Mr. Roisman responded that he did not know but would follow up with BMC.

Mr. Shapiro noted that the counts used for the analysis are above and beyond the counts coded in the TPB model network; VHB captured as many recent counts as possible from Maryland SHA and VDOT. Mr. Roisman added that the counts obtained were both program and special counts, but they were hourly counts rather than average annual daily traffic (AADT) or average annual weekday traffic (AAWDT). Mr. Griffiths asked if that meant that the data represented actual counts as opposed to volume estimates. Mr. Roisman responded that yes, that was correct. Mr. Griffiths then asked if comparisons were made with the AAWDT estimates. Mr. Shapiro responded that the counts obtained were raw counts; however, it has been VHB's experience that Tuesday, Wednesday, or Thursday counts are usually close to the AAWDT estimates. The observed dataset did not include counts on Mondays, Fridays, or weekends. The counts are extensive but not exhaustive. Mr. Shapiro noted that there is a 'wealth' of counts that are available, and by choosing the correct days there wouldn't be a problem with factoring.

Mr. Griffiths asked both states if the special counts were those done for a traffic study or if they were one time counts. Mr. Jamei of VDOT responded that there were two types of counts: regular counts that are part of the annual count program and project counts. Annual program counts come in every year and are used for forecasting. Users should be careful that they are getting the right kind of count. VDOT uses counts for 20-30 projects per year in Northern Virginia. Mr. Mahapatra of Maryland SHA noted that even for the project counts the count depends largely on the type of project under study. For example, sometimes counts must be taken when schools are closed.

Mr. Griffiths asked whether the counts in the state's databases were geo-referenced or just a description of the location. Mr. Jamei responded that they just contained a description of the location. Mr. Graye of M-NCPPC asked how the maximum desirable deviation levels were calculated. Mr. Roisman responded that they were based on the curves from NCHRP #255.

Mr. Milone noted that a majority of the newly proposed screenlines were in the western half of the region and suggested that there be a balance with the eastern half. Mr. Roisman responded that their analysis showed that there was significant coverage in Prince George's County and for most of the CLRP projects in the eastern half of the region, but they would look into additional screenline locations in those areas. Mr. Steverson of Prince William County asked about new screenlines for his jurisdiction. Mr. Roisman responded that there were some proposed new screenlines near Manassas and Manassas Park, but they would look into additional locations within the rest of Prince William County.

Mr. Kirby asked Mr. Shapiro what his reaction was to the comparisons of year 2000 and 2005 counts. Mr. Shapiro responded that he was not surprised by the discrepancies between 2000 and 2005 counts. VHB has been analyzing counts for project planning purposes for a long time, and in some cases they are finding that while the 2005 counts are good, there are problems with the 2000 counts. One check that has been used is taking a 2005 count and "backcasting" to the year 2000 using the nearest permanent count station. The bottom line is that all volume estimates must be carefully checked. What VHB tries to do is review multiple year counts at the same location and see if the differences are explainable.

Mr. Kirby asked if there is a systemic reason for the count discrepancies. Mr. Mahapatra noted that one possible reason is that SHA's factoring methodology has changed between 2000 and 2005. The 2000 methodology pivoted on all facilities within Maryland and tended to overestimate; current factors pivot on facility types for improved accuracy. Mr. Jamei noted that VDOT is experiencing similar issues with their count conversion and factoring. Mr. Griffiths noted that overall count quality has improved in all TPB jurisdictions over time, which is a good thing. What is needed now is metadata to go with each and every count because even with a permanent count station, one of things an analyst needs to check is the number of days the station was operating. If it is not operating 365 days / year, the missing data must be imputed in some way.

Mr. Roisman continued with the next topic – modeling peak spreading. The state of the practice for modeling peak spreading is to apply time-of-day factors to daily trip tables coming out of mode choice. These factors are typically derived from household surveys and validated using traffic counts. This is the method currently used by TPB; its post-processor divides final assignments into hourly increments – if the assigned volume exceeds link capacity, the excess volume is shifted to adjacent hours and the link speeds updated. However, there are limitations to the state of the practice: regional time-of-day factors do not capture spatial-temporal variations in travel demand; for example, I-270 and US 50 have different peaking characteristics. Also, since the factors are applied to

the entire peak period, they don't capture the variation of demand within the peak period; several other large MPOs use this method and are subject to the same issues. Finally, the time-of-day factors are not adjusted based on congestion levels, and the impacts of traffic control and network constraints are not considered in the volume-delay functions used in the model.

Several agencies are applying techniques for modeling peak spreading that are considered state of the art. These include modeling peak spreading outside of the peak period, a trip-based peak spreading logit model, and an activity-based model that addresses peak spreading.

Mr. Shapiro described one potential approach to modeling peak spreading for TPB that would begin with the validated base year model and hourly traffic counts at screenlines. Origin-destination tables for the 2, 3, 4, and 5 hour peak periods would then be prepared using the Cube Matrix Estimator. The resulting peak period tables would then be divided by the regional daily origin-destination table. The resulting new peak period tables would then be assigned to the network. The duration of the peak period would then be reviewed based on the results of the assignment. There were illustrations of peak spreading conditions along I-270 at the Montgomery County / Frederick County line based on 2005 traffic counts and discussion of the traffic count inventory maps on the wall of the meeting room.

Comments and Questions:

Mr. Kirby commented that in addition to peak spreading the region may experience peak sharpening in the case of introducing a significant capacity expansion, such as the new span of the Woodrow Wilson Bridge.

Mr. Shapiro reviewed the use of Dynamic Traffic Assignment (DTA) and traffic simulation models. What tools should be used? It is important that the analyst define the problem under study – for example, intersection operations, arterial congestion, freeway weaving, transit priority, intelligent transportation systems, incidents before choosing a tool such as microsimulation or DTA. The results of the recent TRB survey indicated that the most commonly used microsimulation software packages are Synchro/SimTraffic, CORSIM, and VISSIM.

Synchro/SimTraffic is the most popular; it is ideal for traffic operational analysis, signal timing optimization and signal system coordination. Synchro/SimTraffic can be used to evaluate special conditions such as a rail crossing or toll booths, but these are not its primary functions. In addition, it has limited freeway analysis capabilities. It does provide 3D animation functions. CORSIM was developed by FHWA in the 1970s and provides integrated freeway and arterial analysis. It can evaluate most freeways and high-occupancy vehicle scenarios, as well as freeway incidents and ramp metering. VISSIM allows the greatest control over intersection calibration, but that control requires more coding effort by the user. It can be used to evaluate transit priority, simulate large networks, and is ideal for non-conventional intersection or interchange configurations.

VISSIM also has DTA capabilities and can be used to evaluate express toll lanes, managed lanes, or high-occupancy toll lanes. Other microsimulation programs include Paramics, AIMSUN, TransModeler, and Cube Dynasim.

DTA models include Dynasmart, Dynamec, and Cube Avenue. DTA models require a less detailed network than microsimulation models and use origin-destination tables for loading-matrix estimation. DTA models can be applied to sub-regions or small regions, can evaluate traffic control, and represent queuing. Most importantly, DTA models have potential for use at the assignment step in a traditional travel demand forecasting framework, and have been used in that role by the El Paso, TX MPO. Dynasmart-P is the most widely used DTA application to date and is being used in El Paso, has been used by BMC, and is being evaluated by SCAG, the Los Angeles MPO. Dynasmart-P does need more research to augment its driver-compliance algorithms and improve its modeling capabilities.

Microsimulation has been used successfully for decades, and its 3D animation capabilities are very popular with decision-makers. However, the software is extremely labor-intensive to use. DTA is based on user-equilibrium assignment and traffic simulation, uses time-dependent origin-destination matrices as inputs, and is less labor intensive than microsimulation.

Comments and Questions:

Mr. Kirby asked if DTA could replace the four-step modeling process. Mr. Shapiro explained that it was being used as *the* fourth step of the four-step process (traffic assignment) in El Paso and could be used in that manner in other regions. DTA on its own could be used as the model in small regions, but in a large region like TPB's it is best used as the assignment step or to model smaller sub-regions. Mr. Moran asked how DTA handled queuing. Mr. Shapiro replied that it will represent queuing, but at a certain point the model will also begin to re-route trips based on traffic congestion.

Mr. Clifford asked if some of the software packages had direct links to travel demand modeling software and if some packages were better than others at such a linkage. Mr. Shapiro replied that with some software packages you need to bring in a new trip table, which would allow a user to take the results of a mode choice model and the highway origin-destination tables and assign them using the new software. Mr. Clifford asked if any of the software packages were designed to read in loaded link files. Mr. Shapiro replied that this was not possible because the level of detailed required for simulation or DTA was higher than needed for traditional travel demand modeling. Mr. Pedak of Fairfax County asked about a reasonable area to apply one of these models. Mr. Shapiro stated that for microsimulation a subarea study is the maximum area that he would use.

Mr. Kirby expressed interest in applying these techniques to address choke points in HOT/ETL analyses. He voiced concern that project planning address ramp problems on such facilities before they are opened for use.

Item 4: Design of the Enhanced Arterial Highway Congestion Monitoring Program, Based upon Pilot Program Experience

Daivamani Sivasailam presented the findings of the pilot program conducted to enhance coverage of the highway congestion monitoring using volunteer drivers, in-lieu of paid drivers. He discussed issues related to recruiting volunteers, archiving data, and hardware/software used in the study. He went on to discuss the proposed enhanced arterial highway congestion monitoring program which will use elements of the existing program such as using paid drivers and elements of the pilot program such as using volunteer drivers. Some of the other elements of the proposed program are:

- new route system to be built upon the existing system
- multiple years to cover all the routes
- multiple days from volunteer drivers to achieve day of the week variation in congestion levels in addition to time of day variation from paid drivers

Comments and Questions:

In response to a question as to whether the database to be used for archiving data and linking the data with GIS will be done in-house, Mr. Sivasailam replied it will be decided at a later time. Another questioner asked whether the paid drivers will be sent to a particular route to collect data and in response Siva answered yes; the goal of the program is collect as much data as possible using volunteer drivers and routes for which volunteers cannot be recruited will be filled using paid drivers.

Item 5: Update on Household Travel Survey

The Household Travel Survey is about half way to completion. Including Baltimore Metropolitan Council's add-on, TPB Staff expect to have information on approximately 15,000 households at the conclusion of the survey. We have received an interim data delivery with about 5,000 completed households. The larger jurisdictions are responding, with the exception of Prince George's County. Staff will be increasing the Prince George's County sample to bring the numbers up. The 100-household add-on sample in Arlington is doing well.

The trip rates look reasonable. The households eligible for the incentive (because we do not have a telephone number for them) make one more trip a day then those where we have a phone number. This demonstrates that the address-based with financial incentive strategy is successful. Younger, more mobile households, as well as populations traditionally missed, are responding.

The meeting was adjourned at 11:55 AM.