National Capital Region Transportation Planning Board
Metropolitan Washington Council of Governments
777 North Capitol Street, N.E., Suite 300, Washington, D.C. 20002-4290

Highlights of the March 22, 2013 meeting of the Travel Forecasting Subcommittee

Held at the Metropolitan Washington Council of Governments, from 9:30 AM to 12:00 PM
Status of highlights: Approved 5/17/13

Meeting attendees

- Dan Goldfarb (VHB)
- Bahram Jamei (Virginia DOT)
- Eric Jenkins (M-NCPPC, Prince George's Co.)
- Wendy Jia (WMATA)
- Dial J. Keju (Frederick Co.)
- Rick Kiegel (Maryland Transit Administration)
- David Kline (Fairfax County DOT)
- Yuanjun Li (M-NCPPC, Montgomery Co.)
- Feng Liu (Cambridge Systematics)
- David Roden (AECOM)
- Phil Shapiro (STC)
- Dan Stevens (Fairfax County DOT)

COG/TPB staff in attendance

- William Bacon
- Anant Choudhary
- Joe Davis
- Greg Goodwin
- Bob Griffiths
- Wanda Hamlin
- Hamid Humeida
- Nicole McCall
- Ron Milone
- Abdul Mohammed
- Mark Moran
- Jinchul (JC) Park
- Jane Posey
- Clara Reschovsky
- Rich Roisman
- Meseret Seifu
- Dusan Vuksan
- Feng Xie
- Jim Yin
- C. Patrick Zilliacus

The meeting was chaired by Wendy Jia of WMATA.

1. Introductions and approval of meeting highlights from the previous meeting

The highlights from the January 25, 2013 meeting of the TFS were approved without change.

2. Cooperative Forecasting Program: Background and draft Round 8.2 estimates

This item was presented by Greg Goodwin of COG's Department of Community Planning and Services (COG/CPS). A copy of his presentation slides was distributed to the subcommittee Mr. Goodwin discussed the history and methodology of the COG's Cooperative Forecasting Program, which is used to develop zone-level estimates of jobs, households, and population in the metropolitan Washington region. He also discussed key findings from the latest round of Cooperative Forecasts (Round 8.2), which is currently in draft.

On slides 9 and 10, Mr. Goodwin compared the 20-year forecasts, from 1990-2010, for the growth in households, population, and employment (made in 1991 as part of Round 4.1) to the actual rates of growth for the 20-year period. While both household and employment forecasts overstated the growth that actually occurred in the region between 1990 and 2010, the household forecasts were shown to be generally more accurate than the employment forecasts. [Note: After the meeting, an error was found in the calculated percentages on slides 9 and 10 of the presentation. COG staff corrected these two slides uploaded the corrected presentation on April 4 to the TFS web page]. On subsequent slides, he then compared the employment and population forecasts of rounds 8.1 and 8.2. Mr. Goodwin concluded that the COG Board is expected to approve and adopt the Round 8.2 forecasts by July 2013.

Following the presentation, Mr. Milone commented that, while other planning agencies use land use models as a means of forecasting development, the COG land activity forecasting procedure does not involve a land use model. Instead, COG uses the reconciliation process described by Mr. Goodwin earlier, which is known as a modified Delphi technique. Ms. Jia noted that the employment forecasts appeared to be overly optimistic and suggested that adjustments should be considered to future forecasts. Ms. Jia also indicated that, in addition to the comparisons shown on slides 9 and 10, it would be interesting to see a similar comparison for high-density areas of the region that have high transit usage. Mr. Goodwin responded that there could be some technical issues in making comparisons related to TAZ boundaries, since these boundaries have changed over 20 years. Mr. Griffiths cautioned the group not to put too much emphasis on short-term trends, since the models are generally used for long-term forecasting. He said that the Cooperative Forecasting program is ongoing, and noted that forecasting bias detected in any given land use round is normally addressed in subsequent rounds as new information regarding development becomes available.

3. Status report on the Version 2.3 Travel Model: Updates to the model and the year-2010 validation

This item was presented by Mark Moran and Ron Milone, of TPB staff. A copy of the presentation slides was distributed to the subcommittee. Mr. Moran presented the first half to the presentation, covering updates to the travel model prior to the year-2010 model validation. Mr. Milone presented the second half of the presentation, covering the year-2010 validation and model updates related to the validation. Mr. Moran explained that the model updates prior to the validation were incorporated into "Build 50" of the Version 2.3 Travel Model, whereas those associated with the validation work were part of "Build 52." Build 50 included two main updates. First, the new clean-up procedure, used to delineate which model output files are "temporary" and which are final files, was updated such that all TAB and TXT files are now retained -- previously, only TXT and TAB files associated with the final speed feedback (SFB) iteration, "i4," were retained during the clean-up procedure. Despite the fact that this increased the number of non-temporary model output files, the procedure still results in a 65% reduction in the quantity of output files (26 GB is reduced to about 9 GB).

Second, the developmental model now uses what is being called a "progressive" relative gap threshold in traffic assignment. The current model, like most travel models, uses a static, user equilibrium (UE) traffic assignment, implemented via the Frank-Wolfe method. In the Frank-Wolfe method, a series of

all-or-nothing traffic assignments are performed and flows are combined using a series of weights. The process is repeated for a specified number of UE iterations or until some stopping criterion is met. Currently, the model uses a stopping criterion of a relative gap equal to 10^-3 (i.e., 0.001) and this threshold is kept constant for all speed feedback iterations (from "pump prime" to "i4"). With the updated procedure, the relative gap threshold continues to stay constant *within* a speed feedback loop, but the threshold becomes progressively tighter as the model progresses from one speed feedback (SFB) iteration to the next. So, for example, in the initial SFB iteration (called "pump prime"), the relative gap threshold is set at 10^-2 (i.e., 0.01). For SFB iteration 3, the relative gap threshold is tightened to 10^-3 (i.e., 0.001). By the final SFB iteration ("i4"), the relative gap threshold is set to its tightest value of 10^-4 (i.e., 0.0001). By using a relatively loose threshold for the early SFB iterations, the model achieves run-time savings. By using a relatively tight threshold for the last SFB iteration, the model achieves a high level of convergence in traffic assignment.

Mr. Moran indicated that the addition of the progressive relative gap was based on sensitivity tests conducted by COG's models application staff (Dusan Vuksan and Feng Xie) in the course of project planning work that was being done for the Maryland State Highway Administration (SHA). For the tests, the TPB staff assumed one small network change: a southbound general purpose lane on I-270 (between MD 121 & I-370) was converted to an HOV2+ lane in the AM peak period. Staff also varied the relative gap thresholds, and then produced volume-difference plots to ensure that volume differences made sense and to check how much model "noise" was present in each test. In one of the tests, a highly converged traffic assignment was obtained (relative gap threshold of 10^-4) and model noise was visible in neither the corridor nor the rest of the modeled area, but run times were long. In the final test, the "progressive relative gap," run times were kept about the same as the baseline, but traffic assignment convergence was dramatically improved, and only a very small amount of noise was seen outside the study corridor. After similar testing by COG's models development staff, it was decided to adopt the progressive relative gap threshold for the developmental model.

A TPB staff member noted that, although the progressive relative gap results in less model noise on volume-difference plots, he asked about the effect of using progressive relative gap on traffic volumes in the study corridor itself. Mr. Vuksan responded that staff have examined this and found that the results within the study area, at the project-planning level, are very similar for the currently adopted process and other tests. He noted that the advantage of using the progressive relative gap is both the reduction in model run times and the improvements in model convergence. Without this enhanced convergence, when examining volume-difference plots, a user would have difficulty knowing which volume differences are significant and which are simply background noise from an insufficiently converged model.

A subcommittee member wanted to know why TPB staff was so concerned about shortening model run times. Mr. Moran indicated that by keeping model run times to 18 hours or less, runs can be started at 3 PM and are finished by 9 AM the next day. Also, the shorter the model run time is, the more analyses that can be done in a given time period. Mr. Vuksan added that "toll setting" model runs can take 4-5 days, so this was another reason to strive to keep model run times to a minimum. One meeting attendee warned about the issue of false precision, noting that the errors in the land activity forecasts

used as inputs to the model are far larger than the differences one sees when going from a moderately converged traffic assignment solution to a highly converged solution.

Next, Mr. Milone presented results from the year-2010 validation of the travel model. The key objectives of the validation were: 1) to improve the Version 2.3 Travel Model using reasonable refinements based on known, year-2010 information; and 2) to complete the validation before the next air quality conformity cycle. The focus was on highway assignment results. Consequently, modal trip flows and trip lengths were not adjusted (since no 2010 modal data was available). In terms of motivation for the validation work, Mr. Milone presented a list of five key concerns, including overestimation of vehicle miles of travel (VMT) in DC, Alexandria, and Loudoun Co.; overestimation of traffic crossing the Potomac River, notably screenline #20; and underestimation of non-motorized travel in densely developed areas. The validation effort focused on checking both observed counts and the highway network. For example, a few traffic counts were removed from the count database, due to obvious errors in the counts. Also, it was found that the capacities of many of the road links in DC were over-represented. Consequently, the capacities of many arterials were reduced, based on checking with aerial photography. Also, freeways in and around DC were recoded as expressways, since most of these freeways function as such (e.g., the Southeast/Southwest Freeway on I-395 in the District has a current speed limit of 40 mph).

A TPB staff member mentioned that there was bridge construction in 2010 in the District (e.g., 11th Street Bridge and the 14th Street Bridge) and wondered whether this was accounted for in the validation work. Mr. Milone said that this issue is addressed later in the presentation. Mr. Milone also discussed some of the sensitivity tests that were done, such as using bridge penalties on the Potomac River bridges, which permitted staff to eliminate K factors that had be used to function as bridge penalties in earlier versions of the travel model. He then summarized the features of the final, validated model:

- Progressively increasing levels of traffic assignment convergence;
- 11-minute bridge penalties on the Potomac River bridges;
- Increasing non-work, non-motorized trip shares in dense areas of the region (area types 1 & 2) by 30%;
- Restructured trip generation and trip distribution process;
- Refinements to highway network, such as reduction of link capacities in the District.

Mr. Milone next discussed performance of the validated model, such as daily 2010 VMT by jurisdiction, 2010 screenline crossings, and percent RMSE between estimated and observed link volumes. Although the estimated-to-observed ratios for jurisdiction-level VMT have gotten better in DC (went from 13% overestimation to 2% underestimation) and Alexandria (went from 25% overestimation to 14% overestimation), Mr. Milone noted that he was not able to improve the overestimation in Loudoun Co., which is still over 25% overestimated. Similarly, regarding screenline crossings, the 42% overestimation on screenline 20 (Potomac River) has been reduced to a 7% overestimation in the validated model. Unfortunately, the model is still overestimating traffic on screenlines 2 & 4 (which capture radial traffic in the District), and Mr. Milone thought, as had been brought up earlier in the meeting, that the bridge re-constructions in 2010 caused many travelers to use other routes in DC, which increased traffic on

screenlines 2 & 4. In terms of percent RMSE between estimated and observed link volumes, the model has gone from 46% RMSE regionally to 40% RMSE.

Some transit summaries were also presented, though TPB staff did not make any adjustments to the model's treatment of transit trips as part of the validation. The ratio of estimated-to-observed Metrorail trips has gone from 1.03 to 0.97, which Mr. Milone thought made sense, since the model does not fully account for travel made by non-residents, such as commuter rail trips from Baltimore, tourists, and airport passengers on the Metrorail.

Mr. Milone's presentation hand-outs include slides covering the changes that were made to the travel model as part of the validation (slides 32-35), but, in the interest of time, he did not discuss these as part of his presentation. Mr. Milone finished the presentation with some conclusions and next steps, including updating the user's guide to reflect Build 52 of the Version 2.3 Travel Model and documenting the validation work.

A subcommittee member asked two questions about the revised trip generation and trip distribution procedure on slide 23. First, given that the older, simpler procedure seems to perform similarly to the newer, more complicated procedure, why proceed with the more complicated procedure? Second, did TPB staff develop the new procedure on its own, or did staff receive some help? Mr. Milone said that although the newer and older procedures performed similarly in the base year (2010), he felt the newer procedure would be more robust and yield better results for forecasting future-year conditions. Mr. Milone mentioned that TPB staff has collaborated with Phil Shapiro for various parts of the validation work. Referring to slide 25 ("2010 Daily VMT by Jurisdiction"), a TPB staff member noted that, while the estimated-to-observed ratios for DC and Alexandria had improved, the ratio for Arlington Co. had gotten worse (went from 1.06 to 0.91). The staff member asked whether Mr. Milone was concerned about that worsening ratio and the possible interaction between the three inner jurisdictions. Mr. Milone responded that he was concerned about the worsening performance for Arlington Co., and felt that it might be due to the increasing of non-work, non-motorized trip shares in denser areas. But, nonetheless, Mr. Milone thought that the 9% underestimation of daily VMT for Arlington Co. was still in the acceptable range.

4. Status report on the consultant-assisted project for development of the TPB travel model: Task Orders 8 and 9

This item was presented by David Roden of AECOM. A copy of the presentation slides was distributed to the subcommittee. The focus of Mr. Roden's presentation was on HOT-lane modeling, HOV modeling, and network preparations needed to move to a new transit path building software module (i.e., from Citilabs' TRNBUILD to Citilabs' PT). Mr. Roden began his presentation with a discussion about HOV modeling. He indicated that there is a difference between travelers who are choosing the HOV mode due to time savings and those who are choosing the mode for other reasons, many of which relate to the fact that members of the same household are more likely to travel together. Ideally, this differentiation would occur in the mode choice model. However, in the interim, AECOM was proposing to develop a simple HOV choice model that would be applied post mode choice. For this work, AECOM focused on HBW trips in the Shirley Highway (I-95/I-395) corridor, since the Shirley Highway is the only

facility in the region with HOV3. As part of the proposed changes related to the HOV choice model, AECOM is proposing to replace the "two-step assignment" (run in the AM and PM peak periods) with a regular, multiclass assignment, which would reduce the number of separate assignments from six to four. The proposed model would be an incremental logit model. The model was calibrated to daily and AM peak-period traffic counts on Shirley Highway, but the process was limited by the paucity of detailed count information and the complexity of the HOV operations. For example, the daily counts on the HOV lanes includes SOV, HOV2, and HOV3+, since the reversible lanes operate northbound in the AM peak period, southbound in the PM peak period, and are open to all traffic during certain hours.[1] In the case of the AM peak period HOV counts, the HOV3+ traffic appeared to be underestimated by about 50%, but, since the total traffic was also underestimated (by about 24%), the task was not simply one of shifting modeled traffic from one vehicle occupancy to another.

Mr. Roden showed two different versions of the HOV choice model on slide #10. Both versions improved the estimated-to-observed ratio of HOV3+ trips. In one, the ratio went from 0.51 to 1.04. In the other, the ratio went from 0.51 to 1.15. On slide 12, Mr. Roden pointed out that, with the new HOV choice model, AECOM was able to reproduce what was coming out of the existing COG model, but without using the two-step assignment (i.e., using, instead, a single, multiclass assignment). Robert Griffiths, of TPB staff, asked whether the observed AM peak period HOV traffic counts were one day counts. TPB staff answered in the affirmative, noting that the counts came from COG's most recent HOV report.[2] Mr. Griffiths warned the group that number of HOV users in any one given day could be quite variable, so one needs to be cautious in trying to match on-day counts. As evidence, he cited some work done by TPB staff several years ago for VDOT and NVTC where the coefficient of variation (CV) for HOV vehicles in the HOV lanes was about 30%.[3] On the subject of potential future HOV performance studies conducted by COG, Patrick Zilliacus, of TPB staff, asked Mr. Roden whether he would recommend continuing the practice of collecting one-day counts at a large number of locations, or conducting multi-day counts at a more restricted number of locations. Mr. Roden felt there would be some benefit in reducing the number of counting locations and increasing the number of days that are counted.

Next, Mr. Roden discussed the work done by AECOM on revising the HOT-lane modeling process, including the goals for the revised process, such as eliminating the multi-run approach (e.g., base 2040 then final 2040), which effectively doubles the runtime for any future-year scenario that involves HOT lanes. Mr. Roden discussed the current COG procedure, both for running the HOT-lane modeling process in application and for performing the toll-setting process needed to determine the optimal HOT-lane tolls. He also discussed the goal of reducing the number of toll groups (currently 134) to simplify the toll setting process. He also discussed some of the other ideas to make the toll-setting process more

[1] See, for example, Virginia Department of Transportation, "High Occupancy Vehicle (HOV) Systems: HOV - Northern Virginia: When and Where," 2013, http://www.virginiadot.org/travel/hov-novasched.asp.
[2] C. Patrick Zilliacus and Clara Reschovsky, *2010 Performance of High-Occupancy Vehicle Facilities on Freeways in the Washington Region* (Washington, D.C.: National Capital Region Transportation Planning Board, September 7, 2011).
[3] National Capital Region Transportation Planning Board, *Analysis of AM Peak Period Travel In Northern Virginia's I-95/I-395 Corridor*, Draft (Virginia Department of Transportation, August 10, 2007), 10–11.

tractable. Since the tests into various options are still underway, Mr. Roden did not have any HOT-lane modeling results that were ready to share with the group at this point.

Finally, Mr. Roden discussed the status of the conversion from TRNBUILD to PT. COG, with the help of scripts provided by AECOM, has converted TRNBUILD-format transit routes into PT format and has added transit-only links, such as Metrorail links, to the transportation network (PT does not use a separate highway and transit network, just one transportation network). AECOM has implemented the PT Generate process to develop walk-, KNR-, and PNR-access links. AECOM has also conducted a preliminary comparison of the paths generated by TRNBUILD and PT. Mr. Roden discussed how TRNBUILD paths differ from PT paths, such as the fact that PT requires alternation between "transit legs" (such as riding a bus) and "non-transit legs" (such as walking to the bus). On slide 26, Mr. Roden listed four options for connecting station nodes to the transportation network, and he indicated that AECOM needs COG input on which of the four to pursue.

Bahram Jamei, of VDOT, felt that, when consolidating toll groups, one should not over-consolidate, citing, for example, the different incentives faced by an HOV3 user on I-95 HOV lanes (i.e., travel time savings) and the incentives faced by an HOV3 user on the I-495 Express Toll Lanes (i.e., cost savings and travel time savings). Mr. Roden agreed that the two facilities would need different toll groups.

5. 2011 Air Passenger Survey: Geographic findings report

This item was presented by TPB staff member Richard Roisman. Mr. Roisman was a substitute for Abdurahman Mohammed, who was originally scheduled to present this item. A handout was distributed. Mr. Roisman reminded the subcommittee that general findings from the 2011 Air Passenger Survey were previously presented in September. Today's presentation was intended to provide additional information from the survey relating to airport use and preferences as related to specific locations in the Washington, D.C. region. He addressed several aspects of the survey process and findings, including the survey operation and geo-coding process, the location of local air passenger originations and destinations, and the geographic pattern and temporal profile of airport use. Several key findings from the 2011 survey were underscored by Mr. Roisman:

- Approximately 32 million air passengers boarded flights at the three primary commercial airports (BWI, DCA and IAD) in 2011, which reflects a continuing growth trend over recent years. Of these, 24 million were local originations from the Washington, DC and Baltimore regions.
- In reviewing the hourly profile of air travel departure times, it is evident that a substantial amount of airport-bound trips in the region are coincident with AM and PM peak period travel in the region. Traffic to the regional airports plays a part in overall traffic congestion during rush periods, given the existing flight schedules.
- Based on recent highway time studies, TPB staff anticipates that the presence of the Inter-County Connector (ICC, or MD 200) will affect a measurable shift of the airport travel, away from National and Dulles airports and towards BWI. The ICC did not exist during the 2011 air passenger survey, but the next scheduled (2013) survey will provide observable insight on the shifting of airport choice.

- Air passenger travel is expected to more than double at the region's three major airports based on FAA airport operations projections, particularly at BWI and IAD. USDOT also projects substantial growth in air cargo activity at BWI and IAD, as well.

Some subcommittee members expressed an interest in gaining more detail about the departure times of the local originations to the airport. Mr. Roisman stated that the survey data includes this type of information.

A subcommittee member asked if any information was collected on newly offered express bus service operating on the ICC from Gaithersburg to BWI. Mr. Roisman stated that the new service opened after the 2011 survey. He offered his observation that ridership on the new service appears to be growing. He added that the next (2013) air passenger survey will include information on regarding the new bus service.

A meeting attendee asked for clarification regarding how the FAA projections are furnished. Mr. Roisman responded that the FAA provides airport operations forecasts (e.g., enplanements); the FAA does not provide forecasts of local originations, which would be preferred from a transportation planning perspective. He added that operations forecasts are regularly updated each year.

6. Status report on the geographically focused household travel survey

This item was presented by Robert Griffiths of the TPB staff. Mr. Griffiths first distributed a handout to the group and next provided a brief review of his project. TPB staff is currently engaged in an on-going data collection effort to better understand household travel behavior at the neighborhood level as a means of facilitating land use and transportation planning of TPB member jurisdictions. The TPB has expressed an interest in how household travel behavior is affected by density, physical characteristics, and transportation options for specific target areas in the Washington region. Staff has previously collected data on ten target areas. During the spring of 2012, new data has been collected for seven areas:

- New York/ Rhode Island Avenue, NE Corridor in the District of Columbia
- Friendship Heights in the District of Columbia and Montgomery County, Maryland
- East Falls Church and West Falls Church Metrorail stations areas in Virginia
- Beauregard Corridor in the City of Alexandria, Virginia
- National Harbor/ Oxen Hill area in Prince George's County, Maryland
- Dulles North area in Loudoun County, Virginia
- St. Charles/ Waldorf Area in Charles County, Maryland

Mr. Griffiths reviewed the characteristics and the findings of each area, including the household demographic characteristics and daily/commuting modal shares. He offered some key observations and initial findings that have been drawn from the data:

- He noted the distinguishing features of the New York Avenue, Friendship Heights, and Beauregard areas: lower household sizes, higher proportions of households living in

apartments and condominiums, and significantly higher use of transit and non-motorized travel modes, relative to the regional average.

- The National Harbor, Dulles North, and St. Charles areas were characterized by higher household sizes in single-family homes and greater auto (SOV) use, relative to the regional average.
- The East and West Falls Church areas were found to be interesting in that, while the demographic characteristics were consistent with a suburban profile (higher household sizes reflecting multiple workers with children), the usage of transit and non-motorized modes was nonetheless higher than the regional average.

Mr. Griffiths pointed out that the challenge of creating successful activity centers is to establish a relatively high-density living environment that encourages transit use and non-motorized options, and yet, to offer amenities and services that are attractive to households with children. He added that TPB staff plans to continue conducting geographically focused surveys in the spring of 2013. Twelve new target areas have been identified: four in the District, four in Maryland, and four in Virginia. No questions were asked of Mr. Griffiths.

7. Round-table discussion

This item was deferred to the next meeting due to insufficient time.

8. Other business

The next proposed meeting of the TFS is Friday, May 17, 2013 from 9:30 AM to 12:00 noon. The meeting was adjourned around 12:10 PM.

*** The meeting highlights were prepared by Ron Milone, Mark Moran, and Hamid Humeida ***