Report on Findings of the Second Peer Review Panel of the Baltimore Metropolitan Council Travel Demand Model

Held February 28, 2005
Baltimore, Maryland

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Travel Model Improvement Program (TMIP)
Report on the Findings of the Second Peer Review Panel of the Baltimore Metropolitan Council

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Peer Panelists

Name	Organization
Frank Spielberg, Chair	BMI-SG, a VHB company
Tom Rossi	Cambridge Systematics
Ken Cervenka	North Central Texas Council of Governments
Keith Killough	KLK Consulting
Jeffrey May	Denver Regional Council of Governments
Eric Miller	University of Toronto
Bruce Spear	FHWA
Eric Pihl	Federal Transit Administration

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Executive Summary
The following report summarizes the results of the second of two travel model peer reviews held by the Baltimore Metropolitan Council (BMC) on behalf of the Baltimore Regional Transportation Board. The peer review was sponsored by the Federal Highway Administration's Transportation Model Improvement Program. BMC asked a panel of travel demand modeling experts to evaluate its model, make recommendations for model enhancements, and review its model improvement process.

Baltimore currently has a well-developed four-step model. However, to keep up with the changing transportation landscape, policymakers want to improve the model to enhance the model's performance and model new transportation options such as managed lanes.

The panel felt that BMC's model improvement process was very well planned and looked reasonable. It made the following recommendations:

- Make revisions to the traffic analysis zones early in the model improvement process, since this will affect later stages of the process.
- Continue to coordinate closely with the Metropolitan Washington Council of Governments on employment and population forecasts, since the contiguous planning regions of Baltimore and Washington, DC function as a single metropolitan area.
- Ensure that any changes, especially in the mode choice model, are compliant with New Start guidelines produced by the Federal Transit Administration.
- Consider adding demographic factors such as the age of the head of the household or number of workers in the household to add explanatory power to the model.
- Be sure that modeled speeds are reasonable compared to actual speeds.

I. Background

This report summarizes the second meeting of a travel demand model peer review process for the Baltimore Metropolitan Council (BMC). The purpose of the peer review was to provide the BMC the opportunity to consult with a panel of experts about its travel demand modeling effort. The present peer review meeting was held on February 28, 2005 at the office of the BMC in Baltimore. Presentations and discussion focused on BMC's work plan to implement changes to its model based on the panel's recommendations during a previous peer review meeting held September 23-24, 2004. The meeting was attended by several BMC staff members and managers, representatives from local governments, the Maryland Department of Transportation, and the panel of travel demand modeling experts.

The Baltimore Regional Transportation Board (BRTB) is the metropolitan planning organization for the Baltimore metropolitan region. BMC staff provide support to the work activities of the BRTB. This travel model peer review project was proposed by the BRTB.

The Baltimore region encompasses Baltimore City and the Maryland counties of Anne Arundel, Baltimore, Carroll, Harford, and Howard. It has a population of about 2.4 million people and covers an area of approximately 2,260 square miles.

The Baltimore travel demand model has been subject to several reviews by modeling experts prior to the current peer review. In 1992, SG Associates performed an evaluation of travel analysis capabilities. In the late 1990s, Michael Baker, Jr., Inc. conducted a review relating to air quality analysis. Subsequent reviews and analyses have been performed by URS Corporation (revised mode choice model) and William G. Allen, Jr. (development of truck models). Since these reviews, there has been a growing demand for more and better modeling capabilities creating the need to re-evaluate the region's travel demand model. The Baltimore model must now consider roadway pricing, induced and latent travel demand, non-motorized trips, tourist trips, changing demographics, and new commuting patterns. The BRTB wanted its model reviewed by an expert panel to determine how it can be improved to better understand travel behavior and its implications for regional planning. Specific policy and technical needs include:

- Meeting the Federal Transit Administration's (FTA) New Starts criteria for the Baltimore Regional Transit Plan
- Performing microsimulation and sub-area analysis to support state, regional and local planning efforts
- Continuing to meet air quality conformity regulations
- Better accounting of socio-economic characteristics by taking into account, for example, the number of workers or children in a household
- Modeling non-household trips such as those made by tourists, taxis, and trucks
- Modeling freight travel throughout the region
- Tracking inter-regional traffic between the Baltimore and Washington, DC areas
- Understanding and forecasting the effects of density and other development scenarios
- Modeling various managed lane options

The BMC asked the peer review panel to:

- Evaluate the effectiveness of the current model
- Identify enhancements to the model that can reasonably be made in the short term
- Identify possible long-term enhancements to the model
- Provide suggestions for the future BMC model improvement process

II. Existing BMC Model

The Baltimore model utilizes the traditional four-step process of travel demand forecasting, running on TP+ software (version 3.0). The transit path building element TRNBUILD, utilizes a later module , version 3.0.6, that permits node numbers greater than 32,726. The modeled region includes 1,151 traffic analysis zones (TAZ) within the Baltimore region and 270 in the Washington DC region, and has over 32,000 highway and transit links. Average weekday trip tables are generated and factored into five time periods before the assignment phase (midnight to 6:00 a.m., 6:00 to 10:00 a.m., 10:00 to 3:00 p.m., 3:00 to 7:00 p.m., and 7:00 to midnight). The initial model run assigns the morning peak period trip table. Highway/transit skims are rebuilt from the morning network.

For trip generation, both motorized and non-motorized non-truck trips are generated and classified into six trip purposes. The model also cross classifies household size, vehicle availability, and density codes, but makes no distinction between internal-internal (I-I) and

internal-external (I-E) trips. Trip attractions, developed from 1993 home interviews, are identified only for motorized trips.

The trip distribution model links trip attractions and productions between zones. It uses a gravity model calibrated using barrier penalties. Following distribution, home-based work (HBW), home-based shop and home-based other (HBO) trips are stratified by income. Two passes of trip distribution are made. In the first pass, all trip purposes are distributed based on the free flow network travel times. The second pass, which occurs after the four-step process has been run, redistributes HBW, HBO, HBSch, and work-based other (WBO) trips based on a congested network.

The mode choice model takes data on the number of persons traveling between zones and computes the number of single-occupant automobile drivers, multiple-occupant automobile users, and transit riders. The process is repeated for HBW, HBO, other-based other (OBO), and WBO trips, using congested highway and transit skims (zone-to-zone travel times). Jurisdiction-to-jurisdiction rates are used for HBSch trips. Automobile trips are then converted to the vehicle trip table.

Finally, the trip assignment phase assigns the vehicle trip table to the regional network, producing a simulation of link volumes, vehicle miles traveled, and volume to capacity ratios. There are two passes. The first one produces a morning peak period (6 a.m. to 10 a.m.) assignment used for feedback into the second pass. The second pass produces assignments for each of the five time periods.

III. Presentation Summaries and Panel Comments

The peer review documented in this report focused primarily on issues related to the review panel's recommendations from the 2004 peer review, the first meeting of the process. The meeting consisted of presentations by BMC staff, followed by discussion and panel comments.

A PowerPoint® file of the presentations summarized in this section can be found on the TMIP web site at http://tmip.fhwa.dot.gov.

A. Model Improvement Timeline

Presenter: Charles Baber

BMC has developed a detailed timeline for implementing model enhancements between 2005 and 2009. It chose priority improvements based on feedback from the BMC Model Coordinating Committee, the peer review panel, BMC member jurisdictions, and on the logical order in which improvement must be enacted. The top priorities for 2005 include a major upgrade to the travel model in preparation for a New Starts transit initiative, collection and analysis of speed data using GPS-equipped vehicles, verifying air quality conformity, revising volume to capacity relationships, and upgrading the holding capacity to better gauge the relationship between transportation and land-use planning. Action on model enhancements will, of course, depend on funding availability.

Panel Comments

- The proposed timeline seems reasonable, well thought out, and practical.
- BMC should consider disaggregating and redefining TAZs before 2007. The zone system should be adjusted prior to model calibration work on trip distribution and mode choice to ensure a potentially better calibration and continued maximum utility of the models.
- It is a good idea to keep less critical improvements such as non-motorized modes and tourist surveys in the later years of the work plan.
- BRTB/BMC should work with the Maryland Department of Transportation (MDOT) and the other BRTB board member jurisdictions to try to identify funding sources.
- BMC should coordinate with Maryland Transit Administration (MTA) to ensure that the data from any transit surveys are useful for the development, calibration, and validation of the mode choice model.

B. Air Quality

Presenter: Charles Baber

The Baltimore metropolitan area is currently classified as a non-attainment area for ozone. BMC collaborates with the Maryland Department of the Environment and MDOT for all emissions estimations. BMC summarizes demand and emissions (i.e., jurisdiction, facility type, vehicle type, emission type, etc.) through on- and off-network estimates using commercial software (PPSUITE)

Panel Comment

- The North Central Texas Council of Governments is finding that technology seems to be "solving" air quality problems. Despite projected growth, projected emissions seem to be decreasing.

C. Population and Employment Forecasting

Presenter: Dunbar Brooks

The primary issue for population and employment forecasting is how to manage the integration of forecasts for the contiguous metropolitan areas of Baltimore and Washington, DC. Functionally, they operate as a single metropolitan area, evidenced by the fact that almost half of the commuters to the Washington, DC planning region come from the Baltimore planning region. The modeling areas of the Metropolitan Washington Council of Governments (MWCOG) and BMC overlap in substantial portions of the metro area, as each MPO needs to account for cross-jurisdictional travel.

Currently, the Baltimore region is a net exporter of workers, mostly to the Washington, DC planning region. Forecasts developed by the BRTB's Cooperative Forecasting Group (CFG), made up of local and state planners, demographers, and economists, including BMC staff, suggest that this will continue for at least the next 15 years. Upon initial review, it appears that projected employment growth for the BMC region outstrips the expected labor pool given current labor force participation rates and commutation patterns. However, labor force participation rates are expected to grow towards the end of the forecast period. Furthermore, commutation from the seven state travelshed surrounding Baltimore (made up of parts of

Maryland, Virginia, Delaware, New Jersey, Pennsylvania, West Virginia, and Washington, DC) is expected to grow along with economic growth of the Mid-Atlantic region as new jobs in biotech, health care, research and development, and defense/homeland security are created. Accurately distributing the travel related to this growth requires that BMC continue to work collaboratively with MWCOG in generating employment and population forecasts.

The BMC attempts to account for the strong employment growth in the Washington region by including Frederick County, Prince George's County, Montgomery County and the District of Columbia (all in the MWCOG planning area) in its travel demand modeling area. By doing so, Baltimore's model can incorporate not only its own socio-economic forecasts but also Washington regional forecasts in its modeling activity. The BMC also considers employment forecasts for all jurisdictions in Maryland by reviewing the statewide employment forecasts created by the Maryland Department of Planning, which is also a member of the BRTB's and MWCOG's Cooperative Forecasting Group. Both BMC and MWCOG purchase and evaluate employment forecasts for their jurisdictions and surrounding states in the Baltimore-Washington area from by Woods and Poole Economics, Inc.

During the first peer review meeting, the panel made the following recommendations:

- Establish an independent process to develop regional employment control details.
- Develop statewide and regional totals for the BMC region plus Prince George's County, Montgomery County, and Frederick County.
- Develop related and consistent population and employment controls for the combined areas of the BMC and Washington COG regions.

The BMC staff and the BRTB CFG reviewed the initial peer review panel recommendations and considered these and other measures to improve forecasting for the combined regions. The following options were presented to the BRTB as possible improvement measures.

- Create a task force for employment forecasts composed representatives from BMC, MWCOG, state economic development and planning agencies, and private sector and academic economists.
- Contract with an employment forecasting consultant to develop bi-regional forecasts.
- Purchase existing employment forecasts for the greater Baltimore-Washington, D.C. area from an employment forecasting company.
- Ask individual jurisdictions to generate or purchase employment controls that would be combined for the bi-region and reviewed and evaluated by an expert panel of planners and economists from the area.

The BMC and MWCOG staffs have increased their interaction in the development of forecasts for each area by engaging in bi-monthly staff-to-staff meetings on this issue. Also, representatives from each MPO continue to attend the other's Cooperative Forecasting Group meetings. The BRTB CFG sponsored an employment forecasting workshop for Baltimore area jurisdictions with participation by MWCOG staff specifically to address forecasting methodology and to evaluate jobs/labor force scenarios in the region.

Panel Comments

- MWCOG and BMC should work toward travel demand models that are consistent throughout the two planning areas, both in data format and in socio-economic forecasting.
- BMC should consider a model that incorporates the entire commute shed, including parts of Maryland, Virginia, New Jersey, Pennsylvania, West Virginia, and Delaware.
- The current forecast of external trips seems very high, even considering the high commutation level to the Washington, DC region. BMC should conduct an external survey as soon as practicable.
- It is not clear whether the forecasts of population growth in Montgomery, Prince George's, Howard, and Anne Arundel counties (between Washington, DC and Baltimore) are being used by both BMC and MWCOG to satisfy expected employment growth. If so, some of the resulting HBW trips are being double counted.
- BMC should consider buying Woods and Poole forecasts, either as inputs to the model or to check its existing forecasts.

D. Mode Choice

Presenter: Matt de Rouville

The BMC's current mode choice model utilizes a nested structure accounting for ten modes. Separate coefficients for transit and auto in-vehicle travel times are used in the utility functions because empirical evidence has shown that two separate coefficients generate better-fitting models than a single, common coefficient. Other transit time variables (e.g. run time, walk time, wait time) are treated separately. The FTA has recently developed guidance recommending against separate coefficients for auto and transit in-vehicle time. BMC's mode choice model is scheduled to be upgraded to be consistent with this FTA New Starts criterion.

BMC's mode choice revisions will borrow from the model developed for New Orleans. The model will use data from a transit-on-board survey and 2001 household survey. The model will be calibrated to actual ridership. The MTA has hired a consultant to develop the new mode choice model, and expects to have a forecast by November of 2005.

Several new trip purposes will be evaluated for inclusion to the new model:

- University trips: BMC will borrow trip rates from other regions. Attractions will be based on enrollment in the region's colleges and universities.
- WBO, divided into journey-to-work and journey-at-work trip purposes. The current model classified these trips as either WBO and OBO trips.
- External stations method: I-E trips will be based on the distance from the external station and trip purpose.

The Baltimore model must incorporate the commuter rail and special generators before it models the proposed Red Line, since these trips will affect Red Line usage. Also, it is considering market segmentation for all home-based transit trips, rather than exclusively for work-based trips.

The mode choice model considers several variables for stratification of travelers: household size, household income, the number of workers, auto availability, age of head of household, and life cycle.

The model has separate curves for Baltimore City and suburban travel for household size and income. This reflects the different travel patterns by City and suburban residents. When considering a zone's median household income to the region's median family income, a City zone has fewer trips per household than a zone with an equal ratio in the suburbs, due in part to smaller households in the City.

The income variable has four categories: less than $13,000; between $13,000 and $27,000; $27,000 to $45,000; and over $45,000. Forty-five percent of households are currently in the over $45,000 group. BMC plans to keep the percentage of households in each category static over time, and instead change the incomes that define each category. The income projections assume that real income will not increase. BMC would like better and more income data to improve its mode choice modeling.

Despite the collinearity of income and auto ownership, BMC wants to keep both variables in order to see how the new proposed new transit line affects auto ownership in transit-accessible areas.

Panel Comments

- Before going too far on the New Orleans structure, the BMC should consult with the FTA to be sure it is acceptable for a New Starts analysis.
- Even if the mode choice model is satisfactory for the New Starts submission, it may need significant revisions before it can be applied to the overall model.
- BMC should attempt to get some important front-work completed before re-estimating and calibrating the New Orleans model:
    - If the existing TAZ structure will be changed, this should be done before the roadway/transit skims for mode choice estimation/calibration are prepared.
    - Average link uncongested speeds by functional class need to be checked against the observed off-peak speeds for those facilities submitted to floating car runs. Once the modeled uncongested speeds look reasonable, roadways skims for mode choice estimation can be done using calculations of realistic peak period auto speeds.
    - Once auto speeds are generally reasonable for the base case, bus speeds must be checked for reasonableness. If the speeds aren't reasonable, adjustments should be made to the speed estimation procedure prior to development of the mode choice estimation dataset, or at least prior to calibration.
- The relationship between income and auto ownership is probably changing since, at a given income, auto ownership is increasing.
- The application of changes in real income and auto ownership need to be addressed in the modeling system. From the projections of employment competition provided by BMC staff, real income would certainly have to increase.
- One of the more significant factors in flat and/or declining transit ridership and increasing congestion in urban areas has been the increase in auto ownership, even in areas with

relatively flat real income. While the gentrification of the Baltimore urban core may not experience the same percentage increase in auto ownership as real income, there will certainly be some effect on trip generation, distribution, and mode choice. BMC staff should carefully consider the ramifications of this.

- Market stratification for home-based transit trips is considerably outside the state of the practice.
- It is not clear how the new model will consider transit access and egress factors.
- Bus speeds should be carefully assessed for accuracy relative to highway speeds. The effect of future congestion on bus speeds due to travel pattern redistribution and/or growth needs to be appropriately reflected in the network modeling for good mode choice analysis.
- For validating the model, BMC should consider what cross-tabulations it can get from survey data to compare with model outputs.
- BMC needs to investigate closure criteria for equilibrium and test alternative methods for feedback.

E. Trip Distribution
Presenter: Charles Baber

BMC uses a double constrained gravity model for trip distribution. It is executed twice: once with uncongested skims and a second time with peak skims. Home-based trip purposes of work, shop, and other are stratified by household income after trip distribution. The BMC plans to calibrate the highway times in the trip distribution model. It will also re-calibrate the model with composite time using the harmonic mean of highway and transit time. In addition, it will review truck trips and through-traffic trips. If time permits, it will also consider the effect of tolls on trip distribution.

Currently, the only variable in the gravity model is impedance. The revised trip distribution model will probably have market segmentation by income only.

Panel Comments

- Adding more segmentation to the gravity model would greatly enhance forecasting accuracy.
- Age may add explanatory power, although travel patterns by people of a given age may change over time as travel needs and opportunities increase for elderly people. This is important for work trips.
- May also want to include an indication of how many members of a household are employed.
- Non-work distribution model should probably be singly-constrained.
- The current composite impedance estimation may be fine for simpler models, but consideration should be given to using logsum impedances (either without demographic effects other than market segmentation or stratified by market segment) to address travel patterns associated with a variety of managed lanes and market segmentation combinations.
- There are other ways to represent the utility offered by multiple modes to the distribution model.

- Might want to consider doing the model so that high income people only see the car option and lower income people will see both car and transit.

F. Trip Assignment
Presenter: Matt de Rouville

Trip assignment is done for each of the five time periods using an equilibrium assignment process. Drive access to transit trips and Baltimore/Washington International Airport special generator trips are also assigned. For highway assignment, BMC will review the volume-delay functions and the impedance for pathbuilding. The model will use a "weighted iteration" approach, running an equilibrium assignment for a base year of 2000, and using the resulting weights as the fixed weights. In the past, the trip assignment model has used only the TP+ defaults for convergence. BMC will re-evaluate speed, perhaps by creating more feedback loops. It also wants to consider new methods of speed feedback that will be consistent with requirements from the Environmental Protection Agency (EPA).

Panel Comments

- For the equilibrium assignment, it might be better to equilibrate a future scenario and fix the weights for scenario testing. This will help avoid the situation where a small change in one part of the network affects the entire network.
- The FTA provides guidance on EPA requirements.
- In the final results for the network overall, there is not a big difference between equilibrium and capacity restraint assignment. BMC must be aware of the tradeoffs involved.
- There may be a problem with reliance on the model software's defaults for convergence. Perhaps the criteria should be tightened so that more iterations will always be performed.
- BMC should experiment with the traffic assignment model to determine the number of iterations required to achieve convergence.
- Growth will result in more congestion, and the model will likely require more iterations to achieve convergence. BMC should consider full convergence on a future baseline alternative (at a minimum) before evaluating capital improvement projects. If the future alternative analyses include alternative development patterns, full convergence on each must be conducted. The consequence of inadequately converged equilibrium assignments is that link volumes are unstable from one iteration to the next. This means that the impacts of projects that produce relatively small changes in traffic volumes (e.g., operational improvements or even a new transit line) cannot be measured with any confidence.
- BMC should conduct as many iterations as necessary to achieve a tight convergence to be able to compare results from one alternative to the next.

G. Land Use Modeling
Presenter: Dunbar Brooks

Land use is forecasted at the TAZ level. One of four land use density codes (city center, urban, suburban, and rural) is used to account for urban form. BMC is looking for a land use model that can be used with the transportation model to enhance the MPO's decision-making process. It

plans to use the Production, Exchange, and Consumption Allocation System (PECAS) land use model. This model is an upgrade and refinement of the TRANUS model, which BMC obtained in 1998. It developed land use inputs and a sketch plan network between 1999 and 2002. The preliminary calibration was completed in 2003. However, the Planning Directors Committee of the BMC raised concerns about the accuracy of the land use holding capacity information provided by the state, and deferred further development of the model.

In response to these concerns, the BMC CFG produced a white paper on the accuracy, content, and techniques of capacity inventories used by local governments. Maryland's governor appointed the Development Capacity Task Force to standardize land use capacity data. Local planning agencies now use these standards to develop their own capacity information. The creation of a baseline capacity database for BMC member jurisdictions is almost complete.

BMC has hired JD Hunt to begin conversion of the TRANUS inputs to PECAS structure. The consultant will also integrate the PECAS model with the transport model. BMC would like to expand the integration of the land use and travel demand models, but there is very little money available for the task.

H. Managed Lanes
Presenter: Matt de Rouville

BMC would like its travel demand model to better account for managed lanes. One reason for this is that new managed lane strategies are being considered, with express toll lanes (toll lanes alongside free lanes) the most likely scenario. The toll would be set based on maintaining a level-of-service D or better in the tolled lane.

To represent the existing tolls at harbor crossings, the model imposes a time penalty in highway path building and a cost penalty on links in the mode choice phase. For the express lane scenario, the choice between the tolled and untolled lanes is reflected in the trip assignment model. In addition, BMC is in the process of adding time to the distribution model to reflect the toll. The model uses tolls of 10¢ per mile during the peak periods, and 5¢ during the off-peak. The value of time is $14 per hour. Any modeling of managed lanes would probably be done on a corridor or sub-area level, rather then network-wide.

The next steps in enhancing its modeling of managed lanes will be to expand the number of highways on which the managed lane scenario is modeled, improve the consistency between the managed and free links, and run the managed lane scenarios as part of the air quality conformity effort. However, given that incorporating road pricing into travel demand models is not well-developed in practice, BMC, for now, intends to address the concept of using express toll lanes within the model structure and await more guidance before performing more detailed analysis.

Panel Comments

- Adding minutes to the distribution model to reflect the toll may be double counting the effect of the toll since it is already incorporated by the reduction in volume on the untolled lanes.

- The model should take into account differences in the value of time by, for example, stratifying by income or trip purpose.
- One option is to wait for national research and guidance before delving too deeply into this topic.

I. Peak Period

Presenter: Paul Gilliam

Baltimore's model currently uses 6:00 to 10:00 a.m. for the morning peak period and 3:00 to 7:00 p.m. for the afternoon peak period. During the September 2004 peer review meeting, the panel recommended that BMC shorten its peak period times to allow for better time-of-day modeling, improve transit assignments, and better model managed lanes. After examining existing traffic count data, BMC determined that the actual peak periods were from 7:00 to 9:00 a.m. and 4:00 to 7:00 p.m. The model will be adjusted to reflect these peak hours.

BMC is considering developing peak spreading capabilities. This would involve:

- Developing relationships between peak hours and their adjacent off-peak hours.
- Summarizing peak period trip purposes.
- Conducting 24-hour counts for several capacity-constrained locations.
- Examining historical peak period trends for volume with respect to capacity.
- Developing a trigger value of v/c to determine when to implement peak spreading.

Panel Comments

- Re-evaluating the time frames of the peak periods was a good idea.
- A major unknown is the v/c ratio at which travelers will change their travel time.
- Also do not know to what times trips will shift.
- Based on experience from the Denver Regional Council of Governments (DRCOG), BMC should consider peak spreading on a corridor level rather than for the whole network.
- Automatically triggering peak spreading based on the v/c ratio might be problematic since v/c decreases under heavy congestion.
- If BMC implements this peak spreading scheme, it would be an expansion of the state of the practice. It might not be necessary for BMC to focus on this issue now.
- BMC should continue to study time-of-day variations to determine whether additional time periods should be incorporated into their model structure.

J. BPR Curve and Junction Delay

Presenter: Vimal Kumar

BMC's model uses distinct BPR curves for freeways and non-freeways. It uses a highway speed lookup table based on the roadway's functional classification and the land use density of the link. These speeds give the initial travel time and start the iterative process. Roadway capacities are determined using a lookup table based on the area and roadway types. BMC analysis has shown model speeds to be slightly lower than actual speeds. It plans to revise the BPR curve so that the model more accurately reflects actual speeds.

BMC is looking into the possibility of incorporating junction delay estimation in its model. Junction delay capability would improve speed and volume estimates on arterials. However, current methodologies for junction delay estimates are data intensive and time consuming. BMC staff wanted to hear the panel's comments on the usefulness of incorporating junction delay estimations.

Panel Comments

- The model could account for intersection and interchange delays in a given corridor through micro-simulation or another method simpler than a complete intersection analysis of the entire network.
- Using junction delay methodology to calculate intersection capacity would probably be a lot of effort and yield little benefit.
- The exponents in the volume-delay function (VDF) seem very high. It might be better to focus effort on improving the VDFs rather than on junction delay functions.
- It would be helpful to think in terms of travel times rather then speeds.
- Before spending too much time on intersection delay functions, BMC should compare free-flow speeds with mid-day speeds to make sure the model speeds are realistic.

K. Freight
Presenter: Gene Bandy

Another major component of Baltimore's travel demand model is its truck/commercial vehicle model. Truck types are split into heavy, medium, and commercial. The truck model, borrowed from Lehigh Valley, Pennsylvania, bases its truck trips on employment by type (industrial, office, and retail) and households and then adjusts for special truck zones, jurisdiction, and density.

As part of the upcoming Port of Baltimore Regional Landside Access Study, MDOT is collecting data on traffic counts near the port and conducting origin-destination studies for truck traffic. It will then identify critical highway and rail needs. Using data from this study, the travel demand model could be modified to include a "port" component.

Panel Comment

- BMC should work with MDOT on the upcoming port study to be sure that the study includes collection of data needed for the travel demand model.

L. External Station Survey
Presenter: Bala Akundi

The current model uses 42 external stations. Data for these stations was acquired through various studies conducted between 1985 and 2004 by BMC, MWCOG, and the Maryland Transportation Authority. BMC would like to conduct a new external station survey to obtain more detailed up-to-date data. The survey schedule depends on funding availability. The survey will gather data on the following:

- Trip type (X-I, I-X, X-X)
- Trip purpose

- Trip frequency
- Vehicle occupancy
- Vehicle classification
- Time of day distribution of travel

Data could be collected by gathering license plate numbers for vehicles making external trips and sending mail-back surveys to vehicle owners. Mail-back surveys tend to have low response rates, but, on high-speed roadways, personal interviews or stopping traffic for the survey is not feasible. BMC also proposes to track external travel behavior by matching license plate numbers for vehicles that enter and exit the Baltimore planning region. BMC also has to identify locations to be surveyed, and coordinate the survey with other MPOs around the Baltimore area..

Panel Comments

- The survey should be controlled for the time of year in which the data is collected because travel to the shore is surely seasonal.
- DRCOG conducted an external survey by stopping randomly selected vehicles.
- While surveys conducted at rest stops or through EZ Pass records may be less expensive, they have serious sample biases that probably cannot be corrected.
- BMC might consider doing a screenline survey.
- Methodologies for getting good external travel information are all complicated and expensive.
- BMC should coordinate any study of external trips with both MDOT and MWCOG, as proposed.
- The study should also be developed in such a way that trips through the combined Baltimore-Washington, DC region can be distinguished from trips between Washington, DC and Baltimore and from I-X to the Baltimore and/or Washington, DC study area.

M. Traffic Counts
Presenter: Bala Akundi

In the 2004 peer review meeting, the panel felt that the model needed more traffic count data for Baltimore City. BMC has since obtained additional data from the City of Baltimore and the State Highway Administration. In addition to working with Baltimore City to conduct additional traffic counts, BMC will collect 48-hour volume/class counts at approximately 90 screenline locations in the spring of 2005.

N. Master Network
Presenter: Brian Ryder

The transportation network consists of the highway network and the transit network. The base year for facilities, routes, frequencies, stops, and station locations is 2000. The current master network does not have bus lines, but it does include rail lines. BMC is working to get bus lines incorporated. The master network also includes walk access to rail, which is generated by TP+, and filtered through a MapBasic process and a spreadsheet process. BMC is currently constructing a master network in ArcGIS in which all current and possible future links will be maintained within a common database.

Appendix A. List of Abbreviations

BMC – Baltimore Metropolitan Council
BRTB – Baltimore Regional Transportation Board
CFG – Cooperative Forecasting Group
DRCOG – Denver Regional Council of Governments
EPA – Environmental Protection Agency
FHWA – Federal Highway Administration
FTA – Federal Transit Administration
GPS – Global Positioning System
HBO – Home-Based Other trip
HBW – Home-Based Work trip
I-E – Internal-External trip
I-I – Internal-Internal trip
MDOT – Maryland Department of Transportation
MPO – Metropolitan Planning Organization
MTA – Maryland Transit Administration
MWCOG – Metropolitan Washington Council of Governments
OBO – Other-Based Other trip
PECAS – Production, Exchange, and Consumption Allocation System
TAZ – Traffic Analysis Zone
TMIP – Travel Model Improvement Program
VDF – Volume-Delay Function
WBO – Work-Based Other trip

Appendix B. Meeting Agenda

Date: February 28, 2005
Time: 8:30 a.m. to 4 p.m.

8:30 Welcome and Introductions – Harvey S. Bloom

8:45 Purpose of the Meeting and Charge to the Panel – Frank Spielberg

9:00 Response to User Applications – Charles Baber
Proposed Work Program

10:00 Break

10:15 Analysis in Progress – Demographics
- Coordination with Washington, DC Metropolitan Region

10:30 Analysis in Progress – Mode Choice
- Mode Share Model Transfer
- Trip Generation Enhancements
  - Proposed New Purposes
  - Market Segmentation
- Trip Distribution Enhancements
  - Composite Time
  - Feedback

12:00 Lunch

1:00 Analysis in Progress – BMC Staff
- PECAS – Land Use Model
- Managed Lanes – Maryland's Approach
- Peak Period Analysis
- BPR Curve Update
- Freight – MDOT Port of Baltimore Study
- External Station Surveys
- Traffic Counts
- Master Network

3:00 Break

3:15 Question/Answer Session Between Panel, BMC Staff, and Others

3:45 Adjournment

Appendix C. Attendees

Name	Organization
Frank Spielberg	BMI-SG
Tom Rossi	Cambridge Systematics
Ken Cervenka	North Central Texas Council of Governments
Keith Killough	KLK Consulting
Jeffrey May	Denver Regional Council of Governments
Eric Miller	University of Toronto
Bruce Spear	FHWA
Eric Pihl	Federal Transit Administration
Ben Pickar	Howard County, Maryland
Bruce Spear	Federal Highway Administration
Patrick Fleming	Maryland Department of Transportation
Ann Steffes	Volpe Center
Dunbar Brooks	Baltimore Metropolitan Council
Paul Gilliam	Baltimore Metropolitan Council
Matt de Rouville	Baltimore Metropolitan Council
Charles Baber	Baltimore Metropolitan Council
Gene Bandy	Baltimore Metropolitan Council
Harvey S. Bloom	Baltimore Metropolitan Council
Brian Ryder	Baltimore Metropolitan Council
Vimal Kumar	Baltimore Metropolitan Council
Bala Akundi	Baltimore Metropolitan Council
	Baltimore Metropolitan Council