City of Bellevue

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TO: Bellevue Transportation Commission

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SUBJECT: Downtown Transportation Plan Update

INTRODUCTION

The update to the Downtown Transportation Plan will address mobility issues and challenges and support Downtown growth looking out to 2030.

On June 14, 2012, staff will review 2030 travel demand modeling background and assumptions in preparation for an in-depth review of the modeling results in July. Five distinct topic areas will be covered in the presentation and discussion:

- Measures of Effectiveness: We will briefly review the approved measures of effectiveness for all modes and discuss how the travel demand modeling contributes to the development of recommended projects.
- Background on the BKR Model: Staff will provide an overview of the development of the travel demand model
- Modeling Assumptions: These are the land use assumptions and the transportation system assumptions that will provide the baseline information for 2030. From this baseline, project ideas that may address mobility issues can be tested for their effectiveness.
- Using the BKR Model in the Planning Process: We will discuss how the information obtained from the BKR model will be used to identify potential roadway capacity projects

Questions and discussion about the BKR travel demand model are welcome, and if a more detailed review of the model is requested by the Commission that can be arranged with staff. No action is requested of the Commission at this meeting.

MEASURES OF EFFECTIVENESS

In December 2011, the Transportation Commission approved measures of effectiveness (MOEs) that will be used in the Downtown Transportation Plan Update to help identify and prioritize project ideas that address mobility issues. The City Council reviewed and approved of these in February 2012. These MOEs are based on international best practices adapted to Downtown

Bellevue. MOEs are qualitative and quantitative metrics that will be used to provide information on the performance of each project. Mobility metrics are "personalized" to describe the effect of a project on four types of users of the transportation system: private vehicle occupants, pedestrians, bicyclists, and transit riders. MOEs will also describe the mobility outcomes geographically: at a specific intersection or location, along a corridor, or for Downtown Bellevue as a whole. Sustainability metrics for Downtown are are also. Please refer to the "Transportation Issues Scoping Report" January 2012, pages 6-11 to review the specific MOEs for each mobility type. The document can be found online at: *http://www.bellevuewa.gov/pdf/Transportation/DRAFT_Scoping_Report_FINAL.pdf*.

Travel demand modeling will help inform MOEs in each category of mobility, and is particularly relevant to informing Sustainability Outcomes.

BACKGROUND ON THE BKR MODEL

In 1986, City of Bellevue staff built the Bellevue travel demand forecasting model in consultation with DKS Associates, Inc. - creating the first generation of the Bellevue model.

The BKR model is shorthand for the Bellevue-Kirkland-Redmond travel demand forecasting model, which was built in 1991 by Bellevue staff and RAO Associates with cooperation and support of Kirkland and Redmond - this is the second generation of the BKR Model.

The original BKR model was based on the late 1980s travel survey characteristics in the Puget Sound region. Since then, Bellevue staff have taken the lead to annually validate the base year model (code name MP-0) according to the traffic count survey data. In addition to the MP-0 base year model used by all three cities, Bellevue built a 6-year model for land use/ transportation concurrency analysis, a 12-year model for mid-range transportation facility plan (TFP) and environmental impact statements, and 20-year and 30-year models for long-range transportation planning purposes.

Bellevue has instituted a series of model improvements on the BKR model in the past few years - now as the sixth generation of the BKR model. In 2003 Cambridge Systematics, Inc. provided consulting services for short-term model improvements and Parsons Brinckerhoff Quade & Douglas, Inc. assisted with transit network coding and modeling. The staff team added "PM transit" into the model and has done many additional incremental improvements. In 2007 CH2M Hill added a "Non-Motorized" element for BKR. DKS recently conducted a review of the BKR model and developed a template for model documentation.

Two other transportation model types have been recently added to enable addition support for traffic operations planning. At the micro scale, the VISSIM model simulates traffic operations in the Downtown area or a smaller subset. At the meso scale, Dynameq is used for dynamic traffic assignment, and has been developed over most of the core BKR area. It shows "node

impedance" and the effect of the intersection delay. Using these modeling tools, it is possible to analyze particular issues when needed. Both VISSIM and Dynameq traffic operational models depend on specific input from the BKR travel demand model.

Attachment 1 is a glossary of some of the modeling terms used in this memo and in presentations on the BKR model and other transportation models. This attachment also includes a diagram that describes the basic elements of the model and the applications the program supports.

The Elements of the BKR Model

BKR is a traditional "four step" model: Trip Generation, Trip Distribution, Mode Choice, and Assignment. Before the trip generation step, current and future land use is estimated for each TAZ. The data include single and multifamily households to represent trip productions and square feet to be translated into jobs in sectors that include office, retail, institutional, college FTEs and K-12 at the attraction site. Factors about household composition from the prior decennial census are applied that typify those households in specific subareas, usually a composite of several TAZs.

- Trip Generation

  Trips produced by each TAZ are estimated using surveys from the Puget Sound Regional Council (PSRC). In a similar fashion, trip attraction rates are applied according to the jobs by type and volume in TAZs. Together these comprise trip generation.

- Trip Distribution

  Linking productions and attractions to determine the flows between specific TAZ origins and destinations by four trip purposes is done using a mathematical gravity model. The trip purposes are Home Based Work (HBW), Home Based Other (HBO), Non-Home Based (NHB) and Home Based School (HBS). Impedance matrices inform the convenience of travel connections between zones. This constitutes trip distribution.

- Mode Choice

  For the framework of the model both road and transit networks are coded in detail for the BKR area. The representation in the model includes specific links with lane count, capacity per hour, modes permitted, speed and volume delay function parameters. Nodes are coded to reflect specific turn penalties. Tolls, HOT lanes/fees and freeway ramp metering are coded also. The transit network is coded as an overlay with buses on the road and rail as separate routes. All routes are described with detailed itineraries showing factors about the network geography, headway during AM, Midday, and PM peak periods, vehicle type and capacity, and stops, dwell time, and end of line layovers.

The travel time "skims" are measures of the composite of congested speed on the network connecting each origin and destination. They are created for AM, Midday and PM peak periods for all modes. The mode choice involves monetization of travel times and other costs such as auto operation, tolls and parking rates for trips by zone pair by trip purpose. Penalties for transit waiting time and transfers also are evaluated. The relative mode choices reflect the household composition information from the trip generation combined with those monetized values and auto availability to determine mode choice at the person trip level. PSRC factors are used in BKR to indicate average vehicle occupancy to convert from person trips to vehicle trips. In sum, these all represent the mode choice function of the BKR model.

- Trip Assignment

Assignment of person trips to transit or private vehicle trips to the networks is the fourth step of the model. Runs are done for AM, Midday and PM peak. The set of mathematical equations within the model continues through multiple runs to assign travel paths by mode between zone pairs until all trips are accommodated. It continues until equilibrium, within a tolerated level, is achieved. Auto and Transit assignments are run separately. Portions in the interim are fed back into earlier steps before a final assignment is created.

In order to build a forecasting model, the base year is built and then compared to actual auto and transit count data to validate it. Once that has passed scrutiny the model is determined to be fit for forecasting. Then future year versions of the model are built according to requirements of the work program. Therefore, it is important to base travel demand forecasts on an accurate base year model.

Geographic Structure

The BKR model covers a broad geographic area. The most detailed zones are generally within the Bellevue, Kirkland, and Redmond municipal boundaries, plus associated fringe areas. These comprise the "internal" geography. The balance of the PSRC four-county region is considered the "external" geography and is borrowed in aggregate from PSRC.

The Traffic Analysis Zone (TAZ) structure for the BKR model is shown in Figure 1. The map on the left shows the entire region with zones that are groupings of the PSRC zone structure. The map on the right shows the internal BKR area TAZs maintained by the three partner cities. This TAZ structure is increasingly more detailed in urban areas – down to the block size as in Downtown Bellevue. This allows for a more precise determination of travel behavior in dense, urban areas.

Figure 2 shows the detail of the BKR TAZs in Downtown Bellevue as identified with smaller-sized numbers (1,2,3, etc) as compared to the few zones in the PSRC model TAZ structure that have larger numbers (294, 295, 296, etc).

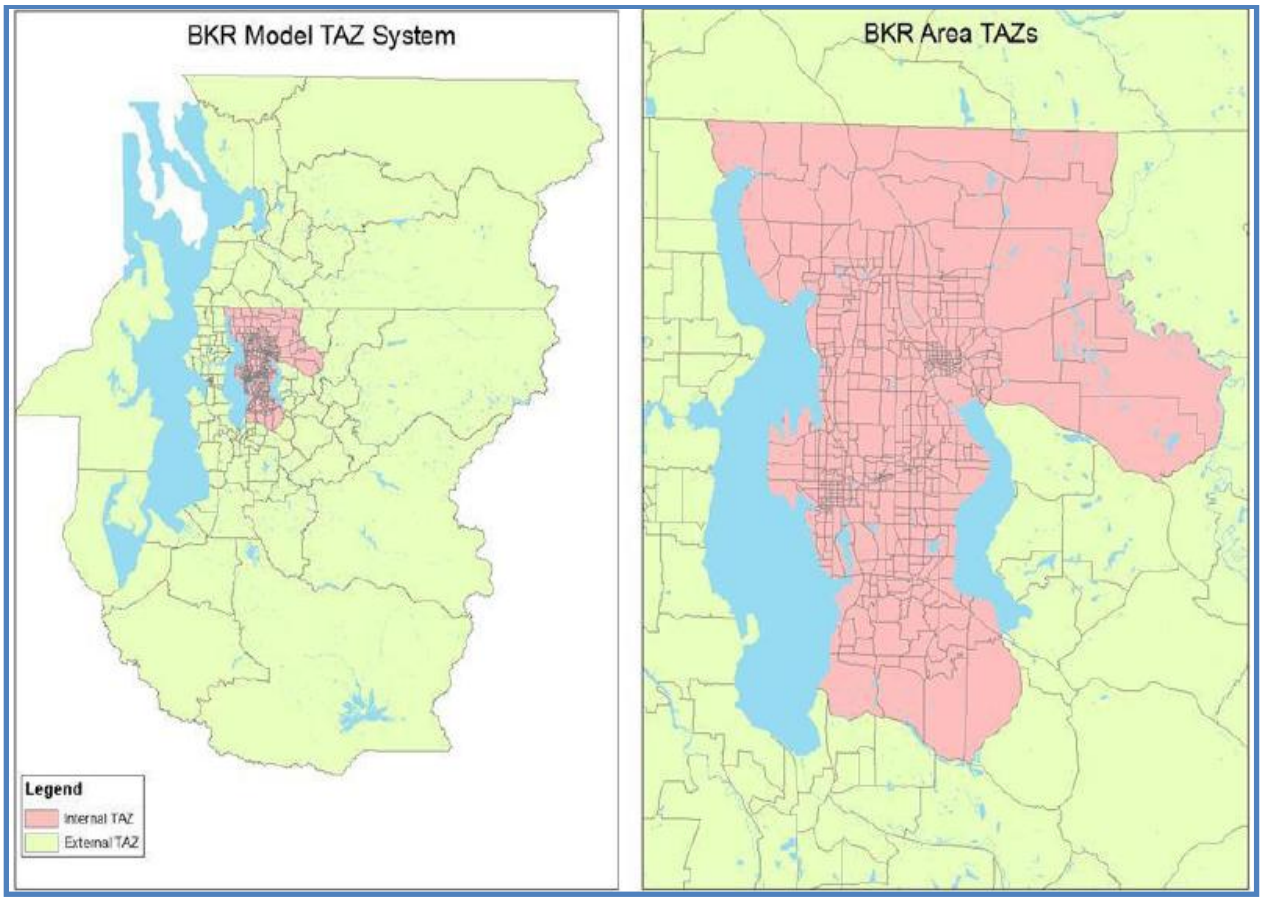

Figure 1

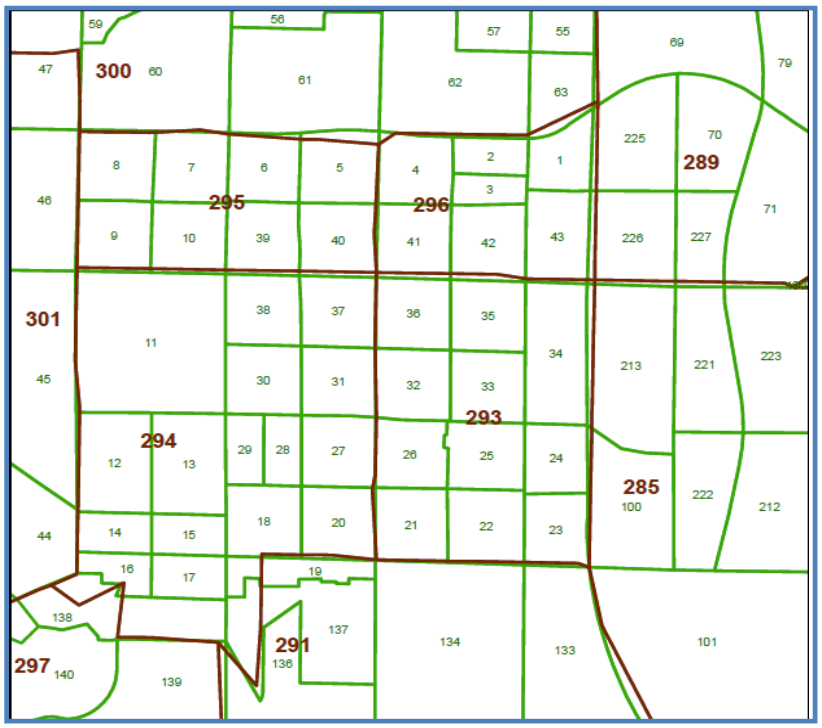

Figure 2

BKR MODELING ASSUMPTIONS

A 2010 Base Year modeling platform was established as the base for the BKR forecasting models used to analyze the travel demand in Downtown Bellevue. It reflects current land use and the existing transportation network. For the 2030 forecast year base case, or "No Build", both future land use and the "reasonably foreseeable" transportation network are projected.

Land Use

The number of employees and residents in Downtown Bellevue are both expected to increase significantly during the time frame for this analysis - 2010 to 2030. Table 1 shows the current and projected land uses that are the key factors in the travel demand forecast. A portion of the employment and population is allocated to each Downtown TAZ by Planning and Community Development staff based on the existing development and the growth potential under the existing zoning capacity.

Table 1

Downtown Bellevue	**2010**	**2030**	**Growth**
Employment	42,525	70,300	+27,775/65%
Population	6,858	19,000	+12,142/177%

Transportation

The transportation system roadway network of BKR traffic modeling comprises of a set of roadway links and roadway attributes. Both nodes (intersections) and links (roadways) are defined in the network at the macro level. In modeling parlance the BKR is a link impedance model, in which driving travel time and accessibility are represented in the direction, capacity and relative speed as a function of the lanes that comprise the roadway network. The capacities are attributed at the level of the entire link. The amending or adding of these features defines the planned or projected roadway projects that would comprise the network by 2030.

- Roadway Network 2010 Base Year

The 2010 Base Year Modeling Platform was established as the base for the BKR forecasting models used to analyze Downtown Bellevue travel demand. The 2010 BKR network reflects the existing roadway network. This network includes regional highways, Bellevue roadways, Redmond and Kirkland roadways, and other roadways in the region.

- Roadway/Transit Network 2030 Baseline

The assumed 2030 roadway network includes a variety of projects in Bellevue, adjacent cities and the broader Central Puget Sound Region. The assumed projects consist primarily of funded or committed actions by the State, regional and local agencies, combined with other projects

that are considered to be "reasonably foreseeable" by 2030. These projects comprise the 2030 additions to the 2010 Base Year for BKR purposes – they are, the "2030 Baseline".

The 2030 regional roadway network includes projects funded through the 2003 Transportation Nickel Package, 2005 Transportation Partnership Account (TPA) package, American Recovery and Reinvestment Act (ARRA) and selected projects included in the Puget Sound Regional Council's Destination 2030 plan. Within King County these funding packages support major regional projects such as the Alaskan Way Viaduct and Seawall Replacement Project, SR 520 Bridge Replacement and HOV Project and the I-405 Corridor Program. Local roadway projects listed in local agency comprehensive plans are also included.

The assumed 2030 roadway network does not include several projects that are adopted in the Bellevue Comprehensive Plan and the Downtown Subarea Plan. While these are important projects intended to enhance circulation, they were deemed to be not "reasonably foreseeable" within the 2030 timeframe due to budget constraints. Projects that are excluded from the 2030 Baseline roadway network include the following:

- NE 6th Street extension across I-405 to 120th Avenue NE
- NE 2nd Street extension across I-405 with ramps to and from the south
- Southbound off-ramp from I-405 to NE 10th Street
- Full interchange on SR 520 @ 124th Avenue NE to add ramps to and from the east

These projects may be included in alternatives considered in the Downtown Transportation Plan Update following initial screening through the Measures of Effectiveness. Their value to the transportation system – as individual projects or in aggregate with others - can be quantified through refined modeling analysis.

USING THE BKR MODEL IN THE PLANNING PROCESS

Typically just a few elements of the model results are requested or reported. For example, PM Peak hour demand is typically used for roadway design decisions. Deltas, or change between two networks representing alternative design or capacities, are another typical result. Resultant mode share results are unique to these forecasts.

Transit service is also represented in the BKR model with information about the frequency, type of coach, dwell and layover times, and route number, which are updated annually to reflect service changes. The BKR model includes transit service for the AM, Midday and PM Peak time periods. Transit can be evaluated in great detail from not only the resulting demand but also on the supply side to indicate service hours, route miles or load factors that are of interest to the transit system provider. In the BKR model only the revenue service representation is coded.

NEXT STEPS

At the next scheduled meeting on July 12, 2012 we will discuss results from the BKR travel demand modeling and review preliminary pedestrian project ideas.

ATTACHMENT

BKR Modeling Terms and Flow Chart