

Liljeblad, Kris; Ren, Jinxiang; Clark, Judith

Conference Paper

Modeled Travel Behavior Changes in Metropolitan Seattle, WA, USA in Response to Introduction of Bridge Tolls and Other Alternatives

50th Congress of the European Regional Science Association: "Sustainable Regional Growth and Development in the Creative Knowledge Economy", 19-23 August 2010, Jönköping, Sweden

Provided in Cooperation with:

European Regional Science Association (ERSA)

Suggested Citation: Liljeblad, Kris; Ren, Jinxiang; Clark, Judith (2010) : Modeled Travel Behavior Changes in Metropolitan Seattle, WA, USA in Response to Introduction of Bridge Tolls and Other Alternatives, 50th Congress of the European Regional Science Association: "Sustainable Regional Growth and Development in the Creative Knowledge Economy", 19-23 August 2010, Jönköping, Sweden, European Regional Science Association (ERSA), Louvain-la-Neuve

This Version is available at:

<https://hdl.handle.net/10419/118846>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

ABSTRACT

Modeled Travel Behavior Changes in Metropolitan Seattle, WA, USA In Response to Introduction of Bridge Tolls and Other Alternatives

Major water bodies predominate in the Seattle metropolitan region, including Lake Washington which separates the City of Seattle from eastside cities of Bellevue, Kirkland and Redmond. Two principal multi-lane highways cross Lake Washington east-west on floating bridges, linking Seattle and eastside communities. The State Route 520 Bridge is under design for replacement and tolls will be introduced to provide financing for the new infrastructure.

The subject of the study is a travel demand modeling analysis conducted by staff of the City of Bellevue, WA, USA subsequent to the City's development of an updated model with a transit patronage forecasting capability. Cross-lake travel was an important consideration in validating the model, and results offer insights into the effects of planned policy changes on cross-lake travel behavior, including shifts from Single Occupant Vehicles to Carpooling, to Bus and Light Rail Transit (LRT), and from the tolled SR-520 to the parallel non-tolled Interstate-90 facility. The results suggest significant trip diversion to the parallel non-tolled alternative freeway, but also improved travel efficiencies, with increases in car pooling and transit ridership. In addition, the analysis identified a positive ridership effect from establishing five feeder bus routes to serve planned new LRT stations in Bellevue.

Since the featured modeling work was completed, funding has been at least partially secured and implementation has progressed on both the bridge replacement and LRT extension projects based on separate, but comparable regional forecasting tools. The presentation will shed light on modeling to support planning and policy-making at the local and metropolitan scale.

Featuring results from the Bellevue-Kirkland-Redmond EMME/2 model, prepared by City of Bellevue, WA, USA. Co-authors: Jinxiang Ren, PE, Judith Clark and Kris Liljeblad, AICP, PTP

BACKGROUND

The Seattle metropolitan region, located in Washington State, USA is made up of four counties - King, Kitsap, Pierce and Snohomish. It had a population of 3.28 million in the year 2000¹, placing it approximately 15th among large urban populations in the United States.² The region is projected to grow its population by 39 percent to 4.54 million by 2030, accompanied by a 43 percent gain in employment. This robust growth would continue an existing trend based on a high quality of life including natural beauty, a diverse economic base, and a well-educated work force.

Several major water bodies have shaped the urban form. On the west is Puget Sound, and on the east is Lake Washington, a 214-foot deep fresh water lake which separates the City of Seattle from eastside cities of Bellevue, Kirkland and Redmond. In 2000 the eastside had a population of 431,000 and employment of 304,000, comprising 13% and 17% respectively of the regional totals. The 2030 projections are to add another 160,300 people (a 37% increase) and 177,500 jobs³ (a 58% increase).

For most of the 1980s and 1990s the region ranked among the top ten U.S. urban areas for traffic congestion including delay (travel time index) and congestion cost per P.M. peak traveler. In 2007, 66 percent of the peak period vehicle miles traveled and 51 percent of the system lane miles were considered congested.⁴ As shown in Figure 1, two principal multi-lane highways, Interstate 90 (I-90) and SR-520 cross Lake Washington east-west on floating bridges, linking Seattle and the eastside communities. The cross-lake bridges are among the most congested highways in the region due to the population and employment growth and associated east-west travel demands. Two major infrastructure efforts are underway to address travel demands, replacement of the SR-520 Bridge and construction of a light rail transit system extension, called East Link across the I-90 bridge to the eastside.

The SR-520 Bridge is 60 feet wide and 1.42 miles long, making it the longest floating bridge in the world.⁵ It was opened to traffic in 1963 as a tolled facility to serve a burgeoning suburban population, and the tolls generated approximately \$60 million in revenue before they were ended in 1979. Designed for 65,000 vehicles per day, the bridge now carries 115,000 with

no space for break-downs, transit/high occupancy vehicles, bicycles or pedestrians. The Washington State Department of Transportation (WS DOT) is designing a 6-lane replacement with bicycle and pedestrian lanes, expected to cost \$4.65 billion. About one-third of the cost is planned to come from tolls on both the existing bridges. Tolls will be introduced next year (in 2011) on the existing SR-520 Bridge and as soon as practicable on the I-90 High Occupancy Toll lanes which are now under construction to replace reversible express lanes (operating 2-lanes for HOVs toward Seattle in the AM peak and outward in the PM peak).

The region has been advancing transportation system capacity projects since the 1990s. In 1996 the region's voters approved Sound Move, a funding package that launched Sound Transit's systems of regional express bus, commuter rail, and starter light rail lines (called Link) serving downtown Tacoma and connecting downtown Seattle with Sea-Tac International Airport. These investments were tied to a land use strategy of focused development or redevelopment in walkable, transit-served urban centers.

In 2008 voters approved the Sound Transit 2 ballot measure of \$17.9 billion to further expand regional express bus and commuter rail services, and to build 36 more miles of Link light rail, forming a 55-mile regional system. This plan will extend Link light rail north from Seattle to Lynnwood in Snohomish County (North Link), south from Sea-Tac International Airport to Federal Way (South Link) and east across Lake Washington (East Link). East Link will connect downtown Seattle to downtown Bellevue, the medical district east of downtown Bellevue, the Overlake neighborhood with the Microsoft corporate campus, and continue on to downtown Redmond.



Figure 1: Map Showing I-90 and SR-520 Bridges and East Link Route (Courtesy of Sound Transit)

BKR MODEL DEVELOPMENT, ENHANCEMENT AND VALIDATION

This paper summarizes an analysis prepared by City of Bellevue staff to evaluate the City's updated travel demand model, after a new transit patronage forecasting capability was added in 2005. The travel demand model prepared by the City of Bellevue was not part of Sound Transit's high capacity transit planning effort that led to passage of the ST2 ballot measure, nor was it part of WS DOT's analysis of instituting tolling on the SR-520 bridge. It was solely an effort by City staff to verify that the model was reasonably predicting local and regional travel behavior. However, the modeling work was helpful in independently verifying what was happening on a regional level, and it can provide valuable lessons on policy initiatives like roadway pricing and transit service to new LRT stations.

The city's travel demand model, called the Bellevue-Kirkland-Redmond (BKR) model, was developed in 1992 in conjunction with the Bellevue-Redmond Overlake Transportation Study, or BROTS. This was a joint transportation planning study by the cities of Bellevue and Redmond for the Bellevue-Redmond Overlake area, which subsequently became the headquarters location of the computer software company Microsoft. Since its development, the BKR model has been continuously maintained and improved by City of Bellevue staff and contractors, with technical and financial support provided through an inter-local agreement with the cities of Kirkland and Redmond.

Beginning in 2002, a series of enhancements to the BKR model was initiated to improve its ability to forecast multimodal travel. These enhancements included the following⁶:

- The four step modeling process was integrated into a single EMME/2 modeling application
- The trip generation model was updated, consistent with the Puget Sound Regional Council (PSRC) model to use household cross-classified 2000 census data, such as family and worker size
- The trip distribution models were validated by the 1999 regional household travel survey
- The mode split models were calibrated to more accurately predict transit and rideshare

- Time of day (peaking) factors were updated based on the 1999 regional household travel survey
- A region-wide transit model, focused on the Eastside, was built and validated. This model implemented transit capacity constrained trip assignments⁷ and park-and-ride capacity constrained mode split process⁸
- Region-wide park-and-ride lots were updated annually with capacity counts and usage data to check the goodness-of-fit of park-and-ride lot modeling results
- Transit coverage percentages (percentage of areas within a quarter mile radius from each transit stop) were updated based on Geographic Information System data from transit agencies
- Special trip generators were updated in the BKR area and region-wide areas based on the PSRC travel demand model
- Home based school trip distribution was constrained to school districts only
- Average vehicle occupancies for Home-Based Work, Home-Based Other and Non-Home Based trips were updated to the 1999 regional household travel survey results
- Extra delay penalties were added to short-distance high occupancy vehicle (HOV) trips on freeways
- Generalized cost assignment procedures were implemented in the future 2030 BKR model with value of time parameters to reflect the road pricing on SR-520
- The 2030 PSRC regional trip table forecasts were used for the 2030 BKR model external areas to capture the regional travel demand behavior

This series of BKR model enhancements greatly improved the mode choice model validation and auto and transit trip assignments as shown in the following:

Table 1: Validation of 2005 Eastside Mode Choice Model vs. 1999 Household Survey

Figure 2: 2005 BKR Base Model PM Peak Hour Auto Screenline Model/Actual Count Ratio

Figure 3: 2005 AM Peak Hour Transit Screenline Model/Actual Ridership Ratio

As shown by table 1, the BKR model is predicting trips to within a range of 3/10th of 1% to 1% of the actual mode choice as surveyed at the household level in 1999 by PSRC. This indicates that the mode choice model is calibrated within acceptable error ranges.

Table 1: Validation of 2005 Eastside Mode Choice Model vs. 1999 Household Survey

Eastside Trip Types And Motorized Modes		Daily Motorized Person Trips	BKR MP0 R7 -2005	PSRC 1999 Household Survey	Absolute Difference
HBW Trips	Drive Alone	199,791	84.80%	85.80%	-1.00%
	Shared Ride	14,672	6.20%	5.20%	1.00%
	Transit – Walk Access	16,545	7.00%	7.20%	-0.20%
	Transit – Auto Access	4,690	2.00%	1.80%	0.20%
	Total	235,698	100.00%	100.00%	
HBO Trips	Auto	708,932	99.10%	99.30%	-0.20%
	Transit	6,488	0.90%	0.70%	0.20%
	Total	715,419	100.00%	100.00%	
NHB Trips	Auto	614,604	99.10%	98.80%	0.30%
	Transit	5,521	0.90%	1.20%	-0.30%
	Total	620,124	100.00%	100.00%	

Figure 2 shows how the BKR model's auto forecast volumes compare with actual traffic counts across 33 identified "screenlines". These imaginary lines are used to aggregate the traffic volumes for all roadways they cross. As shown by Figure 2, the ratios are very close to 1.00

which would indicate a perfect match between the model's prediction and the actual traffic count. The cross-lake screenline, including the SR-520 and I-90 bridges is a 100% match. Typically, a range of values within plus or minus 10% would indicate acceptable validation results.

Figure 3 shows a similar comparison for morning peak hour transit ridership between the BKR model predictions and actual ridership on bus routes operated by King County Metro and Sound Transit at 14 different screenlines. As shown by the ratios, the results range from 0.71 to 1.53, but most are very close to 1.00. The overall average ratio for the 14 screenlines is 1.01 which indicates that the BKR model is accurately predicting transit ridership in most portions of the study area.

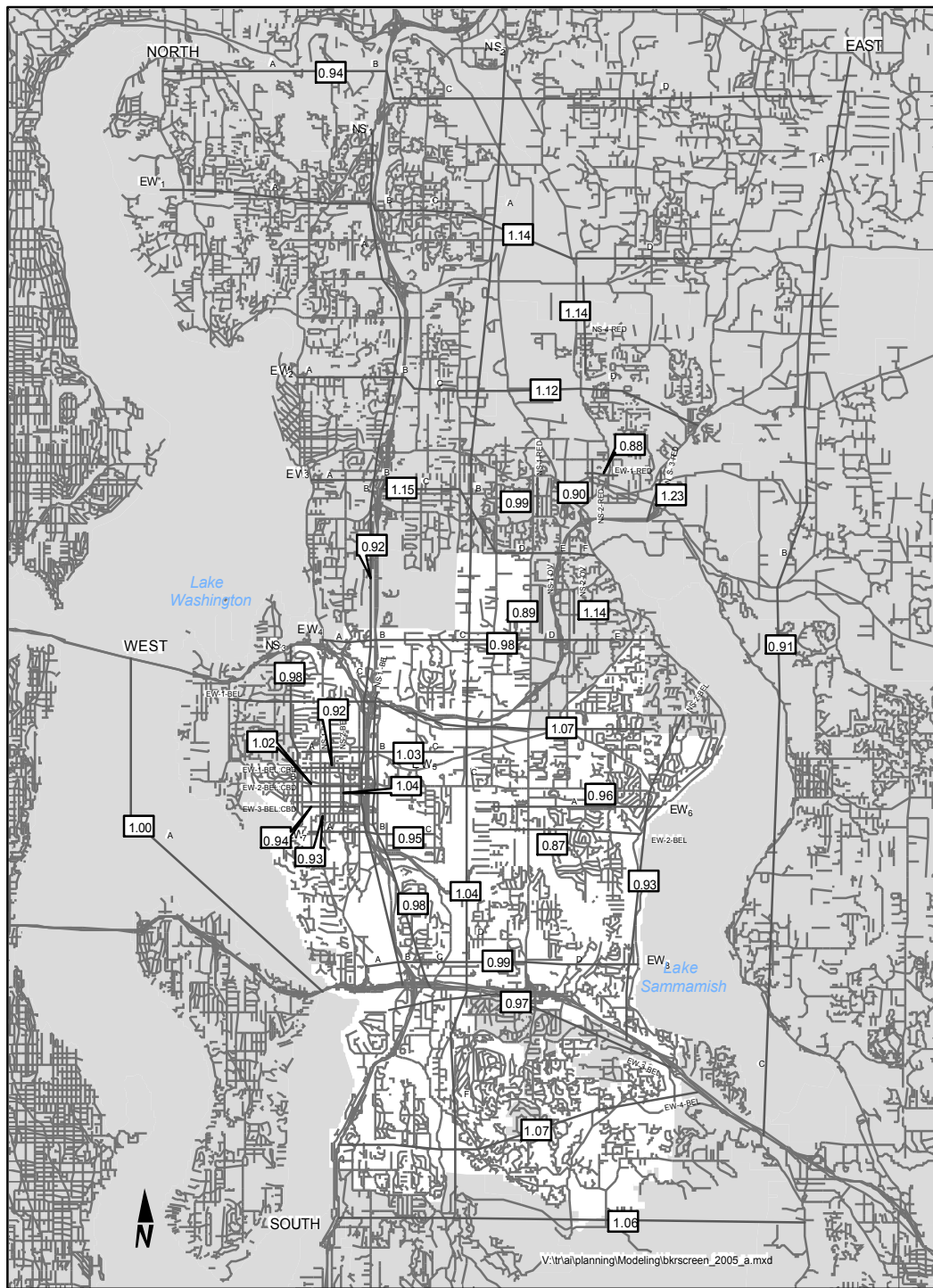


Figure 2: 2005 BKR Model PM Peak Hour Auto Screenlines: Model Forecast/Actual Count Ratio

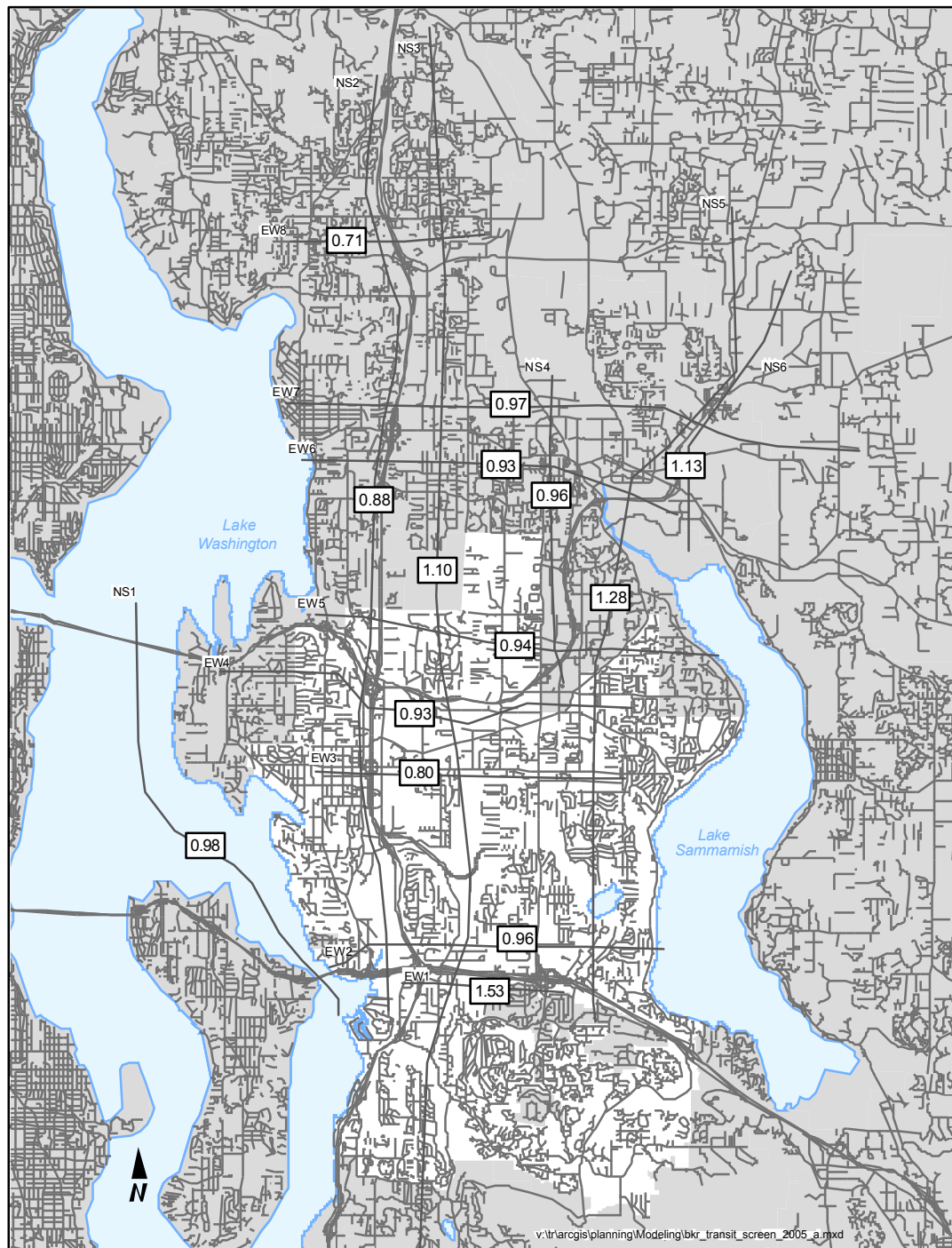


Figure3: 2005 Base Year BKR Model AM Peak Hour Transit Screenlines: Model Ridership/Actual Ratios

HIGH CAPACITY TRANSIT (HCT) ANALYSIS

Cross-lake travel was an important consideration in validating the model, because it captures the regional interactions between Seattle and the eastside for all modes of travel. City staff anticipated that the modeling results could offer insight into the effects of policy changes on cross-lake travel behavior. Among the changes anticipated during the 20-year planning period, the introduction of cross-lake Link LRT service was of major interest. We were especially interested in shifts of trips from Single Occupant Vehicles (SOVs) to LRT and bus, from SOVs to car-pooling, and from the tolled SR-520 to the parallel I-90 freeway, which we assumed would not be tolled (this has since changed).

In the high capacity transit ridership forecast, the City's Transportation Planning section chose 2030 as the forecast year in line with the Sound Transit planning horizon and the PSRC regional travel demand model. Assumptions were made for the 2030 BKR model consistent with regional transportation planning initiatives, such as:

- East Link LRT: Seattle-Bellevue-Overlake-Redmond with 11 eastside stations (S. Bellevue Park-and-Ride, Bellfield/Wilburton, two in downtown Bellevue, Overlake Hospital Medical Center, two in Bellevue's redeveloping Bel-Red corridor, two in Redmond's Overlake neighborhood near the Microsoft corporate campus, one in downtown Redmond and one further east).
- I-405 Implementation Plan: new half interchanges at NE 2nd Street and NE 10th Street as recommended in the 2020 Bellevue Downtown Implementation Plan, plus one added general purpose lane north of downtown Bellevue, and 2 added general purpose lanes south of downtown Bellevue
- Bus Rapid Transit (BRT): on I-405 with direct HOV access to/from arterial or park-and-ride lots
- I-90 with R8A completed: reversible express lanes converted to Link LRT, with 3 general purpose lanes and one HOV lane for 3 or more occupants (3+) in each direction
- SR-520 6-lanes with Tolls: consistent with WSDOT SR-520 toll assumptions, with \$3.50 charged in one-direction of travel only

- King County Metro Feeder Buses: 5 existing bus routes serving Bellevue would be modified as feeder bus routes to serve Link LRT stations
- Parking Costs: increased at an inflation rate of 1.5% annually – the same assumption as in the Sound Transit model
- Park-and-Ride Facilities: Add 8 new park-and-ride lots
- Central Link LRT in Place: From Seattle's Northgate neighborhood to SeaTac Airport
- Seattle Monorail Expansion: the then voter-approved Seattle Green Line plan was included
- Sounder Commuter Rail Lines: Planned north-south expansions were included for Everett, Seattle Downtown and Lakewood

Using these assumptions, a 2030 LRT ridership forecast was produced by the BKR model with an AM peak hour transit model platform. Daily ridership was estimated by converting the AM peak hour ridership (approximately 12.5% to 15.0 % of the current daily total) into future daily totals. 7,100 LRT riders were forecast in the AM peak hour at the cross-Lake Washington screenline (between Mercer Island and Seattle). Converting it resulted in an estimated range of 46,000 – 56,000 daily LRT riders on I-90 at the cross-Lake Washington screenline based on the 12.5% to 15.0% AM peak factor.

In June 2006, Bellevue's Regional Transportation Planning Manager reported the model results to Sound Transit: “Bellevue forecasts daily ridership in the range of 46,000 to 56,000, based on assumptions that factor in tolls on a six-lane SR-520, funded priority improvements on I-405 and I-90, greater availability of park-and-ride lot stalls, and a more extensive local transit feeder system on the Eastside.”⁹

Sound Transit reported its concurrent 2030 forecasts in the published East Link newsletter, in Winter 2007: “In East King County, population is expected to increase by approximately 30% and employment to double by the year 2030. The East Link project is projected to move nearly 45,000 people on the Eastside each day – 13 million per year – by 2030, taking thousands of cars off the road and providing a way through congestion in the most heavily traveled corridors.”¹⁰

The two reported 2030 daily ridership forecasts were very close although they were based on separate travel demand modeling model platforms, which both used PSRC regional travel demand and mode choice validation results per the regional household travel surveys in 1999. The results helped build confidence in the likelihood of ridership success by HCT among local planners and politicians, and ultimately voters approved the 2008 Sound Transit 2 ballot measure to fund the regional transit system expansion.

FUTURE SCENARIOS DESCRIBED

This section identifies the policy assumptions that were made to compare and contrast various future transportation conditions in the modeling analysis. By incrementally testing transportation policy scenarios one by one in the 2030 BKR model, we were able to answer the following questions:

- Will the introduction of tolls on SR-520 cause any travel shift to I-90?
- How will travel pattern change affect transportation system effectiveness on a system-wide scale or only for trips across Lake Washington?
- How will tolling compare with no tolling in terms of travel behavior changes, primarily mode choice changes? With the introduction of feeder buses? With implementation of a BRT system? or With expansion of the Seattle Monorail system?

To address these questions, five different scenarios were modeled. Completion of Sound Transit's East Link LRT was a common part of all the scenarios because it represented a committed city and Sound Transit plan (though unfunded at the time). Also, the SR-520 bridge replacement was assumed, with 2 general purpose lanes and 1 HOV lane in each direction, for a 6-lane cross-section. The five modeled scenarios are described below and summarized in Table 2:

- Alternative 1: Complete Package - Includes the SR-520 bridge replacement with tolls of \$3.50 on one-way travel, East Link LRT with five feeder bus routes serving Bellevue's Link stations, extension of Seattle's Downtown Monorail (Green Line), and Eastside BRT with direct access to I-405 freeway and transit stations.

- Alternative 2: Complete Package Minus SR-520 Tolls - No Tolls on SR-520, but including all other elements of Alternative 1.
- Alternative 3: Complete Package Minus SR-520 Tolls And Feeder Bus Routes - Includes the SR-520 Bridge replacement, East Link LRT, the Seattle Green Line, and Eastside BRT with direct access to I-405 freeway and transit stations.
- Alternative 4: Basic Policy Plus BRT - Includes the SR-520 Bridge Replacement, East Link LRT, and Eastside BRT with direct access to I-405 and transit stations (no tolls, no feeder bus routes, and no Seattle Green Line).
- Alternative 5: Basic Policy - Includes only the SR-520 Bridge replacement and East Link LRT.

Table 2: Alternative Transportation Scenarios

Alternative	New SR-520 Bridge	East Link LRT	Tolling SR-520	Feeder Bus Routes	Seattle Green Line	Bus Rapid Transit
1	Yes	Yes	Yes	Yes	Yes	Yes
2	Yes	Yes	No	Yes	Yes	Yes
3	Yes	Yes	No	No	Yes	Yes
4	Yes	Yes	No	No	No	Yes
5	Yes	Yes	No	No	No	No

TRAVEL MODELING AND TRANSPORTATION SYSTEM PERFORMANCE

- *Will the introduction of tolls on SR-520 cause any travel shift to I-90?*

The parallel I-90 freeway was not planned to be tolled in the future. Therefore, the introduction of tolls on SR-520 was expected to shift some motorists from SR-520 to I-90. Some motorists could change their travel mode from solo driving to car-pooling and taking

transit as these modes would not be tolled on SR-520. Figure 4 provides a comparison of Alternatives 1 and 2 which are the same except one has tolling on SR-520 and the other does not. On Figure 4 increased volumes are shown in red, and reduced volumes are shown in green. As shown, Alternative 1 (Tolling) would reduce drive-alone vehicle trips on SR-520 by 1,780 (in green) while drive-alone vehicle trips would increase by 1,000 on I-90 (in red) during the 2030 AM peak hour. The 1,000 vehicle trip increase on I-90 is directly caused by the tolling on SR-520. Where would the other 780 drive-alone vehicle trips have gone? They shifted modes from solo driving to transit and car-pooling. This conclusion is supported by the analysis on Figure 5, which also compares Alternatives 1 and 2, but for transit. It shows AM peak hour transit ridership increasing (in red) on SR-520 by 650 riders, and on I-90 by 780 riders. (The breakdown of the I-90 transit gain is 270 riders on buses and 510 on HCT.) Introducing tolling on SR-520 would generate an additional 1,430 transit riders in 2030 – that is about 27% ridership increase from the existing 2005 condition of 5,370 cross-lake bus ridership (Source: King County Metro).

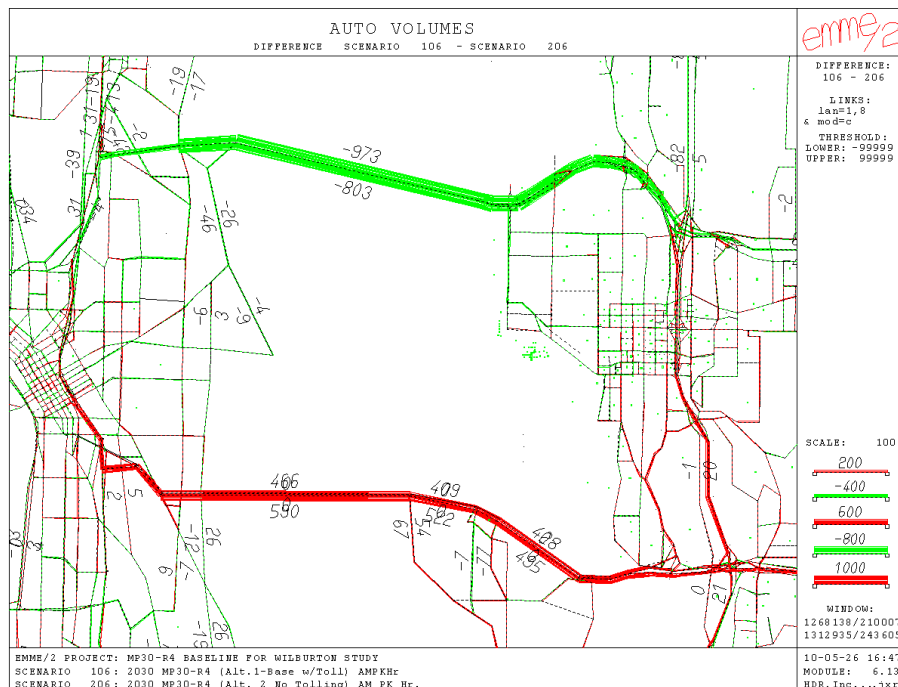


Figure 4: 2030 AM Peak Hour SOV Traffic Change, From No Tolling to Tolling

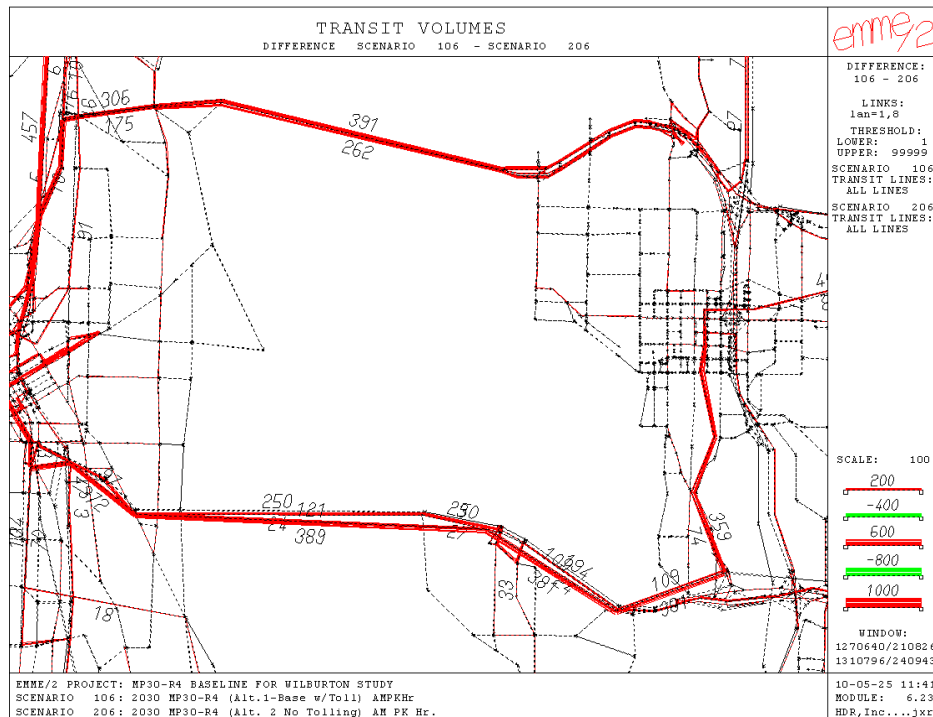


Figure 5: 2030 AM Peak Hour Transit Ridership Change, From No Tolling to Tolling

- How will travel pattern change affect transportation system effectiveness on a system-wide scale or only for trips across Lake Washington?

Table 2 provides system-wide and cross-lake transportation performance data for the AM and PM peak for each of the five alternatives under consideration, including vehicle miles traveled (VMT), vehicle hours traveled (VHT), and average travel speed. The most obvious difference among alternatives is evident between Alternatives 1 and 2, indicating that tolling SR-520 would affect the greatest travel behavior change among the alternatives evaluated.

Tolling SR-520 during the AM peak hour would cause significant reductions in VMT (-10,000 or -18%) and VHT (-520 or -35%), while increasing average speed on SR-520 from 38 to 48 miles per hour (+24%), indicating much improved operating conditions. However, a traffic shift to I-90 would increase its VMT (+6,480 or 9%) and VHT (+500 or 30%), decreasing its average speed from 43 to 36 miles per hour (-16%). These changes, shifting undesirable operating conditions from one bridge to the other, will not occur if tolls are

imposed on I-90 also, as is now planned. The overall system-wide data during the 2030 AM peak hour indicates that tolling would reduce VMT (-13,900 or -2%) and VHT (-1,900 or -6%). For trips across Lake Washington, VMT would be reduced by 3,520 and VHT by 10, representing a favorable 0.3% change.

Table 2: System-wide and Cross Lake System Performance during 2030 AM and PM Peak Hour

2030 AM Peak Hour	Systemwide			SR-520			I-90			Total Cross Lake		
Alternative	VMT	VHT	Speed	VMT	VHT	Speed	VMT	VHT	Speed	VMT	VHT	Speed
Alt1 (with Toll)	6,005,500	316,200	19	45,580	960	47	77,370	2,150	36	122,950	3,110	40
Alt2	6,019,300	318,100	19	55,580	1,470	38	70,890	1,650	43	126,470	3,120	41
Alt3	6,020,100	317,600	19	55,480	1,470	38	70,800	1,650	43	126,280	3,120	40
Alt4	6,012,700	316,800	19	55,550	1,470	38	70,990	1,660	43	126,540	3,130	40
Alt5	6,008,500	316,900	19	55,700	1,480	38	70,860	1,650	43	126,560	3,130	40
2030 PM Peak Hour	Systemwide			SR-520			I-90			Total Cross Lake		
Alternative	VMT	VHT	Speed	VMT	VHT	Speed	VMT	VHT	Speed	VMT	VHT	Speed
Alt1 (with Toll)	7,108,300	419,000	17	53,590	1,340	40	84,150	3,080	27	137,740	4,420	31
Alt2	7,121,300	420,900	17	59,700	1,870	32	78,240	2,340	33	137,940	4,210	33
Alt3	7,122,800	419,700	17	59,700	1,870	32	78,270	2,340	33	137,970	4,210	33
Alt4	7,119,000	419,600	17	59,600	1,860	32	78,280	2,340	33	137,880	4,200	33
Alt5	7,106,300	418,700	17	59,670	1,870	32	78,300	2,340	33	137,970	4,210	33

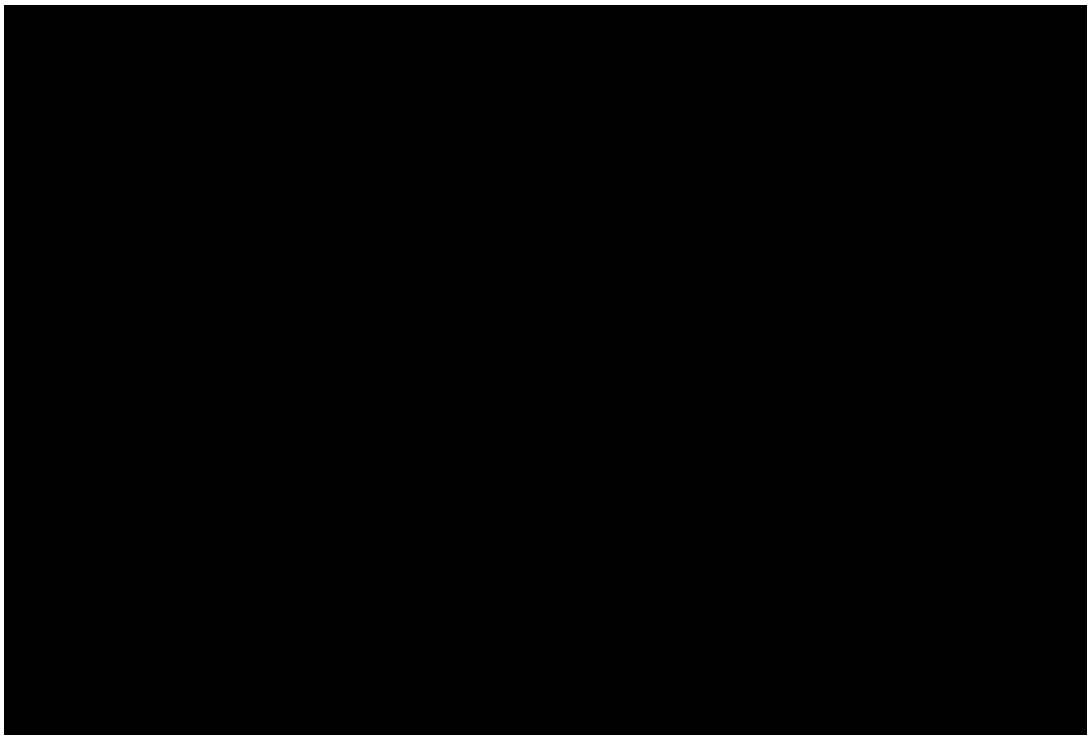
The comparison of Alternatives 1 and 2 for the PM peak hour shows the same significant VMT and VHT increase on I-90 as a result of SR-520 tolls. Average travel speed for total cross-lake travel would decline from 33 mph to 31 mph, and VHT would increase by +210 (4,420 with tolling vs. 4,210 without tolling) despite a cross-lake VMT decrease of -200. System-wide VMT would decline by -13,000 (-2%) and VHT by -1,900 (4%). Introducing tolling on SR-520 alone would cause undesirable impacts on I-90; however it would provide system-wide benefits by reducing region-wide VMT and VHT in both the morning and afternoon peak hours.

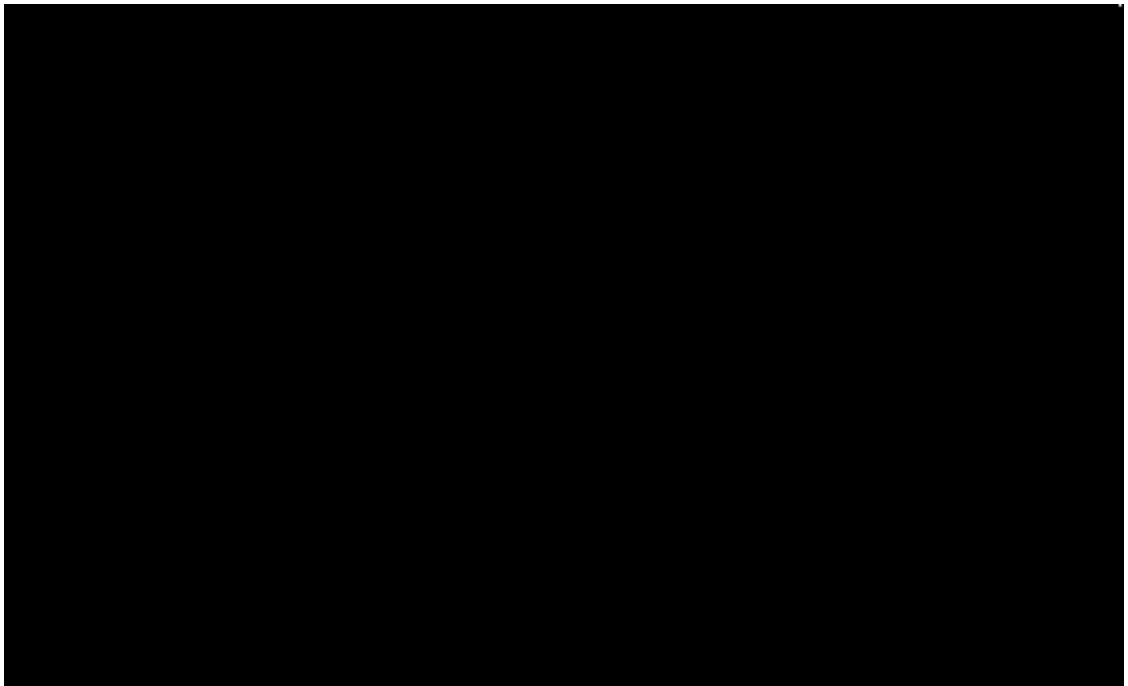
- *How will tolling compare with the introduction of feeder buses? With implementation of a BRT system? Or with expansion of the Seattle Monorail system?*

Figures 6 and 7 on the following pages compare Alternative 1 with the non-tolling alternatives 2, 3, 4 and 5. The non-tolling alternatives show drive-alone commute trips increasing up to +10,900, shared-ride 3+ trips declining up to -5,600, and transit commute trips declining up to -6,780. Mode choice shifts are much higher between Alternative 1

tolling Alternative and all of the non-tolling Alternatives. This indicates that the tolling scenario is the most important driver for shifting travel mode choice from solo commuting to carpool or transit in all contexts - region-wide and Eastside.

The analysis also shows that feeder buses and especially an eastside BRT system would have a positive impact on transit patronage, though not much impact on ride-sharing. Particularly for the cross-Lake Washington AM peak hour commute, similar travel behavior changes would be expected. Alternative 1 shows significantly lower solo commute trips, similar share-ride 3+ trips, and much higher bus and HCT patronage than the non-tolling Alternatives. Among the non-tolling Alternatives, the 2030 AM peak hour drive alone and shared ride 3+ commute trips would change very little except that Non-Feeder Buses (Alternative 2) and Non-BRT (Alternative 5) show lower bus and HCT patronage.





SUMMARY EVALUATION OF MODEL RESULTS

The results suggest significant trip diversion from the tolled SR-520 to the parallel non-tolled I-90 freeway, but also positively affected travel efficiencies, with increases in car pooling and transit ridership. Introducing tolling would be beneficial to system-wide performance.

The positive and negative changes in transportation system performance measures, including VMT, VHT and average speed, suggests that tolling policy will not always improve the local system performance, especially if there are non-tolled facility alternatives available. Our work suggested that tolling would cause a shift of volume from SR-520 to I-90, improving operating conditions on SR-520 but causing undesirable congestion on I-90. It is now planned to apply tolls to both the I-90 and SR-520 bridges, avoiding the undesirable trip diversion that our modeling indicated would occur.

Besides the trip diversion effects, tolling had outstanding effects on changing commuting travel behavior, especially for transit, such as buses and high capacity transit. Tolling contributed significantly to the forecast future transit ridership increase. Among all the policy assumptions modeled, tolling proved to be the most effective policy scenario to cause a shift of

travel mode, more than adding feeder buses to serve LRT stations, more than expanding the Seattle monorail, or building an eastside BRT system.

The analysis identified a positive ridership effect associated with establishing five feeder bus routes to serve planned new Link LRT stations in Bellevue. The same is true with the implementation of Bus Rapid Transit along I-405.

CONCLUSIONS

Since the featured modeling work was completed, funding has been partially secured and implementation has progressed on both the bridge replacement and LRT extension projects based on separate, but comparable regional forecasting tools. The HCT modeling and planning work, though performed for other purposes, was helpful in independently verifying what was happening on a regional level. The results helped build confidence in the likelihood of ridership success on cross-lake HCT, and ultimately voters approved the 2008 Sound Transit 2 ballot measure to fund the regional transit system expansion.

Tolling on both SR-520 and I-90 is now expected to generate funding to help replace the SR-520 Bridge with improved capacity and congestion management capability. It appears to be a highly effective tool for managing our unique transportation systems in the Seattle region, including water crossings and heavy peak period travel demands. Tolling proved to be the most effective strategy evaluated for shifting travel from solo driving to transit.

REFERENCES

-
- ¹ Puget Sound Regional Council, 2006 Population and Employment
- ² Texas Transportation Institute, Texas A&M University, 2009 Annual Urban Mobility Report
- ³ Puget Sound Regional Council, 2006 Population and Employment
- ⁴ Texas Transportation Institute, Texas A&M University, 2009 Annual Urban Mobility Report
- ⁵ Washington State Department of Transportation, SR 520 Bridge Facts, June 2010
- ⁶ 2006 Base Year BKR Model Report, August 31, 2007 Modeling and Analysis Group, Transportation Department, City of Bellevue, August 2006, “2005 Base Year BKR Model Report.”
- ⁷ Larry Blain, 15th International EMME/2 Users’ Group Conference, October 18-20, 2000, Vancouver, Canada, “Capacity Constrained Transit Assignment.”
- ⁸ Heinz Spiess, November 1996, “A Logit Parking Choice Model with Explicit Capacities.”
- ⁹ Bernard, Van de Kamp, City of Bellevue Regional Transportation Planning Manager, June 2006 Internal Report on “Bellevue HCT Ridership Forecast.”
- ¹⁰ Sound Transit Authority, Winter 2007, “East Link” publication.