

August 27, 2008

TO: CRC Pedestrian and Bicycle Advisory Committee
FROM: CRC Transportation Planning Team
SUBJECT: Pedestrian and Bicycle Demand Forecasts for I-5 Bridge

Executive Summary

Columbia River Crossing (CRC) staff, with input from the CRC Pedestrian and Bicycle Advisory Committee (PBAC), developed a methodology for forecasting year 2030 pedestrian and bicycle travel demand for an improved pedestrian and bicycle facility on I-5 across the Columbia River. The forecasts were developed to take into account the three primary factors related to pedestrian and bicycle demand: future land use, percentage of trips by mode, and walking and bicycling trip lengths.

Projected increases in population, employment and density throughout the I-5 corridor, including in downtown Vancouver, on Hayden Island and in North Portland, will increase walking and bicycling trips along I-5 over the Columbia River. In addition, pedestrians and bicyclists may choose to walk and ride longer distances due to the availability of an improved multi-modal system, the cost of driving or taking transit, for health purposes, and other reasons.

During peak summer conditions in 2007, about 80 pedestrians and 370 bicyclists traversed the Interstate Bridge on a daily basis. While about 450 pedestrians and bicyclists used the bridge, more certainly would have, but were discouraged from doing so because of the presence of narrow sidewalks, the sidewalk's proximity to highway traffic, loud traffic noise, and other physical attributes of the Interstate Bridge and connecting multi-modal infrastructure. In addition, commuting trips across the Interstate Bridge average 18 miles in length (compared to less than eight miles for most of the Willamette River bridges in downtown Portland), far outside the comfortable trip range of the vast majority of bicycle commuters, not to mention pedestrians.

Future pedestrian and bicycle trips over the I-5 bridge were forecast using mode share data from the Census Transportation Planning Package provided by the US Census, information from travel surveys conducted by the Bicycle Transportation Alliance for the annual Bicycle Commute Challenge, results from an ongoing bicycle trip study being conducted by Portland State University, and travel characteristics associated with the Hawthorne Bridge.

Average travel times, by mode, were converted into trip distances by mode, creating a matrix of pedestrian and bicycle mode shares. This enabled development of future scenarios that served as part of the forecasting methodology. These scenarios, developed by the PBAC, considered the forecasted number of trips from the regional travel demand model and factored them by the respective pedestrian and bicycle mode share percentages. Daily pedestrian and bicycle travel forecasts were developed as well. The projections focused on weekday conditions because regional river crossings typically experience higher demand on weekdays compared to weekend days.

Exhibit A summarizes the pedestrian and bicycle forecasting results.

Exhibit A: Existing and Forecasted Pedestrian and Bicycle Demands

Pedestrian Scenarios

Name	Description	Daily Volume	% Change over Existing
Existing (2007)	September 2007 data collection	80	-
P1(2030)	No change in existing mode share	600	650%
P2 (2030)	150% of existing mode share	1,000	1,150%

Bicyclist Scenarios

Name	Description	Daily Volume	% Change over Existing
Existing (2007)	September 2007 data collection	370	-
B1 (2030)	No change in existing mode share	900	150%
B2-a (2030)	300% of existing mode share	3,000	700%
B2-b (2030)	50% all trips 3 miles or less by bike, and 300% existing mode share > 3 miles	4,800	1,200%
B3-a (2030)	500% of existing mode share	4,900	1,,225%
B3-b (2030)	50% all trips 3 miles or less by bike, and 500% existing mode share > 3 miles	6,400	1,625%

As shown above, pedestrian and bicycle travel demands would increase substantially for the I-5 bridge by 2030. Pedestrian travel across the bridge would be expected to increase from 80 pedestrians today to between 600 and 1,000 daily walkers, an increase of 650 to 1,150 percent over current conditions. The number of bicyclists predicted to use the crossing would increase from 370 today to between 900 and 6,400 riders, an increase of between 150 to over 1,625 percent. Generally, the I-5 bridge would be expected to serve about five bicyclists to every one pedestrian.

Introduction

The Columbia River Crossing's (CRC) Purpose and Need statement, created by the CRC's 39-member Task Force, defines the transportation goals of the CRC project. One of the six stated goals is to improve mobility and safety for pedestrians and bicyclists across the Columbia River. Enhancing pedestrian and bicycle facilities is necessary because the current pathways do not conform to ADA accessibility or engineering standards. Connections to regional and local pathways on either side of the river are circuitous or non-existent. In addition, existing bridge pathway users feel unsafe and uncomfortable crossing the river in close proximity to highway traffic. To address these issues and others, and to make recommendations to the CRC Task Force, the CRC Pedestrian and Bicycle Advisory Committee (PBAC) was formed to further the goal of improving the pedestrian and bicycle transportation facilities as part of the overall CRC project.

CRC staff developed a methodology for forecasting pedestrian and bicycle demands across the Columbia River with input and advice from the PBAC. Changing land uses and forecasted increases in population and employment density in North Portland, Hayden Island and Vancouver are expected to have a significant effect on pedestrian and bicycle travel over the Columbia River. The higher employment levels and residences in these areas will increase the potential for short trips that are most susceptible to walking and bicycling. In addition, other effects such as higher energy prices, public health concerns and population growth may further increase demand for non-motorized travel between Portland and Vancouver.

This technical memorandum describes the methodology for forecasting pedestrian and bicycle travel demand in 2030. First, the data sources and inputs into the model are described, followed by a discussion of the forecasting approach. An explanation of the calibration process and verification of the methodology is provided. Then, the various scenarios that were modeled for future pedestrian and bicycle demand are discussed. Finally, the results and conclusions are provided.

Data Sources

Data for the pedestrian and bicycling forecasting include information about mode shares, outputs from Metro's regional travel demand model, and existing count data on the Interstate Bridge, as well as on the Hawthorne Bridge, the Willamette River bridge with the highest existing pedestrian and bicycle volumes.

Mode Share Data

An important data source for the pedestrian and bicycle forecasting was the Census Transportation Planning Package (CTPP) data from the 2000 US Census. The CTPP contains information about the average travel times, by mode, for journey to work trips. The CTPP bicycle mode share relationship by trip length for Portland is shown in **Exhibit B**.

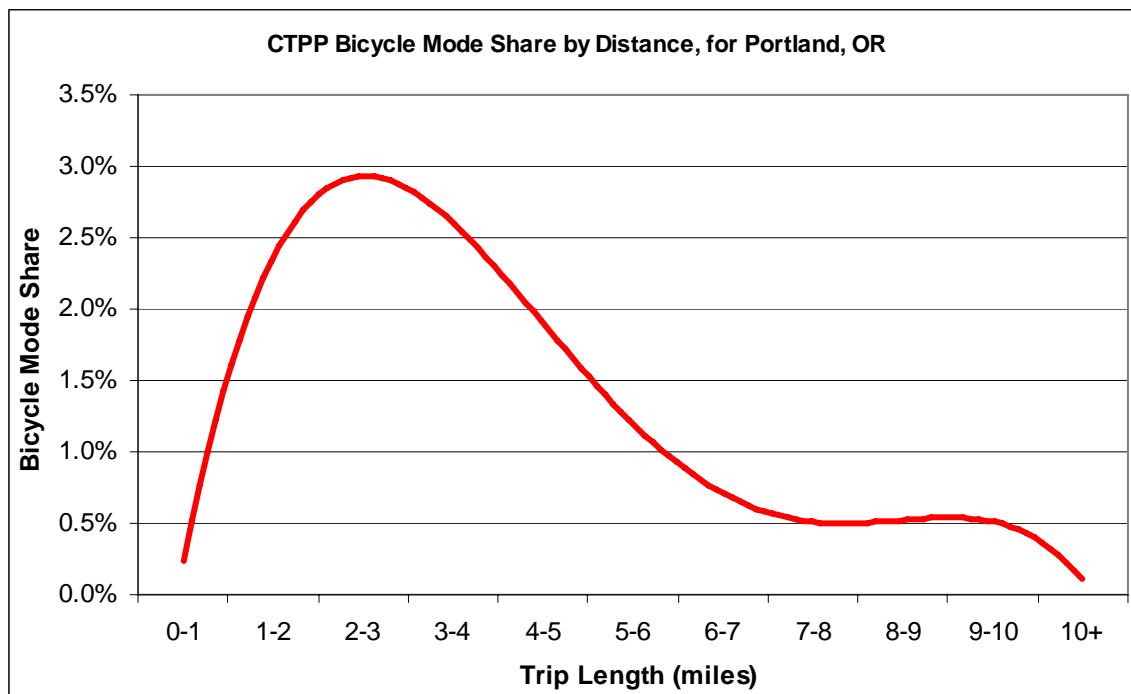


Exhibit B: Existing CTPP Bicycle Mode Share by Distance for Portland, OR

Though the CTPP data is statistically reliable for 2000, bicycling in Portland has increased substantially during the last eight years, and it seemed possible that the mode share to trip length relationship is slightly different today. Additional information was therefore needed to confirm that the 2000 mode share data was still an accurate measure of bicycling behavior in Portland.

The Bicycle Transportation Alliance (BTA), a local advocacy organization, sponsors the annual Bicycle Commute Challenge (BCC). The BCC event takes place annually during the month of September and encourages people to bicycle to work. As part of the event's registration process, BCC participants enter their one-way trip length data into an on-line database. An extensive analysis of this data shows that the

most common one-way bicycle commute trip is approximately three miles long and that the general distribution of bicycle trip lengths is quite similar to the City of Portland CTPP data for 2000.

In addition to the CTPP and BCC data, results from Dr. Jennifer Dill's bicycling study at Portland State University (PSU) provided additional confirmation of the CTPP and BCC bicycle mode share and trip length data. Dr. Dill's results show that the average length of all bicycle trips in her study was approximately three miles long and that the average length of a journey to work bicycle trip was about four miles long. Both measurements are consistent with CTPP and BCC information.

Finally, bicycle trip distance data from the Netherlands was compared with the information from the Portland-Vancouver region. The Netherlands has among the highest mode share of bicycle trips of all developed countries, possesses excellent bicycle system connectivity within its cities, and is a world leader in bikeway design and safety. The Netherlands data reveals that despite a country-wide 29 percent mode share for bicycling, the vast majority of one-way bicycle trips are less than 4.5 miles long. This data provides further confirmation that the majority of bicyclists' one-way trip distance is no longer than five miles.

The trip lengths by pedestrian mode share were assumed to have remained consistent with the 2000 CTPP data. Pedestrian mode share is only significant for trips less than two miles, and it was deemed unlikely that these values would have changed much since 2000 because the majority of walking commutes are already being made. **Exhibit C** illustrates the CTPP pedestrian mode share relationship by trip length for Portland.

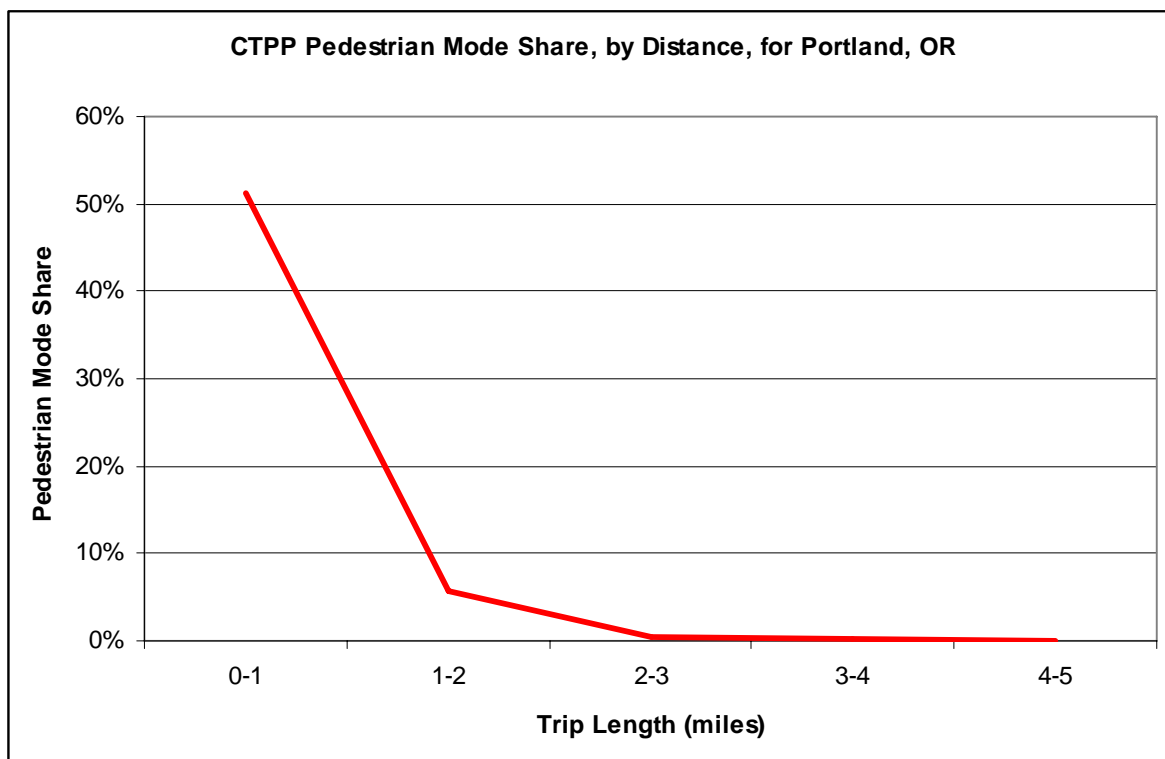


Exhibit C: Existing CTPP Pedestrian Mode Share by Distance for Portland, OR

Regional Travel Demand Data

The number of overall person-trips forecast to be made across the Interstate Bridge, by distance traveled, is an output from Metro's regional travel demand model. The Metro regional model determines travel patterns and demands based upon the region's land use and transportation planning documents.

Bridge Count Data

Fourteen-hour pedestrian and bicycle counts on the Interstate Bridge were conducted in September 2007 during the Bicycle Commute Challenge event. Existing count data from the Portland Department of Transportation (PDOT) for the Hawthorne Bridge was used to develop a factor to expand the 14-hour counts into daily totals. Data from the Hawthorne Bridge was used because it has the highest volume of pedestrian and bicycle activity on bridges in the Portland-Vancouver region, and therefore is the most useful data in applying a sensitivity analysis to the demand forecasts. Based on this factor, on a daily basis the Interstate Bridge was estimated to serve about 80 pedestrians and 370 bicyclists in 2007.

Forecasting Methodology

Pedestrian and bicycle forecasts for the I-5 bridge were developed by combining mode share and trip length data with outputs from Metro's regional travel demand model. The mode share data includes estimated percentages of pedestrians and bicyclists that make trips over the bridge. The regional travel demand data contains the forecasted total number of trips for all modes of travel which are expected to be made over the bridge. The combination of the mode share and travel demand data produces a forecast of daily pedestrian and bicycle volumes for the I-5 bridge.

Mode Share by Travel Distance

The CTPP data measures mode share by travel time. It was converted to mode share by travel distance by using a speed of ten miles per hour (equal to PDOT's methodology for their bicycle route signage) for bicycle trips, and a speed of four feet per second for walking trips. Recently presented data from Dr. Dill's PSU bicycle study found that bicyclists in her study averaged ten miles per hour. Mode share decreased for both pedestrians and bicyclists as the length of a trip increased, with the pedestrian trips exhibiting a faster rate of decline as trip length increased.

Number of Trips by Travel Distance

Metro's regional travel demand model was used to forecast the number of trips, by all modes, crossing the Columbia River. Forecasted trips were output from the model for two four-hour peak periods, i.e., 6 a.m. to 10 a.m. and 3 p.m. to 7 p.m.

Pedestrian and Bicycle Trip Forecasts

To calculate a forecasted number of trips for pedestrians and bicyclists, the mode shares for pedestrians and bicyclists were multiplied by the number of trips for each trip length increment. This process produced a forecasted number of pedestrian and bicycling trips for each trip length increment. The results for each trip length increment were summed together to forecast trips for each of the two four-hour peak periods. A factor, based on travel distributions for the Hawthorne Bridge in 2007, was then applied to convert the results for the two four-hour peak periods into a daily weekday total.

Model Validity Testing

To confirm the validity of the forecasting methodology, its ability to correctly predict trips under current conditions was tested. The methodology applied the existing conditions CTPP pedestrian and bicycle mode share and trip length data to the 2005 four-hour peak direction, peak period travel demand data from Metro's regional model. The results were then compared against actual 2007 pedestrian and bicycle count data for the Interstate Bridge.

Applying this methodology to the morning peak period for southbound travel produced an estimate of 24 pedestrian and 96 bicycle daily trips. The actual 2007 counts during this time were nine pedestrian and 62 bicycle trips. While the forecasting methodology overestimates the total number of trips, the actual difference is relatively small. The difference can be explained by the unmet latent demand for higher quality pedestrian and bicycle facilities than currently exist in the I-5 corridor. That is, the methodology appears to account for travel that is not occurring because of pedestrians and bicyclists that currently are unwilling to use the poor quality, non-standard facilities on the Interstate Bridge. If a new pedestrian and bicycle facility were sized based on an overestimation of demand in the future, the methodology would constitute a conservative approach in providing adequate capacity.

The results for the afternoon peak period for northbound travel estimated 61 pedestrian and 125 bicycle trips. The 2007 actual counts during this time were 19 pedestrian and 100 bicycle trips. As in the morning peak period, the methodology overestimates the number of trips, but the difference still remained quite small in relative terms. In addition, the estimate again appeared to capture latent demand, as the actual counts are less than the predicted numbers.

A second test of the validity of the CTPP data and the forecasting methodology was conducted for the Hawthorne Bridge in downtown Portland. The analysis of bicycle trips made over the Hawthorne Bridge reveals that the CTPP mode share is an accurate predictor of bicycle traffic on the Hawthorne Bridge, but only after the mode share is increased by a factor of three across all trip lengths in the peak travel direction (i.e., toward downtown in the mornings and departing from downtown in the afternoons). The CTPP mode shares require the three times factor to account for the fact that the Hawthorne Bridge is the most heavily traveled bridge by bicyclists in Portland, has wide, directional separated bicycling facilities, and has the most complete network of bicycling infrastructure leading towards and away from any Willamette River bridge in Portland.

Ultimately, measuring the validity of the CTPP data and understanding its usefulness in forecasting demand through the calibration process, led to the development of multiple modeling scenarios where assumptions about future travel demand and mode share could be fully tested.

Scenarios Modeled

Five bicycle and two pedestrian mode share scenarios were modeled based upon input from the PBAC. More bicycle mode share scenarios were examined than for pedestrians because of the greater variance in mode share by travel distance that is to be expected with bicycling compared to walking. The increased variance at the bicycle mode share level produces a greater range of forecasted traffic volumes.

It should be noted that the last decade has seen enormous growth in pedestrian and bicycle use throughout the Portland-Vancouver metropolitan region. Non-motorized traffic along Vancouver's Waterfront Trail has risen to over 260,000 yearly users since the trail was constructed. Downtown Portland's Eastbank Esplanade has been a major success in attracting pedestrian and bicycle traffic, and use of the Esplanade has increased since it opened in 2001. The Hawthorne Bridge is arguably Portland's most visible example of the growth in bicycle traffic, as average summer bicycle volumes have grown from about 1,900 daily riders in 1995 to over 6,400 daily riders in 2007, which constitutes almost an 11 percent compounded annual growth rate. Pedestrian volumes have also grown on the Hawthorne Bridge, and have been estimated at more than 8,000 daily walkers in 2007. These examples of growth in pedestrian and bicycle traffic influenced the development of the pedestrian and bicycle forecasting scenarios.

Bicycle Scenarios

Five different scenarios for bicycle demand for the I-5 bridge in the future year 2030 were modeled based upon input from the PBAC committee.

- B1 No change in existing mode share
- B2-a 300% of existing mode share
- B2-b 50% of trips 3 miles or less by bike, and 300% existing mode share for trips longer than 3 miles
- B3-a 500% of existing mode share
- B3-b 50% of all trips 3 miles or less by bike, and 500% existing mode share for trips longer than 3 miles

The first scenario assumes no change in existing mode share percentages. The second scenario assumes that the bicycle mode share over the I-5 bridge in 2030 will mimic the high use seen on the Hawthorne Bridge today. The third scenario is similar to the second, except it assumes that 50 percent of *all trips* crossing the I-5 bridge that are three miles or less would be made by bicycle.

The fourth scenario assumes that the bicycle mode share will be five times the existing mode share and 66 percent higher than the Hawthorne Bridge today. The fifth scenario is similar to the fourth, but assumes that 50 percent of *all trips* three miles or less will be made by bicycle.

The bicycle mode share curves for three of the five scenarios can be seen in **Exhibit D** (note that scenarios B2-b and B3-b are not displayed in **Exhibit D** for graphical clarity). The different scenarios were developed to account for a wide range of possible land uses, behavior and travel conditions in 2030 that might affect ridership. The 300% and 500% existing mode share means that for each trip length increment, the respective scenario has increased the mode share for that increment by three or five times.

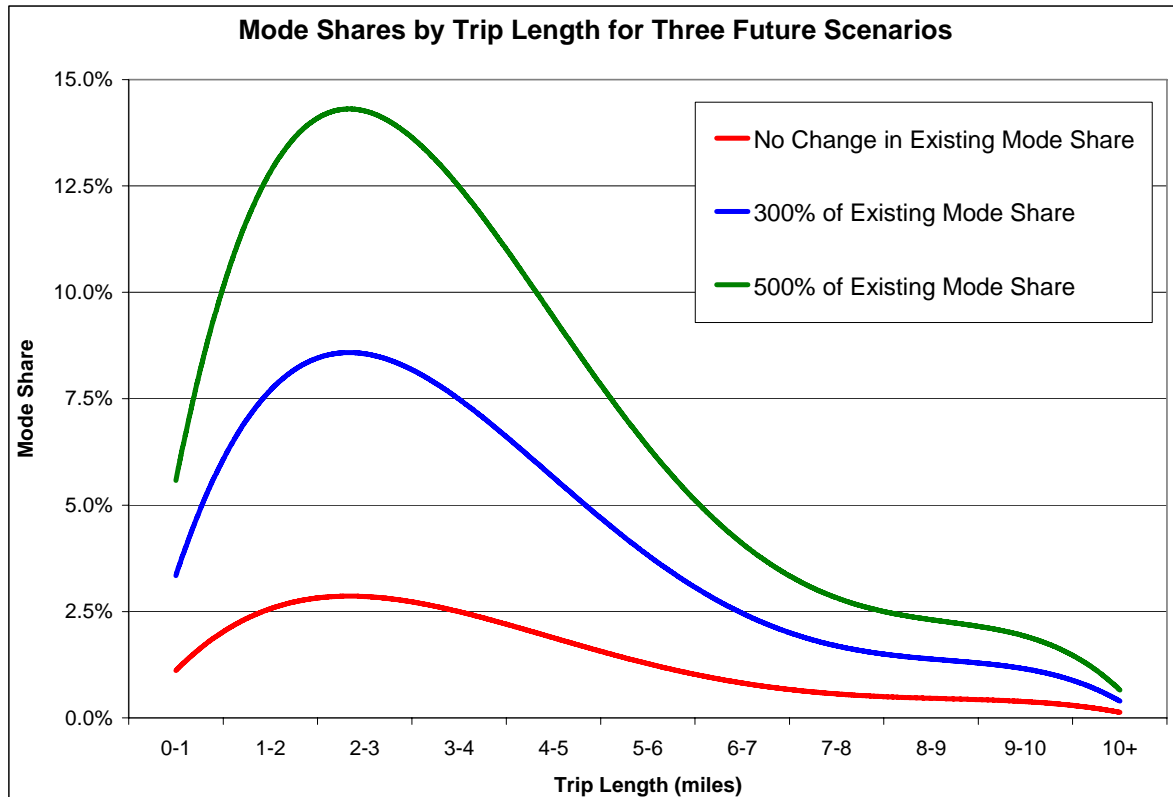


Exhibit D: Bicycle Mode Share Future Scenarios

Pedestrian Scenarios

Two scenarios were modeled for pedestrians for the I-5 bridge in the future year 2030. The mode share curves for these two scenarios can be seen in **Exhibit E**. Fewer scenarios were used for pedestrian forecasting in this case because there is a narrower set of variables that might affect walking conditions across the Columbia River.

The two pedestrian scenarios were modeled for year 2030 conditions:

- P1 No change in existing mode share
- P2 150% of existing mode share

The first scenario assumes that there will be no change in the existing pedestrian mode share. The second scenario assumes a 50 percent increase in walking mode share across all trip distances five miles or less.

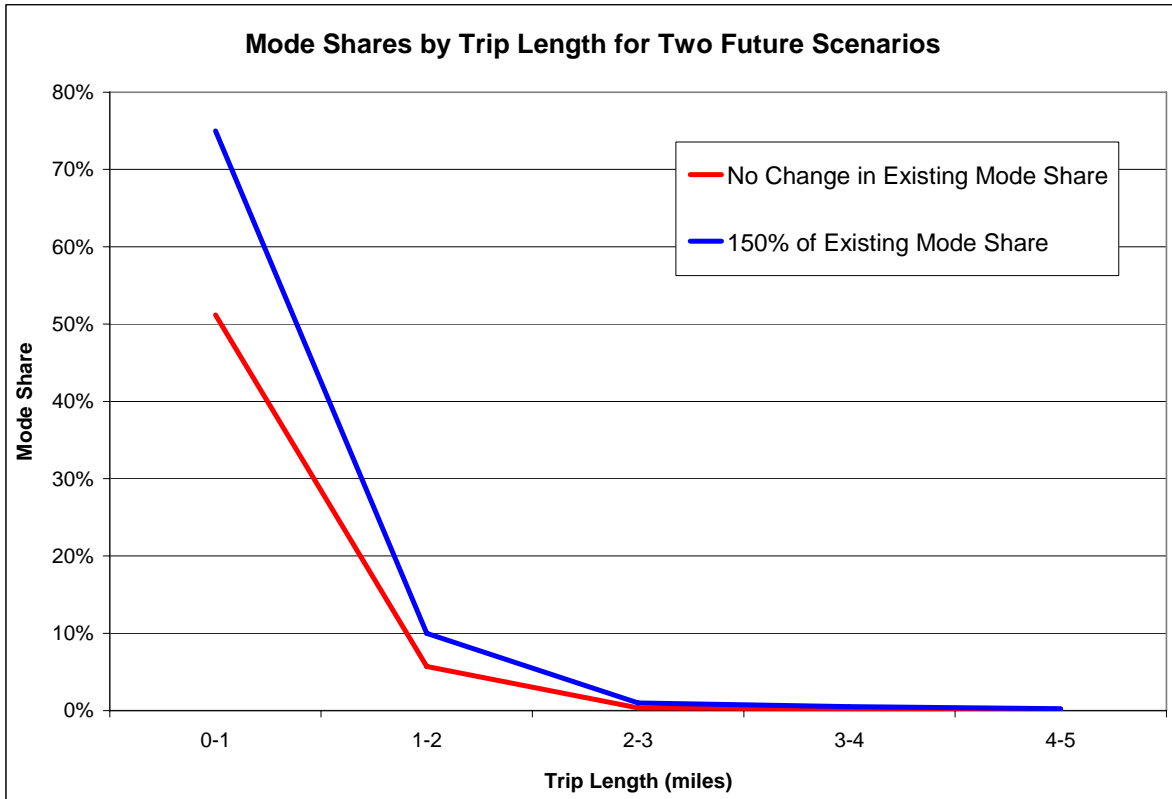


Exhibit E: Pedestrian Mode Share Future Scenarios

Future Pedestrian and Bicycle Forecasts

The results of the pedestrian and bicycle forecasts for year 2030 are presented in **Exhibit F**. For comparison, year 2007 volumes on the existing Interstate Bridge are shown. The pedestrian forecasts show a range of between 600 to 1,000 daily walkers on the I-5 bridge in 2030, a substantial increase from the 80 pedestrians observed in 2007. The more optimistic of the two pedestrian scenarios would result in a 1,150 percent increase in daily pedestrian volumes.

The bicycle forecasts show a range of daily usage between 900 and 6,400 riders, a significant amount of growth from the 370 bicyclists observed in 2007. This would represent an increase of between 150 and 1,625 percent over the existing count of 370.

The two scenarios that assumed all trips three miles or less across the I-5 bridge would be made by bicycle would produce between 4,800 daily bike trips (for scenario B2-b) and 6,400 daily bike trips (for scenario B3-b). These scenarios were modeled to measure how sensitive the forecasts are to a drastic change in bicycle mode share for short trips.

A sensitivity test was conducted on bicycle travel directions during weekday peak periods. In the summer of 2007, the majority of peak hour bicycle traffic during the morning peak period, about 65 percent, occurred in the southbound direction. In the afternoon, the reverse is true, with about 65 percent of bicyclists using the Interstate Bridge traveling northbound. Forecasted changes in land use, population and employment patterns would have an affect on commuting patterns by 2030. These changes would be expected to produce a bicycle commute pattern where southbound and northbound trips would be more evenly distributed during the peak periods. This reflects the expected growth in bicycle trips originating in North Portland as housing density increases and employment opportunities increase in Vancouver. In addition, growth in recreational or non-commute trips would be expected to increase substantially; this would create a more even distribution of trips between the peak commuting and off-peak hours compared to conditions in 2007.

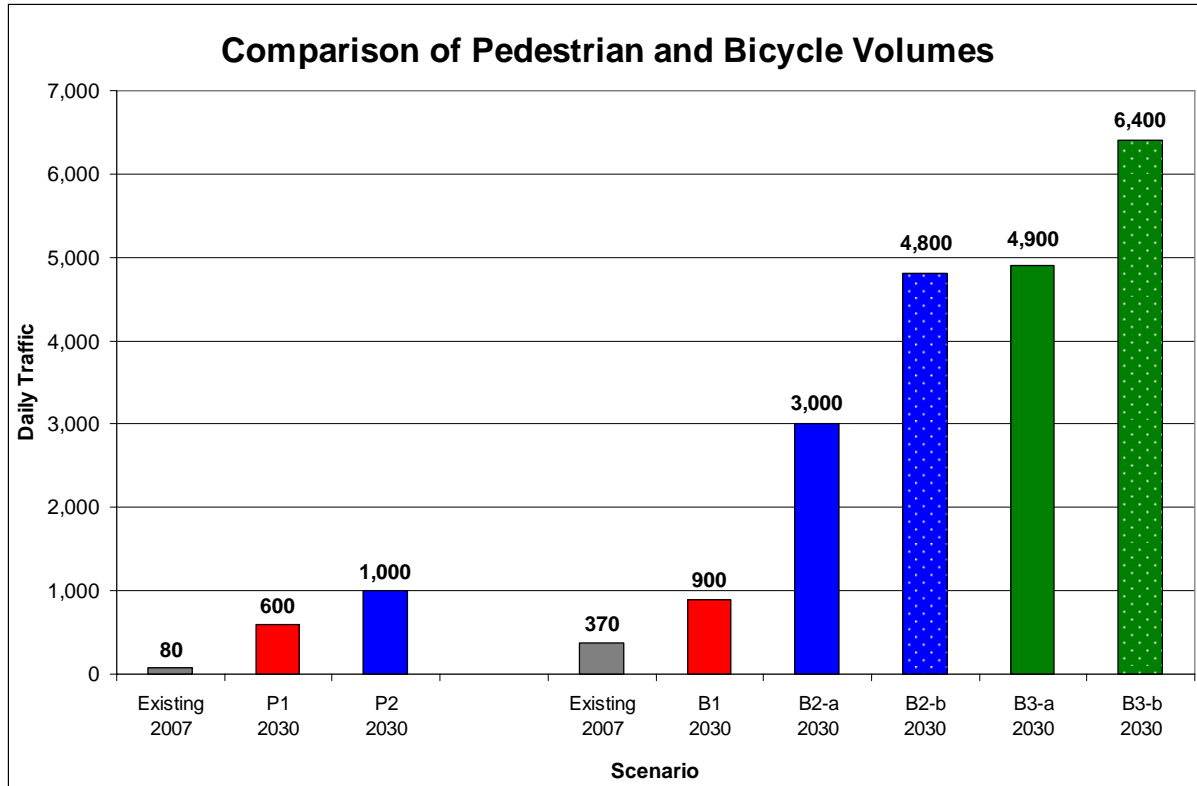


Exhibit F: Comparison of Pedestrian and Bicycle Volumes and Forecasts

Conclusions

The existing non-standard pedestrian and bicycle facilities across and connecting the Interstate Bridge discourage many pedestrians and bicyclists from crossing the Columbia River. The “build” alternatives proposed as part of the CRC project would provide vastly improved facilities for pedestrians and bicyclists. The CRC project proposes to improve connections in Vancouver, on Hayden Island and in North Portland that would enhance safety, wayfinding and the quality of the experience of crossing the Columbia River as a pedestrian and bicyclist. These improvements, based on the experience of similar changes provided to other bridges, multi-use pathways and their connections in the Portland-Vancouver area, would be expected to induce a significant increase in pedestrian and bicycle trip-making across the bridge.

The results of the forecasting scenarios reveal that pedestrian and bicycle travel demands would increase substantially for the I-5 bridge by 2030. Pedestrian travel across the bridge would be expected to increase from 80 pedestrians today to between 600 and 1,000 daily walkers, an increase of 650 to 1,150 percent over current conditions. The number of bicyclists predicted to use the crossing would increase from 370 today to between 900 and 6,400 riders, an increase of between 150 to over 1,625 percent. Generally, the I-5 bridge would be expected to serve about five bicyclists to every one pedestrian.

Interstate 5’s proposed pedestrian and bicycle facilities should be designed to not only accommodate projected future pedestrian and bicycle demands, but to also meet their functional needs. The I-5 crossing of the Columbia River would be over 6,300 feet long and would continue to include grades approaching five percent. These constraints, while a significant improvement over existing conditions, would pose challenges to some pedestrian and bicyclists.

To meet the goals of providing a facility to meet the needs of multiple user types, the PBAC has recommended that the new pedestrian and bicycle facility include a separated recreational pathway that is adjacent to two one-way bicycle lanes. This design would allow bicyclists of different speeds and

abilities to pass one another safely and provide adequate width to separate slower pedestrians from faster bicyclists. The proposed design would also provide areas for pedestrians to rest and to take in the view of the Columbia River. According to the PBAC, the new facility should be constructed with universal design standards, and provide excellent visibility, sightlines and pavement markings to alert users to potential conflict areas.

Details on the PBAC's recommendation for a "world-class" facility are included in the PBAC memorandum titled "Recommendation for World Class Pedestrian and Bicycle Facilities", dated June 17, 2008.