Attachment 19

Transportation Analysis Technical Memoranda

I-90 Sensitivity Analysis

Washington State Department of Transportation

SR 520 Bridge Replacement and HOV Program

I-90 Toll Sensitivity Analysis Technical Memorandum

Washington State Department of Transportation

February 2011

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Acronyms and Abbreviations

ESHB	Engrossed Substitute House Bill
ESSB	Engrossed Substitute Senate Bill
Final EIS	final environmental impact statement
FHWA	Federal Highway Administration
FY	fiscal year
GP	general-purpose (lanes)
HCT	high-capacity transit
HOT	high-occupancy toll
HOV	high-occupancy vehicle
PSRC	Puget Sound Regional Council
SR	State Route
TTR	Toll Traffic and Revenue Technical Report
WSDOT	Washington State Department of Transportation

Purpose of the SR 520/I-90 Tolling Sensitivity Analysis

Introduction

This technical memorandum reviews the potential transportation effects that tolling I-90 could have in conjunction with current and future planned tolling on SR 520. The sources for the assessment are a series of policy and financial planning studies examining tolling approaches for the State Route (SR) 520 corridor, which also considered potential tolls on I-90, as well as information from transportation forecasts developed for the SR 520 Bridge Replacement and HOV Program. The information developed through these sources is summarized here to provide context for the Final Environmental Impact Statement (Final EIS) for the SR 520, I-5 to Medina: Bridge Replacement and HOV Project, which assumes tolling on SR 520 to provide funding for the proposed improvements. While the EIS analysis does not assume tolling on I-90, regional long-range planning efforts, including the Puget Sound Regional Council's *Transportation 2040*, have been considering tolling on I-90 and other regional facilities, and the SR 520 Legislative Workgroup recommended tolling of I-90 as a potential source of funding for the SR 520, I-5 to Medina project.

The tolling policy and financial planning studies used in developing this analysis include the SR 520 Finance Plan, the 520 Tolling Implementation Committee's Tolling Report prepared for the Washington State Legislature in January 2009, and supporting tolling and traffic modeling and financial analyses conducted by the Washington State Department of Transportation (WSDOT). These other planning efforts considered tolling prior to the anticipated construction of the Evergreen Point Bridge as part of the SR 520, I-5 to Medina project (generally 2011 to 2016), as well as post-completion (2016 to 2017, and in the design year of 2030).

A companion technical memorandum is focused on the effects of tolling SR 520 only, and provides a more detailed discussion of the differences in approaches between the tolling studies and the Final EIS. It assesses the effects of tolling predicted by the various efforts, including key differences in their objectives and assumptions.

The analysis of tolls in the referenced policy and financial planning studies considered alternatives that would toll SR 520 or the SR 520 and I-90 corridors before and after construction of the I-5 to Medina project. They concluded that tolling has the potential to result in changes in travel demand and user behavior, including changes in the mode of travel, the volume of travel, time of the trip, and the route travelers may use to cross Lake Washington. The analysis has also helped to identify ways that tolling and other facility and system management decisions can help to provide a means of financing improvements.

Tolling Planned for SR 520

All-electronic tolling is planned to start on the floating portion of the Evergreen Point Bridge in the summer of 2011 under the SR 520 Variable Tolling Project, which is part of the Lake Washington Congestion Management Program. The purpose of this tolling is to manage congestion on SR 520 by tolling the existing four-lane facility. The Washington State Department of Transportation (WSDOT), with the Federal Highway Administration (FHWA), published an Environmental Assessment (EA) for the Variable Tolling Project on April 9, 2009. The EA disclosed the results of WSDOT's analysis of the effects of implementing tolling on the corridor prior to and during construction of the SR 520, I-5 to Medina Project (2010 through 2016). The FHWA issued a Finding of No Significant Impact (FONSI) for the variable tolling project on June 5, 2009. The SR 520, I-5 to Medina EIS evaluates the effects of tolling that is assumed to occur to fund construction of corridor improvements.

The Washington State Legislature, in Engrossed Substitute Senate Bill (ESSB) 6392, allowed revenue generated from the SR 520 Variable Tolling Project to be used to fund portions of the SR 520 corridor program that have already completed their environmental review and are proceeding toward construction. These include the SR 520, Medina to SR 202: Eastside Transit and HOV Project, as well as the construction of pontoons necessary for replacement of the Evergreen Point Bridge in the event of a catastrophic failure. The Legislature has also allocated funding from the tolls for the floating portion of the bridge and its landings, pending the completion of environmental review under the SR 520, I-5 to Medina project.

From its inception, the SR 520, I-5 to Medina project has been envisioned and publicly discussed as a toll project, and tolls on the facility were assumed for each of the build alternatives evaluated in the Draft, Supplemental Draft, and Final EIS. The purpose of these tolls would be to fund full construction of the new corridor. Therefore, in a true “no build” alternative for the SR 520, I-5 to Medina project, neither the floating bridge nor the Seattle portion of the project would be constructed, and funding for this purpose would not be required. However, revenue from the Variable Tolling Project would still be used to pay for the Eastside project and the construction of replacement pontoons. Bonds for these projects could be retired prior to 2030; hence, the EIS analysis has assumed that tolls would no longer be needed in the corridor after retirement of those bonds. Although regional tolling efforts, including tolling on I-90, are envisioned in the *Vision 2040* regional transportation plan, they are not currently planned or programmed for implementation.

Potential Tolling for I-90

Currently, there are no plans to implement tolling on I-90. Per State Legislature direction, WSDOT submitted an expression of interest regarding I-90 tolling to the Federal Highway Administration (FHWA) in 2008. In 2009, the U.S. Department of Transportation identified existing federal programs and regulations that could provide tolling authority for I-90. The scenarios of potential interest to WSDOT at the time were (a) tolling the general-purpose (GP) lanes; (b) tolling the express or high-occupancy vehicle (HOV) lanes (a concept known as “high-occupancy toll” [HOT] lanes because high occupancy and tolled vehicles would be allowed); or (c) a combination of both. The potential tolling limits were also not confined to the bridge portion of I-90, but could extend between Seattle and Issaquah. WSDOT is currently studying various tolling strategies at the regional level, but has not developed any specific proposals related to tolling of I-90.

Tolling Scenarios Evaluated in the Final EIS

Preferred Alternative

When complete, the Preferred Alternative for the Evergreen Point Bridge will include a total of six continuous lanes, with two GP lanes and one transit/carpool lane in each direction. The new transit/carpool lanes will accommodate an expected increase in transit and carpool use along the corridor. The Preferred Alternative will also have a pedestrian/bicycle path, as well as shoulder lanes to keep traffic flowing in the event of a vehicle breakdown.

The Preferred Alternative assumes that tolls to fund the project will be in effect in the project design year of 2030. For analysis purposes, because the toll levels had not been set at the time the Final EIS was being developed, the Final EIS assumed a variable toll rate depending on time of day, with a maximum toll rate of $3.81 in 2007 dollars. Previous analyses (described below) by the 520 Tolling Implementation Committee and related studies examined tolling scenarios similar to the tolling approach assumed for the

Preferred Alternative. They also considered dual corridor (tolling on both SR 520 and I-90) approaches, which were not assumed in traffic modeling for the Final EIS.

Although an I-90 toll was not assumed in traffic modeling for the Preferred Alternative, tolling on I-90 and HOT lanes on I-405 are among the items evaluated in the Final EIS's assessment of cumulative impacts because they may be considered as part of other projects and programs WSDOT and others may implement in the region. To help assess these cumulative effects, the Final EIS analysis included sensitivity tests of changes in the regional and cross-lake transportation networks, including year 2030 forecasts with the Preferred Alternative and the regional network with and without tolling on I-90 and other facilities.

No Build Alternative

The No Build Alternative being examined in the Final EIS does nothing to improve the existing facility from the east side of Lake Washington to I-5. The study area and its transportation functions are assumed to remain as they are today, providing a four-lane highway crossing the lake, with no pedestrian or bicycle facilities, no shoulders, and no HOV or transit facilities. The existing Portage Bay and Evergreen Point bridges crossing Lake Washington and its bays may not remain intact through 2030, the project's design year, but for purposes of analysis, the facility and its functions are assumed to remain available for use. Because the SR 520, I-5 to Medina project would not be built and therefore would not require funding, the No Build Alternative was assumed not to be tolled. However, to anticipate the potential for future tolling, WSDOT prepared a technical memorandum entitled "Tolling Sensitivity Analysis for the SR 520 No Build Alternative" (WSDOT, February 2011).

Planning Efforts Involving Tolling

There have been several recent planning efforts, separate from the SR 520 Bridge Replacement and HOV Program, that focused on decisions about the structure for tolling in the SR 520 corridor and possibly the I-90 corridor. The 520 Tolling Implementation Committee, a multi-agency partnership, involved the public and regional decision-makers regarding the regional policy questions that tolling will involve. These issues included tolling rates, timing of tolling (pre-construction and post-construction scenarios), and the general revenue and project funding implications of tolling. WSDOT also conducted a supporting forecasting and financial planning effort, resulting in the SR 520 Toll Traffic and Revenue Technical Report (TTR), which supported the work of the Committee and also provided information on additional revenue aspects of tolling. For example, the report discussed financial aspects of tolling related to the SR 520, I-5 to Medina project's implementation, including the cost and timing of expenditures, and the use of bonds or other funding mechanisms that would be available. This work also supported the development of the SR 520 Finance Plan.

Both of these efforts applied the Puget Sound Regional Council (PSRC) travel demand model to help support their analysis, using the same land use, population, and employment assumptions that were applied in the forecasts used for the SR 520 Bridge Replacement and HOV Program. However, their objectives and approaches were different for those used in the SR 520 Final EIS transportation analysis. More information on these studies is provided below.

Analysis of SR 520 Tolling and Traffic (2008-2009)

In April 2009, WSDOT completed the Toll Traffic and Revenue Technical Report. The report analyzed SR 520 tolling scenarios that had been developed for the SR 520 Finance Plan, which was coordinated with the work of the 520 Tolling Implementation Committee. The report documented the methodology and technical findings of the toll traffic and revenue projections prepared for SR 520 and I-90, and updated an earlier draft report from 2008. The results of this report are provided in Attachment B. These efforts were directed by the Washington State Legislature and the Governor through ESSB 6099 and Engrossed Substitute House Bill (ESHB) 3096, in support of developing the SR 520 Finance Plan. They built on the work performed by the 520 Tolling Implementation Committee, as well as a 2004 SR 520 Toll Feasibility Study, and a Funding Alternatives Report by the Washington State Treasurer completed in early 2007.

The TTR comprised the following:

- Examined a range of variable toll strategies, including 13 tolling scenarios considered in the SR 520 Finance Plan, with both SR 520-only scenarios and SR 520 and I-90 scenarios, and included SR 520 post-completion travel in the horizon year of 2030.
- Evaluated effects of tolling “short segment” trips between I-5 and I-405 that do not cross Lake Washington.
- Evaluated tolling the existing bridge prior to construction.
- Assessed the potential cross-lake traffic impacts of alternative future highway and transit network assumptions, including the various improvements to SR 520.
- Included detailed model forecasts of travel demand on SR 520 and the regional transportation system with variable toll strategies, which were compared to existing conditions and future No Build conditions.
- Provided predictions of changes in the mode of travel, as well as potential diversion of trip routes or destinations with various toll scenarios, which were compared to a baseline six-lane SR 520 scenario with no tolls.
- Provided a net toll revenue analysis (including toll operations and maintenance, and facility operations and maintenance cost projections).

Modeling Tools Applied

Two sets of highway and transit networks were used in the analysis of toll scenarios in 2008. These networks were based upon the assumptions for the level of development of other “background” highway and transit facilities, as well as either the existing or replaced Evergreen Point Bridge. The two basic network assumptions were categorized as a “Pre-completion” Transportation Network (2010 through 2016), and a “Post-completion” Transportation Network (2016 through 2030).

The pre-completion network reflected today’s transportation system, while the post-completion network assumed a variety of currently funded projects throughout the region, including high-capacity transit (HCT). The pre-completion highway networks assumed the same operating conditions on I-90, SR 520, I-405, and SR 522 as today, including today’s reversible roadway operations on I-90. The primary change to today’s transit networks was to assume some level of increased transit service to match what is proposed as part of the Lake Washington Urban Partnership, which would increase transit service across SR 520 in the near term.

520 Tolling Implementation Committee Tolling Report

This Committee report, developed in response to direction provided by the Washington State Legislature in 2008, evaluated tolls as a means of financing a portion of the SR 520 Bridge Replacement and HOV

Program. The Committee's members were Bob Drewel, Executive Director of PSRC; Paula Hammond, Washington State Transportation Secretary; and Richard "Dick" Ford, Washington State Transportation Commissioner. The Committee's work efforts included research into other tolling programs, detailed travel demand modeling by applying the PSRC's regional model, financial analysis and planning, and extensive public and interagency outreach. The Committee also recommended potential mitigation measures for diversion and other effects that could possibly result from tolls. The Committee's efforts engaged citizens and local and regional leadership in the evaluation through open houses, workshops, presentations, surveys, and draft findings provided for public review. The Committee reported to the Governor and the State Legislature in 2009.

The Committee and its staff developed and evaluated ten scenarios with tolls on SR 520 and on both SR 520 and I-90, and presented its results to the public in the summer of 2008. Based upon the comments received, six additional scenarios were defined, analyzed, and brought back for further public review in the fall. The scenarios included tolls on SR 520 only, or tolls on both SR 520 and I-90, and examined the effects of different rates and timelines for tolling on one or both of the facilities, as well as whether tolls would be imposed at a single location in a corridor or in several locations.

Other Resources

In addition to the technical and policy efforts undertaken by the tolling committee, an independent peer review of the tolling model and the traffic efforts was also undertaken in support of a subcommittee of the Joint Transportation Committee of the Washington State Legislature (also known as the 2211 committee). The peer review panel members were Chuck Purvis of the Metropolitan Transportation Commission (San Francisco), Erik Sabina of the Denver Regional Council of Governments, Teresa Slack of the Georgia State Road & Tollway Authority, and Richard Walker from the Portland Metro MPO.

The peer review group was charged with evaluating the modeling techniques used to generate information on traffic, particularly for reliability and credibility, assessing the model assumptions on tolling and traffic, and recommending any additional refinements or changes to the modeling procedures and processes.

Tolling Scenarios

What type of tolling is planned on SR 520 in the near future?

In spring 2011, the Washington State Legislature adopted a schedule of toll rates for the existing Evergreen Point Bridge as part of the SR 520 Variable Tolling Project. The rates were recommended by the Washington State Transportation Commission, which had been instructed under ESSB 6392 (March 2010) to set a variable schedule of toll rates to maintain travel time, speed, and reliability on the corridor and generate revenue for the SR 520 Bridge Replacement and HOV Program. Tolls are currently planned for implementation in summer 2011. As noted previously, the current tolling program on the existing corridor would remain in place until completion of the new Evergreen Point Bridge under the SR 520, I-5 to Medina project. At this point, it is anticipated that the Legislature would make decisions about subsequent toll levels based on project funding needs and the new 6-lane configuration.

What alternative tolling approaches were previously examined in the policy and financial planning studies?

As noted above, various other analyses of tolling have been done in conjunction with the Lake Washington Congestion Management Program and under direction from the Legislature. These analyses had different objectives and used different approaches than the modeling done for the EIS. Their methods and assumptions are summarized below.

520 Tolling Implementation Committee

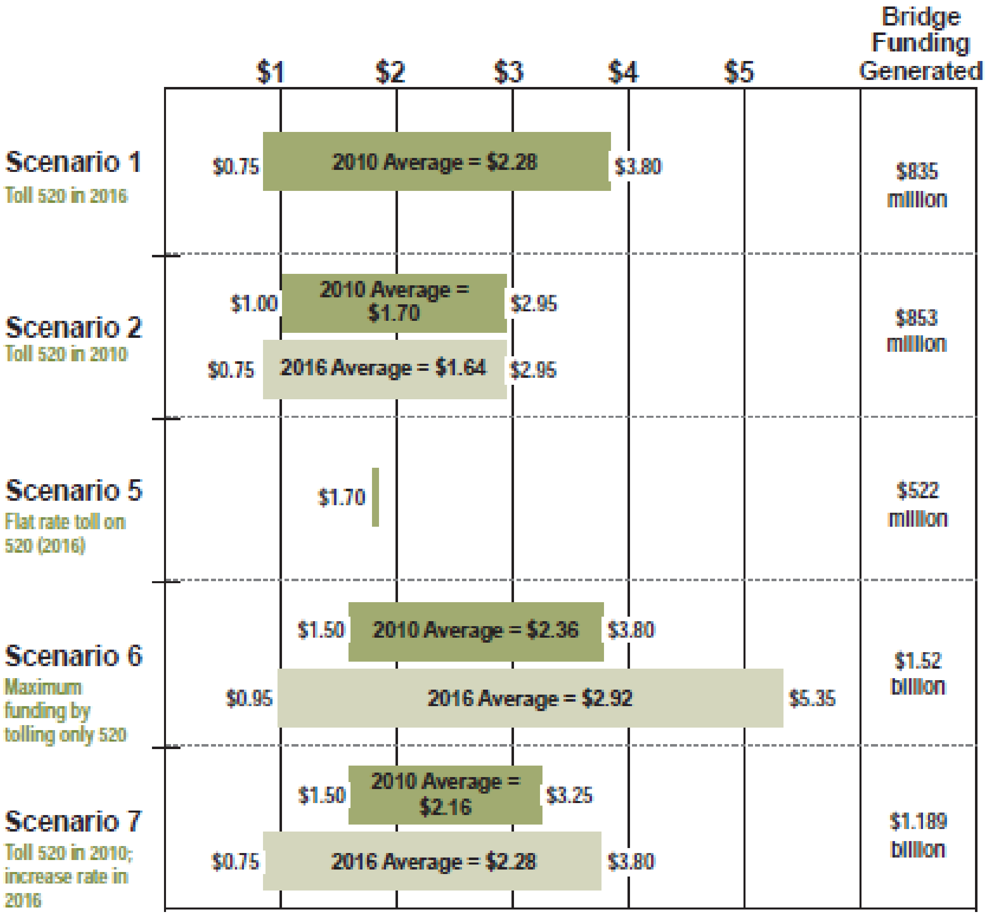
The State Legislature directed the Committee to study three basic tolling approaches:

- Toll SR 520 when the new bridge opens;
- Toll the existing Evergreen Point Bridge; and
- Toll both the SR 520 and I-90 bridges and fund improvements on both.

The Committee’s efforts considered a total of ten options (referred to in the study as scenarios) that represented variations on these three approaches. Four initial scenarios were refined into six additional scenarios that underwent further detailed analysis. Although the scenarios are identified by numbers 1 to 10, they fell into two groups: SR 520-only scenarios, and two-bridge scenarios. In addition, the Committee’s work examined the effect of tolls on different segments of SR 520 or I-90, compared to a single-point tolling approach. Finally, they evaluated tolling at the start of construction for the I-5 to Medina project, or waiting until 2016 when construction the floating bridge was assumed to be complete. Their work was primarily focused on the initial tolling period prior to 2016. The following pages provide figures from the Committee’s report depicting the tolling scenarios. Since a primary objective of the study was to estimate the potential revenue generated for Evergreen Point Bridge construction under each scenario, the graphics also show the estimated funding that each scenario would make available for this purpose.

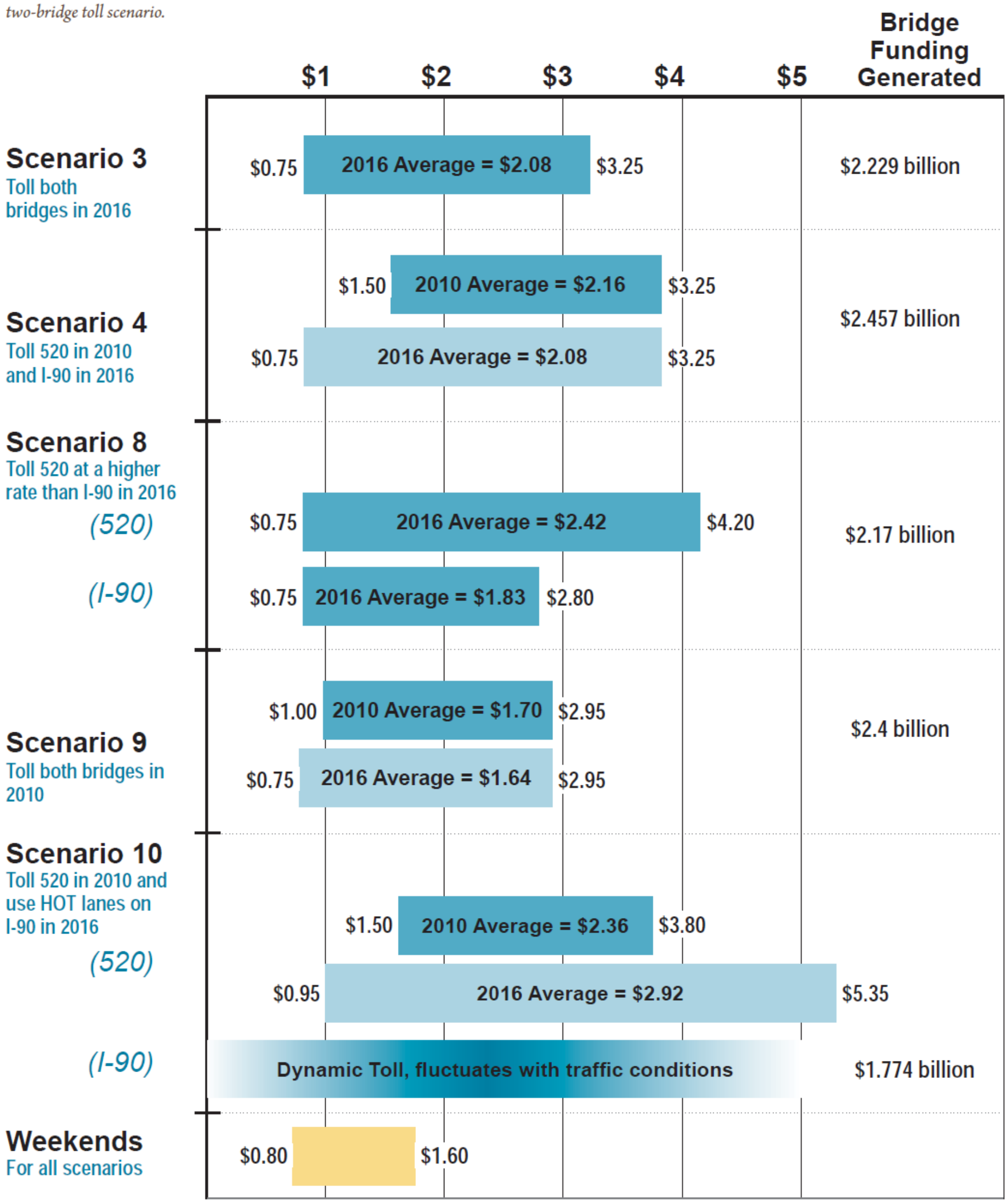
520-only Toll Scenarios

Figure 8. 520-only toll scenario rates, one-way, expressed in 2007 dollars.
Chart shows minimum toll, maximum toll and average toll paid in each 520-only toll scenario.



Two-bridge (520 and I-90) Scenarios

Figure 9. Two-bridge (520 and I-90) toll scenario rates, one-way, expressed in 2007 dollars.
Chart shows minimum toll, maximum toll and average toll paid in each two-bridge toll scenario.



The review also explored decisions about tolling locations, such as at a single point like the eastern end of the Evergreen Point Bridge, or several tolling locations, where drivers would pay a partial toll for using just a portion of the SR 520 corridor, such as for trips between I-5 and the Montlake interchange in Seattle. Some toll scenarios were modeled with single-point tolls and some with segment tolls.

SR 520 Finance Plan Scenarios

The traffic and revenue analysis performed under the SR 520 Finance Plan began with the same tolling plan scenarios evaluated by the 520 Tolling Implementation Committee, but also considered tolling and traffic levels out to the year 2030 and provided additional variations. The work incorporated updated assumptions regarding costs and construction phasing, as well as other considerations related to the SR 520 Finance Plan. The study also evaluated three additional scenarios (11 to 13) beyond those previously identified by the Tolling Implementation Committee. The scenarios are described below, along with the tolling rates that were applied for all scenarios (scenario numbers are as assigned by the committee):

SR 520-only Scenarios

1. Toll SR 520 post-completion (2017) on the bridge and with short segments, with variable tolls of up to $3.80 in 2007 dollars, with exemptions for transit and 3+ HOVs.
2. Toll SR 520 pre-completion (2011) on the bridge only, with variable tolls of up to $2.95 in 2007 dollars, and toll exemptions for transit and 3+ HOVs.
5. Toll SR 520 post-completion on the bridge only, with fixed-rate tolls of $1.70, and toll exemptions for transit and 3+ HOVs.
6. Toll SR 520 pre-completion on the bridge and short segments, with tolls of up to $3.80 starting in 2011, and up to $5.35 starting in 2017, with no toll exemptions.

6.1 Same scenario as 6 but with toll exemptions.

7. Same as 2 but with higher tolls in 2011 ($3.25) and increasing in 2017 ($3.80).

7.1 Same as 7 but with exemptions for transit only.

7.2 Same as 7 but with exemptions for transit and 2+ HOVs.

Two-bridge Scenarios

3. (Based on Scenario 1) tolling both I-90 and SR 520 post-completion (2017), with variable tolls on the bridges and segments of up to $3.25.
4. (Based on Scenario 2) tolling both I-90 and SR 520 pre-completion (2017), with variable tolls on the bridges and segments of up to $3.25.
8. Toll SR 520 and I-90 post-completion on the bridges only, with variable tolls of up to $4.20, and toll exemptions for transit and 3+ HOVs.
9. Same as 8, but beginning pre-completion with tolls of up to $2.95.
10. Same as 6 but with tolling on the I-90 HOT lanes (other lanes remain free) beginning in 2017 (post-completion).
11. Same as 7 but with tolling on I-90 beginning pre-completion.
12. Same as 8 but with tolling on SR 520 beginning pre-completion.

12.1 Same as 12 but with 25 percent higher tolls in 2011, when SR 520 only is tolled, and in 2017, when both corridors are tolled.

13. Same as 12 but begin tolling on I-90 in 2013.

Potential Effects of I-90 Tolling on Transportation Conditions

Traffic Findings from the 520 Tolling Implementation Committee

The Committee’s report concluded that all of the tolling had the ability to influence traffic patterns and travel behavior. The potential changes in transportation conditions include changes in traffic volumes, trip mode, trip timing, destinations, and routes.

The Committee's report provided a detailed analysis of the forecasts in model years 2010 and 2016 (see Attachment A), and extended revenue forecasts for SR 520 tolling through 2055. These forecasts showed that the amount of the toll would affect travel behavior, with higher tolls having higher effects on GP trips as well as mode, corridor, or trip destination choice. The studies also looked at the effect of tolling on HOVs.

> The Committee’s review of the pre-2016 tolling scenarios was compared to having no tolls on the existing structure in the year 2010. No other corridor improvements were assumed. This comparison is similar to the EIS No Build Alternative for that time period, although the EIS modeled the No Build Alternative only for 2030, when demand is expected to be considerably higher than in 2016.
>
> For the post-2016 scenarios, the Committee compared a tolled six-lane facility in 2016 to a “baseline” untolled six-lane facility. These assessments did not include a No Build; thus, their results are not directly comparable to the EIS traffic modeling results. . This approach reflected the Committee’s mandate to investigate scenarios that would help fund the SR 520 Program because the forecasts of traffic on an untolled SR 520 represented the likely maximum “market” of travelers that could be drawn to the improved corridor. The various tolling scenarios showed how that travel market could change depending on the cost of using the improved facility.

The report found that if I-90 were tolled along with SR 520, there would be less potential for travelers to choose I-90 over SR 520; however, they would be more likely to move to other corridors such as SR 522 or I-405, or change the time of day for their trips. The report identified the following types of travel changes that could result with tolls:

- People shifting from driving alone to carpools and transit;
- People diverting to alternative routes including I-90, SR 522, or I-405;
- People shifting to alternative times for their trips; and
- People choosing a different destination, i.e., not crossing the lake.

Predicted Effects

As stated above, the Committee’s report compared all results for the post-2016 scenarios to a 2016 baseline that assumed no tolls on a 6-lane SR 520. The report found that in all scenarios (with or without I-90 tolling), most travelers who would be drawn to the improved SR 520 corridor with no tolls would stay on it even if it were tolled; however, some would divert to other corridors, including I-90, and some travelers might choose other destinations rather than crossing the lake. If I-90 were also tolled, the report predicted that trips on I-90 would decrease compared to the baseline, as well as compared to scenarios with tolls on SR 520 only. Trips on SR 520, on the other hand, would fall between the baseline and the SR 520-only tolled results—in other words, there would be less diversion.

The results below are specifically for the post-2016 two-bridge tolling scenarios.

- For daily vehicle trips, the report showed:
    - SR 520 volumes at 8 percent to 16 percent lower compared to the baseline
    - I-90 volumes at 17 percent to 21 percent lower than the baseline
    - I-405 vehicle volumes could increase by 3 to 14 percent
    - SR 522 vehicle volumes could increase from 4 to 6 percent
    - Total cross-lake vehicle trips on all routes (SR 520, 1-90, SR 522, and I-405) at 3 percent to 8 percent lower than the baseline
- For daily person trips:
    - SR 520 person trips would be 7 percent to 12 percent lower than the baseline
    - I-90 person trips would be 13 percent to 19 percent below the baseline
    - I-405 person trips could increase 3 percent to 14 percent
    - SR 522 person trips could increase 3 to 7 percent
    - Total cross-lake person trips would be 2 percent to 5 percent lower than the baseline

Traffic Findings from the Toll Traffic and Revenue Technical Report (2009)

The TTR yielded similar findings to the 520 Tolling Implementation Committee Report, but also produced year 2030 forecasts, as well as some additional comparative information on the relative impacts of the various tolling decisions, both in terms of the revenue produced and transportation effects. The report included detailed forecasts for SR 520-only and two-bridge tolling scenarios. It also provided a discussion of modeling methods used. The transportation findings of the report included:

- The SR 520-only tolling scenarios created the highest increases in total vehicle trips on I-90, for both pre-completion and post-completion model years.
- The two-bridge tolling scenarios resulted in more balanced traffic flows and speeds throughout the cross-lake system of SR 520 and I-90, particularly for scenarios with differential tolling, where higher variable-rate tolls are applied to SR 520 and lower tolls are applied to I-90. This result is largely due to greater capacity constraints on SR 520.
- Scenarios with higher toll rates generated lower traffic volumes, and traffic flow and speeds improved on the corridors that were tolled.
- A variable tolling method provided congestion management benefits when applied to one or both corridors, compared to scenarios with fixed-rate tolling(variable-rate tolling applies the highest tolls during the peak travel periods, encouraging travelers to shift their trips to a less congested time period or to use transit).
- Scenarios providing toll exemptions for HOV/transit vehicles found that when 3+ HOVs are toll-free, HOV volumes increase on SR 520 and/or I-90; however, when 3+ HOVs must pay a toll, some HOVs may divert from SR 520 and I-90 to avoid the tolls, while other travelers may form new carpools to share the new toll cost.

Potential Transportation Effects of Tolling SR 520 and I-90

Because the TTR and the Final EIS both developed year 2030 forecasts, the sections below compare the results and identify common elements. The TTR results provided the most detail, and also included additional scenarios. Therefore, Exhibits 1 through 4 and the discussions below focus on the TTR and Final EIS forecast results, and on comparisons between them. The comparisons made are as follows:

- Comparison of TTR baseline results (6-lane untolled SR 520) with results from the Final EIS model for a 6-lane untolled SR 520
- Comparison of TTR Scenario 7 with the Final EIS Preferred Alternative (both assume tolls on a 6-lane SR 520 only)—daily and PM peak results for vehicles, transit trips, and person trips
- Comparison of TTR Scenario 12 with the Final EIS cumulative effects analysis (both assume tolls on both a 6-lane SR 520 and I-90)—daily and PM peak results for vehicles, transit trips, and person trips
- Comparison of Final EIS cumulative effects analysis (tolling on a 6-lane SR 520 and I-90) with Final EIS No Build Alternative (no tolls on a 4-lane SR 520)

As discussed earlier, the model used for the TTR and the model used for the Final EIS had different objectives and assumptions. This is because the TTR model was designed to primarily to estimate potential revenue, while the Final EIS model was designed primarily to estimate potential traffic volumes. The levels of predicted demand from either model do not always reflect the operations that a facility or a connection would provide in the future. In some cases, particularly at the peak period, the facility would not operate well enough to accept all the trips predicted, and travel times on routes could therefore be slower than the model indicates, particularly for GP trips. The values below, though, reasonably represent the likely range of changes in vehicle trips and person trips that could occur on SR 520 and I-90, given potential tolls on both corridors, compared to a year 2030 No Build Alternative.

EXHIBIT 1. DAILY VEHICLE TRIPS IN 2030, ON I-90 AND SR 520

Scenario	SR 520 GP Lanes	SR 520 Total Volumes	I-90 GP Lanes	I-90 Total Volumes	Total 520 and I-90
TTR SR 520-only Tolled Scenarios	95,100 to 114,400	100,800 to 129,100	155,400 to 163,700	166,000 to 173,500	
TTR SR 520 and I-90 Scenarios	107,200 to 125,700	116,200 to 135,500	124,400 to 141,100	131,200 to 149,600	
TTR Scenario 7 Tolled	106,520	115,670	161,700	168,540	284,210
TTR Baseline (6-lane untolled)	129,010	137,340	151,890	158,850	296,190
TTR Scenario 12 Tolled	120,200	129,800	141,100	149,600	279,400
Final EIS Preferred Alternative tolled	111,600	121,100	171,900	178,200	299,300
Final EIS Preferred Alternative Two-Bridge Toll Test	118,960	129,040	139,620	148,120	277,160
Final EIS No Build	127,600	127,600	166,800	176,100	303,700
Percent Change Final EIS Tolled to No Build	**-12.5%**	**-5.1%**	**3.1%**	**1.2%**	**-1.4%**
Percent Variance Scenario 12 and Final EIS Two-Bridge Toll Test	1.0%	0.6%	1.1%	1.0%	0.8%
Difference in Trips with Final EIS Two-Bridge Toll Test and No Build	-8,640	1,440	-27,180	-27,980	-26,540
As a %	-6.8%	1.1%	-16.3%	-15.9%	-8.7%
Difference between Scenario 7 and Scenario 12	-13,680	-14,130	20,600	18,940	4,810
As a %	*-11.4%*	*-10.9%*	*14.6%*	*12.7%*	*1.7%*
Final EIS Preferred Alternative Tolled	111,600	121,100	171,900	178,200	299,300

Findings for Daily Vehicle Trips

The TTR baseline results for an untolled 6-lane SR 520 were generally replicated by the Final EIS model, particularly for SR 520 vehicle volumes. However, the Final EIS model predicted more daily traffic on I-90 than the TTR, with a resulting higher level of trips for both corridors combined. Because the TTR baseline may be under-predicting by up to 10 percent the vehicle trips that may occur on I-90, this does affect any comparisons back to the baseline.

The TTR Scenario 7 (SR 520-only tolled) and the Final EIS Preferred Alternative tolled results were also found to be generally similar, although the Final EIS model predicts that more GP vehicle trips remain on the SR 520 corridor when it is tolled, and also that there would be more GP vehicle trips on the I-90 corridor, as well as for both corridors combined. However, both models show that vehicle trips across the board are less than those for an improved SR 520 corridor with no tolls.

The TTR daily Ttraffic forecasts for Scenario 12 (tolls on both corridors) are very closely replicated by a similar model run conducted for the Final EIS cumulative effects analysis (for a Preferred Alternative with tolls on both SR 520 and I-90). In this case, the two models' results differed by 1 percent or less.

Comparing the daily traffic forecasts in the Final EIS cumulative effects analysis with the Final EIS No Build Alternative (which did not assume tolling on I-90) produced the following findings:

- SR 520 daily GP trips would be about 7 percent less when both bridges are tolled than with the No Build Alternative; however, the total SR 520 vehicle trips would be actually 1 percent higher than the No Build Alternative, due to increased numbers of trips in the HOV lanes (SR 520's total vehicles with two bridges tolled would also be higher than if SR 520 only were tolled).
- When tolled, I-90 shows a larger drop in both GP trips and total trips compared to the No Build Alternative, with about 16 percent fewer GP trips and total trips. With tolling, relatively few I-90 GP trips appear to be converting to HOV lanes.
- Total daily cross-lake trips on I-90 and SR 520 combined would drop by about 9 percent or by 26,000 vehicles.
- SR 522 does not appear to be substantially affected compared to the No Build Alternative, with daily volumes fluctuating less than 1 percent, whether SR 520 only is tolled, if both SR 520 and I-90 are tolled, or with the No Build Alternative.

EXHIBIT 2. PM PEAK VEHICLE TRIPS IN 2030, ON I-90 AND SR 520

Scenario	SR 520 GP Lanes	SR 520 Total Volumes	I-90 GP Lanes	I-90 Total Volumes	Total 520 and I-90
TTR SR 520–only Scenarios	20,400 to 24,800	21,300 to 25,900	33,700 to 34,400	36,200 to 38,100	
TTR SR 520 and I-90 Scenarios	22,100 to 24,800	26,400 to 27,900	22,800 to 30,800	30,100 to 33,700	
TTR Scenario 7 Tolled	22,200	25,100	33,990	36,520	56,220
TTR Baseline (6-lane untolled)	25,530	28,180	33,050	35,640	63,800
Scenario 12	23,400	25,600	30,700	34,300	59,900
Final EIS Preferred Alternative Tolled	24,200	26,600	37,000	38,700	65,300
Final EIS Preferred Alternative Two-Bridge Toll Test	24,780	27,490	30,960	33,010	60,500
Final EIS No Build	26,600	26,600	36,500	39,400	66,000
Percent Change Final EIS Tolled to No Build	**-9.0%**	**0.0%**	**1.4%**	**-1.8%**	**-1.1%**
Percent Variance Scenario 12 and Final EIS Two-Bridge Toll Test	-5.6%	-6.9%	-0.8%	3.9%	-1.0%
Difference in Trips with Final EIS Two-Bridge Toll Test and No Build	-1,820	890	-5,540	-6,390	-5,500
As a %	-6.8%	3.3%	-15.2%	-16.2%	-8.3%
Difference between Scenario 7 and Scenario 12	-1,200	-500	3,290	2,220	-3,680
As a %	*-5.1%*	*-2.0%*	*10.7%*	*6.5%*	*-6.1%*

Findings for PM Peak Period Vehicle Trips

The PM peak forecasts show many of the same patterns as the daily vehicle trip comparisons.

The TTR Scenario 7 (SR 520-only tolled) and the Final EIS Preferred Alternative tolled results were generally similar; however, the Final EIS model predicts about 10 percent more GP and total vehicle trips on SR 520 and about 9 percent fewer GP trips on I-90 compared to the TTR forecasts.

The TTR Daily Traffic Forecasts for Scenario 12 (tolls on both corridors) remain similar to those from the Final EIS cumulative effects analysis; however, the Final EIS model shows about 5 percent higher traffic levels on SR 520, and about 4 percent lower forecasts on I-90 than the TTR, although cross-lake totals are within 1 percent of each other.

Comparing the daily traffic forecasts in the Final EIS cumulative effects analysis with the No Build Alternative produced the following findings:

- SR 520 peak period GP trips would be about 7 percent less when both bridges are tolled than with the No Build Alternative; however, the total SR 520 vehicle trips would be actually 3 percent higher than the No Build Alternative, due to increased numbers of trips in the HOV lanes. This is similar to the daily results but indicates that with the higher toll, more peak-period trips would be using the HOV lanes to take advantage of that time period.
- I-90 shows a much larger drop in both GP trips and total trips at the peak, with about 15 to 16 percent fewer GP trips and total trips. Again, relatively few I-90 GP trips appear to be converting to HOV lanes, continuing the pattern seen at the daily level.
- PM peak daily cross-lake trips on I-90 and SR 520 combined would drop by about 8 percent, or by 5,500 vehicles from the 66,000 peak period vehicle trips predicted for the two corridors with the No Build Alternative.
- SR 522 does not appear to be substantially affected compared to the No Build Alternative, with similar PM peak volumes whether SR 520-only is tolled, or if both SR 520 and I-90 are tolled.

EXHIBIT 3. DAILY TRANSIT TRIPS AND TOTAL PERSON TRIPS IN 2030, ON I-90 AND SR 520

Scenario Types	Transit Trips on SR 520	Transit Trips on I-90	Total Person Trips on SR 520	Total Person Trips on I-90	Total 520 and I-90
TTR SR 520-only Scenarios	10,400 to 11,600	35,400 to 39,300	139,800 to 176,800	251,800 to 262,700	
TTR SR 520 and I-90 Scenarios	10,000 to 10,700	35,400 to 40,000	167,200 to 192,100	209,500 to 245,400	
TTR Scenario 7 Tolled	10,800	36,500	167,500	252,100	419,600
TTR Baseline (6-lane untolled)	Not avail	Not avail	Not avail	Not avail	Not avail
TTR Scenario 12	10,700	39,600	185,100	235,800	420,900
Final EIS Preferred Alternative Tolled	7,050	40,350	167,880	262,680	430,760
Final EIS Preferred Alternative Two-Bridge Toll Test	7,270	38,850	178,970	229,880	408,850
Final EIS No Build	3,670	43,380	158,780	271,620	430,400
Percent Change Final EIS Tolled to No Build	**92.1%**	**-7.0%**	**5.7%**	**-3.3%**	**0.1%**
Percent Change Cumulative Effects (Two-bridge tolled) to Final EIS Preferred Alternative	3%	-4%	7%	-12%	-5%
Percent Variance Scenario 12 and Final EIS Two-Bridge Toll Test	47.2%	1.9%	3.4%	2.6%	2.9%
Difference in Trips with Final EIS Two-Bridge Toll Test and No Build	3,600	-4,530	20,190	-41,740	-21,550
As a %	98.1%	-10.4%	12.7%	-15.4%	-5.0%
Difference between Scenario 7 and Scenario 12	100	-3,100	-17,600	16,300	-1,300
As a %	*0.9%*	*-7.8%*	*-9.5%*	*6.9%*	*-0.3%*

Findings for Daily Transit Trips and Person Trips

The TTR did not produce baseline person trip forecasts, and there was not a No Build scenario that could be used for comparison. Therefore, the primary comparisons between the Final EIS and the TTR results can only be made from examining the scenarios.

The TTR Scenario 7 (SR 520-only tolled) and the Final EIS Preferred Alternative tolled results for person trips show more of a variance at the individual corridor level than they did for vehicle trips; however, they remain similar at their totals for combined cross-lake trips.

The Final EIS predicts fewer SR 520 transit trips and more I-90 transit trips with the tolled Preferred Alternative, compared to the TTR Scenario 7; in percentage terms, the variances are relatively high but the net differences are more balanced, showing 3,500 more transit trips on SR 520 and 4,500 fewer transit trips on I-90 than the Final EIS model predicts.

This variance in transit trips by facility is less distinct with the TTR Scenario 12 and the Final EIS's cumulative effects models, and total person trips on either corridor. With respect to both corridors combined, this variance is within 3 percent between the two models.

Both models predict about 20,000 fewer daily person trips on the combined corridors when both I-90 and SR 520 are tolled, compared to when SR 520 only is tolled.

Both models predict more total person trips on SR 520 when both I-90 and SR 520 are tolled, compared to when SR 520 only is tolled; this appears to be primarily due to an increase in HOV trips made on SR 520, although there would be more GP and other non-HOV trips using SR 520.

Because the results from the two models are similar, it is reasonable to assume that a No Build comparison would be applicable to both, even though the TTR did not provide No Build comparisons. Comparing the daily person trip forecasts in the Final EIS cumulative effects analysis with the Final EIS No Build Alternative produced the following findings:

- SR 520 daily transit trips with both I-90 and SR 520 tolled would nearly double compared to the No Build Alternative, and would be 5 percent higher than the Preferred Alternative forecasts.
- Total person trips on SR 520 would be about 13 percent higher compared to the No Build Alternative, and about 7 percent higher than with the Preferred Alternative.
- Transit trips on I-90 would be about 10 percent lower than with the No Build Alternative, or about 7 percent lower than with the Preferred Alternative that assumes tolls on SR 520-only.
- Total person trips on I-90 would drop by nearly 15 percent compared to the No Build Alternative, and 12 percent compared to the Preferred Alternative.
- Total person trips on the two corridors would be about 5 percent less than the No Build Alternative or the Final EIS Preferred Alternative (or a drop of nearly 21,000 compared to the No Build Alternative). This is largely due to the reduction of nearly 40,000 trips using I-90.
- I-90 shows a 15 percent drop in person trips and total trips compared to the No Build Alternative.
- Trips using SR 522 continue to be fairly stable compared to the No Build Alternative, with daily trips fluctuating less than 1 percent, whether SR 520-only is tolled or if both SR 520 and I-90 are tolled.

EXHIBIT 4. PM PEAK TRANSIT TRIPS AND TOTAL PERSON TRIPS IN 2030, ON I-90 AND SR 520

Scenario	Transit trips on SR 520	Transit Trips on I-90	Total Person Trips on SR 520	Total Person Trips on I-90	Total Persons Trips I-90 and SR 520
SR 520-Only Scenarios	3,400 to 3,800	11,700 to 13,000	30,900 to 40,500	60,800 to 64,700	
Two-Bridge Scenarios	3,300 to 3,500	11,700 to 13,200	40,900 to 42,900	54,100 to 58,800	
TTR Scenario 7 Tolled	3,600	12,000	39,300	60,800	100,100
TTR Baseline (6-lane untolled)	Not avail	Not avail	Not avail	Not avail	Not avail
Scenario 12	3,500	13,100	41,100	58,500	99,600
Final EIS 6-lane Tolled	2,350	13,760	38,710	62560	101,270
Final EIS Preferred Alternative Two-Bridge Toll Test	2,470	13,040	40,770	56,220	96,990
Percent Change Cumulative Effects (two- bridge tolled) compared to Preferred Alternative	5%	-5%	5%	-10%	-4%
Final EIS No Build	1,130	15,930	32,880	67,600	100,400
Percent Change Final EIS Tolled to No Build	**108.0%**	**-13.6%**	**17.7%**	**-7.5%**	**0.9%**
Percent Variance Scenario 12 and Final EIS Two-Bridge Toll Test	41.7%	0.5%	0.8%	4.1%	2.7%
Difference in Trips with Final EIS Two-Bridge Toll Test and No Build	1,340	-2,890	7,890	-11,380	-3,410
As a %	118.6%	-18.1%	24.0%	-16.8%	-3.4%
Difference between Scenario 7 and Scenario 12	100	-1,100	-1,800	2,300	500
As a %	*2.9%*	*-8.4%*	*-4.4%*	*3.9%*	*0.5%*

Findings for PM Peak Period Transit Trips and Person Trips

PM peak travel forecasts for person trips show similar patterns as the daily person trip forecasts; however, some of the shifts during the peak period are more pronounced because the highest tolls would occur during the peak period.

The Final EIS continues to predict fewer SR 520 peak-period transit trips and more I-90 transit trips with its Preferred Alternative with a toll, compared to the TTR Scenario 7. However, the total numbers of person trips on both facilities during the peak period are very similar between the TTR and Final EIS models.

When both corridors are tolled, as in the TTR Scenario 12 and the Final EIS cumulative effects forecasts, transit trips increase on SR 520 and drop on I-90 compared to either the No Build Alternative or when SR 520-only is tolled.

Both models predict about 3 to 4 percent PM peak-period trips on the combined corridors when both I-90 and SR 520 are tolled, compared to when 520 only is tolled. This prediction is slightly lower than the 5 percent drop in person trips seen on a daily basis. This indicates that PM peak trips, when many commute trips occur, are less likely to choose other destinations and corridors because of the I-90 toll, compared to trips made at other times of the day, even though the toll would be higher during the PM peak period.

Both models predict more total person trips on SR 520 when both I-90 and SR 520 are tolled, compared to when only SR 520 is tolled.

Because the results from the two models are similar, it is assumed that a No Build comparison is applicable to both, even though the TTR did not provide No Build comparisons. Comparing the daily person trip forecasts supporting the Final EIS cumulative effects analysis with the Final EIS No Build Alternative produced the following findings:

- SR 520 daily transit trips with both I-90 and SR 520 tolled would more than double compared to the No Build Alternative, and are 5 percent higher than the Preferred Alternative forecasts. Tolling SR 520 or tolling both I-90 and SR 520 would increase transit trips on SR 520.
- Total person trips on SR 520 would be about 24 percent higher compared to the No Build Alternative, and about 5 percent higher than with the Preferred Alternative.
- Transit trips on I-90 would be about 18 percent lower than with the No Build Alternative, or about 5 percent lower than with the Preferred Alternative that assumes tolls on SR 520 only.
- Total person trips on I-90 would drop by nearly 17 percent compared to the No Build Alternative, and 10 percent compared to the Preferred Alternative (consistent with the expectation that in any case an improved SR 520 would pull trips from I-90 compared to the No Build Alternative).
- Total person trips on the two corridors would be about 3 percent less than the No Build Alternative or the Final EIS Preferred Alternative (or a drop of nearly 3,410 person trips compared to the No Build Alternative). This is largely due to the reduction of nearly 17 percent, or 11,000 trips on I-90 during the peak period, compared to the No Build Alternative. Some of this drop on I-90 is due to tolls and some is a result of SR 520 improvements attracting more HOV and transit trips, which will offer travel time benefits by means of continuous HOV lanes.
- As with all other forecast comparisons examining SR 522, there appears to be little effect on that corridor under any scenario when compared to the No Build Alternative.

Summary Conclusions

Several studies conducted as part of the 520 Tolling Implementation Committee effort and the SR 520 Finance Plan have suggested that tolling on SR 520 and I-90 have the potential to affect transportation conditions in the following ways:

- People shifting from driving alone to carpools and transit;
- People diverting to alternative routes including I-90, SR 522, or I-405;
- People shifting to alternative times for their trips; and
- People choosing a different destination, i.e., not crossing the lake.

For the most part, these studies predicted the changes due to tolling as diverted trips, compared to a future baseline with an improved SR 520 corridor that features continuous HOV lanes and no tolls assumed. In some cases, they predicted that diversions as large as 17 percent would occur compared to this baseline.

The Final EIS forecast volumes for person and vehicle trips are generally consistent with the forecasts of the other studies, including scenarios for travel on SR 520, I-90, and other regional facilities. However, the Final EIS uses the No Build Alternative as a baseline, rather than an untolled SR 520 with HOV improvements. This provides a more accurate assessment of the likely effects in 2030 if tolling is in place on SR 520 and I-90 along with the SR 520 improvements.

With the Preferred Alternative, assuming tolls on both bridges in 2030 and comparing the results to a 2030 No Build Alternative produced the following findings:

- Total daily vehicle trips on I-90 and SR 520 combined would drop by about 9 percent, largely due to a 16 percent decrease in I-90 vehicle trips.
    - SR 520's daily GP trips would be about 7 percent less when both bridges are tolled than with the No Build Alternative; however, the total SR 520 vehicle trips would be actually 1 percent higher than the No Build Alternative, due to increased numbers of trips in the HOV lanes (SR 520's total vehicles with two bridges tolled would also be higher than if SR 520-only were tolled). Similar patterns occur at the peak period.
    - I-90 shows a larger drop in both GP trips and total vehicle trips compared to the No Build Alternative, with about 16 percent fewer daily vehicle trips, and a similar drop in peak-period vehicle trips.
    - SR 522 does not appear to be substantially affected compared to the No Build Alternative, with daily volumes fluctuating less than 1 percent.
- The total daily person trips on the two corridors, when both are tolled, would be about 5 percent less than the No Build Alternative, with transit and HOV trips comparatively higher, and fewer person trips made in the GP lanes.
    - Total person trips on SR 520 would be about 13 percent higher compared to the No Build Alternative (and about 7 percent higher than the Preferred Alternative).
    - SR 520 daily transit trips with both I-90 and SR 520 tolled would nearly double compared to the No Build Alternative (and about 5 percent higher than the Preferred Alternative).

- Total daily person trips on I-90 would drop by nearly 15 percent compared to the No Build Alternative, and 12 percent compared to the Preferred Alternative.
- Daily transit trips on I-90 would be about 10 percent lower than with the No Build Alternative, or about 7 percent lower than with the Preferred Alternative assuming tolls on SR 520 only.
- Trips using SR 522 continue to be fairly stable compared to the No Build Alternative, with daily trips fluctuating less than 1 percent whether SR 520-only is tolled or if both SR 520 and I-90 are tolled.

Overall, tolling I-90 in addition to SR 520 would result in 9 percent fewer vehicle trips but only 5 percent fewer person trips on the two corridors together, compared to the No Build Alternative. Most of the reduction in trips would occur on I-90. SR 520 would have more person trips, largely due to the travel time benefits of the continuous HOV lanes for transit and HOV users, and because of the toll on I-90. The Final EIS forecasts do not indicate large increases in the use of alternative routes to I-90 and SR 520. It appears more likely that persons affected by a toll on I-90 would shift to SR 520, shift to HOV or transit, or choose a different destination.

Attachment A: 520 Tolling Implementation Committee Evaluation Results for Two-Bridge Scenarios: 2016

520 Tolling Implementation Committee
Evaluation Results for All Scenarios

November 10, 2008

Two-Bridge (520 & 90) Scenarios: 2010	Scenario 3: Toll both bridges in 2016 when project is complete		Scenario 4: Toll 520 bridge in 2010, and 90 bridge in 2016		Scenario 8: Toll 520 at a higher rate than 90 in 2016		Scenario 9: Toll both bridges in 2010	
Estimated Bridge Funding	$2,229M		$2,457M		$2,170 M		$2,428 M	
"Reasonableness" of Toll Rates* (Toll Rates are shown in 2007 dollars)	520	90	520	90	520	90	520	90
Morning (5 – 9 AM)			$2.60				$2.15	$2.15
Mid-day (9 AM – 3 PM)			$2.10				$1.60	$1.60
Afternoon (3 – 7 PM)			$3.25				$2.95	$2.95
Evenings (7 – 10 PM)			$1.95				$1.30	$1.30
Nights (10 PM – 5 AM)			No charge				$0.75	$0.75
Weekends			$0.80 - $1.60				$0.80 - $1.60	$0.80 - $1.60
Segment								
Average Toll Paid			$2.08				$1.70	

Route	Baseline		Scenario 3		Scenario 4		Scenario 8		Scenario 9	
	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
2010 Vehicle Volume (Does not include transit riders)										
520 Midspan	44,640	73,590			37,170	54,430			39,850	66,310
I-90 Midspan	63,540	86,730			65,280	92,880			53,150	76,430
SR 522 at 61st	20,210	29,790			20,560	30,360			20,820	30,280
I-405 at SR 167	55,990	101,770			56,730	104,730			57,800	105,330
Total Change	184,380	291,880			179,740	282,400			171,620	278,350
2010 Vehicle Volume Changes (Compared with the 2010 Baseline volumes - excludes transit riders)										
520 Midspan					-7,470	-19,160			-4,790	-7,280
I-90 Midspan					1,740	6,150			-10,390	-10,300
SR 522 at 61st					350	570			610	490
I-405 at SR 167					740	2,960			1,810	3,560
Total Change					-4,640	-9,480			-12,760	-13,530
Percent Change in Vehicle Volume (Compared with the 2010 Baseline Condition - excludes transit riders)										
520 Midspan					-17%	-26%			-11%	-10%
I-90 Midspan					3%	7%			-16%	-12%
SR 522 at 61st					2%	2%			3%	2%
I-405 at SR 167					1%	3%			3%	3%
Total Change					-3%	-3%			-7%	-5%
2010 Person Volumes (Includes transit riders)										
520 Midspan	56,300	90,850			49,750	68,600			51,910	81,400
I-90 Midspan	84,990	109,950			87,260	118,260			74,420	99,720
SR 522 at 61st	24,950	37,130			25,460	37,850			25,670	37,740
I-405 at SR 167	76,170	136,930			77,490	141,230			78,740	141,590
Total Change	242,210	387,860			239,960	365,940			230,740	360,450
2010 Person Volume Changes (Compared with the 2010 Baseline Person volumes - includes transit riders)										
520 Midspan					-6,550	-22,250			-4,390	-9,450
I-90 Midspan					2,270	8,310			-10,570	-10,230
SR 522 at 61st					510	720			720	610
I-405 at SR 167					1,320	4,300			2,570	4,660
Total Change					-2,450	-8,920			-11,670	-14,410
Percentage Change in Person Volume (Compared with the 2010 Baseline Condition - includes transit riders)										
520 Midspan					-12%	-24%			-8%	-10%
I-90 Midspan					3%	8%			-12%	-9%
SR 522 at 61st					2%	2%			3%	2%
I-405 at SR 167					2%	3%			3%	3%
Total Change					-1%	-2%			-5%	-4%

Type of Diversion	Scenario 3		Scenario 4		Scenario 8		Scenario 9	
	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Person Changes by Type of Change (Compared with the 2010 Baseline Condition for each Route)								
Shift to Transit			1,630	650			1,220	360
Shift to I-90			2,270	8,310			-10,570	-10,230
Shift to SR 522			510	720			720	610
Shift to I-405			1,320	4,300			2,570	4,660
Changes Destination			-2,450	-8,920			-11,670	-14,410
Total			-8,180	-22,900			-5,610	-9,810
Shift Time of Day			8,940				3,880	
Percentage of Person Changes by Type of Change (Compared with the 2010 Baseline Persons on SR 520)								
Shift to Transit			3%	1%			2%	0%
Shift to I-90			4%	9%			-	-
Shift to SR 522			1%	1%			1%	1%
Shift to I-405			2%	5%			5%	5%
Changes Destination			4%	10%			8%	7%
Total			15%	25%			16%	13%
Shift Time of Day			8%				3%	

Route	Free-Flow Speed	Baseline		Scenario 3		Scenario 4		Scenario 8		Scenario 9	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Average Peak Direction Corridor Travel Speeds from I-5 to I-405 (except I-405 which is from I-90 to I-5 in Tukwila)											
520 GP Lanes	60	22	35			36	54			33	47
I-90 GP lanes	60	32	52			31	48			42	56
SR 522 GP Lanes	36	17	31			16	29			16	29
I-405 GP Lanes	60	23	32			23	32			22	32
Change in Average Peak Direction Corridor Travel Speeds from I-5 to I-405 (except I-405 which is from I-90 to I-5 in Tukwila)											
520 GP Lanes	60					15	19			11	12
I-90 GP lanes	60					-1	-4			10	4
SR 522 GP Lanes	36	17	31			-1	-2	-1	-2	-1	-3
I-405 GP Lanes	60	23	32			0	1	0	0	-1	1

* These are example toll rates for planning purposes. Actual toll rates will depend on a final finance plan and determined by the State Transportation Commission with approval by the State Legislature.

520 Tolling Implementation Committee
Evaluation Results for All Scenarios

November 10, 2008

Two-Bridge (520 & 90) Scenarios: 2016	Scenario 3: Toll both bridges in 2016 when project is complete		Scenario 4: Toll 520 bridge in 2010, and 90 bridge in 2016		Scenario 8: Toll 520 at a higher rate than 90 in 2016		Scenario 9: Toll both bridges in 2010	
Estimated Bridge Funding	$2,229M		$2,457M		$2,170 M		$2,428 M	
"Reasonableness" of Toll Rates* (Toll Rates are shown in 2007 dollars)	520	90	520	90	520	90	520	90
Morning (5 – 9 AM)	$2.60		$2.60		$3.35	$2.25	$2.15	
Mid-day (9 AM – 3 PM)	$2.10		$2.10		$2.20	$1.45	$1.05	
Afternoon (3 – 7 PM)	$3.25		$3.25		$4.20	$2.60	$2.95	
Evenings (7 – 10 PM)	$1.95		$1.95		$2.20	$1.20	$1.00	
Nights (10 PM – 5 AM)	$0.90		$0.90		$0.75	$0.75	$0.75	
Weekends	$0.80 to $1.60		$0.80 to $1.60		$0.80 to $1.60		$0.80 to $1.60	
Segment	$0.40 to $0.80		$0.40 to $0.80					
Average Toll Paid	$2.08		$2.08		520 $2.42	I-90 $1.83	$1.64	

Route	Baseline		Scenario 3		Scenario 4		Scenario 8		Scenario 9	
	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
2016 Vehicle Volume (does not include transit riders)										
520 Midspan	51,430	82,380	46,340	74,360	46,340	74,360	43,110	71,490	46,310	75,700
I-90 Midspan	62,877	87,633	51,000	69,150	51,000	69,150	52,150	72,390	50,300	72,100
SR 522 at 61st	20,370	30,360	21,550	31,450	21,550	31,450	21,220	32,310	21,140	31,750
I-405 at SR 167	67,970	118,540	73,720	135,300	73,720	135,300	70,170	125,710	69,930	121,840
Total Change	202,647	318,913	192,610	310,260	192,610	310,260	186,650	301,900	187,680	301,390
2016 Vehicle Volume Changes (Compared with the 2016 Baseline volumes - excludes transit riders)										
520 Midspan			-5,090	-8,020	-5,090	-8,020	-8,320	-10,890	-5,120	-6,680
I-90 Midspan			-11,877	-18,483	-11,877	-18,483	-10,727	-15,243	-12,577	-15,533
SR 522 at 61st			1,180	1,090	1,180	1,090	850	1,950	770	1,390
I-405 at SR 167			5,750	16,760	5,750	16,760	2,200	7,170	1,960	3,300
Total Change			-10,037	-8,653	-10,037	-8,653	-15,997	-17,013	-14,967	-17,523
Percent Change in Vehicle Volume (Compared with the 2016 Baseline Condition - excludes transit riders)										
520 Midspan			-10%	-10%	-10%	-10%	-16%	-13%	-10%	-8%
I-90 Midspan			-19%	-21%	-19%	-21%	-17%	-17%	-20%	-18%
SR 522 at 61st			6%	4%	6%	4%	4%	6%	4%	5%
I-405 at SR 167			8%	14%	8%	14%	3%	6%	3%	3%
Total Change			-5%	-3%	-5%	-3%	-8%	-6%	-7%	-6%
2016 Person Volumes (includes transit riders)										
520 Midspan	68,870	102,270	64,110	93,210	64,110	93,210	60,840	90,110	63,720	94,330
I-90 Midspan	90,179	115,608	77,770	94,020	77,770	94,020	78,760	97,460	76,770	97,380
SR 522 at 61st	24,700	36,740	25,580	37,860	26,000	37,860	25,930	39,370	25,880	38,890
I-405 at SR 167	92,620	158,960	100,610	181,640	100,610	181,640	95,700	167,940	95,200	163,550
Total Change	276,369	413,578	268,490	406,730	268,490	406,730	261,230	394,880	261,570	394,150
2016 Person Volume Changes (Compared with the 2016 Baseline Person volumes - includes transit riders)										
520 Midspan			-4,760	-9,060	-4,760	-9,060	-8,030	-12,160	-5,150	-7,940
I-90 Midspan			-12,409	-21,588	-12,409	-21,588	-11,419	-18,148	-13,409	-18,228
SR 522 at 61st			1,300	1,120	1,300	1,120	1,230	2,630	1,180	2,150
I-405 at SR 167			7,990	22,680	7,990	22,680	3,080	8,980	2,580	4,590
Total Change			-7,879	-6,848	-7,879	-6,848	-15,139	-18,698	-14,799	-19,428
Percentage Change in Person Volume (Compared with the 2016 Baseline Condition - includes transit riders)										
520 Midspan			-7%	-9%	-7%	-9%	-12%	-12%	-7%	-8%
I-90 Midspan			-14%	-19%	-14%	-19%	-13%	-16%	-15%	-16%
SR 522 at 61st			5%	3%	5%	3%	5%	7%	5%	6%
I-405 at SR 167			9%	14%	9%	14%	3%	6%	3%	3%
Total Change			-3%	-2%	-3%	-2%	-6%	-6%	-6%	-6%

Type of Diversion	Scenario 3		Scenario 4		Scenario 8		Scenario 9	
	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Person Changes by Type of Change (Compared with the 2016 Baseline Condition for each Route)								
Shift to Transit	610	320	610	320	720	340	470	170
Shift to I-90	-12,409	-21,588	-12,409	-21,588	-11,419	-18,148	-13,409	-18,228
Shift to SR 522	1,300	1,120	1,300	1,120	1,230	2,630	1,180	2,150
Shift to I-405	7,990	22,680	7,990	22,680	3,080	8,980	2,580	4,590
Changes Destination	-7,879	-6,848	-7,879	-6,848	-15,139	-18,698	-14,799	-19,428
Total	-5,370	-9,380	-5,370	-9,380	-8,750	-12,900	-5,620	-8,110
Shift Time of Day	5,960		5,960		7,560		3,660	
Percentage of Person Changes by Type of Change (Compared with the 2016 Baseline Persons on SR 520)								
Shift to Transit	1%	0%	1%	0%	1%	0%	1%	0%
Shift to I-90	-	-	-	-	-	-	-	-
Shift to SR 522	2%	1%	2%	1%	2%	3%	2%	2%
Shift to I-405	12%	22%	12%	22%	4%	9%	4%	4%
Changes Destination	5%	3%	5%	3%	10%	9%	9%	9%
Total	19%	27%	19%	27%	17%	20%	15%	16%
Shift Time of Day	4%		4%		5%		2%	

Route	Free-Flow Speed	Baseline		Scenario 3		Scenario 4		Scenario 8		Scenario 9	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Average Peak Direction Corridor Travel Speeds from I-5 to I-405 (Except I-405 which is from I-90 to I-5 in Tukwila)											
520 GP Lanes	60	21	37	35	52	35	52	36	54	32	48
I-90 GP lanes	60	26	53	40	58	40	58	34	56	36	56
SR 522 GP Lanes	36	15	30	14	28	14	28	14	27	14	28
I-405 GP Lanes	60	25	36	24	36	24	36	24	35	24	36
Change in Average Peak Direction Corridor Travel Speeds from I-5 to I-405 (Except I-405 which is from I-90 to I-5 in Tukwila)											
520 GP Lanes	60			14	14	14	14	15	16	11	10
I-90 GP lanes	60			14	6	14	6	8	3	10	4
SR 522 GP Lanes	36			-1	-2	-1	-2	-1	-3	-1	-2
I-405 GP Lanes	60			-1	-1	-1	-1	-1	-1	-1	-1

* These are example toll rates for planning purposes. Actual toll rates will depend on a final finance plan and determined by the State Transportation Commission with approval by the State Legislature.

Attachment B: Results from the Toll Traffic and Revenue Technical Report (Final 2009)

Exhibit 18 – 2030 PM Peak Toll Analysis Comparison Matrix – Post-Completion Scenarios

		Scenario	*Scenario Elements*			*Maximum PM Peak Bridge Toll*		*2030 PM Peak Toll Model Outputs for SR 520 & I-90 Bridges*										*Toll Impacts on 2030 PM Peak Traffic (Relative to Toll-Free Build Condition)*					
			Toll Configuration	*Toll Strategy*	*Toll Exemptions*	*2007 $s*	*Opening Year 2016 $s*	*Vehicles in GP Lanes*		*Vehicles in HOV Lanes*		*Total Vehicles*		*Transit Person Trips*		*Total Persons (Including Transit)*		*Net Toll Diversion (%)*		*Transit Mode Shift (%)*		*HOV Mode Shift (%)*	
								SR 520	*I-90*	*SR 520*	*I-90*	*SR 520*	*I-90*	*SR 520*	*I-90*	*SR 520*	*I-90*	*SR 520*	*I-90*	*SR 520*	*I-90*	*SR 520*	*I-90*
ONE BRIDGE TOLLED	Lower	Scenario 2	SR 520: Bridge Only	Variable Toll Schedule (Lowest)	Transit & HOV 3+	$2.95	$3.70	23,100	33,800	2,800	2,600	25,900	36,400	3,800	13,000	40,500	61,700	– 10%	+ 2%	+ 23%	+ 4%	+ 7%	– 1%
ONE BRIDGE TOLLED	Lower	Scenario 5	SR 520: Bridge Only	Fixed-Rate Toll	Transit & HOV 3+	$1.70	$2.15	24,800	33,700	2,800	2,600	27,600	36,200	3,400	12,300	42,000	60,800	– 3%	+ 2%	+ 10%	– 1%	+ 7%	– 1%
ONE BRIDGE TOLLED	Medium	Scenario 1	SR 520: Bridge + Short Segments	Variable Toll Schedule (Medium)	Transit & HOV 3+	$3.80	$4.75	22,700	34,100	3,000	2,600	25,700	36,700	3,700	12,100	40,400	61,100	– 11%	+ 3%	+ 19%	– 3%	+ 13%	– 1%
ONE BRIDGE TOLLED	Medium	Scenario 7	SR 520: Bridge Only	Variable Toll Schedule (Medium)	Transit & HOV 3+	$3.80	$4.75	22,200	34,000	2,900	2,500	25,100	36,500	3,600	12,000	39,300	60,800	– 13%	+ 3%	+ 14%	– 3%	+ 9%	– 2%
ONE BRIDGE TOLLED	Higher	Scenario 6	SR 520: Bridge + Short Segments	Variable Toll Schedule (Higher)	No Toll Exemptions	$5.35	$6.65	20,400	34,400	900	3,700	21,300	38,100	3,500	11,700	30,900	64,700	– 21%	+ 4%	+ 13%	– 6%	– 64%	+ 44%
TWO BRIDGES TOLLED	Lower	Scenario 9	SR 520: Bridge Only I-90: Bridge Only	Variable Toll Schedule (Lowest)	Transit & HOV 3+	$2.95	$3.70	24,200	29,200	2,800	2,700	26,900	31,900	3,400	12,800	41,100	56,400	– 5%	– 12%	+ 8%	+ 3%	+ 4%	+ 5%
TWO BRIDGES TOLLED	Lower	Scenario 3	SR 520: Bridge + Short Segments I-90: Bridge + Island Segments	Variable Toll Schedule (Lower)	Transit & HOV 3+	$3.25	$4.05	24,800	30,600	3,100	2,800	27,800	33,400	3,500	13,200	42,900	58,800	– 3%	– 7%	+ 12%	+ 6%	+ 16%	+ 8%
TWO BRIDGES TOLLED	Lower	Scenario 4	SR 520: Bridge + Short Segments I-90: Bridge + Island Segments	Variable Toll Schedule (Lower)	Transit & HOV 3+	$3.25	$4.05	24,800	30,600	3,100	2,800	27,800	33,400	3,500	13,200	42,900	58,800	– 3%	– 7%	+ 12%	+ 6%	+ 16%	+ 8%
TWO BRIDGES TOLLED	Lower	Scenario 13	SR 520: Bridge Only I-90: Bridge Only	Variable Toll Schedule (Lower)	Transit & HOV 3+	$3.25	$4.05	24,900	30,800	3,000	2,900	27,900	33,700	3,300	12,700	42,700	58,800	– 3%	– 7%	+ 6%	+ 2%	+ 15%	+ 13%
TWO BRIDGES TOLLED	Mixed	Scenario 8	SR 520: Bridge Only I-90: Bridge Only	Variable Toll Schedule: Higher on SR 520 Lower on I-90	Transit & HOV 3+	SR 520: $4.20 I-90: $2.80	SR 520: $5.25 I-90: $3.50	23,400	30,700	3,000	2,700	26,400	33,400	3,500	13,100	41,100	58,500	– 8%	– 7%	+ 13%	+ 5%	+ 14%	+ 6%
TWO BRIDGES TOLLED	Mixed	Scenario 12	SR 520: Bridge Only I-90: Bridge Only	Variable Toll Schedule: Higher on SR 520 Lower on I-90	Transit & HOV 3+	SR 520: $4.20 I-90: $2.80	SR 520: $5.25 I-90: $3.50	23,400	30,700	3,000	2,700	26,400	33,400	3,500	13,100	41,100	58,500	– 8%	– 7%	+ 13%	+ 5%	+ 14%	+ 6%
TWO BRIDGES TOLLED	Higher	Scenario 10	SR 520: Bridge + Short Segments I-90: (2+2) HOT Lanes I-5 to I-405 & (1+1) HOT I-405 to Issaquah	SR520: Variable Toll Schedule (Higher) I-90: Dynamic Tolls (Weekday Peaks/Midday)	Transit & HOV 3+	SR 520: $5.35 I-90: $0.95 per mile	SR 520: $6.65 I-90: $1.18 per mile	22,100	22,800	3,500	11,500	25,600	34,300	3,500	11,700	40,900	56,800	– 14%	– 31%	+ 13%	– 6%	+ 32%	NA
TWO BRIDGES TOLLED	Higher	Scenario 11	SR 520: Bridge Only I-90: Bridge Only (Option K on SR 520)	Variable Toll Schedule (Higher)	Transit & HOV 3+	$5.35	$6.65	23,700	27,400	3,200	2,600	26,900	30,100	3,300	12,800	41,800	54,100	– 7%	– 17%	+ 7%	+ 3%	+ 21%	+ 2%
DIAGNOSTIC TESTS		Scenario 6.1	SR 520: Bridge + Short Segments	Variable Toll Schedule (Higher)	Transit & HOV 3+	$5.35	$6.65	19,900	34,300	2,900	2,500	22,800	36,900	3,600	11,800	36,600	60,900	– 22%	+ 4%	+ 15%	– 6%	+ 10%	– 2%
DIAGNOSTIC TESTS		Scenario 7.1	SR 520: Bridge Only (Existing 4 Lane Bridge)	Variable Toll Schedule (Medium)	Transit Only	$3.80	$4.75	22,500	34,000	NA	4,000	22,500	38,100	3,100	12,200	30,100	65,800	NA	NA	NA	NA	NA	NA
DIAGNOSTIC TESTS		Scenario 7.2	SR 520: Bridge Only (HOV2+ on SR 520)	Variable Toll Schedule (Medium)	Transit & HOV 2+	$3.80	$4.75	20,100	32,600	8,300	6,700	28,400	39,300	3,500	12,300	53,700	72,500	NA	NA	NA	NA	NA	NA
DIAGNOSTIC TESTS		Scenario 12.1	SR 520: Bridge Only I-90: Bridge Only	Variable Toll Schedule: 25% Higher Tolls than Scenario 12	Transit & HOV 3+	SR 520: $5.25 I-90: $3.50	SR 520: $6.56 I-90: $4.35	22,700	30,000	3,100	2,700	25,800	32,800	3,600	13,200	40,600	57,900	– 11%	– 9%	+ 15%	+ 6%	+ 17%	+ 6%

Transit Optimizing Sensitivity Analysis

Washington State Department of Transportation

SR 520 Bridge Replacement and HOV Program

SR 520 Four-lane Transit Optimized Concept Tolling Sensitivity Analysis Technical Memorandum

Prepared for

Washington State Department of Transportation

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Acronyms and Abbreviations

Final EIS	final environmental impact statement
HOV	high-occupancy vehicle
mph	miles per hour
PSRC	Puget Sound Regional Council
SR	State Route
WSDOT	Washington State Department of Transportation
vph	vehicles per hour

Purpose of the SR 520 Four-lane Transit Optimized Concept Tolling Sensitivity Analysis

Overview

This technical memorandum reviews the potential transportation effects of using tolls to manage traffic volumes if there were a four-lane configuration or concept for replacement of the Evergreen Point Bridge. The goal of tolling a four-lane facility for this analysis would be to provide free flow conditions for transit and HOV in order to meet the project purpose by improving person mobility through the year 2030. This goal was set to illustrate what level of tolling would be necessary to achieve the same transit/HOV travel time, reliability, and mobility benefits achieved in a 6-Lane Alternative.

The scenario is based on the potential application of higher tolls that could help achieve free-flow traffic on State Route (SR) 520. It also examines the potential effects of the higher tolls on other corridors, including I-90 and SR 522. If free-flow conditions could be achieved on general-purpose lanes on SR 520, the potential exists to improve transit operations, thereby benefiting both transit and high-occupancy vehicle (HOV) 3+ travel.

To conduct this sensitivity assessment, the Washington State Department of Transportation (WSDOT) applied the Puget Sound Regional Council (PSRC) travel demand model to test the effects of tolls ranging from no toll to $8.00 (in 2008 dollars) each way during peak periods on a four-lane configuration for the Evergreen Point Bridge. WSDOT used a version of the regional demand model that was developed to provide forecasts for the SR 520 Finance Plan and the work of the SR 520 Tolling Implementation Committee. This analysis, however, was not developed to be used for revenue estimates, and was developed only for the purpose of the NEPA sensitivity assessment.

Additionally, this sensitivity assessment draws on results from the detailed modeling forecasts developed with the PSRC model for the Final Environmental Impact Statement (Final EIS) for the SR 520, I-5 to Medina: Bridge Replacement and HOV Project. The Final EIS evaluates an untolled four-lane No Build Alternative, which is functionally equivalent to the four-lane configuration discussed in this analysis. WSDOT has also conducted modeling sensitivity tests for a tolled No Build Alternative using the same toll rates applied in the year 2030 for the project's Preferred Alternative (Toll Sensitivity Analysis for the SR 520 No Build Alternative Technical Memorandum, February 2011)**.**

Definition of a Four-lane Concept for This Analysis

For this sensitivity test, there were assumed to be no capacity improvements to SR 520 from Medina to I-5. SR 520 would be a four-lane highway with no HOV lanes. Wider shoulders, and bicycle and pedestrian facilities could also be provided, but would not alter the anticipated travel demand model results. Transit facilities are assumed to feature similar access points and networks as applied for the No Build Alternative. (The Preferred Alternative has a similar network, but assumes the elimination of the Montlake Freeway Transit Station.) The key assumptions are:

- Tolling would occur at the Evergreen Point Bridge mid-span using variable toll rates based on time of day. During peak periods the tolls were modeled for a range starting at $2.50 and ending at $8.00 (in year 2008 dollars), increasing at $0.50 increments.
- Transit and 3+ HOVs would be toll-exempt.

The model results for this analysis were focused on vehicle volumes and movement of people on the corridor.

Tolling Rates Assumed for the Preferred Alternative and in a No Build or Four-lane Concept Toll Sensitivity Test

Modeling for the Preferred Alternative in the FEIS assumed that AM-peak, midday, PM-peak, evening, and night (directional) toll rates for crossing the Evergreen Point Bridge were, respectively, $3.05, $2.10, $3.81, $1.95, and $0.91 (expressed in 2007 constant dollars). This analysis was performed prior to the sensitivity test, thus it is expressed in an earlier year. Modeling done for the No Build tolling sensitivity test used these same toll-rate assumptions.

Potential Transportation Effects of Tolling a Four-lane Concept

Transportation Effects on SR 520

Exhibits 1 and 2 summarize the results of 2030 model forecasts for a four-lane concept with no toll and with tolls ranging from $2.50 to $8.00 during the evening peak periods. Exhibit 2 provides a comparison of person-trip demand among the Final EIS No Build Alternative, the Preferred Alternative, and the Four-Lane concept. Attachment A provides a full set of the model results. Exhibits 1 and 2 and the conclusions below focus on the primary differences in transportation conditions in 2030 that would be expected with a potential toll on unimproved four-lane SR 520.

For this analysis, "free flow" was defined as a volume to capacity ratio of 0.85 or lower and typical speeds of about 45 miles per hour [mph]. Exhibit 1 indicates that the minimum toll rates to ensure free-flow conditions on westbound SR 520 during the PM peak would be $5.00 to $5.50. () However, for eastbound traffic during the PM peak, a toll as high as $8.00 would still not be likely to achieve free flowThus, at the highest demand level of the peak period, the toll would not be effective in reducing traffic to levels that could improve mobility by providing a time savings benefit from shifting to transit or HOV. The red color in Exhibit 1 illustrates when the v/c ratio exceeds 1.0. The green color shows when the v/c is 0.85 or less.

EXHIBIT 1. YEAR 2030 PM PEAK HOUR TRAFFIC VOLUMES AND CONGESTION LEVELS ON SR 520, FOUR-LANE CONCEPT WITH INCREASING TOLLS

SR 520 Toll Rate (year 2008 dollars)	Speed (mph)		V/C Ratio		Vehicle Trip Demand (vph)	
	EB	WB	EB	WB	EB	WB
$0.00	12.7	18.4	1.20	1.12	4,457	4,138
$2.50	17.9	29.0	1.12	0.99	4,162	3,670
$4.00	22.7	37.3	1.06	0.89	3,938	3,307
$5.00	26.8	42.5	1.02	0.82	3,763	3,016
$5.50	29.0	44.8	0.99	0.77	3,670	2,846
$6.00	31.4	46.3	0.96	0.73	3,567	2,699
$6.50	33.8	47.5	0.94	0.69	3,464	2,546
$7.00	36.3	48.4	0.91	0.64	3,354	2,382
$7.50	38.3	49.0	0.88	0.60	3,253	2,235
$8.00	40.4	49.4	0.85	0.56	3,145	2,071

Exhibit 2 illustrates that there would be a small increase in the number of people using of the SR 520 corridor with an untolled 4-Lane Alternative compared to No Build. This increase is due to the small improvement in corridor reliability that results from providing widened shoulders on the floating bridge. Because a four-lane concept would not provide exclusive HOV or transit capacity cross-lake, a reduction of nearly 30 percent in peak-hour traffic would be needed to reach free-flow conditions in the general purpose lanes. Unless these vehicle trips shift to other modes, it is likely they would shift to other corridors. Also, this level of decrease in vehicle trips would result in a decrease in person trips cross-lake, as shown in Exhibit 2. An $8.00 toll would result in 35 percent less person-trip demand than the No Build Alternative and would reduce demand by almost half compared to the Preferred Alternative.

EXHIBIT 2. PM PEAK PERIOD (THREE HOUR TOTAL) PERSON TRIP VOLUMES ON SR 520

	Person Trip Volumes (combined eastbound and westbound)				Compared to the No Build Alternative	Compared to the Preferred Alternative
	Total Non-HOV[1]	HOV (3+)	Transit	Total		
Travel Demand Model Results used in the SR 520 I-5 to Medina Project FEIS Analysis						
2006 Base Year	25,900	3,670	3,490	33,060	101%	85%
2030 No Build Alternative	29,530	2,220	1,130	32,880	N/A	85%
2030 Preferred Alternative	27,710	8,650	2,350	38,710	118%	N/A
2030 Four-lane Concept with Varying Toll Rates (year 2008 dollars)						
$0 toll	29,840	2,230	1,130	33,200	101%	86%
$2.50 toll	24,620	2,590	1,530	28,740	87%	74%
$4.00 toll	22,390	2,880	1,650	26,920	82%	70%
$8.00 toll	14,590	4,030	2,090	20,710	63%	54%

[1] Includes non-HOV vehicles and commercial vehicles.

Transportation Effects on I-90 and Other Corridors if Tolls were Applied to a Four-lane Concept SR 520

The forecasts also indicate that a higher toll on SR 520, with no other improvements, would have a high potential to worsen conditions on other corridors compared to the No Build Alternative. As the toll rate increases, non-HOV trips become more likely to divert to other corridors to avoid the toll. The highest impacts would be to I-90, as shown in Exhibit 3 below. Exhibit 3 shows conditions on I-90 with the range of SR 520 tolls used for this evaluation. Even with no tolls on SR 520, conditions on I-90 are expected to be highly congested in 2030; in the 2030 PM peak period, I-90 is predicted to be well over capacity eastbound and approaching capacity westbound. With a toll of approximately $5.00 on SR 520, eastbound I-90 would also exceed its capacity, with I-90 congestion becoming worse as SR 520 tolling increased from this level. A $5.50 toll level, which would provide westbound free flow on SR 520 during the PM peak period, would increase I-90's volume to capacity ratio to 1.19 for eastbound lanes and 1.03 for westbound lanes.

In addition to the effects of diversion on I-90 itself, other parts of the transportation network would experience increased congestion as a result of the high tolls on SR 520. Traffic seeking to divert from SR 520 to I-90 would be required to travel south using I-405, I-5, and/or local arterials through Bellevue and Seattle. Using tolls to create free flow on SR 520 would result in additional delays for travelers on those other corridors.

While an operations model would further demonstrate the high levels of congestion resulting from attempting to accommodate the shift of vehicles from SR 520 to I-90, additional modeling is not necessary to conclude that this level of diversion would have significant impacts to I-90 users and the regional system. The projected I-90 volumes could not be accommodated in the peak period without spilling into adjacent time periods, and the high volumes would also be likely to worsen travel time reliability and system efficiency. Exhibit 4 below shows the effects on I-90 of a $3.50 toll on SR 520, which is close to the $3.81 toll rate used for the EIS analysis. The increase in vehicle trips on I-90 during the 3-hour peak period from diversion is very small (450 trips, or a little over 1 percent). Peak period person trips on I-90 drop slightly with the toll on SR 520, primarily as a function in a reduction of HOV trips on I-90. Since these trips would not be tolled on SR 520, they would be more likely to choose that corridor to take advantage of free flow conditions.

EXHIBIT 3. PM PEAK HOUR TRAFFIC VOLUMES AND CONGESTION LEVELS ON I-90, FOUR-LANE CONCEPT WITH INCREASING TOLLS ON SR 520

SR 520 Toll Rate (Year 2008 dollars)	PM Peak Hour					
	Speed (mph)		V/C Ratio		Vehicle Trip Demand (vph)	
	EB	WB	EB	WB	EB	WB
$0.00	19.2	39.8	1.15	0.94	6,393	5,239
$2.50	17.7	36.8	1.17	0.97	6,496	5,398
$4.00	16.8	34.5	1.18	0.99	6,561	5,520
$5.00	16.2	32.4	1.19	1.01	6,606	5,629
$5.50	15.9	31.0	1.19	1.03	6,631	5,704
$6.00	15.5	29.9	1.20	1.04	6,663	5,762
$6.50	15.1	28.9	1.21	1.05	6,701	5,816
$7.00	14.6	27.7	1.21	1.06	6,738	5,881
$7.50	14.2	26.7	1.22	1.07	6,776	5,937
$8.00	13.7	25.6	1.23	1.08	6,816	5,998

EXHIBIT 4. PM PEAK PERIOD (THREE HOUR TOTAL) I-90 VEHICLE AND PERSON TRIP VOLUMES IN 2030, FOUR-LANE SR 520 WITH AND WITHOUT TOLLING

Forecasts for I-90 with a Four-lane Concept on SR 520 (combined eastbound and westbound)								
Roadway Facility	Peak Period Vehicle Volumes			Peak Period Person Trip Volumes				
	Total Non-HOV[1]	HOV (3+)	Total	Non-HOV	HOV (3+)	Commercial	Transit	Total
I-90 (no Toll on SR 520)	36,230	3,130	39,360	36,030	11,200	5,440	14,930	67,600
I-90 ($3.50 toll on SR 520)	37,100	2,710	39,810	37,660	9,650	4,780	14,830	66,920

[1] Includes non-HOV vehicles and commercial vehicles.

Effects on Other Facilities

The forecasts show that some traffic would also divert to other corridors, including SR 522; however, there would not be a notable change in the volume-to-capacity levels or the travel speeds on those corridors. These data are consistent with the findings of other tolling sensitivity analyses, such as the SR 520 Toll Traffic and Revenue Technical Report – 2008 (April 2009), and the Tolling Implementation Committee Final Report (2009).

Conclusion

Tolling a four-lane SR 520 at levels that would reduce traffic enough to allow free-flow conditions would not achieve the mobility goals of the I-5 to Medina project, and would create lower levels of cross-lake mobility and system efficiency than the No Build or the Preferred Alternative. Toll rates that could achieve partial (westbound) free-flow conditions in the PM peak period would require higher tolls than the Preferred Alternative. Even a much higher toll (up to $8.00) would not achieve free-flow conditions on eastbound SR 520 in the evening peak hour, when the corridor has the highest travel demand. A four-lane concept with an $8.00 toll would result in less person-trip mobility compared to the No Build and Preferred Alternatives. In this scenario, person-trip demand on SR 520 would be up to 35 percent less compared to the No Build Alternative and almost half of the demand provided with the Preferred Alternative.

In addition, as the tolls increased and traffic volumes were reduced on a four-lane SR 520, traffic would be redirected to I-90 via I-405, I-5, and local arterials, substantially worsening regional congestion compared to the Preferred Alternative. The higher levels of traffic would overload I-90, which will already be congested in 2030. Speeds on the I-90 corridor could drop by 30 percent or more, and severe congestion would likely extend for longer periods of the day, increasing with higher toll rates. While tolling and improving travel speeds on SR 520 may lead to some non-HOV trips converting to transit or HOV, the improved travel times for transit or HOV trips do not appear to attract enough users to avoid the high levels of traffic impacts created by vehicles diverting to I-90.

Attachment A: SR 520 Four-lane Sensitivity Travel Demand Results

TABLE 1A.
COMPARISON OF PM PEAK PERIOD CROSS-LAKE VEHICLE AND PERSON TRIP VOLUMES SR 520 MODEL - BASE YEAR (2006), 2030 NO BUILD AND PREFERRED ALTERNATIVE

Base Year (2006)

	PM Peak Period Vehicle Volumes			PM Peak Period Person Trip Volumes				
Roadway Facility	**Total Non-HOV[1]**	**HOV (3+)**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Transit**	**Total**
SR 522 (West of 61st Ave.NE)	10,270	470	10,740	10,980	1,660	630	640	13,910
SR 520 (Evergreen Point Bridge) - GP Lanes	23,260	1,030	24,290	23,190	3,670	2,710	3,490	33,060
SR 520 (Evergreen Point Bridge) - HOV Lanes	-	-	-	-	-	-	-	-
I-90 (West Bridge) - GP Lanes	33,460	900	34,360	31,500	3,220	4,480	990	40,190
I-90 (West Bridge) - HOV Lanes	3,790	1,410	5,200	7,570	4,990	-	2,540	15,100
I-90 Rail	-	-	-	-	-	-	-	-
Total Cross-Lake	**70,780**	**3,810**	**74,590**	**73,240**	**13,540**	**7,820**	**7,660**	**102,260**

2030 No Build Alternative

	PM Peak Period Vehicle Volumes			PM Peak Period Person Trip Volumes				
Roadway Facility	**Total Non-HOV[1]**	**HOV (3+)**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Transit**	**Total**
SR 522 (West of 61st Ave.NE)	11,500	290	11,790	12,340	1,020	810	630	14,800
SR 520 (Evergreen Point Bridge) - GP Lanes	25,950	620	26,570	26,270	2,220	3,260	1,130	32,880
SR 520 (Evergreen Point Bridge) - HOV Lanes	-	-	-	-	-	-	-	-
I-90 (West Bridge) - GP Lanes	36,230	230	36,460	36,030	830	5,440	-	42,300
I-90 (West Bridge) - HOV Lanes	-	2,900	2,900	-	10,370	-	990	11,360
I-90 Rail	-	-	-	-	-	-	13,940	13,940
Total Cross-Lake	**73,680**	**4,040**	**77,720**	**74,640**	**14,440**	**9,510**	**16,690**	**115,280**

TABLE 1A. (CONTINUED)

2030 Preferred Alternative[2]

Roadway Facility	PM Peak Period Vehicle Volumes			PM Peak Period Person Trip Volumes				
	Total Non-HOV[1]	HOV (3+)	Total	Non-HOV	HOV (3+)	Commercial	Transit	Total
SR 522 (West of 61st Ave.NE)	11,700	240	11,940	12,690	830	680	530	14,730
SR 520 (Evergreen Point Bridge) - GP Lanes	24,150	-	24,150	23,950	-	3,760	-	27,710
SR 520 (Evergreen Point Bridge) - HOV Lanes	-	2,400	2,400	-	8,650	-	2,350	11,000
I-90 (West Bridge) - GP Lanes	36,870	160	37,030	37,470	570	4,710	-	42,750
I-90 (West Bridge) - HOV Lanes	-	1,710	1,710	-	6,050	-	990	7,040
I-90 Rail	-	-	-	-	-	-	12,770	12,770
Total Cross-Lake	**72,720**	**4,510**	**77,230**	**74,110**	**16,100**	**9,150**	**16,640**	**116,000**

2030 No Build or Four-lane Concept Tolled[3]

Roadway Facility	PM Peak Period Vehicle Volumes			PM Peak Period Person Trip Volumes				
	Total Non-HOV[1]	HOV (3+)	Total	Non-HOV	HOV (3+)	Commercial	Transit	Total
SR 522 (West of 61st Ave.NE)	11,750	260	12,010	12,730	910	690	550	14,880
SR 520 (Evergreen Point Bridge) - GP Lanes	23,100	1,180	24,280	23,060	4,230	3,480	1,480	32,250
SR 520 (Evergreen Point Bridge) - HOV Lanes	-	-	-	-	-	-	-	-
I-90 (West Bridge) - GP Lanes	37,100	130	37,230	37,660	460	4,780	-	42,900
I-90 (West Bridge) - HOV Lanes	-	2,580	2,580	-	9,190	-	1,050	10,240
I-90 Rail	-	-	-	-	-	-	13,780	13,780
Total Cross-Lake	**71,950**	**4,150**	**76,100**	**73,450**	**14,790**	**8,950**	**16,860**	**114,050**

[1] Includes non-HOV vehicles and commercial vehicles

[2] Toll model run was executed for mode choice and route diversion effects using trip distribution results from 2030 Preferred Alternative model run.

[3] Toll model run was executed for mode choice and route diversion effects using trip distribution results from 2030 No-Build Alternative model run.

TABLE 1B.
COMPARISON OF DAILY CROSS-LAKE VEHICLE AND PERSON TRIP VOLUMES SR 520 FINAL EIS MODEL - BASE YEAR (2006), 2030 NO BUILD AND PREFERRED ALTERNATIVE

Base Year (2006)

	Daily Vehicle Volumes			Daily Person Trip Volumes				
Roadway Facility	**Total Non-HOV[1]**	**HOV (3+)**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Transit**	**Total**
SR 522 (West of 61st Ave.NE)	47,940	2,170	50,110	51,470	7,620	2,690	1,740	63,520
SR 520 (Evergreen Point Bridge) - GP Lanes	110,360	4,860	115,220	110,640	17,170	12,580	9,820	150,210
SR 520 (Evergreen Point Bridge) - HOV Lanes	-	-	-	-	-	-	-	-
I-90 (West Bridge) - GP Lanes	151,220	3,840	155,060	142,470	13,590	19,210	5,630	180,900
I-90 (West Bridge) - HOV Lanes	15,270	5,410	20,680	30,550	19,050	-	5,070	54,670
I-90 Rail	-	-	-	-	-	-	-	-
Total Cross-Lake	324,790	16,280	341,070	335,130	57,430	34,480	22,260	449,300

2030 No Build Alternative

	Daily Vehicle Volumes			Daily Person Trip Volumes				
Roadway Facility	**Total Non-HOV[1]**	**HOV (3+)**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Transit**	**Total**
SR 522 (West of 61st Ave.NE)	52,550	1,760	54,310	56,490	6,200	3,290	1,840	67,820
SR 520 (Evergreen Point Bridge) - GP Lanes	123,040	4,530	127,570	123,750	16,020	15,340	3,670	158,780
SR 520 (Evergreen Point Bridge) - HOV Lanes	-	-	-	-	-	-	-	-
I-90 (West Bridge) - GP Lanes	164,750	2,090	166,840	164,780	7,360	23,070	-	195,210
I-90 (West Bridge) - HOV Lanes	-	9,320	9,320	-	33,030	-	1,990	35,020
I-90 Rail	-	-	-	-	-	-	41,390	41,390
Total Cross-Lake	**340,340**	**17,700**	**358,040**	**345,020**	**62,610**	**41,700**	**48,890**	**498,220**

TABLE 1B. (CONTINUED)

2030 Preferred Alternative[2]

Roadway Facility	Daily Vehicle Volumes			Daily Person Trip Volumes				
	Total Non-HOV[1]	HOV (3+)	Total	Non-HOV	HOV (3+)	Commercial	Transit	Total
SR 522 (West of 61st Ave.NE)	53,970	1,520	55,490	58,410	5,340	2,910	1,590	68,250
SR 520 (Evergreen Point Bridge) - GP Lanes	111,640	-	111,640	111,690	-	15,450	-	127,140
SR 520 (Evergreen Point Bridge) - HOV Lanes	-	9,470	9,470	-	33,690	-	7,050	40,740
I-90 (West Bridge) - GP Lanes	170,150	1,760	171,910	172,300	6,190	21,570	-	200,060
I-90 (West Bridge) - HOV Lanes	-	6,320	6,320	-	22,270	-	1,990	24,260
I-90 Rail	-	-	-	-	-	-	38,360	38,360
Total Cross-Lake	**335,760**	**19,070**	**354,830**	**342,400**	**67,490**	**39,930**	**48,990**	**498,810**

2030 No Build or Four-lane Concept Tolled[3]

Roadway Facility	Daily Vehicle Volumes			Daily Person Trip Volumes				
	Total Non-HOV[1]	HOV (3+)	Total	Non-HOV	HOV (3+)	Commercial	Transit	Total
SR 522 (West of 61st Ave.NE)	54,190	1,600	55,790	58,590	5,620	2,950	1,630	68,790
SR 520 (Evergreen Point Bridge) - GP Lanes	106,390	6,200	112,590	106,820	21,950	14,430	4,750	147,950
SR 520 (Evergreen Point Bridge) - HOV Lanes	-	-	-	-	-	-	-	-
I-90 (West Bridge) - GP Lanes	171,470	1,790	173,260	173,710	6,290	21,740	-	201,740
I-90 (West Bridge) - HOV Lanes	-	8,410	8,410	-	29,780	-	2,110	31,890
I-90 Rail	-	-	-	-	-	-	40,850	40,850
Total Cross-Lake	**332,050**	**18,000**	**350,050**	**339,120**	**63,640**	**39,120**	**49,340**	**491,220**

[1] Includes non-HOV vehicles and commercial vehicles

[2] Toll model run was executed for mode choice and route diversion effects using trip distribution results from 2030 Preferred Alternative model run.

[3] Toll model run was executed for mode choice and route diversion effects using trip distribution results from 2030 No-Build Alternative model run.

Light Rail Transit History

Washington State Department of Transportation

SR 520 Bridge Replacement and HOV Program

I-90 Light Rail Transit
Planning History and Decisions

Washington State Department of Transportation

October 19, 2010

Background

Since the first rail transit plans were proposed in the 1960s, planning for cross-Lake Washington high-capacity transit (HCT) service has focused on what is now the I-90 corridor. This is a result of the corridor's location and direct linkages to Downtown Seattle and the rest of the planned Eastside and Westside HCT network, as well as the opportunity presented by the construction of I-90. Two major transportation investments made in the 1980s and 1990s reinforced this decision. One investment was the Washington State Department of Transportation's (WSDOT) building of the I-90 center roadway and related transit extensions from I-90 into Downtown Seattle. The second investment was King County Metro's improvements to the Downtown Seattle Transit Tunnel. These investments provided the basic infrastructure to accommodate cross-Lake Washington HCT service first in the form of Bus Rapid Transit (BRT), and later in the form of light rail.

Over the past 40 years, a wealth of studies have examined many ways to provide HCT service between Seattle and the Eastside and re-affirmed the identification of I-90 as the initial cross-lake corridor for high capacity transit. The studies have consistently shown that LRT on the I-90 corridor would result in similar or higher ridership than LRT on SR 520, and have substantially lower costs (environmentally and financially). In 2006, Sound Transit completed the *East Corridor Mode Analysis History Report (August 2006)*, which documents the history of high capacity and light rail transit planning in the region. The information in this document was the basis for Exhibit 1 Regional High Capacity and Light Rail Planning (at the end of this document), which provides an overview of transit planning as it relates to evaluating HCT across Lake Washington.

Selection of I-90 for LRT

The last round of evaluation that confirmed I-90 as the preferred initial corridor for light rail crossing Lake Washington was completed during the Trans-Lake Washington Study (1998-1999) and Trans-Lake Washington Project (2000-2002). With the confirmation of I-90 as the preferred initial corridor for light rail, regional planning efforts and major transportation investments have continued with that as a baseline assumption. The Central Link LRT Line, from the University of Washington to Sea-Tac Airport, was designed and built to accommodate an Eastside branch on I-90. Work is under way now to shift the I-90 high-occupancy vehicle (HOV) lanes to the outer roadway, making room for light rail in the center roadway. These are the most significant of several investments that are based on the I-90 light rail corridor as a planning assumption.

An overview of the evaluations performed for the Trans-Lake Study and Project is provided in Exhibit 2 (at the end of this document). The Trans-Lake Washington Study and Project documents that contain the analyses, results, and recommendations that led to the decision to make I-90 the first corridor for extending light rail across Lake Washington are:

- Multi-Modal Alternatives Evaluation Report (2001) (Appendix A);
- Trans-Lake Transit Alternatives Recommendation - Draft Memo from Sound Transit (Appendix B);
- Summary of HCT Screening Process (2002) (Appendix C); and
- Accommodating High-Capacity Transit in the SR 520 Corridor report (2002) (Appendix D).

These evaluations compared the effectiveness of SR 520 and I-90 as light rail corridors. The recommendations from the Multi-Modal Alternatives Evaluation (2001) as documented in the Summary of HCT Screening Process (2002) document are:

- Total person throughput across the lake would not vary if the future HCT line is placed within either the I-90 or the SR 520 corridor; only the proportion of person trips that each route carries would change.
- Alternatives with LRT in the I-90 corridor would result in slightly higher daily cross-lake transit ridership than those with HCT in the SR 520 corridor. High-quality bus transit service in both corridors (bus transit in the I-90 and in the SR 520 corridor) would result in the highest daily cross-lake transit ridership by a slight margin.
- HCT in the SR 520 corridor would cause more environmental impacts that LRT in the I-90 corridor. With LRT in the I-90 corridor, environmental impacts to Lake Washington are minimized because much of the alignment is located within the footprint of the existing highway facilities.
- The I-90 LRT alternatives, with capital costs of approximately $2.7 billion (2001 dollars), would be substantially less costly to construct than the SR 520 HCT alternatives, which has capital costs of approximately $4.7 billion (2001 dollars).

In 2001, Sound Transit concurred with these recommendations via a technical memorandum (see Appendix B), and I-90 was selected as the corridor for light rail extension between Downtown Seattle and Redmond.

The *Accommodating High-Capacity Transit in the SR 520 Corridor (Trans-Lake Washington Project, August 8, 2002)* report also summarized the evaluations and conclusions that led to the confirmation of I-90 as the corridor for the initial extension of light rail across Lake Washington. These conclusions were:

- According to travel forecasts developed during the multimodal phase of the Trans-Lake Washington Project, only one HCT corridor across Lake Washington will be necessary to satisfy transit demand through the year 2020.
- In the short to medium terms, merging an SR 520 HCT line into Central Link would be feasible. However, in the longer term, when Central Link is extended to Northgate, the segment between the University of Washington and Downtown Seattle will be capacity-constrained, and another HCT line between the University of Washington and Downtown Seattle would be required.
- Based on the multimodal study work, the Translake executive committee chose to continue planning for HCT in the I-90 corridor with an investment in BRT in the SR 520 corridor.

Conclusion

Many planning and evaluation efforts contributed to the selection of I-90 as the preferred corridor for the first extension of LRT across Lake Washington. Transportation planning and investments in the region has since progressed based on this regional decision. The Sound Transit Staff Report (December 14, 2006) documents the alternatives to be studied in the East Link Draft Environmental Impact Statement (EIS) and includes a list of prior Board/Committee actions related to the adoption of the I-90 corridor for light rail extensions (see Appendix E). Sound Transit since completed the East Link Draft EIS in December 2008 and a Preferred Alternative was selected in July 2010.

EXHIBIT 1. REGIONAL HIGH CAPACITY AND LIGHT RAIL PLANNING

1967-9
- *Comprehensive Public Transportation Plan for the Seattle Metropolitan Area - 1985 Horizon* identifies rail corridor from Seattle-Mercer Island-Bellevue-Redmond
- Included in *Forward Thrust* bond measure in 1968 - had simple majority but failed because it didnt' have 60% supermajority needed for financing

1970's
- Region debates at length whether to expand and modernize I-90, including whether transit should have semi- or fully exclusive ROW

1976
- I-90 Memorandum of Agreement - specifies dedicated transit facility to be included on new I-90 bridge
- Signed by cities of Seattle, Mercer Island, Bellevue and King County Metro Transit and WSDOT
- This agreement comes well prior to any similar process for SR 520 (which wasn't until 1998)

1986
- Puget Sound Council of Governments (PSCOG)-Metro performs The Multi-Corridor Analysis
- LRT on SR 520 elminated as alternative in Phase II analysis due to low ridership, lower feeder bus potential, higher cost, and lower cost-effectiveness compared with I-90.

1990's
- Joint Regional Policy Committee (JRPC) begins planning regional high capacity transit
- JRPC, which includes King, Pierce and Snohomish counties and WSDOT, is pre-cursor to RTA

1993
- JRPC completes EIS on Regional Transit System - light rail on I-90 identified as preferred mode
- Following adoption of JRPC's Regional Transit Plan, Central Puget Sound Regional Transit Authority (RTA) forms

1994-5
- RTA conducts public outreach on JRPC's Regional Transit Plan & identifies set of HCT investments for vote
- RTA adopts plan in 1994 -includes I-90 LRT btwn Seattle, Bellevue, Redmond - presents to voters in 1995 (fails)
- RTA develops new investment plan - Sound Move - express bus service in HOV lanes substituted for LRT

1996-8
- Sound Transit adopts first long-range plan - plan highlights I-90 corridor as HOV expressway & potential LRT
- SR 520 identified for "local bus service" (later identified as regional express bus service)
- I-90 Two-Way Transit and HOV Project EIS started

1999
- Trans-Lake Study - ST (a co-lead) wants to confirm I-90 as preferred cross-lake corridor or define a better crossing location
- Recommends HCT element (doesn't specify what kind) be carried forward into development of EIS alternatives

2000
- Trans-Lake Washington Project - series of studies (see next page) confirms I-90 rather than SR 520 as the preferred corridor for light rail due to higher ridership and lower cost (environmental & financial)

2004
- Amendment to I-90 Memorandum of Agreement -identified R8A from I-90 Two Way Transit and HOV Project as first step to having transit operating in dedicated ROW
- PSRC prepares Central Puget Sound Region High Capacity Transit Corridor Assessment Report - findings about 520 HCT/LRT

2005
- ST updates and adopts long-range plan (based on SEIS and extensive public outreach)
- I-90 remains the priority corridor and HOV/BRT system added to SR 520 corridor

2006
- Sound Transit Board passes Resolution No. R2006-15
- identifies light rail as the preferred mode for HCT for Seattle to Bellevue and Redmond via I-90

2010
- SR 520 Bridge Replacement and HOV Program revisits SR 520 with LRT

EXHIBIT 2. TRANS-LAKE WASHINGTON STUDY AND PROJECT SR 520 AND I-90 HCT EVALUATIONS PROCESS

1996 ST Long Range Plan*
I-90 identified as HCT corridor

ST I-90 Two-Way Transit & HOV*
**don't have to widen = less cost & impacts*

ST Central Link*
LRT capacity north of DT Seattle

I-405 Corridor Program*
accounted for in 520 traffic forecasts

Stage/Study/Project + Purpose	Analysis & Documentation	Outcomes

1998-1999
Trans-Lake Washington *Study*

Stage/Study/Project + Purpose:

Purpose is to identify a set of reasonable & feasible solutions to improve mobility across and/or around Lake Washington. Solution sets:
* No Action
* MTP Flipped
* New Crossing
* Maximize Alternatives
* MTP 98
* Roadway/Rail
* Roadway/Bus

Analysis & Documentation:

- Trans-Lake Study Overview & Recommendation Pamphlet (10/99)

ST wants to confirm I-90 as preferred cross-lake corridor or define a better crossing location & SR 520 planned for regional

Outcomes:

EIS should evaluate the following on SR 520:
- Study passenger ferry options *(ST performed)*
- One HOV in each direction
- One HOV in each direction + HCT
- One HOV + One GP in each direction
- One HOV + One GP + HCT
- Minimum footprint i.e. 4 Lane + bike/ped
- Continue to study ST I-90 Two-Way Transit
- ***Qualification of SR 520 as best cross-lake HCT route***
- Preference of HCT in SR 520 Corridor

2000-2002
Trans-Lake Washington *Project*

Stage/Study/Project + Purpose:

First level screening evaluation = 2 stages

Stage 1:
ID of potential alignment corridors:

Analysis & Documentation:

- Preliminary Definition of Alternatives for First Level Screening (9/28/00)
- First Level Screening Evaluation Results- Technical Steering Committee Review Draft with Comments (10/12/00)

Outcomes:

Recommendations
- EIS should evaluate the following:
  - Alt C1: HCT in 520 corridor
  - Alt C2: HCT in I-90 corridor
  - Alt C3: HCT in new mid-lake corridor
- Do not analyze further due to high costs:
  - Alt C4.2 – mid-lake crossing Sand point to Kirkland
  - Alt. C4.1 – mid-lake crossing Madison to Kirkland

Stage/Study/Project + Purpose:

First level screening evaluation Stage 2:
Evaluate modes (i.e. highway and transit) separately for corridors selected in Stage 1 (Alts C1, C2 & C3) to determine which HCT alts (BRT & LRT) performed the best and which should be analyzed further in the multi-modal evaluation

Analysis & Documentation:

- HCT Modal Evaluation Initial Findings (3/9/01)
- HCT Modal Evaluation: Transportation, Environmental, Cost Findings (4/10/01)
- Definition of HCT Alternatives for Modal Evaluation (4/11/01)

Outcomes:

Recommendations
- Exclude the following HCT alternatives:
  - Bus only lanes
  - Mid-lake crossing
  - Pure BRT alternatives
- HCT modal alts combined with GP/HOV alts into these multi-modal alternatives:
  - Alt 2: 4 Lane with I-90 LRT
  - Alt 3: 520 HOV with I-90 LRT
  - Alt 4: 520 HOV+GP+I-90 LRT
  - Alt 5: 520 HOV+520 HCT
  - Alt 6: 520 HOV+GP+ 520 HCT
  - Alt 7: 520 HOV with BRT connections
  - Alt 8: 520 HOV+GP+BRT connections

Stage/Study/Project + Purpose:

Second level screening: Multi-Modal Evaluation
Purpose of this screening was to analyze in more detail the multi-modal alternatives (Alt 2-8) developed in First level screening: Stage 2 (Alt 1 was No Action)

Analysis & Documentation:

- Preliminary Definition of Multi-Modal Alternatives for Second Level Screening (5/14/01)
- Multi-Modal Alternatives Evaluation Report (6/6/01)
- Multi-Modal Alternatives Evaluation – Environmental Findings (6/7/01)
- Final Multi-Modal Cost Methodology and Multi-Modal Cost Opinions for Alternatives Analysis (7/11/01)
- Update to Multi-Modal Alternatives Evaluation Report to include all elements of analysis (4/12/02)

Outcomes:

Recommendations for DEIS:
- Carry forward No Action
- Analyze 4-Lane
- Analyze 6-Lane w/ combined HOV/BRT (with & without additional Montlake Cut crossing)
- Analyze 8-Lane (+1 GP+1HOV/BRT)
- ***Supports ST Long-range plan for LRT on I-90 and BRT on SR 520***
- Consider whether 520 alts should include provisions to accommodate HCT in distant future (beyond 2020?)

See ST memo dated Nov 15, 2001 confirming I-90 as the corridor for potential LRT extension across Lake Washington + revision to Long-Range plan to include BRT/HOV system on the SR 520 corridor (was adopted)

Stage/Study/Project + Purpose:

Accommodating HCT in the SR 520 Corridor
Purpose was to examine options /how to accommodate HCT (likely LRT in 520)

Analysis & Documentation:

- Accommodating HCT in the SR 520 Corridor (9/29/02)

Outcomes:

Evaluated 4 scenarios:
- No HCT accommodation
- HCT accommodation on floating bridge, approach structures, and EP lid
- HCT accommodation on entire lake crossing plus adj. to lids east of EP
- HCT envelope preservation between Montlake Blvd and Redmond

Recommendations:
- Selection of HCT accommodation scenario = reconstruct corridor I-5 to Redmond with + 30 ft to accommodate future HCT (likely LRT)

Summary of HCT Screening Process: Evaluations and Recommendations (December 2002)

Purpose of this report was to summarize the analyses that have been conducted as part of the Trans-Lake Project regarding HCT and BRT on the SR 520 and I-90 corridors.

* indicates effect on SR 520 that was considered/accounted for in Trans-Lake Washington Project alternatives development and analysis

Appendix A – Trans-Lake Washington Project: Multi-Modal Alternatives Evaluation Report (June 2001)

Trans-Lake Washington Project

Multimodal Alternatives Evaluation Report

Prepared for

Washington State Department of Transportation
Office of Urban Mobility
401 Second Avenue South, Suite 300
Seattle, Washington 98104

Sound Transit
401 South Jackson Street
Seattle, Washington 98104

Prepared by

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April 12, 2002
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ACRONYMS

BRT	Bus Rapid Transit
BMPs	Best Management Practices
BNSFRR	Burlington Northern Santa Fe Railroad
CBD	Core Business District
CD	Collector Distributor
CO	Carbon Monoxide
dBA	Decibels
EIS	Environmental Impact Statement
GP	General-purpose
HCT	High Capacity Transit
HOV	High-Occupancy Vehicle
I	Interstate
LOS	Level of Service
LRT	Light Rail Transit
NOx	Nitrogen Oxide
O&M	Operations and Maintenance
PGIS	Pollutant-Generating Impervious Surface
PHS	Priority Habitat and Species
PSRC	Puget Sound Regional Council
SOV	Single Occupancy Vehicle
SPUI	Single Point Urban Interchange
SR	State Route
TDM	Transportation Demand Management
TIA	Total Impervious Area
VHT	Vehicle Hours Traveled
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compounds
vph	Vehicles Per Hour
WDFW	Washington Department of Fish and Wildlife

EXECUTIVE SUMMARY

Eight multimodal transportation alternatives have been studied as candidates to be included in an Environmental Impact Statement (EIS) of improvements to State Route (SR) 520. The studies included several stages of conceptual engineering, transportation study and environmental analysis. For each alternative, 40 different criteria were applied to help predict that alternative's ability to meet the project's purpose and need.

This report reviews the transportation and environmental performance results for each alternative, based on the detailed evaluations. The project used a forecast year of 2020 to evaluate the demand for travel, based on expected population and employment growth in the region.

ES.1 THE ALTERNATIVES AND THE RESULTS

The evaluated alternatives are summarized in Figure ES-1 and listed below:

- Alternative 1: No Action
- Alternative 2: SR 520 Safety and Preservation with I-90 Light Rail
- Alternative 3: SR 520 High Occupancy Vehicle Lanes (HOV) with I-90 Light Rail
- Alternative 4: SR 520 HOV and General Purpose (GP) with I-90 Light Rail
- Alternative 5: SR 520 HOV and High Capacity Transit (HCT)
- Alternative 6: SR 520 HOV and GP and HCT
- Alternative 7: SR 520 HOV with Bus Rapid Transit (BRT)
- Alternative 8: SR 520 HOV with BRT and GP

Although eight alternatives were tested, many of these alternatives are similar when considered from a regional system perspective. The highway elements involve three basic approaches to the capacity of SR 520: leaving it with four lanes, increasing it to six lanes by completing the HOV lanes throughout the corridor, or increasing it to eight lanes by adding HOV and general-purpose lanes in both directions.

These three basic lane configurations on SR 520 were matched with three options for HCT: light rail on I-90, HCT on SR 520, or Bus Rapid Transit. All of the alternatives assumed that Transportation Demand Management (TDM) programs would be implemented. The remaining differences between the alternatives were in design options for interchanges at Montlake and approaching I-5 in Seattle.

Section ES.2 summarizes the differences between alternatives. Section ES.3 further compares the alternatives according to key differences in their transportation performance, environmental impacts and costs.

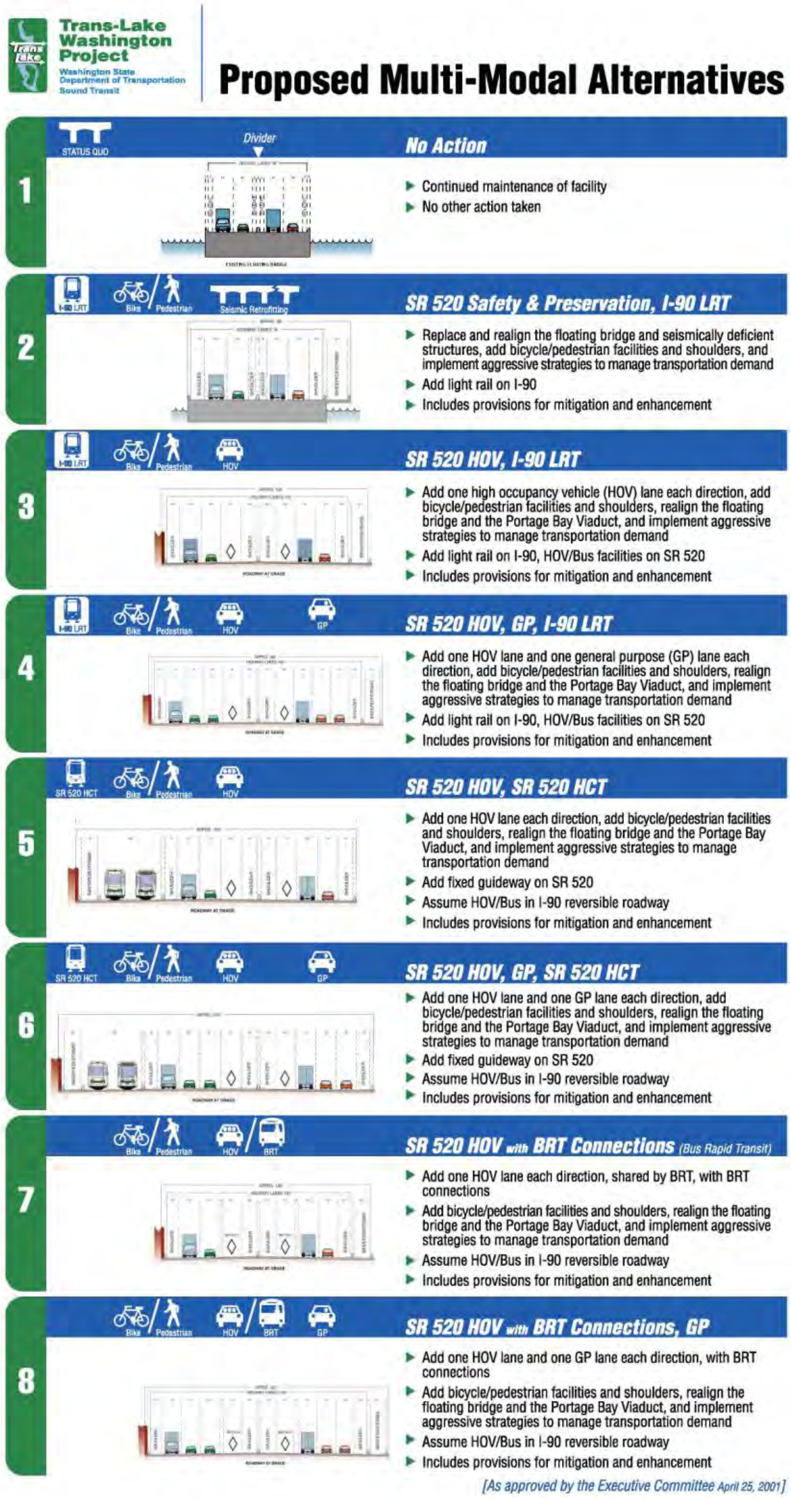

Trans-Lake Washington Project
Washington State Department of Transportation
Sound Transit
Proposed Multi-Modal Alternatives
1
STATUS QUO
Divider
No Action
Continued maintenance of facility
No other action taken
2
I-90 LRT
Bike
Pedestrian
Seismic Retrofitting
SR 520 Safety & Preservation, I-90 LRT
Replace and realign the floating bridge and seismically deficient structures, add bicycle/pedestrian facilities and shoulders, and implement aggressive strategies to manage transportation demand
Add light rail on I-90
Includes provisions for mitigation and enhancement
3
I-90 LRT
Bike
Pedestrian
HOV
SR 520 HOV, I-90 LRT
Add one high occupancy vehicle (HOV) lane each direction, add bicycle/pedestrian facilities and shoulders, realign the floating bridge and the Portage Bay Viaduct, and implement aggressive strategies to manage transportation demand
Add light rail on I-90, HOV/Bus facilities on SR 520
Includes provisions for mitigation and enhancement
4
I-90 LRT
Bike
Pedestrian
HOV
GP
SR 520 HOV, GP, I-90 LRT
Add one HOV lane and one general purpose (GP) lane each direction, add bicycle/pedestrian facilities and shoulders, realign the floating bridge and the Portage Bay Viaduct, and implement aggressive strategies to manage transportation demand
Add light rail on I-90, HOV/Bus facilities on SR 520
Includes provisions for mitigation and enhancement
5
SR 520 HCT
Bike
Pedestrian
HOV
SR 520 HOV, SR 520 HCT
Add one HOV lane each direction, add bicycle/pedestrian facilities and shoulders, realign the floating bridge and the Portage Bay Viaduct, and implement aggressive strategies to manage transportation demand
Add fixed guideway on SR 520
Assume HOV/Bus in I-90 reversible roadway
Includes provisions for mitigation and enhancement
6
SR 520 HCT
Bike
Pedestrian
HOV
GP
SR 520 HOV, GP, SR 520 HCT
Add one HOV lane and one GP lane each direction, add bicycle/pedestrian facilities and shoulders, realign the floating bridge and the Portage Bay Viaduct, and implement aggressive strategies to manage transportation demand
Add fixed guideway on SR 520
Assume HOV/Bus in I-90 reversible roadway
Includes provisions for mitigation and enhancement
7
Bike
Pedestrian
HOV
BRT
SR 520 HOV with BRT Connections (Bus Rapid Transit)
Add one HOV lane each direction, shared by BRT, with BRT connections
Add bicycle/pedestrian facilities and shoulders, realign the floating bridge and the Portage Bay Viaduct, and implement aggressive strategies to manage transportation demand
Assume HOV/Bus in I-90 reversible roadway
Includes provisions for mitigation and enhancement
8
Bike
Pedestrian
HOV
BRT
GP
SR 520 HOV with BRT Connections, GP
Add one HOV lane and one GP lane each direction, with BRT connections
Add bicycle/pedestrian facilities and shoulders, realign the floating bridge and the Portage Bay Viaduct, and implement aggressive strategies to manage transportation demand
Assume HOV/Bus in I-90 reversible roadway
Includes provisions for mitigation and enhancement
[As approved by the Executive Committee April 25, 2001]

Figure ES-1

ES.2 COMPARATIVE SUMMARY OF RESULTS

The evaluation ratings and selected data for the alternatives are shown in Tables ES-1 and ES-2. The discussion below summarizes the major differences between the highway and transit features of the alternatives.

ES.2.1 The Four-Lane Alternatives

No improvement to transportation conditions. With Alternatives 1 (No Action) and 2 (Safety and Preservation with I-90 light rail), both I-90 and SR 520 would have a limited ability to meet future travel needs. These alternatives received low to medium ratings in most transportation performance categories. Most transportation criteria were at the low end of the scale.

Neither alternative would provide the multimodal transportation services needed to keep pace with the expected growth in population and employment in the area. Even with no major improvements in highway capacity or operations, the daily demand for person trips would still increase by about 38,000 by 2020, most of which would be in HOV/transit trips or in off-peak travel. Vehicle trips are expected to increase by about 14,000 daily, and nearly all of that added traffic could only be served in the off-peak periods. General-purpose and commercial trips are expected to increase slightly. All of these increases in cross-lake travel demand would be less than the rates of regional average growth in travel, population and employment through 2020.

Longer travel times. Based on detailed traffic analysis, a typical general-purpose vehicle trip on SR 520 in 2020 may take up to twice as long as today. The HOV and bus transit times could also take 10 to 15 minutes longer due to overall congestion and the lack of full HOV facilities on SR 520.

Worsened congestion. Congestion would increase considerably in duration and in severity from today. During peak periods, about 3,300 vehicles per hour would be served on SR 520 at mid-lake, essentially the same as today despite the increased demand. This would leave nearly 600 vehicles unserved each hour. The primary trouble spots for congestion would be much the same as today, including the westbound approach at the bridge, at Montlake in both directions, and approaching I-405 and I-5. Many other interchanges have inefficient designs that will continue to aggravate local and highway congestion with increased demand.

Light rail performance will be indendent of lake crossing. The I-90 light rail for Alternative 2 drew similar numbers of riders as other HCT alternatives on either SR 520 or I-90. Traffic analyses predicted that the presence of light rail would not tend to reduce vehicle volumes, compared to No Action, although it would slightly reduce HOV volumes.

Table ES-1 Transportation Criteria

	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV / BRT	Alt 8: HOV / BRT & GP
Person Trip Demand	◔	◔	◑	●	◑	●	◑	●
Daily SR 520	183,200	173,200	200,700	261,200	212,225	284,190	215,200	293,600
Daily Total with I-90	429,100	428,900	457,375	503,260	442,925	513,490	451,300	526,000
Vehicle Demand	◑	◑	◕	●	◕	●	◕	●
Daily SR 520	121,300	120,500	129,400	174,100	130,400	181,100	131,700	188,100
Daily Total with I-90	287,000	286,100	301,700	332,200	293,200	341,700	296,300	347,900
PM Vehicles Served on SR 520 Per Hr	7,450	7,450	7,700	10,400	7,700	10,100	7,700	10,400
Mode Share	◑	◑	◑	◑	◑	◑	◑	◑
All Non-HOV	80%	80%	78%	79%	79%	79%	78%	79%
Transit Demand	◕	◕	◕	◕	◕	◕	◕	◕
Trans-Lake Total	44,900	48,200	50,075	54,300	45,325	51,090	50,300	56,600
VHT/VMT	◑	◑	◕	◑	◕	◑	◕	◑
Travel Time Savings								
General-purpose	Base	◑	◑	●	◑	●	◑	●
HOV	Base	◑	◕	◕	◕	◕	◕	◕
Transit	Base	◔	◕	◕	◕	◕	◕	◑
Traffic Congestion (Freeway)	◔	◔	◑	◑	◔	◔	◑	◔
Traffic Congestion (Local)	◑	◑	◕	◔	◕	◑	◕	◑
Travel Demand Reduction	◑	◕	◕	◔	◕	◔	◕	◔
Exclusive ROW	○	◕	●	●	●	●	◑	◑
Safety	○	◔	◑	◕	◑	◕	◕	●
Reliability	○	◔	◑	◕	◑	◕	◔	◑
Incident Mgmt	○	◔	◑	◕	◑	◕	◑	◕
Compatibility with other plans	○	○	◑	◑	◑	◑	◑	◑
System Continuity	○	○	◕	◑	◕	◑	◑	◔
Land Use/TDM Plan Compatibility	○	○	◑	◑	◑	◑	◑	◑

Transportation Criteria Rating Key

WORST				BEST
○	◔	◑	◕	●
Least Effective	Low Effectiveness	Medium Effectiveness	Better Effectiveness	Most Effective

Table ES-2. Environmental Criteria

Criteria	1: No Action	2: S&P, I-90 LRT	3: HOV, I-90 LRT	4: HOV, GP, I-90 LRT	5: HOV, 520 HCT	6: HOV, GP, 520 HCT	7: HOV/BRT	8: HOV/ BRT, GP
Air Quality	least	least	least	medium	least	medium	least	most
Water Resources	least	medium	most	most	most	most	most	most
Fish-Bearing Streams	no	least	medium	medium	least	most	least	least
Critical Upland Habitat	least	medium	medium	most	medium	most	medium	most
Wetlands and Shorelines	no	medium	most	most	most	most	most	most
Noise and Vibration	least	least	medium	most	medium	most	medium	most
Land Use	no	least	least	medium	medium	most	least	medium
Parklands	no	least	medium	most	medium	most	least	medium
Cultural Resources	no	medium	most	most	least	medium	least	least
Displacements and Disruption	no	least	medium	medium	medium	most	medium	most
Neighborhoods	medium	least	least	most	least	most	least	medium
Visual Quality	no	most	most	most	medium	medium	least	least

Environmental Criteria Rating Key

WORST →				BEST
Most Impacts	Medium Impacts	Least Impacts	No Impact	Improved Environment

At the lower end for costs and environmental impacts. No Action provides the baseline for environmental evaluations. Alternative 2, although more limited in extent than other build alternatives, nonetheless would still result in substantial environment impacts (mostly natural resources) due to SR 520 bridge replacement and the construction of I-90 light rail. Although the impacts are less than other alternatives, some impacts would be of a high magnitude.

ES.2.2 The Six-Lane Alternatives

The six-lane alternatives include Alternative 3 (SR 520 HOV with I-90 light rail), Alternative 5 (SR 520 HOV and HCT), and Alternative 7 (SR 520 HOV/BRT).

Increased demand for person trips substantially, with a slight increase in vehicle trips. The addition of HOV lanes in the SR 520 corridor would result in up to 30,000 more person trips daily (up to 17 percent) than No Action, with 10,000 (5 percent) more vehicles. All of the alternatives with SR 520 HOV result in fewer HOV trips on I-90, regardless of how the I-90 center roadway is configured.

Increased the demand for transit and HOV trips. Transit and HOV use would increase over No Action both for SR 520 and I-90 combined. However, their combined mode share would remain proportionately the same as No Actions; HOV and transit would make up about 20 percent of cross-lake trips. The location of HCT on either SR 520 or I-90 would not tend to affect the overall transit volumes for the six-lane alternatives. Alternative 7, which would offer BRT in both corridors, would have the best overall transit results for the six-lane alternatives. However, BRT may ultimately be constrained by congested local streets by 2020, especially in downtown Seattle and University District.

Vehicle travel times would improve. A detailed traffic analysis found that travel times on SR 520 would markedly improve for HOV (bus transit and car/vanpools) and general-purpose vehicles compared to No Action. While HOV would receive the most direct travel time benefits from the completed HOV lanes, general-purpose vehicle trips would also be faster. Overall corridor traffic conflicts would be reduced with an inside HOV lane, delays would be reduced at and near the improvements at interchanges that are currently operating poorly. Depending on the time period and direction of travel, the travel time savings for HOV will be 15 to 25 minutes, and for GP will be 9 minutes to 30 minutes. (A different method using the regional model showed smaller travel time savings, but both methods show improvements with the added HOV lanes.)

HOV lanes will be mostly free-flowing, and GP congestion would ease. Based on traffic analysis, about 10 percent more vehicles would be served each hour at peak, compared to No Action, and most of these would be HOV. The continuous HOV lanes and reconfigured interchanges will directly improve carpool/bus transit traffic flow. New HOV ramps to the I-5 express lanes, new I-405 HOV ramps and a new HOV connection to the University District all appear to offer distinct advantages to HOV. In addition, by moving the HOV lanes inside and eliminating many weaving movements, overall traffic flow on SR 520 would improve. Redesigned interchanges would improve traffic flow at several locations that are chronic bottlenecks today, particularly at Montlake/Lake Washington Boulevard, 108th/Bellevue Way S., and 124th Avenue NE. Transit reliability would improve with HCT in either I-90 or SR 520, but bus reliability would also improve due to the continuous HOV on SR 520.

Congestion on local streets will worsen slightly but impacts could be reduced. The relatively modest additional vehicle trips created by the six-lane alternatives would worsen some local intersections that are already operating poorly under No Action. Intersection and street improvements would address most impacts.

Environmental impacts would be medium to high. High impacts to natural resources would occur in the Lake Washington and Portage Bay areas, with more area affected by the wider roadway. The impacts to wetland and shoreline resources at Lake Washington are unavoidable and would be difficult to fully mitigate. Water resources would need substantial mitigation, a physical challenge in a constrained corridor. The HOV lane extension through to Union Hill Road in Redmond would further increase potentially significant natural impacts, including impacts to salmon-bearing streams in the Bear Creek and Sammamish River areas. Although nearly 30 structures could be directly impacted, this is considered moderate for a project of this length. Other land use, neighborhood and noise impacts also would be medium. The interchange areas have the most potential for increased impacts, particularly as local street mitigations are further identified. There would be impacts to 11 park properties, most due to the highway improvements.

The HCT environmental impacts are lower for the I-90 route than for the SR 520 route, although both routes involve high impacts to sensitive areas. Most of the differences in the extent of impacts are related to the ability of the I-90 route to use existing structures to cross Lake Washington, while the SR 520 routes would need to create a new right-of-way to reach and cross Lake Washington, affecting more land in parklands and natural resource areas.

ES.2.3 The Eight-Lane Alternatives

The eight-lane alternatives are Alternative 4 (SR 520 HOV and GP with I-90 light rail), Alternative 6 (SR 520 HOV and GP and HCT), and Alternative 8 (SR 520 HOV/BRT and GP). Alternatives 4 and 8 include a new Eastlake connection, and Alternative 6 features a new general-purpose connection from Montlake to the University District.

Large increase in the demand for travel by people and vehicles. About 80,000 to 100,000 more people would want to use SR 520 daily, bringing 45,000 to 60,000 more vehicles to the corridor. The differences in demand among the different eight-lane alternatives are mostly due to different options for new access to the University District or to Eastlake.

HOV demand would also increase. HOV demand would still make up nearly 20 percent of daily trips, and the volume of trips would increase by nearly 50 percent over No Action. General-purpose trips would also increase nearly 50 percent over No Action. Traffic analyses indicated that the increase in general-purpose capacity would apparently not reverse the high demand for transit and HOV seen with four-lane or six-lane alternatives. In fact, HOV and transit demand increased. The location of HCT ineither I-90 or SR 520 did not greatly change Cross-lake HOV use overall, although shares did vary between the I-90 or SR 520 corridors.

Provides the greatest overall travel-time improvement over No Action. General-purpose vehicle times are expected to improve considerably over No Action, and in some estimates could be up to 30 minutes better. HOV and transit vehicle travel times are about the same as the six-lane alternatives, or up to 45 percent better than No Action and more people would be served. The added general-purpose capacity, the completed HOV lanes (all on the inside), and improved traffic flow at interchanges would all contribute to the travel-time improvements. HCT travel times savings ove "No Action" bus travel times will be improved regardless of whether HCT was on I-90 or SR 520 inmost cases.

Congestion should ease over No Action, although the higher traffic volumes present new challenges. The eight-lane alternatives would effectively serve about 30 percent more vehicles at peak periods (5,000 more), compared to No Action, although they would still result in backups in some areas and at the height of peak travel. The higher volumes of traffic with eight-lanes also would present new challenges at I-5 as well as on some local streets. Traffic flow would be particularly complex near closely spaced interchanges, such as areas like Montlake and I-5, 108th Ave NE/Bellevue Way NE, I-405, and 124th Ave NE. To minimize weaving, some of the interchange functions may be provided with directional and braided ramps that separate conflicting movements. This would increase costs and has the potential to worsen environmental impacts.

I-5 must be modified to avoid impacts. At I-5, the increased traffic volumes from an eight-lane SR 520 would likely degrade I-5 unless additional improvements are made. These would include moving the SR 520 ramps to and from southbound I-5 to the west side of I-5, helping reduce backups on the ship canal portion of SR 520 and the "Mercer Weave" on I-5. A new lane would be needed on southbound I-5 from SR 520 south to Stewart Street. Although the direct connection to Eastlake could attract a substantial number of trips, it would worsen traffic conditions in the Eastlake neighborhood, and I-5 improvements would still be needed.

Local streets would have more congestion, requiring major improvements. Up to 16 intersections would operate at Level of Service (LOS) E or F during the AM and/or PM peak hours, compared to 10 intersections with these LOSs under No Action. These traffic problems could be mitigated, but they would require substantial improvements. One of the major areas that would have high impacts without mitigation is at Montlake, where improvement would require a second crossing of the Montlake Cut and a grade separation at the Pacific/Montlake Boulevard intersection. If the Eastlake Tunnel is carried forward, the Eastlake/Fairview intersection and possibly the Valley/Fairview intersection would need to be grade-separated. Other actions would involve widening or other improvements at Lake Washington Boulevard in Kirkland, 148th Avenue NE in Bellevue, 124th Avenue NE in Bellevue, NE 40th & NE 51st Streets, W. Lake Sammamish Parkway and Leary Way NE in Redmond.

Highest impacts to natural resources, water resources, noise, parks, neighborhoods. As with all alternatives that reconstruct the floating bridge, high impacts to natural resources would occur in the Lake Washington and Portage Bay areas, but they would be greater in extent due to the wider roadway footprint. Alternative 6, which would have eight-lanes and HCT, would have the greatest total footprint and the greatest impacts along SR 520. In many areas the wetland and shoreline resource impacts are unavoidable and would be difficult to fully mitigate. Water resources would require greater mitigation as paved areas increase and more fisheries habitat is affected, including at Lake Washington, Bear Creek and the Sammamish River. Noise impacts increase as traffic volumes increase and as the highway and/or transit moves closer to sensitive locations. Mitigation such as noise barriers could reduce the impacts for many of the most sensitive receptors. Local traffic would have greater impacts on nearby neighborhoods. There are 16 direct park impacts, 14 of which are related to the highway. Property impacts would involve an increased number of structures, particularly near I-405 and I-5 interchanges, including potential impacts to a historic school. The interchange areas and related local street improvements have the potential to increase these impacts.

ES.2.4 HCT Comparative Summary

Overall transit demand will increase greatly. Overall transit demand (by bus and HCT) for Trans-Lake travel is expected to at least triple by 2020 in all alternatives, compared to 1995. For SR 520 and I-90 combined, 16,000 person trips were on transit across the lake daily in 1995. In 2020, daily ridership will range from 45,000 to 57,000. The highest transit ridership occurred with alternatives that substantially improved transit service on both I-90 and SR 520, rather than focusing the improvements on one corridor or the other.

SR 520 and I-90 HCT alternatives offer similar ridership and similar average travel times. Both SR 520 and I-90 HCT corridors showed similar ridership, ranging from 28,000 to 34,000 daily trips. Although these HCT routes serve different areas, particularly on the Seattle side, they still connect the same major transit markets on each side of the lake (i.e., downtown Seattle, Bellevue and Redmond). Based on ridership alone, there appears to be no clear preference for a SR 520 versus an I-90 route. Similarly, average travel times between the two routes will be similar formost origin-destination combinations.

A fixed guideway HCT system on either route would increase cross-lake transit ridership by up to 30 percent, in a conservative estimate compared to No Action. A Trans-Lake HCT system could increase daily transit demand across the lake by 4,000 to 12,000 person-trips by 2020, compared to No Action. However, the regional model forecasts may tend to understate the ridership benefits of HCT. The model results for No Action transit trip forecasts are considered high, given that bus transit vehicles would not have HOV lanes or exclusive transit facilities to ensure quick and reliable transit service. HCT trips could well be higher than that forecased by the regional model if HCT delivers much a faster trip than a typical general-purpose trip. A more detailed traffic operatoins model indicated that the general-purpose lanes could be up to 20 minutes slower and much less reliable than the regional model forecasts show. This leads to the conclusion that an HCT system may be more attractive than the ridershop results show, particularly a fixed guidewaty HCT system with exclusive right-of-way.

BRT alternatives show high ridership, but face long-term limits. The BRT alternatives (7 and 8) had among the highest ridership forecasts. These alternatives featured frequent and comparatively quick transit service on both I-90 and SR 520 compared to No Action. Both of these corridors already have good transit ridership, and future growth in population and employment will occur near I-90 and SR 520. The results for BRT clearly showed that both corridors were important for transit. However, the long range potential for BRT will be constrained by the limited capacity of streets and transit transfer points in downtown Seattle, the University District, and Bellevue. These areas will be close to their bus operating capacities by 2020, eventually slowing BRT travel times and reducing reliability, resulting in low potential for any further growth in ridership.

HCT environmental impacts will be similar overall, but SR 520 HCT crossing will have the highest impacts. The environmental impacts of HCT located in I-90 and SR 520 will be similar overall, although in the bridgehead areas, the SR 520 HCT alternatives would have more impacts. This would be due to the extent of sensitive areas and parklands that SR 520 HCT would encounter on either side of Lake Washington. An I-90 HCT route would also be near sensitive wetlands, stream and shoreline areas around Lake Washington, but it would require less new right of way. East of Bellevue, both routes would have the same impacts. Compared to either SR 520 or I-90 HCT, the BRT routes would have the advantage of limited new right of way with fewer impacts.

I-90 Alternatives will have lower costs. The alternatives with I-90 HCT will be less costly than SR 520 HCT alternatives, by $0.8 billion to $2.3 billion.

1 ALTERNATIVES EVALUATED

1.1 INTRODUCTION

This report summarizes the results of eight multimodal alternatives being considered by the Trans-Lake Washington project. The alternatives represent the range of highway, high capacity transit (HCT) and transportation demand management (TDM) actions being considered for the SR 520 corridor between Redmond and Seattle, including the Lake Washington crossing. The alternatives analysis is being conducted to help select alternatives for further examination in an Environmental Impact Statement (EIS) focused on SR 520.

As part of the analysis, the project is also considering the comparative benefits, impacts and costs of using I-90 or SR 520 as a route for HCT to cross Lake Washington.

Chapter 1 of this report describes the alternatives currently being considered. Chapter 2 provides the transportation effectiveness results, Chapter 3 provides environmental results, and Chapter 4 provides cost results. Chapter 5 provides analysis of issues that were raised after presentation of the initial Committee Discussion Draft in June 2001. This includes supplemental studies of new options that have been suggested for the eight alternatives below.

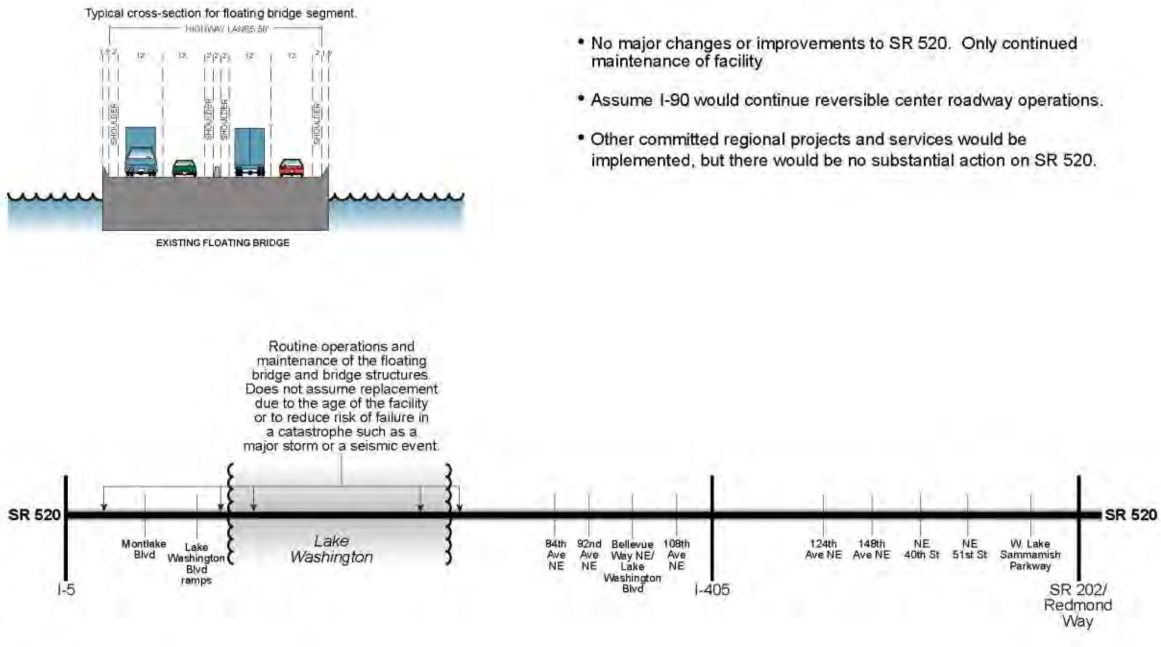
1.2 MULTIMODAL ALTERNATIVES

The following multimodal alternatives were identified following earlier analysis and refinement of a larger set of highway, HCT and TDM actions. In April 2001, the project's Executive Committee selected eight alternatives to represent the most promising range of actions for meeting the project's purpose and need, and asked that these alternatives be further evaluated before EIS alternatives are selected.

Figure ES-1 in the executive summary, summarizes the proposed multimodal alternatives. The text and figures that follow briefly describe the alternatives and depict the major features and assumptions.

1.2.1 Alternative 1: No Action

This alternative (Figure 1-1), represents SR 520 with no major improvements or actions to the corridor. It assumes that the floating bridge will continue to be maintained and operated as it is today, at least until the year 2020. It does not include replacement of the floating bridge or any of the bridge structures to reduce the risk of failure due to catastrophic events such as a major storm or an earthquake.



Trans-Lake Washington Project

Figure 1-1
Alternative 1
No Action

1.2.2 Alternative 2: SR 520 Safety and Preservation with I-90 Light Rail Transit (LRT)

1.2.2.1 SR 520 Improvements

Alternative 2 (Figure 1-2) represents the SR 520 corridor with no major capacity improvements, but it would replace the floating bridge due to its limited remaining service life. All seismically substandard bridges on SR 520 would also be replaced. A 12-foot bicycle and pedestrian path would be provided along SR 520 between Lake Washington Boulevard in Seattle and 84th Avenue NE in Medina, connecting with existing bicycle and pedestrian paths. The replaced segments are assumed to be reconstructed to full design standards, which would include inside and outside shoulders and a median. Construction requirements would also involve realigning the facility up to 200 feet to the north at Portage Bay and across Lake Washington.

1.2.2.2 I-90 High Capacity Transit

On I-90, light rail would connect downtown Seattle to Bellevue, with lines connecting to Kirkland/Redmond. The route is shown in Figure 1-3. Although the majority of Trans-Lake transit riders would be focused to the I-90 light rail system, SR 520 would still serve regional bus routes between the University District and Bellevue, Kirkland and Redmond. A route from central Kirkland to downtown Seattle would also use SR 520.

1.2.3 Alternative 3: SR 520 HOV with I-90 LRT

1.2.3.1 SR 520 Improvements

On SR 520, a continuous HOV lane would be provided each way from I-5 to SR 202/Redmond Way (Figure 1-4). This would provide two general-purpose lanes and one HOV lane each way for a total of six lanes, with the HOV lanes relocated to the inside. The Portage Bay and Lake Washington bridges would be replaced and realigned up to 200 feet to the north. The widening assumes full design standards, including shoulders on the inside and outside (each way), and a 12-foot bicycle/pedestrian path on the north side of the new facility. Areas within a half-mile of interchanges and transit stations could be two to four lanes wider to accommodate vehicles merging and weaving between on and off ramps.

A number of interchange design and access options are also being tested with this alternative (all are shown on Figure 1-3), but the set of options unique to this alternative are:

- HOV ramps to and from SR 520 and the I-5 express lanes to the south.
- Direct HOV-to-HOV connections at the I-405/SR 520 interchange.
- A Montlake area tunnel under the Montlake cut connecting transit and HOV directly to Pacific Street in the University District.

1.2.3.2 I-90 Light Rail

The I-90 light rail system would be the same as described in Alternative 2.

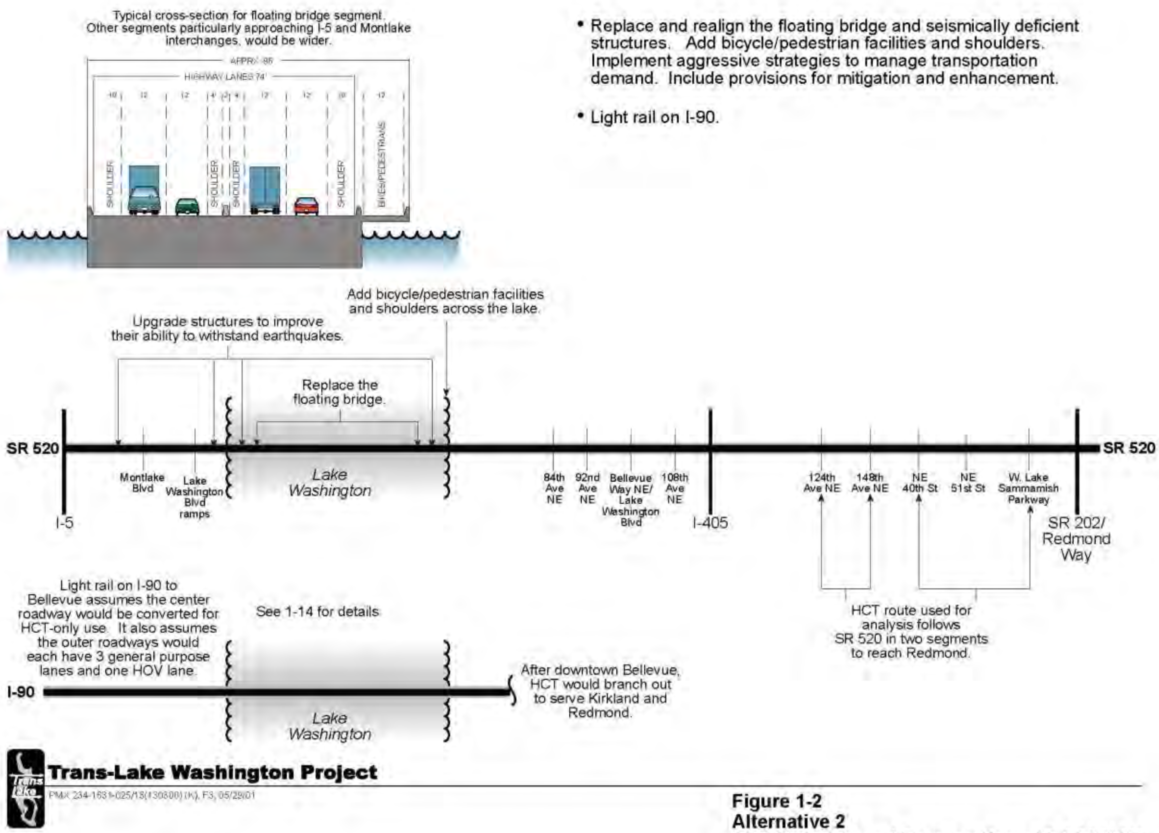


Figure 1-2
Alternative 2
SR 520 Safety and Preservation with I-90 HCT

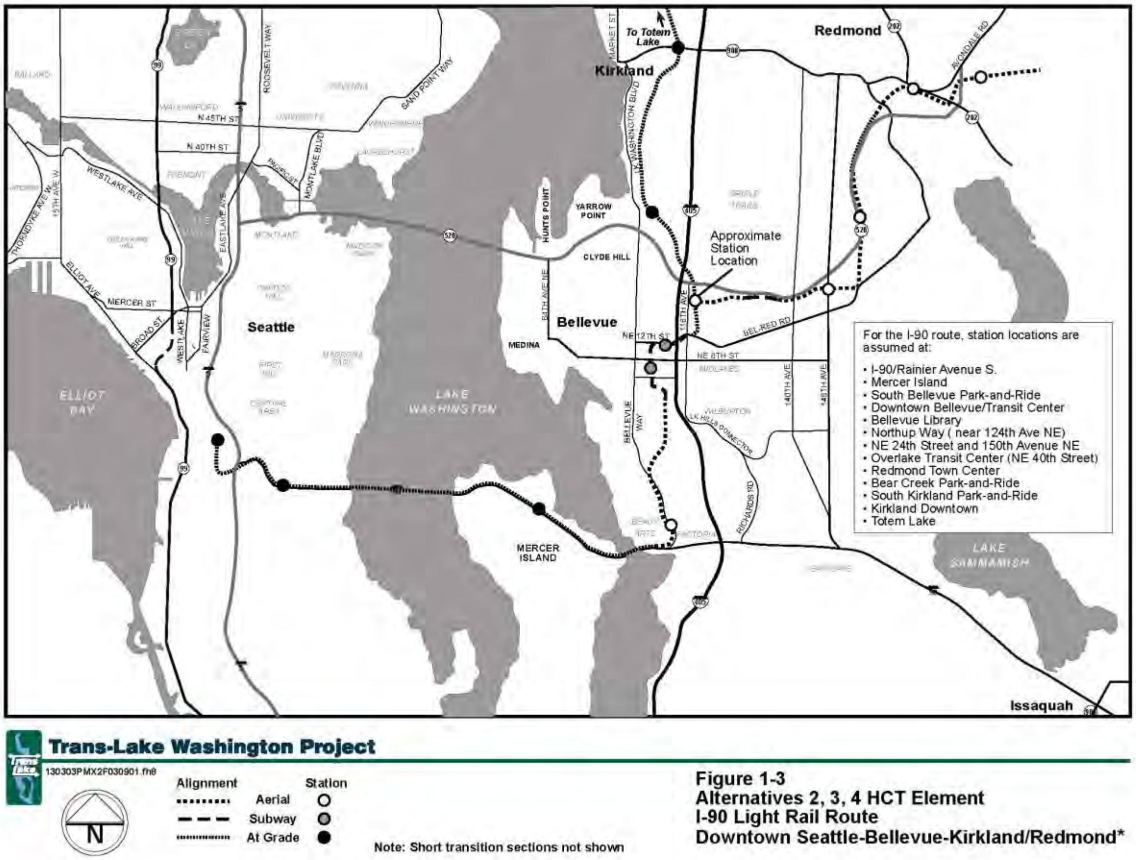


Figure 1-3
Alternatives 2, 3, 4 HCT Element
I-90 Light Rail Route
Downtown Seattle-Bellevue-Kirkland/Redmond*

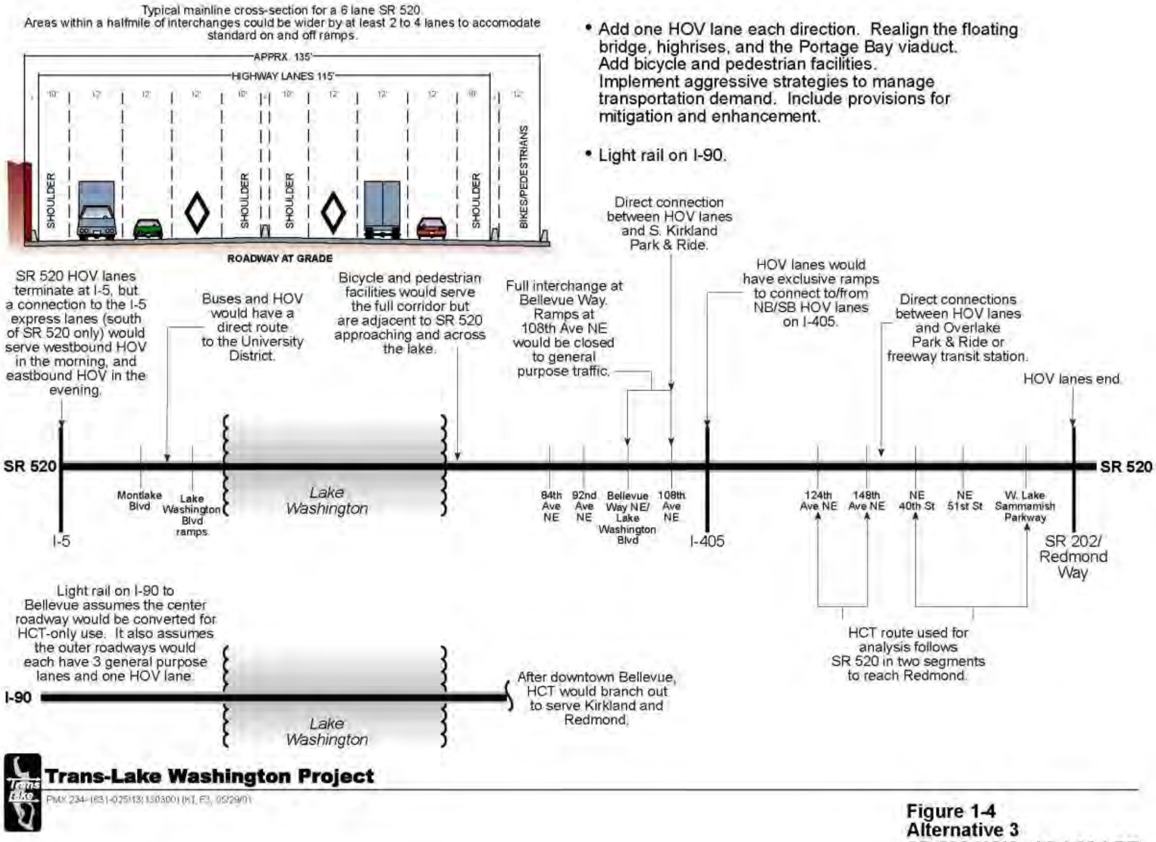


Figure 1-4
Alternative 3
SR 520 HOV with I-90 LRT

1.2.4 Alternative 4: SR 520 HOV and GP with I-90 LRT

On SR 520, Alternative 4 (Figure 1-5) would add one HOV lane and one general-purpose lane in each direction between I-5 and West Lake Sammamish Parkway, for a total of eight lanes. The new general-purpose lanes would end at West Lake Sammamish Parkway on the east. The added HOV lanes would continue east to SR 202/Redmond Way.

- All of the interchanges and overpasses in the corridor would be reconstructed to accommodate the wider highway. As with Alternative 3, full design standards are assumed, a bicycle and pedestrian path would be provided on the north side of the facility, the HOV lanes would be relocated to the inside, and the Portage Bay and Lake Washington bridges would be replaced and realigned up to 200 feet to the north. Areas within a half-mile of interchanges and transit stations could be two to four lanes wider to accommodate vehicles merging and weaving between on and off ramps.
- Interchange and access design options are being tested at I-5, Montlake Boulevard, Bellevue Way NE, Bellevue Way/NE 108th, I-405 and SR 202/West Lake Sammamish Parkway. The set of options unique to the alternative are:
- HOV ramps to and from the I-5 express lanes to the south and to the north.
- HOV-to-HOV connections at the I-405/SR 520 interchange.
- An HOV/transit tunnel from SR 520 to the University District.

An Eastlake area tunnel for general-purpose traffic, connecting SR 520 to Eastlake/Fairview Avenues.

1.2.4.1 I-90 Light Rail

The I-90 light rail system would be the same as described in Alternative 2 (see Figure 1-3).

1.2.5 Alternative 5: SR 520 HOV and HCT

1.2.5.1 SR 520 Highway Improvements

The Alternative 5 highway improvements to SR 520 would be the same as described for Alternative 3, with continuous HOV lanes provided between I-5 and SR 202/Redmond Way, and two general-purpose and one HOV lane in each direction (see Figure 1-6).

The interchange and access design options are similar to Alternative 3, except for:

- Approaching I-5, the SR 520 HOV lane designation would end and HOV traffic would use general-purpose ramps to the I-5 mainline.
- There would not be an HOV/bus transit tunnel to the University District.

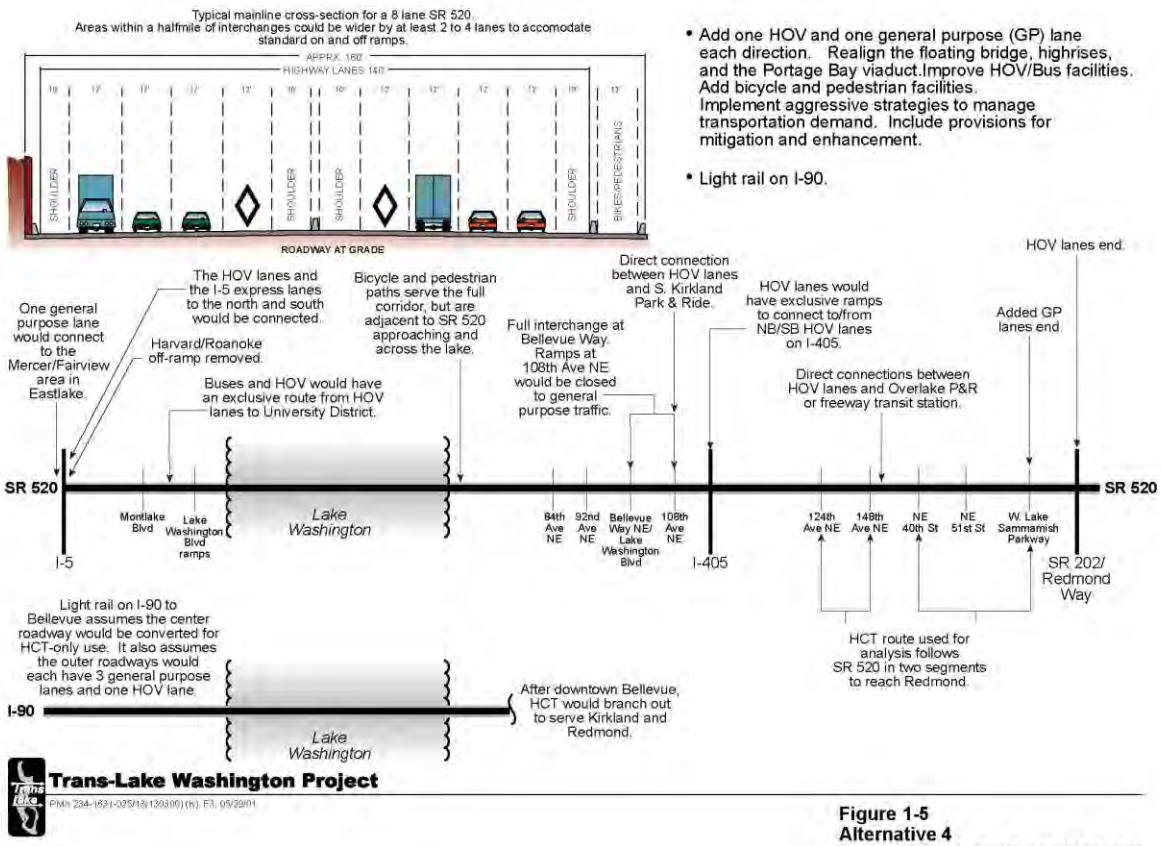


Figure 1-5
Alternative 4
SR 520 HOV and GP with I-90 LRT

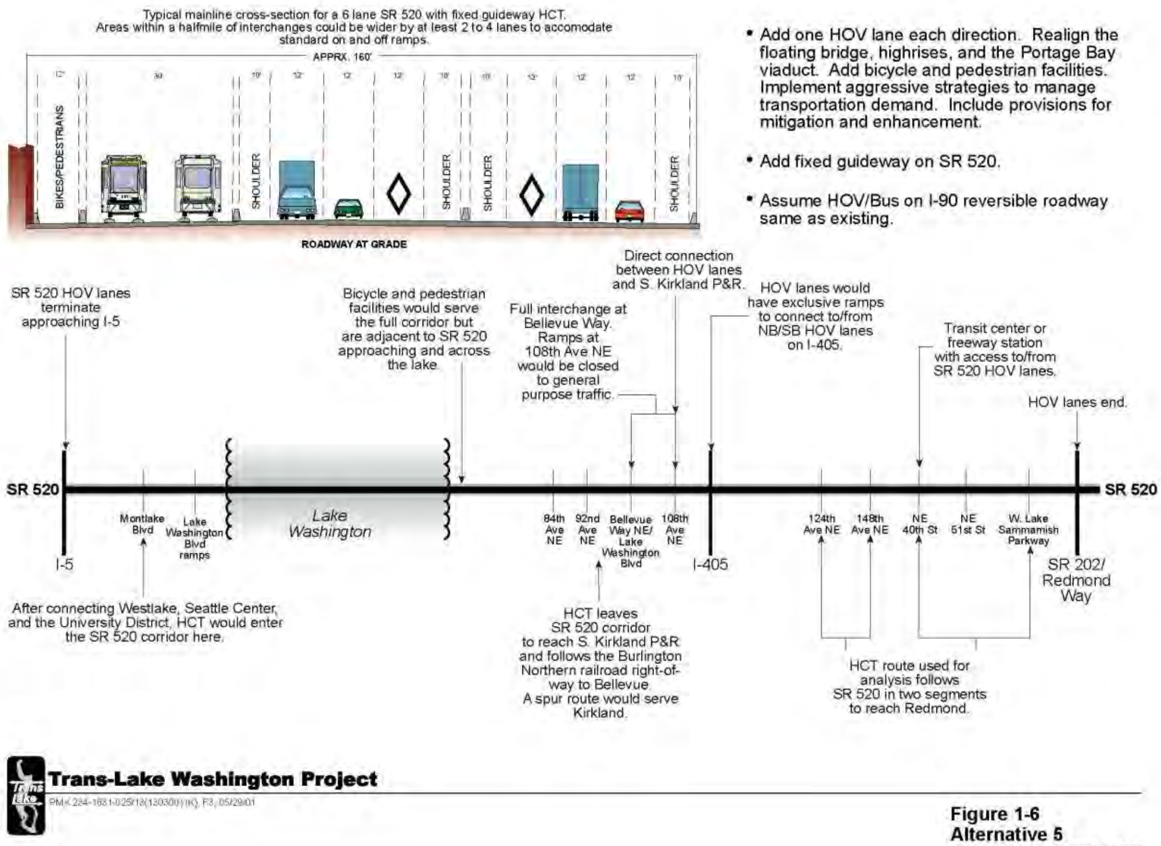


Figure 1-6
Alternative 5
SR 520 HOV and HCT

1.2.5.2 SR 520 High Capacity Transit

A fixed guideway[1] line would begin in downtown Seattle, pass through Fremont and Wallingford to the University District, and then follow the SR 520 corridor across Lake Washington (Figure 1-7). The main line would proceed to Redmond, with a branch to downtown Bellevue. There would also be a Kirkland-Bellevue shuttle. Although most Trans-Lake transit riders along the corridor will be focused to the SR 520 HCT line, some would continue to use the I-90 corridor.

Regional bus routes from southeast Bellevue and Issaquah would use I-90 to serve downtown Seattle. Bus service would also be provided from the I-405 south corridor into downtown Seattle via I-90. (The I-90 center roadway is assumed to maintain current operations with this alternative, with the center roadway operating reversibly.)

1.2.6 Alternative 6: SR 520 HOV and GP and HCT

1.1.1.1 SR 520 Highway Improvements

The highway improvements to SR 520 for Alternative 6 would be similar to Alternative 4, with an eight-lane highway providing three general-purpose lanes and one HOV lane each way (Figure 1-8). However, the west side terminus for the added general-purpose lanes would be at Montlake.

The interchange and access options would be the same as alternative 4, except for:

- A tunnel would connect general-purpose traffic to Pacific Avenue in the University District (it would not be an exclusive HOV connection).
- There would not be a Fairview Avenue/Eastlake Avenue tunnel for general-purpose traffic.

1.2.6.1 SR 520 High Capacity Transit

The SR 520 HCT would be as described for Alternative 5 (with the route shown in Figure 1-7).

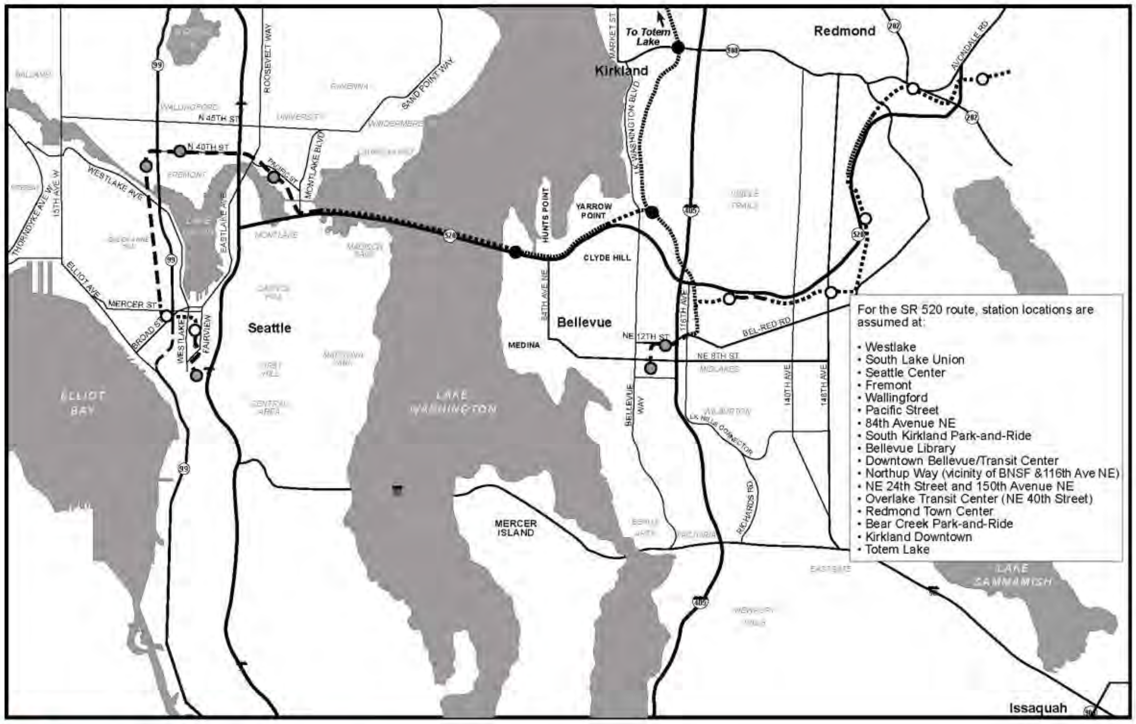
1.2.7 Alternative 7: SR 520 HOV with Bus Rapid Transit connections

1.2.7.1 SR 520 Highway Improvements

SR 520 would be a six-lane highway (Figure 1-9) with continuous HOV lanes provided between I-5 and SR 202/Redmond Way, similar to Alternative 3. However, the HOV lanes would be shared by BRT vehicles[2].

[1] A fixed guideway is assumed to be a rail or rubber-tired transit system that operates predominantly in an exclusive right-of-way at, below or above grade.

[2] Bus rapid transit would be an express/limited stop rubber tired transit system operating predominantly in a "managed lane" roadway environment. This would include bus-only lanes, HOV 3+ lanes (restricted to vehicles with three or more occupants), or HOT lanes (restricted to vehicles with three or more occupants or vehicles paying tolls).



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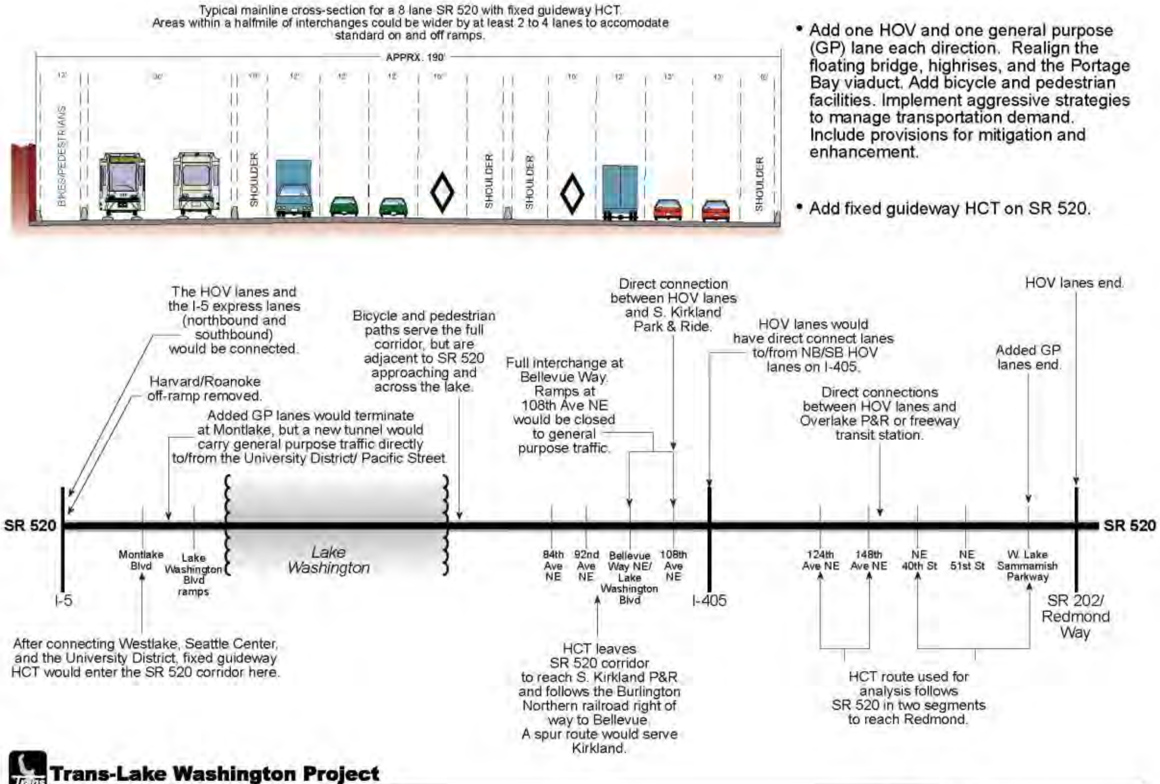
Alignment		Station
·········	Aerial	○
— — —	Subway	● (grey)
▪▪▪▪▪▪▪	At Grade	●

N

Note: Short transition sections not shown

Figure 1-7
Alternatives 5 and 6 HCT Element
SR 520 Fixed Guideway Route
Downtown Seattle-U District-Kirkland/Redmond/Bellevue



Trans-Lake Washington Project

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Figure 1-8
Alternative 6
SR 520 HOV and GP and HCT

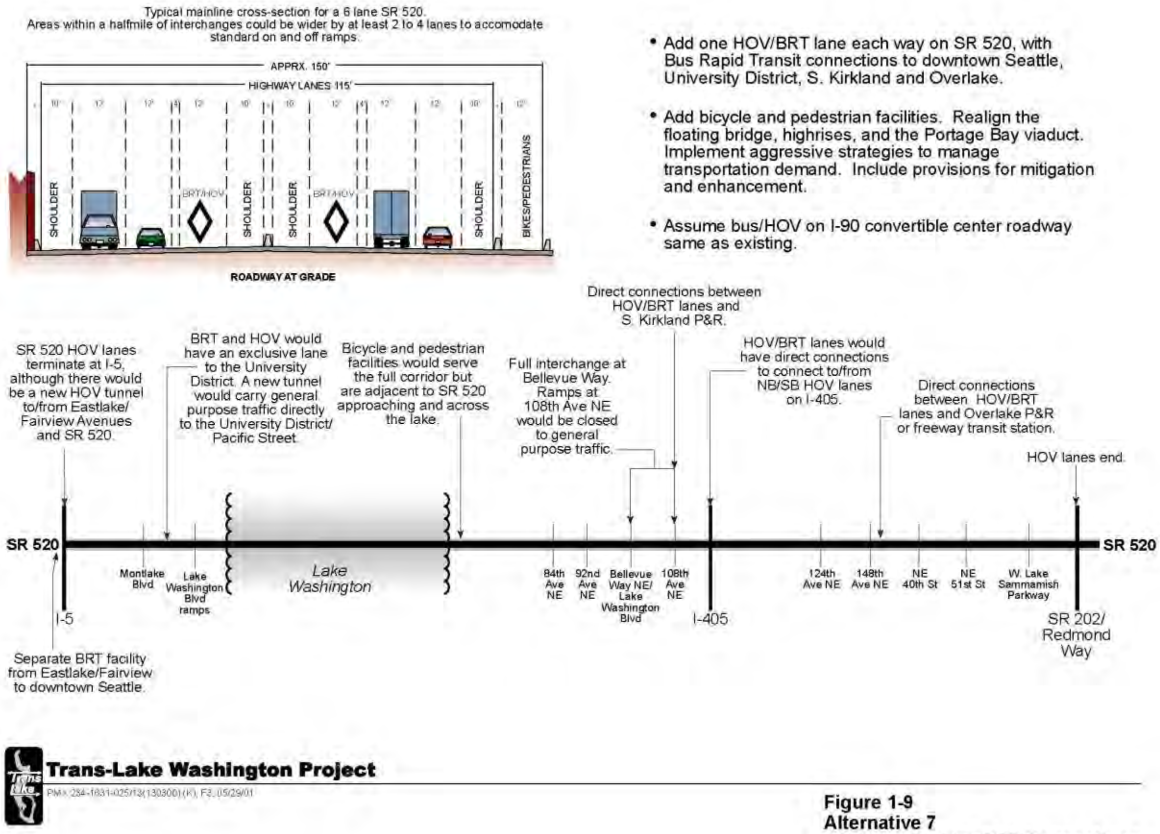


Figure 1-9
Alternative 7
SR 520 HOV with BRT Connections

The interchange and access options would be the same as Alternative 3, except:

- The SR 520 HOV lane designation would end at I-5, and HOV traffic would use general-purpose ramps to the I-5 mainline.
- An HOV/BRT tunnel would connect SR 520 to Eastlake and Fairview Avenues.
- There would also be a BRT/HOV tunnel connection to Pacific Avenue in the University District.

1.2.7.2 SR 520 BRT

All-day BRT routes would link Bellevue, Redmond/Overlake and Kirkland/Totem Lake to downtown Seattle or to the University District. Peak-service only transit routes on the east side would supplement this service, and local transit routes would also connect to the all-day BRT routes. For I-90, BRT service is also assumed for the I-90 corridor, and the I-90 center roadway is assumed to operate reversibly, as it does today.

1.2.8 Alternative 8: SR 520 HOV with BRT connections and GP

SR 520 would be an eight-lane highway including one additional HOV lane and one additional general-purpose lane each way (Figure 1-10), similar to Alternative 4. BRT vehicles would share the HOV lanes for most of the corridor, but there would be added connections and facilities in several locations.

The options are similar to Alternative 4, except:

- A tunnel for general-purpose and HOV/BRT traffic would connect SR 520 to Eastlake Avenue/Fairview Avenue in the south Lake Union area.
- A busway would connect from Eastlake Avenue/Fairview to Downtown Seattle.
- A new tunnel for general-purpose traffic would connect SR 520 directly to the University District.
- An exclusive HOV lane between SR 520 and the University District would be provided by converting one lane in each direction.

1.2.8.1 SR 520 BRT

All-day BRT routes would link Bellevue, Redmond/Overlake and Kirkland/Totem Lake to downtown Seattle or to the University District. Peak-service only transit routes on the east side would supplement this service, and local transit routes would also connect to the all-day BRT routes. For I-90, BRT service is also assumed for the I-90 Corridor, and the I-90 center roadway is assumed to operate reversibly, as it does today.

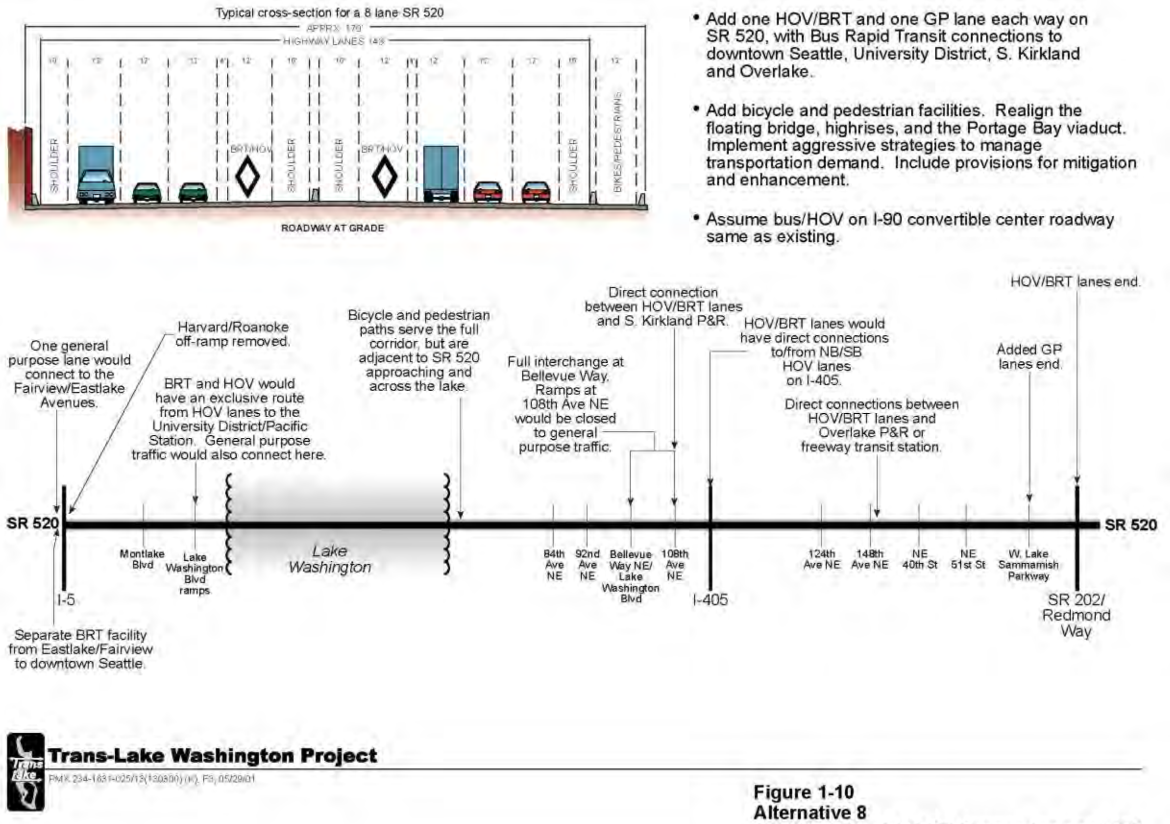


Figure 1-10
Alternative 8
SR 520 HOV with BRT Connections and GP

2 TRANSPORTATION EFFECTIVENESS

This chapter summarizes the transportation performance of the eight multimodal alternatives. Twelve mobility criteria and three reliability and safety criteria were developed for use in the evaluation. These criteria provide measures of the relative and cumulative contributions of highway, transit (including HCT), and TDM elements for the corridor.

The Puget Sound Regional Council's (PSRC) travel demand forecasting model was the primary information source for determining future transportation demand for the evaluation. To establish existing conditions information, the project team also collected transportation data from state and local jurisdictions and transportation agencies, and conducted traffic counts along the corridor.

The PSRC model predicts daily and peak period travel demand for the corridor in the year 2020. The model forecasts person trips and vehicle trips, and predicts travel speeds, travel times, and the mode of travel. The model also provides general assumptions about the growth of traffic throughout the corridor and region. A variety of other data sources and analytical tools were used to calculate future operating conditions along the corridor, including traffic volumes by time of day and location, the level of congestion, and local street impacts.

The performance of the alternatives under each transportation criteria is discussed below. The criteria and their definitions are followed by a summary of the transportation performance of each alternative. In some cases, the criteria definitions have been adjusted to reflect changes in methodology, but each criterion is still applied. The changes to criteria are shown in strikeout.

2.1 MOBILITY CRITERIA

The mobility criteria cover broad measures of corridor performance, including the number of people and vehicles served, or the level of transit ridership. There are also more detailed measures to reflect conditions on highways and local streets, including congestion, delay and queuing.

2.1.1 Person Trip Demand

Criteria Definition: *The number of person trips attracted to each Single Occupancy Vehicle (SOV) and HOV lane for the corridor will be quantified.* ~~*The total person throughput on freeway links for each alternative will also be quantified.*~~

The demand for travel across Lake Washington for each of the alternatives for the SR 520 and I-90 corridors combined is illustrated in Figures 2-1a and 2-1b. The person trips are detailed in Tables 2-1, 2-2, and 2-3 which also include the qualitative ratings for the alternatives. The forecasts are from PSRC's model, as applied for this project. The forecasts include daily and peak periods, predicting future demand for travel across a mid-lake north-south screenline through SR 520 and I-90. The PSRC model projects trip volumes based on travel demand and lane capacity without reference to capacity limits arising from merging traffic at interchanges or other bottlenecks. The model also reallocates trips to employment and other destinations based upon the capacity of the roadway network. For that reason, the total number of trips attracted to the Trans-Lake corridor changes according to the capacity of the alternatives. Appendix A and B to this report provides forecasts for the alternatives that also specify the mode of travel, although the changes in mode preference are discussed in more detail in the mode share and transit ridership criteria in this chapter.

Figure 2-1a
Daily Person Trip Demand SR 520 and I-90

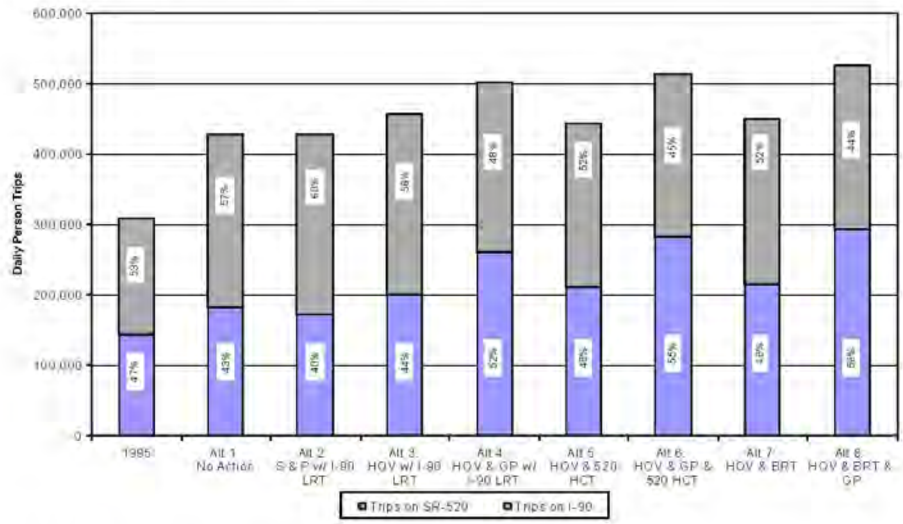
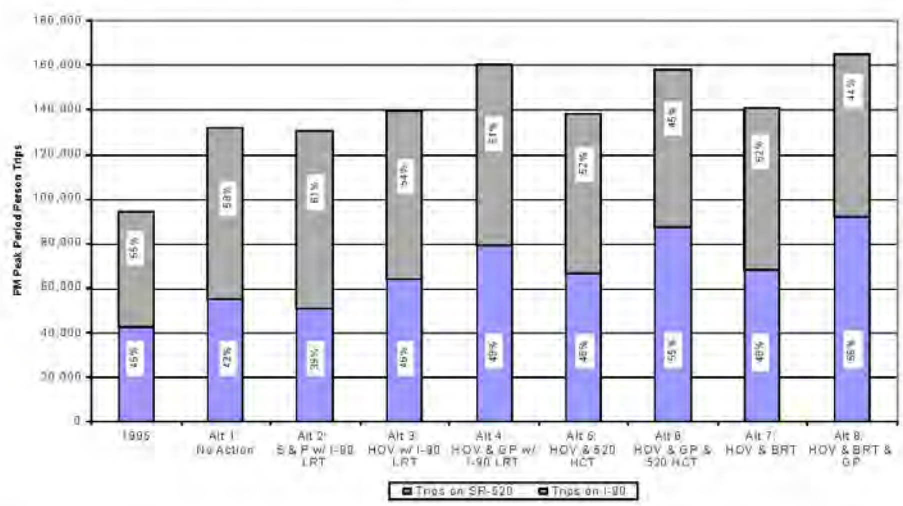


Figure 2-1b
Peak Period Person Trip Demand SR 520 and I-90



Demand forecasts provide a measure of how many people would be attracted to Trans-Lake corridors in 2020 under each alternative, but they do not necessarily indicate how many people could be accommodated, particularly at peak periods. Other models and analysis were used to evaluate the corridor's ability to serve the forecast demand. See criteria for traffic congestion in Section 2.1.8.

Table 2-1. Person Trip Demand
Daily and Peak Period Demand Forecasts for Person Trips on SR 520 and I-90

Facilities	1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
DAILY PERSON TRIPS									
SR 520									
Person Trips	144,600	183,200	173,200	200,700	261,200	212,225	284,190	215,200	293,600
I-90									
Person Trips	164,900	245,900	255,700	256,675	242,060	230,700	229,300	236,100	232,400
Total	**309,500**	**429,100**	**428,900**	**457,375**	**503,260**	**442,925**	**513,490**	**451,300**	**526,000**
PEAK PERIOD PERSON TRIPS									
SR 520									
Person Trips	42,400	54,900	51,000	64,100	78,900	66,330	87,250	68,000	92,400
I-90									
Person Trips	51,400	77,200	79,600	75,590	81,430	71,700	71,000	72,700	72,700
Total	**93,800**	**132,000**	**130,600**	**139,690**	**160,330**	**138,030**	**158,250**	**140,700**	**165,100**

Source: PSRC Regional Forecasting Model

Table 2-2. Person Trip Demand Criteria Rating

1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
--	◔	◔	◑	●	◑	●	◑	●

Rating Key

WORST				BEST
○	◔	◑	◕	●
Least Effective, Most Impacts	Low Effectiveness, Medium Impacts	Medium Effectiveness, Low Impacts	Increased Effectiveness, No Impact	Most Effective, Improved Conditions

Table 2-3. Daily Vehicle Volumes by Alternative, Facility, and Mode

Facilities	1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & HCT	Alt 6: HOV & GP & HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
SR 520									
Non-HOV	82,600	89,900	86,700	88,800	124,600	89,100	128,200	90,200	134,200
Commercial	23,700	29,600	29,600	29,500	37,600	30,100	40,000	30,400	41,600
HOV (3+)	700	4,800	4,200	11,100	11,900	11,200	12,900	11,100	12,300
Total Vehicle Trips	107,000	121,300	120,500	129,400	174,100	130,400	181,100	131,700	188,100
I-90									
Non-HOV[a]	96,200	122,300	122,900	130,100	121,000	122,900	121,300	124,300	120,700
Commercial	27,100	35,200	35,200	37,900	32,500	35,200	34,500	35,700	34,100
HOV (3+)	800	8,200	7,500	4,300	4,600	4,700	4,800	4,600	5,000
Total Vehicle Trips	124,100	165,700	165,600	172,300	158,100	162,800	160,600	164,600	159,800
Totals	**231,100**	**287,000**	**286,100**	**301,700**	**332,200**	**293,200**	**341,700**	**296,300**	**347,900**

Source: PSRC Regional Forecasting Model

[a] Includes SOVs and 2 person HOVs with an overall average vehicle occupancy of 1.33

2.1.1.1 Overview of Person Trip Demand Forecasts

Based on the model, total daily person trips across the lake in 1995 were about 310,000 on a typical weekday. By 2020, with no improvements to either SR 520 or I-90, this demand is expected to grow to about 430,000 people/day, an increase of approximately 40 percent. With No Action, most of the increased travel demand would be in HOV and transit usage.

In alternatives with no major increase in SR 520 capacity (Alternatives 1 and 2), the daily person-trips for SR 520 are similar, at around 170,000 to 180,000 people per day by 2020, a 20 to 27 percent increase. Both Alternatives 1 and 2 would have high rates of increases in HOV and transit trips compared to 1995 (70 to 160 percent), yet they would involve incomplete HOV facilities on SR 520 and high levels of congestion in the shared general-purpose lanes. For these reasons, the forecasts for person trips could be considered optimistic, and would not fully account for the effect of low reliability and variable travel times for HOV and transit in highly congested general-purpose lanes. They also would include substantial lengthening of the peak period, lasting most of the day. The forecasts assume that people will still want to make their trips even if it would require traveling hours before or after the traditional peak.

When HOV lanes are added to the SR 520 corridor (Alternatives 3, 5 and 7), person trips increase by 10 to 17 percent on SR 520, 16,000 to 32,000 people, compared to No Action. This total includes increased HOV and transit use, and a relatively slight increase in general-purpose trips. In all alternatives with an HOV facility on SR 520, there is a consistent reduction of about

10,000 people using the HOV travel mode in the I-90 corridor.[3] The shift of HOV users from I-90 to SR 520 indicates that a substantial number of HOV users in the Trans-Lake area would prefer the SR 520 corridor if HOV facilities were available.

When HOV and general-purpose capacity is added to the SR 520 corridor, (Alternatives 4, 6 and 8) the proportion of people using SR 520 increases to over half of the trips for SR 520 and I-90 combined. This would place 78,000 to 110,000 more people on SR 520 than No Action. (Trips overall on I-90 and SR 520 combined would increase by about 73,000 to 97,000). For the GP+HOV alternatives, the person trips on I-90 are similar to or lower than No Action. Again, this indicates that SR 520 would be an attractive choice for more people in the year 2020 if the corridor had added capacity.

The effect of choosing I-90 or SR 520 for HCT is more subtle, based on the forecasts and the alternatives as defined. If HCT is placed within the SR 520 corridor rather than the I-90 corridor (Alternatives 5-8) the proportion of total daily cross-lake trips carried by the SR 520 corridor increases by about 3 to 4 percent, but remains similar overall. A similar increase to I-90 would occur when that corridor has HCT. The transit forecasts are discussed in more detail in Section 2.1.4.

2.1.1.2 Ranking the Person Trip Demand Results

Alternative 4, 6 and 8, which all involved adding general-purpose and HOV lanes to the SR 520 corridor, would attract the highest numbers of people and were given the highest ratings. Alternatives 3, 5 and 7, which would add HOV lanes to SR 520 but had less dramatic increases in person trips compared to No Action, had moderate ratings. Alternatives 1 and 2, which would not add additional lane capacity to SR 520, had the lowest ratings. The ratings are based on the assumption that the more trips attracted by the corridor the better.

Alternatives 7 and 8, the BRT alternatives, had the highest ratings for the SR 520 corridor for six and eight lane configurations, and Alternative 8 had the highest rating overall. However, the BRT service assumed in these alternatives would need to be carefully considered if these alternatives move forward. The performance for BRT depends in large part on competitive travel times. The additional on-street buses in Downtown Seattle and the University District, where street capacity is limited, could result in slower travel times and increased congestion. These factors could substantially reduce BRT ridership. The higher performance of Alternative 8 was also due in part to the design options that were tested, which added two new general-purpose access points in Seattle (one to the University District and one to Eastlake).

The eight-lane alternatives resulted not only in the highest total person trips, but they also created the highest transit and HOV ridership levels in real numbers. This tends to reflect the model's assumption that overall vehicle capacity increases result in a proportionate increase in the use of other modes.

[3] Although there are different assumptions for HOV facilities on the I-90 corridor among the alternatives, HOV users on I-90 would still enjoy travel time advantages over people in the general-purpose lanes in all alternatives.

2.1.2 Traffic Volumes

Criteria Definition: *Daily, AM-peak-period and PM-peak-period traffic volumes will be summarized and compared at 10 to 15 locations on freeway ~~and principal arterial links~~ within the Trans-Lake Washington study area.*

The traffic volume forecasts for daily travel and peak periods represent the demand for vehicle travel on Trans-Lake routes, as forecasted by the PSRC regional travel demand model. For peak periods, the forecasts are for SR 520, and are based on the model's predicted rates of traffic growth at specific points in the corridor, and applied to year 2000 traffic volumes. These volumes represent the demand for travel at the peak period; they do not indicate the number of vehicles that could be served. Daily traffic demand is summarized in Table 2-3 and charted in Figure 2-2 (a more complete table is provided in Appendix A.). (Principal arterial volumes are discussed in Section 2.1.8.)

See Table 2-4 for the rating of the alternatives.

Table 2-4. Traffic Volume Criteria Ratings

1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & HCT	Alt 6: HOV & GP & HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
--	◑	◑	◕	●	◕	●	◕	●

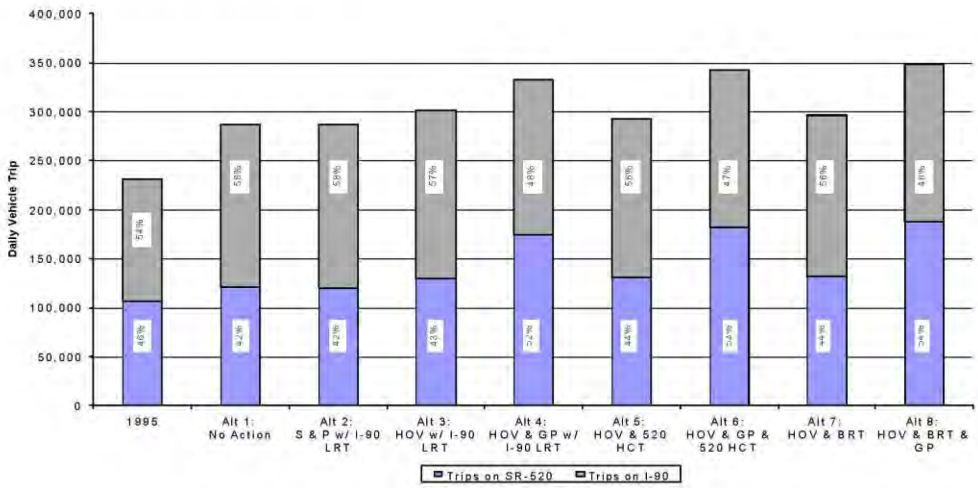
Rating Key

WORST				BEST
○	◔	◑	◕	●
Least Effective, Most Impacts	Low Effectiveness, Medium Impacts	Medium Effectiveness, Low Impacts	Increased Effectiveness, No Impact	Most Effective, Improved Conditions

Alternative 1 (No Action) sets the baseline level of growth in travel demand that would be expected on Trans-Lake corridors with no capacity improvements in 2020. Alternative 2 (SR 520 Safety and Preservation with I-90 HCT) is similar in terms of vehicle trips. Compared to 1995, the 121,300 vehicle trips in Alternative 1 for SR 520 would represent a nearly 13 percent increase. Interestingly, this is substantially lower than the 34 percent increase in traffic growth that I-90 is forecasted to experience by 2020. The SR 520 share of vehicle trips across the lake would drop from 46 to 42 percent. This would tend to reflect I-90's capacity to absorb additional traffic growth, while SR 520 is already over its capacity for much of the day. Compared to person-trip growth, vehicle-trip growth would occur at a slower rate in both corridors, in large part because no additional general-purpose capacity is planned, and most of the person trips growth would be focused on transit and HOV.

As shown in Figure 2-2, total daily vehicle trips for SR 520 and I-90 combined in 1995 were about 231,000 on a typical weekday, with SR 520 carrying 46 percent of trips and 54 percent on I-90. By 2020, trips would increase to 287,000, approximately 24 percent.

Figure 2-2
Daily Vehicle Volumes SR 520 and I-90



Trans-Lake Washington Project | 2-7 | **Transportation Effectiveness**
Multimodal Alternatives Evaluation Report | | *April 2, 2002/Figures insert.doc*

For SR 520, existing traffic volumes on the corridor already exceed the available capacity during peak periods. For the No Action alternative, the growth in traffic by 2020 would occur before and after traditional peak periods. For instance, in the AM peak period, the growth would most likely be earlier (prior to 6 AM) when the highway would still have available capacity. In the PM peak, growth would likely fill the minimal available capacity during mid-day hours and extend later into the evening (after 7 PM).

The spreading of the peak is discussed in more detail in Section 2.1.8.

The key findings for the traffic volume criteria include:

- In Alternatives 1 and 2, which have no increase in SR 520 lane capacity, the daily vehicle volumes on SR 520 are similar, around 120,000 vehicles per hour (vph) by 2020. This represents a 13 percent growth over the year 1995. The addition of an LRT line to the I-90 corridor (Alternative 2) does not substantially affect the number of daily vehicle trips. Although HCT encourages more people to switch to transit, vehicle trips remain steady because more trips are attracted to the corridor as capacity becomes available. It is also important to note that all alternatives with LRT on I-90 assume that HOV lanes would be placed on the outer roadways. If this did not occur and I-90 capacity is effectively reduced to six lanes, vehicle trips would be affected.
- When new HOV capacity is added on SR 520 in addition to the I-90 LRT (Alternative 3), the overall daily vehicle volumes across the lake increase by about 15,000 vehicles over no build, due to substantial increases in HOV 3+ vehicles, along with lesser increases in general-purpose traffic. This reflects the movement of HOV vehicles from general-purpose lanes to the HOV lane, and a smaller increase in general-purpose vehicles to fill the available capacity.
- If general-purpose and HOV lanes are added to SR 520, (Alternatives 4, 6 and 8), the total daily vehicle volumes across the lake would increase about 45,000 to 60,000. On SR 520, the highest traffic volumes would occur with Alternative 8 (SR 520 HOV with BRT connections and general-purpose), which would have 188,100 daily vehicle trips on SR 520, or a 55 percent increase over No Action. The other eight-lane alternatives (Alternatives 4 and 6) would have similar traffic growth. The differences in traffic growth for the eight-lane alternatives appear to be related to design options that would provide general-purpose access to the University District and to Fairview Avenue N. Eastlake Avenue N. The HCT in the I-90 center roadway has little effect on traffic volumes across the lake. As reversible operations cease, the HOV lanes are assumed to be relocated on the outer roadways.
- If HCT is placed within the SR 520 corridor rather than the I-90 corridor (Alternatives 5-8), the proportion of daily vehicle volumes across the lake on SR 520 does not appear to change substantially. People switch from bus transit to HCT on SR 520 and new non-HOV vehicle trips are also attracted to the corridor.

2.1.3 Mode Share

Criteria Definition: *The anticipated mode share of non-HOV (general-purpose), HOV and transit will be quantified.*

The mode share analysis focuses on the percentage of trips made by mode for each of the alternatives. The percentages are drawn directly from the PSRC model person trip forecasts for the SR 520 and I-90 corridors combined. The results are charted in Figure 2-3, with more detail in Table 2-5, and charted in Figure 2-3. The rating of the alternatives is found in Table 2-6.

Table 2-5
Daily Mode Share Summary
Based on Year 2020 Daily Person Trip Forecasts

Facilities	1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & HCT	Alt 6: HOV & GP & HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
SR 520									
Non-HOV	76.0%	63.1%	66.6%	58.9%	63.5%	55.9%	60.5%	55.8%	60.8%
Commercial	16.4%	16.2%	17.1%	14.7%	14.4%	14.2%	14.2%	14.1%	14.2%
HOV 3+	1.6%	8.3%	7.7%	17.4%	14.4%	16.6%	14.4%	16.3%	13.2%
Transit	6.0%	12.4%	8.6%	9.0%	7.8%	13.3%	10.9%	13.8%	11.8%
I-90									
Non-HOV	77.6%	66.2%	63.9%	67.4%	66.5%	70.9%	70.4%	70.1%	69.1%
Commercial	16.4%	14.3%	13.8%	14.8%	13.4%	15.3%	15.0%	15.1%	14.7%
HOV 3+	1.6%	10.5%	9.3%	5.3%	6.0%	6.5%	6.6%	6.1%	6.8%
Transit	*4.4%*	*9.0%*	*13.0%*	*12.5%*	*14.1%*	*7.4%*	*7.9%*	*8.7%*	*9.4%*

Source: PSRC Regional Forecasting Model

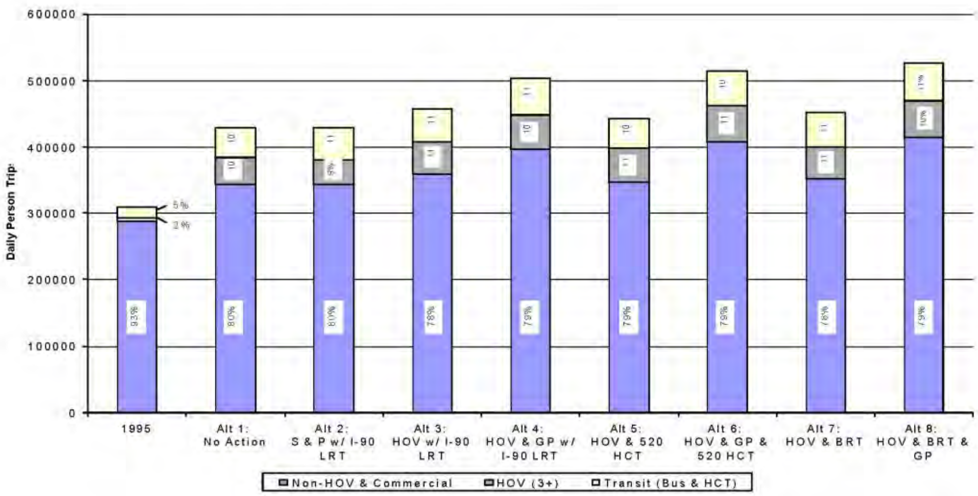
Table 2-6. Mode Share Ratings

1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & HCT	Alt 6: HOV & GP & HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
--	◑	◑	◑	◑	◑	◑	◑	◑

Rating Key

WORST				BEST
○	◔	◑	◕	●
Least Effective, Most Impacts	Low Effectiveness, Medium Impacts	Medium Effectiveness, Low Impacts	Increased Effectiveness, No Impact	Most Effective, Improved Conditions

Figure 2-3
Mode Share for Person Trips I-90 and SR 520 Corridors Combined



The most notable change in mode share is not in the alternatives being considered for 2020, but in the change from 1995 to 2020. For the "No Action" alternative, the daily transit mode share across the lake would double from 5 percent in 1995 to 10 percent in 2020, while HOV 3+ mode share is forecasted to increase five-fold from 2 to 10 percent. The increased use of transit and HOV in No Action would result from changes in population and employment in urban centers, increased congestion for travel across the lake, and the resulting travel time advantages provided by existing HOV facilities in the SR 520 and I-90 corridors. However, these forecasted increases for the No Action alternative could be considered optimistic as they do not fully account for the effect of low reliability and variable travel times for HOV and transit using highly congested GP lanes.

The key findings for mode share are:

- For Alternatives 1 and 2 (no additional lanes on SR 520), and for Alternatives 3, 5, and 7 (adding HOV lanes on SR 520), most of the future growth in trips would be focused on increased use of transit or carpools/vanpools. A relatively small amount of growth would be by non-HOV/commercial, and most of this growth would occur on I-90.
- The proportion of HOV and transit trips to all forecasted trips remains relatively constant for all 2020 alternatives, although total trips across the lake increase substantially compared to No Action.
- None of the alternatives would reduce the volume of non-HOV/commercial trips compared to No Action, but they would reduce the proportion of all trips that are made by non-HOV/commercial vehicles. The change in mode share comes from the amount of additional HOV and transit use that would occur with all alternatives.
- The alternatives that would add only HOV lanes to SR 520 (Alternatives 3, 5 and 7) would have the highest shares for HOV as a percentage of all trips, but it is within 1 percent of the eight-lane alternatives.
- All of the eight-lane alternatives (Alternatives 4, 6 and 8) would decrease the percentage of non-HOV/commercial trips compared to No Action. However, as noted above, they would result in substantially higher non-HOV/commercial volumes than No Action or the six-lane alternatives. Because the eight-lane alternatives include HOV and transit improvements, more people would be forecasted to use these modes as well, so the proportionate share of non-HOV/commercial remains similar to alternatives without a general-purpose lane addition.
- Daily transit mode share is very consistent across all the alternatives, although there are minor decreases (less than 1 percent) when a general-purpose lane is added to SR 520 (comparing Alternatives 3, 5 and 7 to Alternatives 4, 6 and 8).
- The forecasts show noticeable differences in mode share for the I-90 corridor. Transit use increases substantially on I-90 with Alternatives 2 through 4, as I-90 is used for HCT and the majority of east/west transit users are focused to I-90 (dropping the usage levels on SR 520 about 35 percent).

2.1.4 Transit Ridership

Three measures for transit ridership are used in the analysis of multimodal alternatives: regional transit ridership, study area transit ridership, and ridership by subarea. The forecasts for transit are charted in Figure 2-4. Tables 2-7 and 2-8 have more detail on the ridership forecasts. The ratings of the alternatives is found in Table 2-9.

Table 2-7. Daily Transit Trip Forecasts

Facilities	1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
SR 520									
Bus Transit	8,700	22,800	14,900	18,000	20,300	700	700	--	--
HCT	--	--	--	--	--	27,525	32,190	29,800	34,700
All Transit	8,700	22,800	14,900	18,000	20,300	28,225	32,890	29,800	34,700
I-90									
Bus Transit	7,200	22,100	3,600	3,400	3,500	17,100	18,200	20,500	21,900
HCT	--	--	29,700	28,675	30,560	--	--	--	--
All Transit	7,200	22,100	33,300	32,075	34,060	17,100	18,200	20,500	21,900
All Cross-Lake Routes									
Bus Transit	15,900	44,900	18,500	21,400	23,800	17,800	18,900	20,500	21,900
HCT	--	--	29,700	28,675	30,560	27,525	32,190	29,800	34,700
All Transit	15,900	44,900	48,200	50,075	54,300	45,325	51,090	50,300	56,600
Regional System Total									
Transit	281,553	652,710	659,826	656,748	652,710	651,426	648,048	655,288	653,048

Table 2-8. Peak Period Transit Volumes

Facilities	1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
SR 520									
Transit	3,100	8,300	5,400	6,400	7,200	9,130	10,651	10,400	12,000
I-90									
Transit	2,800	7,400	11,200	10,790	11,630	6,300	6,300	6,900	7,400
All Cross-Lake Routes									
Transit	5,900	15,700	16,600	17,190	18,830	15,430	16,951	17,300	19,400

Figure 2-4
Daily Transit Ridership Forecasts SR 520 and I-90 Transit Ridership

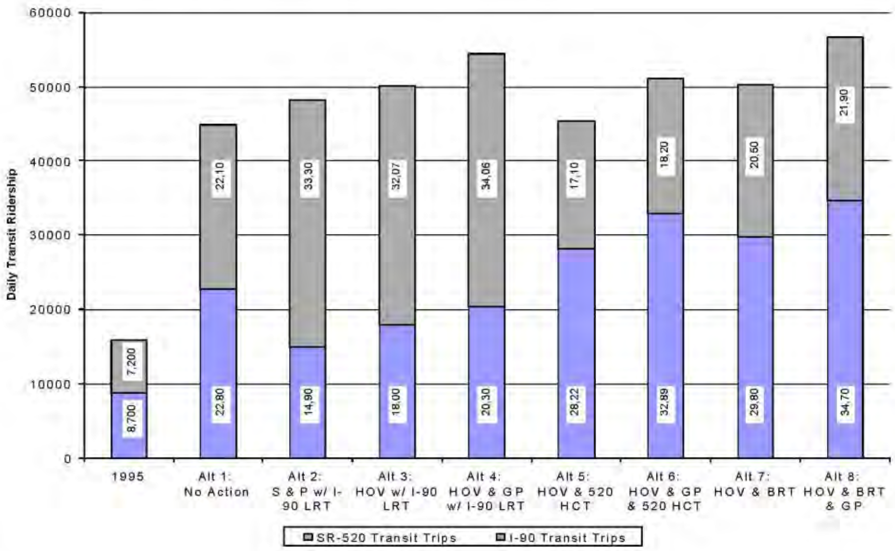


Table 2-9. Transit Ridership Ratings

1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & HCT	Alt 6: HOV & GP & HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
--	◕	◕	◕	◕	◕	◕	◕	◕

Rating Key

WORST				BEST
○	◔	◑	◕	●
Least Effective, Most Impacts	Low Effectiveness, Medium Impacts	Medium Effectiveness, Low Impacts	Increased Effectiveness, No Impact	Most Effective, Improved Conditions

Overview of Transit Ridership Forecasts

Daily Trans-Lake ridership in 1995 was about 16,000 in the model, representing a mode share of about 5 percent of total cross-lake person trips. By 2020, under the "No Action" alternative, this is expected to increase to about 44,000, a 65 percent increase in trips, and a doubling of transit's mode share.

In 2020, the alternative with the highest cross-lake transit ridership forecasts is Alternative 8 (SR 520 HOV/BRT+GP), with 63,400 total transit trips per day. Alternative 7, which also provided BRT, had relatively high ridership for a six-lane SR 520 configuration, but the forecasts were similar to Alternative 3, which would provide HCT on I-90.

The alternative with the lowest daily cross-lake transit ridership in 2020 is Alternative 2 (Safety and Preservation with I-90 HCT), at 48,900 per day. The next lowest is Alternative 5 (SR 520 HOV plus HCT), at 49,425 per day.

Alternative 8 achieved high ridership forecasts in part because of its two-corridor service strategy, which balanced service on I-90 and SR 520. Alternative 8 also had higher overall person trips and vehicle trips due to the eight-lane SR 520 and its new access options to the University District and Eastlake. The model assumed that the increase in total trips would also result in a proportionate increase in transit ridership.

Ridership for the BRT alternatives (Alternatives 7 and 8), could be viewed as optimistic at this point, because they could be negatively affected by reliability, as well as operating constraints. In particular, there are long-term challenges for operating BRT on downtown Seattle and University District streets. If buses are subjected to large and unpredictable delays as a result of congestion in the Seattle core business district (CBD) and/or the University District, BRT would be less likely to attract and accommodate the levels of ridership forecast. The BRT options may also require substantial additional improvements to allow reliable bus operations in the Seattle CBD and the University District.[4] Outside of the University District and downtown Seattle, the BRT vehicles are also expected to share lanes with HOVs, which could negatively affect travel speeds and reliability if the HOV lanes become congested.

Other observations for the transit forecasts are:

- Daily 2020 Trans-Lake transit ridership for the build alternatives ranges is forecasted to range from 45,000 to 57,000, or 0 to 23 percent higher than the "No Action" alternative.
- In general, the alternatives with the SR 520 Fixed Guideway alignment have lower cross-lake ridership (about 45,000 and 51,000 per day), and the I-90 Fixed Guideway and SR 520 BRT alternatives have higher levels of ridership (between 50,000 and 57,000 per day). It appears that the longer westside HCT alignment associated with Alternatives 5 and 6 result in less attractive transit service for cross-lake trips. Also, the I-90 LRT alternatives improve the frequency of service for the Central Link route, due to through routing of trains between Northgate and the Eastside, which increased ridership in the downtown tunnel stations and Capitol Hill. (See Table 2-9 for more detail on station boardings.)

2.1.5 HCT Boardings

Criteria Definition: *Transit boardings for each Trans-Lake alternative will be quantified, including the added boardings on stations for the Central Link LRT system.*

Because this criteria involves a combination of Trans-Lake as well as all-east or all-west transit usage, the results are provided without an additional ranking. Boardings by station are reported in Table 2-10. On the Eastside, most of the alternatives had similar ridership levels at both the station area and the total eastside levels. The areas with the largest boardings were in downtown Bellevue, South Bellevue, both areas that would also have high rates of transfers. The boardings for Redmond remained relatively constant (highest for Alternative 8, which would include BRT and an eight-lane SR 520). Kirkland boardings fluctuated, but this in large part reflects transfer activity in South Kirkland.

Seattle boardings were more complex to evaluate because they reflect Central Link service changes as well as the effects of added east/west service. Downtown Seattle boardings increased with all HCT alternatives. The highest increases were with I-90 routes, which would increase the frequency of Central Link stations from the International District station to Northgate, improving ridership.

[4] The No Action alternative bus volumes approach the estimated operating capacity for transit on the downtown and University District surface streets in 2020, and there would be little to no room for future growth. Accommodating the additional volume of buses from BRT alternatives would likely require actions such as peak period restrictions on Third Avenue, join bus/rail operations in the Downtown Seattle Transit Tunnel, or bus intercept terminals.

The fixed guideway alternatives across the lake (Alternatives 2 through 6) appeared to increase overall boardings at Central Link stations in the downtown Seattle transit tunnel. The BRT alternatives did not have that effect, and resulted in the lowest levels of combined boardings for East and West side.

Table 2-10. Daily HCT Station Boardings

Station	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & HCT	Alt 6: HOV & GP & HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
Westside Station Areas								
Northeast Seattle		4,100	4,100	4,100				
University District		6,500	6,500	6,500	17,200	17,200	9,700	12,100
Capitol Hill/First Hill		11,100	11,100	11,100				
Downtown Seattle		28,900	28,900	28,900	10,400	10,400	17,000	17,900
South Seattle		1,300	1,300	1,300	400	400		
Seattle Center/S Lake Union					12,300	12,300	2,800	2,800
North Seattle					12,400	12,400		
HCT West Side Totals		**51,900**	**51,900**	**51,900**	**52,700**	**52,700**	**29,500**	**32,800**
Eastside Station Areas								
Mercer Island		2,300	2,300	2,300				
South Bellevue		5,900	5,900	5,900				
Central Bellevue		10,300	10,300	10,300	9,900	11,000	9,000	9,600
Kirkland		2,300	2,300	2,300	9,600	10,500	7,000	7,300
Evergreen Point					1,200	1,300	1,600	1,800
Redmond		5,500	5,500	5,500	5,200	5,800	6,200	6,900
HCT East Side Totals		**26,300**	**26,300**	**26,300**	**25,900**	**28,600**	**23,800**	**25,600**
East and West Side Grand Totals		**78,200**	**78,200**	**78,200**	**78,600**	**81,300**	**53,300**	**58,400**

Source: PSRC Regional Forecasting Model

2.1.6 Vehicle Miles Traveled and Vehicle Hours Traveled

Criteria Definition: *Vehicle Miles Traveled (VMT) and Vehicle Hours Traveled (VHT)—Daily, VMT and VHT within the Trans-Lake Washington study area will be quantified.*

Estimates of future daily VMT and VHT were directly output from the regional traffic model. Although several variants of this value were originally proposed (creating a per-person value), the results would be similar to daily VMT and VHT. In general, this criteria indicates whether the alternatives would have a substantial effect on overall transportation system performance.

Overall, the alternatives were similar to No Action at the regional level. See Table 2-11 for values and Table 2-12 for ratings. The eight-lane alternatives (Alternatives 4, 6 and 8) are the

Table 2-11. Study Area and Regional VMT/VHT

VMT and VHT	ALTERNATIVES								
	1995	Alt 1 No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV/ BRT	Alt 8: HOV/ BRT & GP
Study Area									
Vehicle-Miles Traveled	15,215,000	20,198,000	20,743,000	20,205,000	20,743,000	20,238,000	20,703,000	20,283,000	20,743,000
% change*		32.8%	2.7%	0.0%	2.7%	0.2%	2.5%	0.4%	2.7%
Vehicle-Hours Traveled	535,000	1,021,000	1,043,000	1,010,000	1,043,000	1,016,000	1,038,000	1,028,000	1,036,000
% change*		90.8%	2.2%	-1.1%	2.2%	-0.5%	1.7%	0.7%	1.5%
Regional									
Vehicle-Miles Traveled	69,523,000	100,596,000	101,060,000	100,556,000	101,060,000	100,611,000	101,046,000	100,643,000	101,058,000
% change*		44.7%	0.5%	0.0%	0.5%	0.0%	0.4%	0.0%	0.5%
Vehicle-Hours Traveled	2,293,000	3,943,000	3,966,000	3,932,000	3,966,000	3,939,000	3,963,000	3,951,000	3,958,000
% change*		72.0%	0.6%	-0.3%	0.6%	-0.1%	0.5%	0.2%	0.4%

* The No Action percent change is compared to 1995. The alternatives percent change is compared to No Action.

Table 2-12. VMT/VHT Ratings

1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & HCT	Alt 6: HOV & GP & HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
--	◑	◑	◕	◑	◕	◑	◕	◑

Rating Key

WORST				BEST
○	◔	◑	◕	●
Least Effective, at reducing VMT/VHT	Low Effectiveness	Medium Effectiveness	Increased Effectiveness	Most Effective at reducing VMT/VHT

only alternatives that would change VMT and VHT by any substantial amount. With the eight-lane SR 520, VMT increases 2.5 to 2.7 percent in the study area, while VHT increases 1.5 to 2.2 percent. This suggests that average trip lengths areawide would increase, but average travel times would be lower, reflecting congestion relief and/or shorter in-vehicle times per trip and/or the benefits of ridershare and transit use. The six-lane alternatives (Alternatives 3, 5 and 7) would result in minor increases in VMT, indicating a small increase in distance traveled, and/or a reduction in the number of vehicles used per person to make the trip. Alternatives 3 and 5 also reduce VHT, which indicates shorter trips and/or improvements in travel times. The ratings assume that lower VMT and VHT are better.

2.1.7 Travel Time

Criteria Definition: *How effective are overall point to point travel times for each alternative and travel mode? The origin-destination pairs selected for the analysis will be the same for all alternatives. This will include calculation of weighted average travel times. Origin-destination pairs will include those crossing Lake Washington and some exclusively on the east or west side of Lake Washington (e.g., Capitol Hill to University District on the west side or downtown Bellevue to downtown Kirkland on the east side).*

The travel time forecasts in Table 2-13 were obtained directly from the PSRC model. These forecasts are provided for travelers using general-purpose, HCT, or bus transit modes. The PSRC model produces trip volumes based on travel demand and lane capacity without reference to other capacity limits such as bottlenecks at interchanges.

The average travel time estimated by the PSRC model in Table 2-13 is for all travelers during the PM peak period between two points, using any combination of routes, which could include SR 522, SR 520, and I-90, as well as local streets. Particularly for GP travel, the times in Table 2-13 do not fully reflect the cumulative delays of high traffic congestion, including delays at bottlenecks or interchanges reflected in the microsimulation analysis. However, the travel times in Table 2-13 provide a reasonable *comparison* of the relative benefits of the Trans-Lake alternatives among various modes of travel.

Table 2-13. Travel Time Comparison
Weighted Average PM Peak Period Travel Time (minutes) Between Designated Districts

(Year 2020 Forecasts for all available highway routes incl. SR 520, I-90 and SR 522, and for bus, HCT and BRT routes. Transit times are for in-vehicle travel only.)

District-to-District Pair		1995	Alt 1 No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/ I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV/B RT	Alt 8: HOV/B RT & GP
Downtown Seattle to Bellevue	GP	29.5	32.4	32.3	32.7	29.3	32.3	31.6	32.7	31.5
	HOV	25.7	25.2	25.0	23.8	23.1	24.4	24.0	24.4	24.4
	Transit	25.9	24.1	25.1	24.3	24.4	23.3	23.4	23.7	23.9
Downtown Seattle to Redmond	GP	37.4	44.8	44.6	45.0	41.0	44.6	43.0	44.9	42.8
	HOV	33.7	35.3	35.0	31.1	31.3	32.6	31.4	32.6	32.7
	Transit	38.8	37.4	39.0	36.8	36.8	35.1	35.2	35.8	36.6
Downtown Seattle to Issaquah	GP	38.8	44.1	44.0	44.4	41.1	43.9	43.6	44.4	43.6
	HOV	35.8	37.7	37.5	37.4	36.4	37.7	38.0	37.7	37.9
	Transit	37.2	31.2	33.7	33.7	33.6	30.9	30.9	31.0	31.0
Downtown Seattle to Kirkland	GP	32.0	37.3	37.1	37.5	34.5	37.2	36.4	37.5	36.1
	HOV	29.5	30.1	29.9	25.7	25.8	27.4	26.1	27.3	27.4
	Transit	31.2	31.1	30.7	26.8	26.7	27.1	27.3	28.9	29.0
University District to Redmond	GP	34.2	41.5	41.3	42.0	38.1	41.4	37.9	41.8	38.7
	HOV	33.4	36.9	36.8	29.8	30.1	29.6	29.2	29.6	29.4
	Transit	32.6	31.1	33.8	30.3	30.3	26.3	26.6	26.0	26.7

% change compared to No Action.
Source: PSRC Regional Forecasting Model

An additional more detailed analysis of travel time limited to the SR 520 corridor was performed using the CORSIM micromodel which simulates traffic operation and is summarized in Figure 2-5 and Table 2-14. This analysis was performed for a peak period of 5:00 AM to 10:00 AM and 2:30 PM to 7:30 PM to depict conditions averaged over the entire morning and afternoon peak periods. This analysis therefore does not depict the worst case single-hour peak period as it would be experienced by motorists.

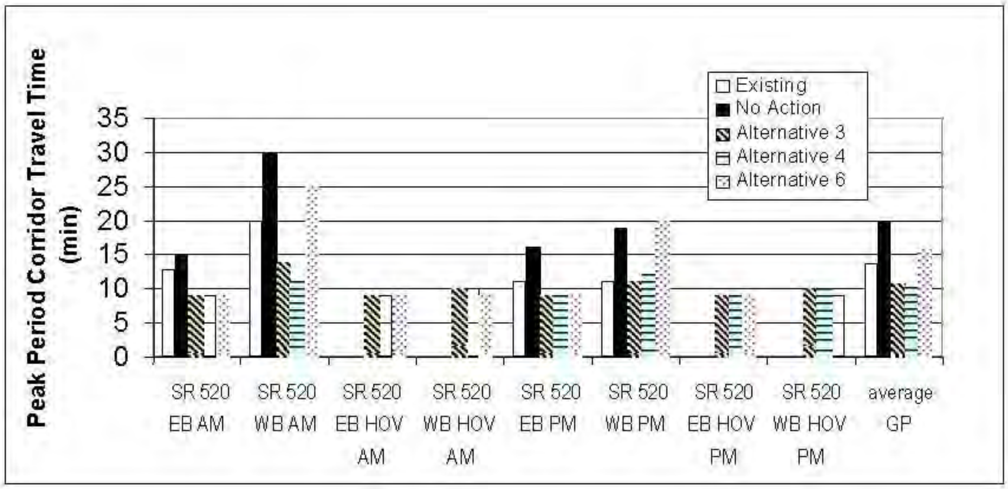
Table 2-14.
Peak Hour SR 520 Travel Time (minutes)

	Westbound				Eastbound			
	AM		PM		AM		PM	
Alternative	GP	HOV	GP	HOV	GP	HOV	GP	HOV
Existing	32	23	11	10	16	20	11	10
No-Action	50	36	25	20	18	23	16	21
Alternative 3	17	11	10	10	9	9	9	9
Alternative 4	13	10	13	10	9	9	9	9
Alternative 6	31	10	27	10	9	9	10	9

The key findings of the travel time analysis include:

- The results of the PSRC model forecasts in Table 2-13 indicates that HOV and transit vehicles consistently have travel times 25 to 30 percent faster than non-HOV vehicles for all alternatives, or up to 10 minutes faster. All of the alternatives with HOV lanes (Alternatives 3, 5 and 7) and no new general-purpose lanes would provide travel time savings of up to 3 to 5 minutes for HOV travelers, compared to Alternative 1 (No Action) (using a representative Seattle and Redmond trip). These alternatives do not notably improve travel times for non-HOV vehicles.
- The results of the more detailed SR 520 corridor analysis in Table 2-14 indicates that the future No-Action Alternative will result in general-purpose and HOV trips times of 50 and 36 minutes, respectively westbound between 124th Ave NE and I-5.
- The analysis of the SR 520 corridor depicted in Table 2-14 indicates substantially shorter HOV trips for the No-Action Alternatives as compared to Existing Conditions.
- Substantial improvements in travel time occur on the SR 520 corridor for Alternatives 3 through 8, as compared to the No-Action Alternative as indicated in Figure 2-5 and Table 2-14.
- For Alternative 3, the six-lane design with HOV lanes added, these improvements in HOV travel times on the SR 520 corridor, as compared to general-purpose trips, are mixed. Substantially less time required HOV trips for the westbound AM peak period. There is little difference between HOV and general-purpose trips westbound in the PM peak and eastbound in both the AM and PM peak. This apparent anomaly may be due in some part to the analysis methodology used in the microsimulation analysis which presents results averaged over the entire 5 hour peak period.
- For Alternative 4, the eight lane alternative with additional HOV and general-purpose lanes, HOV vehicle enjoy a travel time advantage on westbound trips in both the AM and PM. No advantage for HOV trips is depicted for eastbound trips.
- For Alternative 6, the eight-lane alternative without the tunnel to Eastlake/Fairview Avenues, the travel times for general-purpose vehicles is substantially degraded compared to Alternative 4 which includes this feature. This appears to be related to the congestion and queues created by the greater volumes merging onto I-5 in the absence of the diversion of trips to the tunnel and to the congestion caused by the "Mercer weave" resulting from vehicles using the SR 520 to I-5 southbound on-ramp on the left side of I-5 weaving across lanes of traffic to access the Mercer Street off-ramp on the right side. This alternative also provides little benefit for eastbound HOV trips as compared to general-purpose trips.

Figure 2-5
SR 520 Corridor Travel Time Comparisons



Comparison of travel times between Tables 2-13 and 2-14 must take into consideration the difference in the methodologies used for the two analyses and the fact that Table 2-14 deals with only the SR 520 corridor which is only a portion of the trip between destinations and only one alternative route for many destination pairs which also can use I-90. The PSRC analysis also includes transit trips where transfers between routes, or longer routes would be involved. Both methods of analysis indicate that transit travel times would be competitive with general-purpose travel times for most alternatives and most locations.

Ratings were not assigned to this criterion because the results tended to have benefits that differ by area and mode, and showed no substantial trend.

2.1.8 Traffic Congestion

Criteria Definition: *The relationship of volume to capacity for the AM- and PM-peak-period will be calculated and compared at the 10 to 15 locations where year 2020 traffic volume forecasts are available.*

2.1.8.1 Congestion on Freeways

This criteria focuses on the overall effects of the alternatives on freeway operations. The methodology is based on vehicle demand forecasts from PSRC's model. This forecast has been further analyzed based on the capacity of the system to serve the demand, using a microsimulation program. The results are reported in terms of unserved traffic demand which illustrates the relationship between demand and the volumes served. This methodology approximates volume/capacity (v/c) ratios by providing a measure of how projected demand relates to freeway capacity.

Table 2-15 provides a ranking comparison of the results by alternative.

Table 2-15. Freeway Congestion Rating

1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
--	◔	◔	◑	◑	◔	◔	◑	◔

RATING KEY

WORST				BEST
○	◔	◑	◕	●
Least Effective, Most Impacts	Low Effectiveness, Medium Impacts	Medium Effectiveness, Low Impacts	Increased Effectiveness, No Impact	Most Effective, Improved Conditions

The above ratings reflect the relative difference in the unserved proportion of travel demand for the various alternatives averaged over the entire SR 520 corridor. The addition of capacity in the alternatives does not uniformly convert to improvement in operations because the alternatives with higher capacity also tend to attract more trips and can be affected to a greater extent by bottlenecks at interchanges.

The PSRC model forecasts trip volumes based on travel demand and lane capacity without reference to capacity limits arising from merging traffic at interchanges or other bottlenecks. This model also reallocates trips to employment and other destinations based upon the capacity of the roadway network. For that reason, the total number of trips attracted to the Trans-Lake corridor changes according the capacity of the alternatives with the alternatives with more lanes attracting more traffic. The PSRC model can allocate vehicle volumes to a transportation facility in excess of the facility's capacity to serve the traffic volumes. Such over-allocations currently occur for SR 520 where demand exceeds capacity in peak hours. This excess of demand would result in congestion and queues as the facility delays vehicles that it cannot immediately serve. These delayed vehicles are gradually passed through the system and the queues diminish if peak periods are followed by periods in which demand is less than capacity.

The results presented in Figures 2-6a through 2-6d are based on subjecting the PSRC forecasts to additional more detailed modeling which was performed using the CORSIM micromodel. This analysis was performed for a morning peak period of 5:00 AM to 10:00 AM and an afternoon peak period of 2:30 PM to 7:30 PM. The analysis presents conditions averaged over the entire 5-hour period. This analysis therefore does not depict the worst case single-hour peak period. The Figures also average between four points on the corridor, which also tends to moderate extremes. These model results provide an adequate *comparison* between future conditions but does not predict actual driving experience as it would occur for a vehicle in a particular period of time.

Since the eight alternatives involved are basically four variations of SR 520 capacity, the operations analysis consolidates alternatives. The alternatives analyzed in detail included:

- Alternative 1: No Action, which also approximates the results of Alternative 2: SR 520 Safety and Preservation;
- Alternative 3: SR520 HOV with I-90 LRT (six lanes), which also approximates the impacts of Alternatives 5 and 7 which have the same number of vehicle lanes;
- Alternative 4: SR 520 HOV and GP with I-90 LRT (eight lanes) which also approximates the impacts of Alternatives 8 which shares the same lane configuration; and
- Alternative 6: SR 520 HOV and GP and HCT (eight lanes), which was analyzed using the same traffic volumes as Alternative 4, but with the elimination of the Fairview Avenue/Eastlake Avenue tunnel.

Figure 2-6a
Average of 4 EB SR 520 AM Peak Screenlines

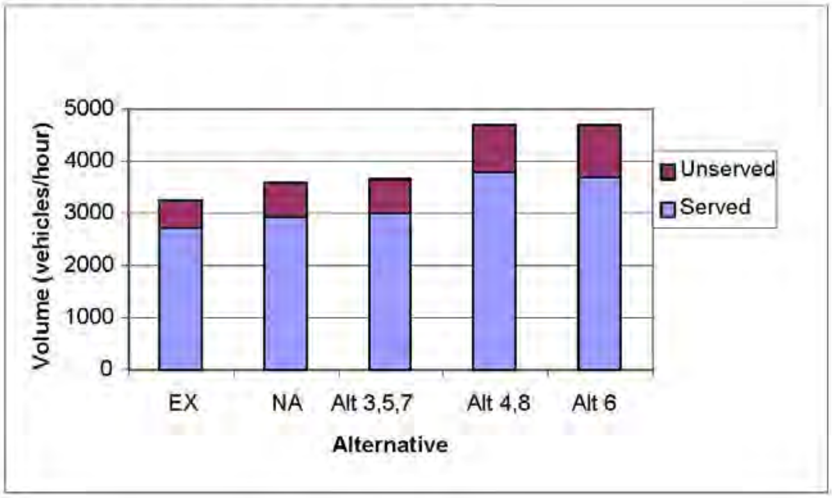


Figure 2-6b
Average of 4 EB SR 520 PM Peak Screenlines

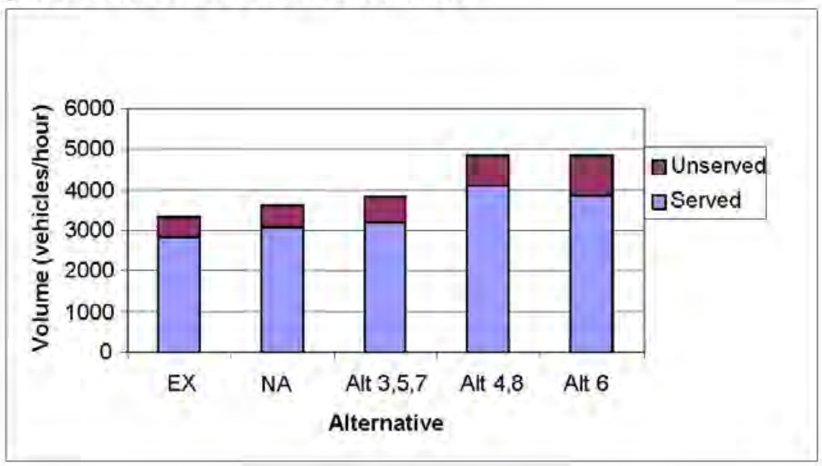


Figure 2-6c
Average of 4 EB SR 520 AM Peak Screenlines

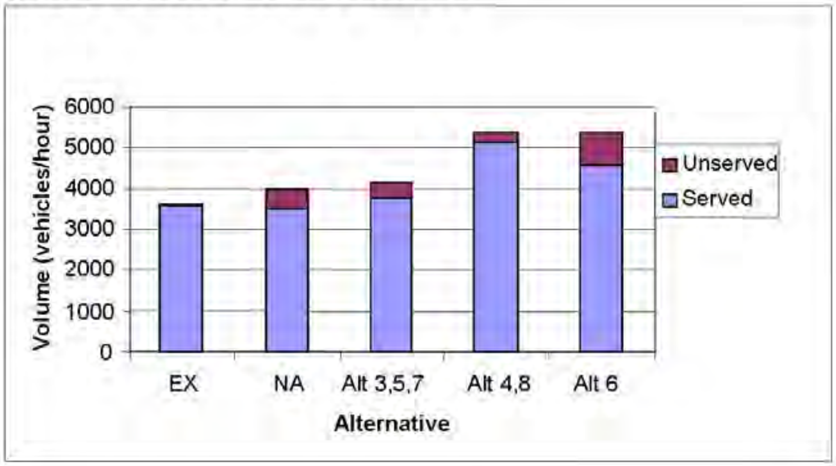
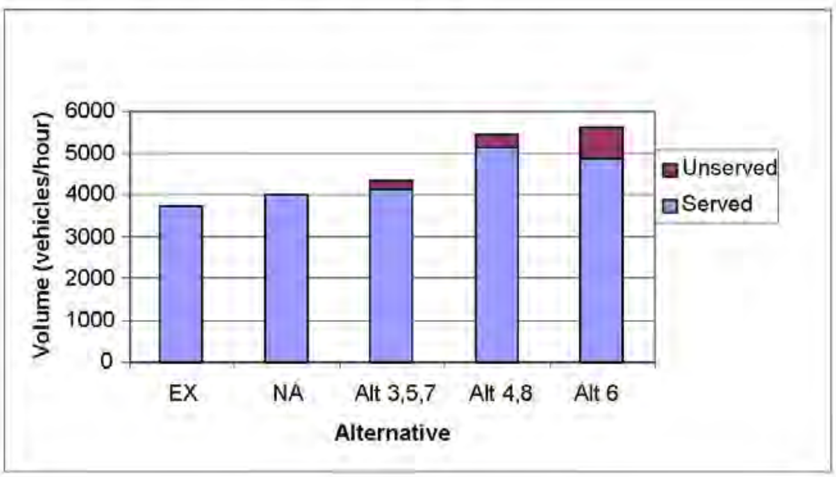


Figure 2-6d
Average of 4 EB SR 520 PM Peak Screenlines



The key findings of the traffic capacity analysis on SR 520 includes:

- Existing Conditions analysis indicates that the facility currently is at or over capacity for most movements. This does not precisely represent the current experience during the one to two hour peak periods when portions of the corridor are over-capacity. This is because the current peak hours are preceded and followed by several hours in which current volumes are below capacity, for some movements. The analysis of the five hour peak period averages the over capacity periods with those periods where some capacity is still available with reported results that are less severe than the existing experience for the single peak hour.
- The future No-Action Alternative results in conditions with roadway capacity similar to Existing Conditions but with expanded travel demand which more than fills the capacity over the entire five hour averaging period for most movements.Alternative 3, the six-lane design which adds HOV lanes in each direction, adds demand from the attraction of additional trips to the facility. The addition of HOV lanes increases capacity both for HOVs which would use the new lanes and for general-purpose traffic which can utilize the capacity released to other vehicles by moving HOVs to a separate lane. This alternative produces about the same proportion of unserved trips as No-Action, but serves slightly more trips.
- Alternative 4, the eight-lane alternative with added HOV and general-purpose lanes, considerably increases the number of trips served, because of the increase in roadway capacity, but continues a similar proportion of unserved trips, due to the increase in demand exceeding the increase in capacity. The full capacity of the additional general-purpose lane provided is not utilized because of bottlenecks at locations such as the Montlake interchange.
- Alternative 6, which is also an eight-lane alternative, but without the tunnel to Eastlake/Fairview Avenues, attracts about the same demand as Alternative 4, but serves a lower proportion of the demand because of greater congestion both at Montlake and at the I-5 merge.

The initial analysis of I-5 clearly showed that I-5 would be affected by the addition of vehicular capacity on SR 520. The additional volumes to I-5 would increase the potential for congestion at the interchange between the two facilities.

In the southbound direction on I-5, there is currently a large volume unserved north of SR 520 resulting from congestion produced by the NE 45th Street merge. This effectively meters the amount of traffic on I-5 southbound at the southbound merge from SR 520. South of the SR 520 merge the factor which most affects mainline capacity is the weaving maneuver between the SR 520 southbound on-ramp on the left side of the roadway and the Mercer Street off-ramp on the right side of the roadway. The AM peak period has the highest traffic volumes on the southbound section of I-5 south of SR 520 and is the focus of the review below.

- The No-Action Alternative adds slightly to demand on I-5 south of SR 520 and increases the proportion of unserved traffic as compared to Existing Conditions.
- Alternative 3, a six-lane design which adds HOV lanes and includes the tunnel to Eastlake/Fairview Avenues, adds slightly to demand on I-5 as compared to Existing Conditions and No-Action with the increase in capacity not keeping pace with the

increase in demand resulting in a slightly higher proportion of unserved demand as compared to Existing and about the same proportion of unserved demand as No-Action.

- Alternative 4, an eight-lane design which adds both HOV and general-purpose lanes and includes a tunnel to Eastlake/Fairview Avenues, provides the greatest increases in demand among the alternatives southbound south of SR 520 as compared to Existing Conditions and No-Action. The increase in capacity from the design results is an improvement in the proportion of unserved demand as compared to No-Action.
- Alternative 6, a eight-lane design which adds both HOV and general-purpose lanes between I-405 and Montlake and which eliminates the tunnel to Eastlake/Fairview Avenues, results in an increase in demand similar to Alternative 4. The capacity of this alternative is less than Alternative 4, resulting in an increase in unserved traffic and resulting congestion on I-5 southbound south of SR 520. This reduction in capacity occurs largely because of the lack of the tunnel to Eastlake/Fairview Avenues resulting in a greater proportion of the trips routed south on I-5 which perform the "Mercer weave" of southbound traffic from SR 520 entering I-5 on the left and crossing several lanes of traffic in a relatively short stretch of highway to exit at the Mercer Street off-ramp on the right.

For Northbound traffic on I-5 there are two areas of concern. South of SR 520 existing congestion is largely related to the northbound "Mercer weave" where northbound traffic entering I-5 on the left from Mercer Street must cross several freeway lanes to the SR 520 eastbound off-ramp on the right. To the north of SR 520, the freeway presently enjoys adequate capacity to serve present demands. This may be related to the metering function created by the congestion to the south. The period of greatest traffic northbound on I-5 is the PM peak period which is the focus of the summary below:

- Existing conditions show no unserved traffic volumes for northbound traffic on I-5 during the averaged 5-hour peak period.
- The No-Action Alternative increases demand slightly as compared with Existing Conditions with slightly less of an increase in capacity, leading to a small proportion of traffic volume unserved.
- Alternative 3, a six-lane design which adds HOV lanes and includes a HOV connection to the I-5 reversible lanes, adds moderately to northbound demand on I-5 as compared to Existing Conditions and No-Action volumes but with a greater increase in capacity as compared to No-Action resulting in virtually no unserved capacity.
- The eight-lane Alternative 4, with both HOV and an additional general-purpose lane, has a somewhat higher demand than Alternative 3. The capacity of Alternative 4, however, is greater than Alternative 3 resulting in little unserved traffic volume for this movement.
- Alternative 6, which has eight lane with both HOV and an additional general-purpose lane, but without the tunnel to Eastlake/Fairview Avenues, has a slightly lower demand as compared to Alternative 4 which is also eight lanes, and has lower capacity resulting in greater unserved traffic volumes than Alternative 4.

Chapter 5 of this report summarizes a supplemental study of I-5 that also examined the benefit of moving the westbound SR 520 to southbound I-5 on-ramp to the right side of I-5, and adding a lane on I-5 to Steward Street. That study also presents a more detailed comparison of No Action and SR 520 expansion alternatives' impacts on I-5.

2.1.8.2 Congestion on Local Streets

Criteria Definition: *Volume/capacity ratios for the AM- and PM-peak-period will be calculated and compared at 10 to 15 locations where year 2020 traffic volume forecasts are available.*

Congestion on Local Streets

This criteria focuses on the overall effects of the alternatives on local arterial street congestion. Traffic volumes on local streets are expected to be the highest for the eight-lane SR 520 alternatives and somewhat lower for the six-lane alternatives. Table 2-16 provides a ranking comparison of the results by alternative.

Table 2-16. Local Street Congestion Rating

1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
--	◑	◑	◕	◔	◕	◑	◕	◑

Rating Key

WORST				BEST
○	◔	◑	◕	●
Least Effective, Most Impacts	Low Effectiveness, Medium Impacts	Medium Effectiveness, Low Impacts	Increased Effectiveness, No Impact	Most Effective, Improved Conditions

All of the proposed SR 520 improvement alternatives would result in local traffic volume growth, reflecting population and employment increases by the year 2020. In general, the eight-lane freeway alternatives (Alternatives 4, 6, and 8) would result in substantially larger traffic volume increases along the SR 520 corridor and local streets than No Action or the six-lane alternative. However, many of the alternatives also introduce different interchange configurations along the corridor that could relieve some existing and projected congestion points.

Table 2-17 provides a summary that lists the interchanges that would have highly congested intersections under No Action or one of the other build alternatives. (Note that the table does not list all intersections that were analyzed, but only those where impacts were identified.)

Two separate evaluation reports were prepared to document results of traffic operations analyses for westside locations (Seattle) and for eastside locations (Appendix D). These reports focus on intersection operations at freeway ramp termini locations and other intersections that could be substantially impacted by the freeway alternatives and interchange options currently being considered. The findings documented in these reports were used to develop the overall local traffic congestion ratings shown above.

From a local traffic system perspective, Alternatives 1 and 2 would not provide any changes to the existing interchange configurations and arterial roadways in the SR 520 corridor. Therefore, local intersection operations would continue to worsen as traffic volumes increase. A total of ten intersections at or near freeway ramp termini locations would be expected to operate at unacceptable levels of service (LOS E or F) during the AM and/or PM peak hours in the year 2020 if no roadway or intersection capacity improvements are made. The deficient intersections

Table 2-17. Local Street Congestion Impacts

Location	Alt. 1	Alt. 2	Alt. 3,5,7	Alt 4	Alt. 6	Alt. 8
SR 520/Roanoke St./Harvard Ave Ramp						
Harvard Ave. E/Roanoke St./SR 520 WB Off-Ramp	X	X	X	X		
I5/Mercer St. Off Ramps						
Mercer St/Fairview Ave. N/I-5 Ramps	X	X	X (-)	X	X(-)	X
Fairview Ave. N/Valley St.				X (-)		X(-)
Fairview Ave. N/Eastlake Ave. E				X (-)		X(-)
SR 520/Montlake Blvd. Interchange						
Montlake Blvd/NE Pacific St.	X	X	X	X(-)	X(-)	
Montlake Blvd./E. Shelby St.				X(-)		
Montlake Blvd./E. Hamlin St.	X	X				
Montlake/SR 520 WB Ramps				X(-)		
Montlake Blvd./Lake Washington Blvd/SR 520 Ramps	X	X	X(-)	X(-)		
SR 520/Lake Washington Blvd Interchange						
Lake Washington Blvd/SR 520 Westbound Off-Ramp	X	X				
SR 520/84th Ave NE Interchange						
84th Ave NE/SR 520 Westbound On-Ramp				X(-)	X(-)	X(-)
NE Points Dr./84th Ave NE	X	X	X(-)	X(-)	X(-)	X(-)
SR 520/92nd Ave NE Interchange						
Yarrow Point Rd/SR 520 Westbound off Ramp				X(-)	X(-)	X(-)
SR 520/Bellevue Way Interchange						
Lake Washington Blvd/Northup Way			X(-)	X(-)	X(-)	X(-)
Northup Way/NE 38th Place			X(-)	X(-)	X(-)	X(-)
Northup Way/108th Ave NE	X	X				
Bellevue Way (Single Point Urban Interchange)				X(-)	X(-)	X(-)
SR 520/148th Ave. NE Interchange						
148th Ave. NE/SR 520 Westbound Ramps				X(-)	X(-)	X(-)
148th Ave. NE/SR 520 Eastbound Ramps				X (-)	X (-)	X (-)
SR 520/NE 40th St. Interchange						
NE 40th St./SR 520 Eastbound Ramps				X(-)	X(-)	X(-)
SR 520/W. Lake Sammamish Pkwy. Interchange						
W. Lake Sammamish Pkway/SR 520 Westbound Ramps/Leary Way NE				X(-)	X(-)	X(-)
SR 520/SR 202 Interchange						
Redmond Way/SR 520 NB Ramps				X(-)	X(-)	X(-)
Redmond Way/NE 76th St./SR 520 SB On-Ramp	X	X	X(-)	X(-)	X(-)	X(-)
SR 520/NE Union Hill Road	X	X	X	X(-)	X(-)	X(-)

X = Level of Service (LOS) E/F Locations
X(-) = LOS E/F and worse than No Action

are located at or near the following interchanges: SR 520/Roanoke St./Harvard Ave. E, I-5/Mercer St., SR 520/Montlake Blvd., SR 520/Lake Washington Blvd., SR 520/84th Ave. NE, SR 520/Bellevue Way, SR 520/148th, SR 520/NE 40th St. Interchange, SR 520/W. Lake Sammamish Parkway, and SR 520/SR 202.

Alternatives 3, 5, and 7 would provide six freeway lanes (two general-purpose lanes and one HOV lane in each direction), resulting in increases in traffic volumes entering/exiting the local arterial system. The alternatives included different design options for different interchanges; the options for Alternative 3 were used in evaluating local traffic impacts, but the future traffic volumes for all of the six-lane alternatives are expected to be similar, regardless of the specific interchange options.

With Alternative 3, the SR 520/Montlake Blvd. interchange was reconfigured as a single-point urban interchange (SPUI) with a separate transit/HOV-only connection to SR 520; a new SPUI was also assumed to replace the existing Bellevue Way and 108th Ave. NE interchanges; and braided ramps would be provided at the I-405 and SR 520 interchange to separate northbound to eastbound traffic from traffic destined to the eastbound 124th Ave. NE off-ramp. With these changes, a total of nine intersections would operate at LOS E or F during the AM and/or PM peak hours; of these, six would operate at worse than No Action conditions and possibly require additional mitigation.

Alternative 4 would provide eight freeway lanes (three general-purpose lanes and one HOV lane in each direction), resulting in traffic volume increases in the local arterial street system. With this alternative, the I-5/SR 520 interchange options was evaluated with a new two-lane general-purpose ramp connection from SR 520 to the Eastlake Ave. E./Fairview Ave. N. intersection. In addition, the local traffic impacts evaluation for the Westside assumed that a separate transit/HOV-only connection to SR 520 near the Montlake Blvd./SR 520 interchange would be provided and the existing SR 520/Lake Washington (Arboretum) ramps would be removed. On the Eastside, the same changes described for Alternative 3, including the Bellevue Way/108th Ave. NE SPUI and the I-405/SR 520 braided northbound-to-eastbound ramps would also be provided. With these proposed changes, a total of 21 intersections would operate at LOS E or F during the AM and/or PM peak hours; of these, 19 intersections would operate at worse than No Action conditions and possibly require additional mitigation.

For Alternatives 6 and 8 (three general-purpose lanes and one HOV lane in each direction), the freeway interchanges on the Eastside would be configured similar to Alternative 4. On the Westside, the local traffic impacts evaluation for Alternative 6 assumed that the Harvard Ave. E. westbound off-ramp would be removed; Alternative 8 assumed that a new four-lane (general-purpose and HOV) ramp connection from SR 520 to the Eastlake Ave. E/Fairview Ave. N. intersection would be provided and the Harvard Ave. E. westbound off-ramp would be removed. The Montlake Blvd./SR 520 interchange was configured to include a new GP-only tunnel to a new underground SPUI located east of the existing interchange, and the existing Lake Washington Blvd (Arboretum) ramps would be removed. With Alternative 6, the Montlake Blvd./Pacific St. GP/HOV intersection would remain at-grade; with Alternative 8, GP traffic would be directed below-grade while HOV and local traffic would remain at-grade. With

Alternative 6, 15 intersections would operate at LOS E or F during the AM and/or PM peak hours; of these, 15 would operate at worse than No Action conditions. With Alternative 8, 16 intersections would operate at LOS E or F during the AM and/or PM peak hours; of these, 15 would operate worse than the No Action alternative.

2.1.8.3 Total Hours of Delay

Criteria Definition: *How effective is the alternative at reducing total person hours of delay compared to the No Action alternative?*

Delay forecasts were obtained from microsimulation analysis of freeway operations. The results are for vehicles only. Performance data is summarized for the entire Trans-Lake freeway system which includes SR 520 from 124th Street to I-5, I-5 from NE 45th Street to Mercer, and I-405 from NE 70th Street to NE 4th Street. Table 2-18 summarizes the results for the analysis of system performance data. To provide comparable information between alternatives that vary in number of lanes and number of vehicles served, the additional parameters of total VMT was included to provide an indication of the amount of demand served and is used to derive the final column of delay in minutes per VMT.

Table 2-18. System Perfomance/Delays

Alternative	Total VMT	Delay Total Time	Delay Minutes/ Mile
AM Peak			
Existing	740,000	6600	0.54
Alt. 1 No Action Alt. 2 Safety & Preservation	755,000	11,500	0.91
Alt. 3 HOV & I-90 LRT Alt. 5 HOV & SR 520 HCT Alt. 7 HOV & SR 520 BRT	804,000	6200	0.47
Alt. 4 HOV, GP & I-90 LRT Alt. 8 HOV, GP & SR 520 BRT	875,000	6200	0.43
Alt. 6 HOV, GP & SR 520 CCT w/o Eastlake/Fairview tunnel	838,000	8700	0.62
PM Peak			
Existing	856,000	6400	0.45
Alt. 1 No Action Alt. 2 Safety & Preservation	909,000	10,100	0.66
Alt. 3 HOV & I-90 LRT Alt. 5 HOV & SR 520 HCT Alt. 7 HOV & SR 520 BRT	918,000	7600	0.5
Alt. 4 HOV, GP & I-90 LRT Alt. 8 HOV, GP & SR 520 BRT	988,000	7600	0.46
Alt. 6 HOV, GP & SR 520 HCT w/o Eastlake/Fairview tunnel	946,000	8300	0.52

Alternatives analyzed in the operational analysis included Alternative 1: No Action, which also approximates the results of Alternative 2: SR 520 Safety and Preservation; Alternative 3: SR520 HOV with I-90 LRT (six lanes), which also approximates the impacts of Alternatives 5 and 7, which have the same number of vehicle lanes; Alternative 4: SR 520 HOV and GP with I-90 LRT (eight lanes), which also approximates the impacts of Alternative 8 which shares the same lane configuration, and Alternative 6: SR 520 HOV and GP and HCT, which was analyzed using the same traffic volumes as Alternative 6, but with the elimination of the Fairview Avenue/ Eastlake Avenue tunnel.

Key findings include:

- The most substantial change is from Existing Conditions to No Action, reflecting the increase in demand from population and employment growth in the region. All build alternatives improve delay as compared to No Action.
- The six and eight lane alternatives operate with essentially the same delay, although more vehicles are served by the eight-lane alternatives.
- The greatest difference between alternatives resulted from the exclusion of a particular design feature, the Fairview/Eastlake tunnel, rather than from differences in mainline design and capacity.

No separate ranking of this criteria is provided because delay is reflected in the overall rating of congestion.

2.1.8.4 Vehicle Queue Lengths

Criteria Definition: *Average and maximum vehicle queue lengths for the AM- and PM-peak-period will be quantified for each alternative on select freeways within the Trans-Lake Washington study area.*

Vehicle queues are an additional measure of congestion and represent the storage of excess demand behind a particular bottleneck. Forecasts of queues were obtained from microsimulation analysis of freeway operations. The analysis presented is based on conditions averaged over a 5-hour AM and PM peak period. This analysis therefore does not depict the worst case single-hour peak period. These model results provide an adequate *comparison* between future conditions but do not predict actual driving experience as it would occur for a vehicle in a particular period of time. The results of the analysis performed to date allow the location of areas of queues and approximate duration, but do not allow precise measurement or queue length. Such detained information will be prepared at a later phase of analysis.

Queues are identified for particular freeway sections in Figures 2-7a through 2-7d and are summarized in Table 2-19. Queues are defined as traffic moving less than 30 miles per hour. The graphic representation of queues is not to scale and provides a general comparison of congestion in that area.

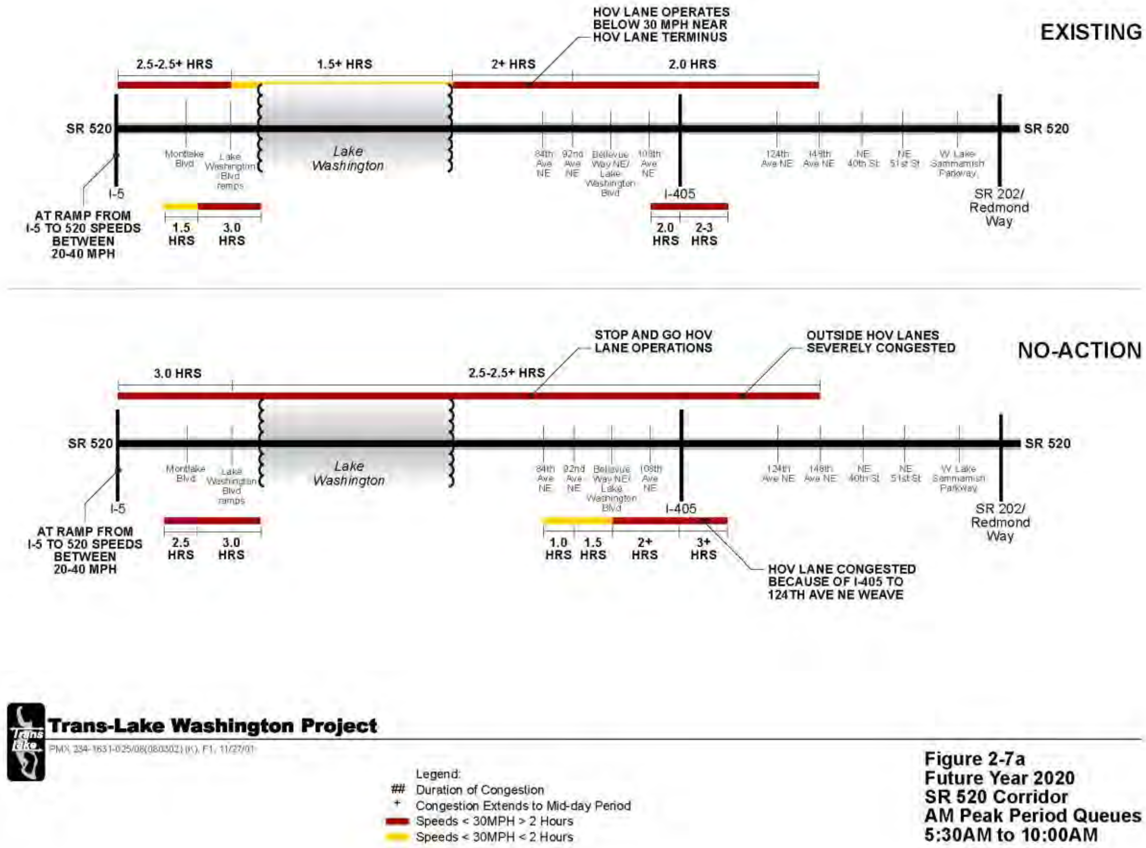


Figure 2-7a
Future Year 2020
SR 520 Corridor
AM Peak Period Queues
5:30AM to 10:00AM

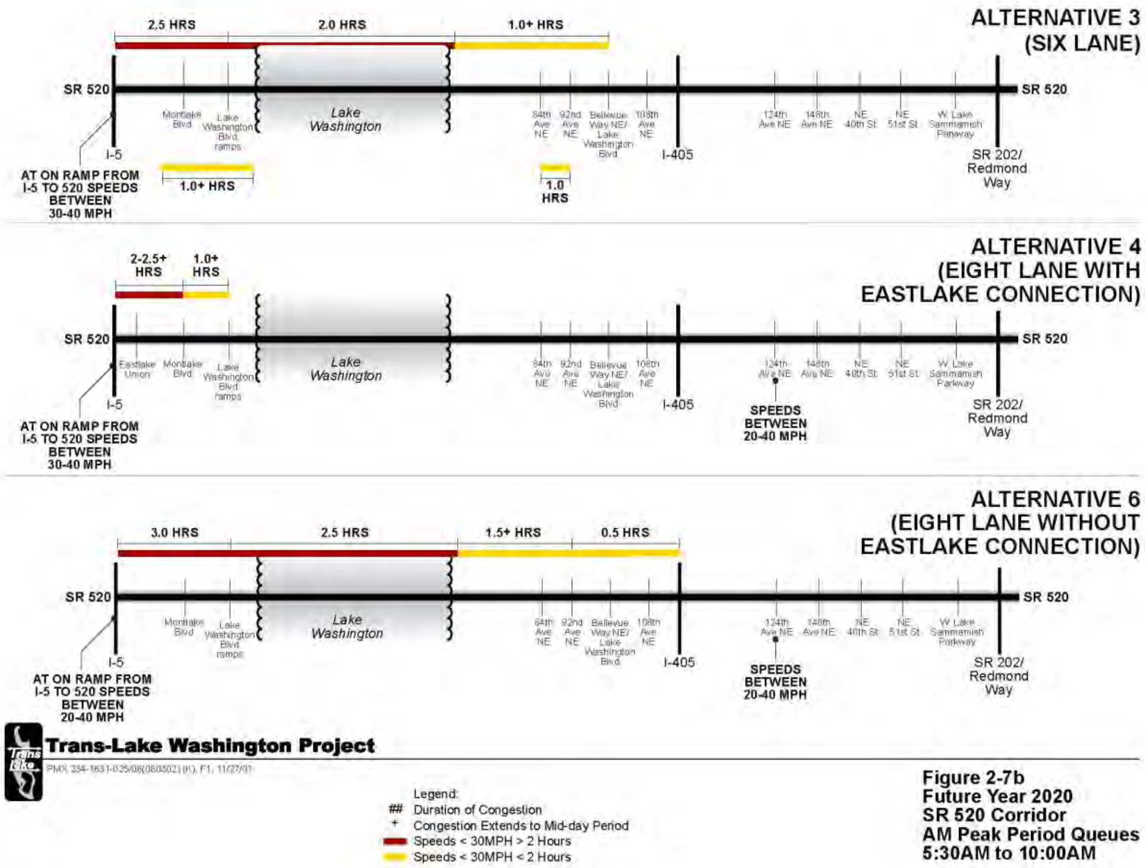


Figure 2-7b
Future Year 2020
SR 520 Corridor
AM Peak Period Queues
5:30AM to 10:00AM

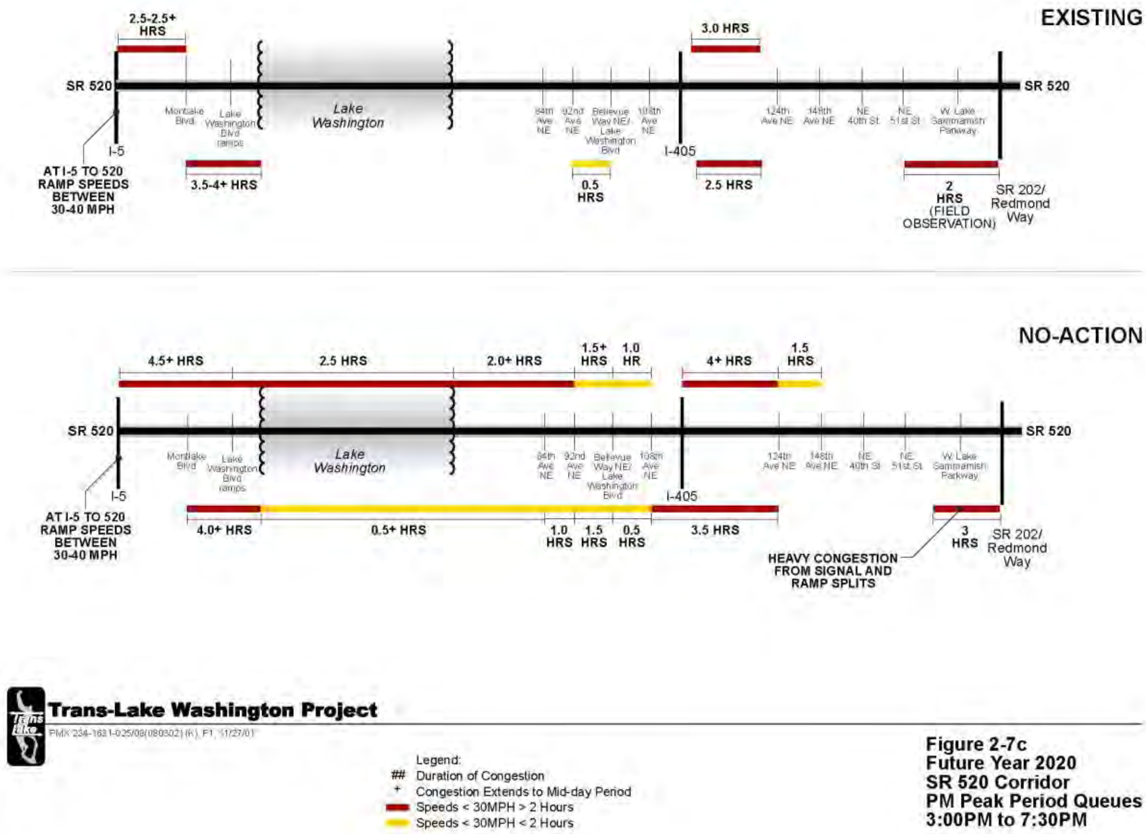


Figure 2-7c
Future Year 2020
SR 520 Corridor
PM Peak Period Queues
3:00PM to 7:30PM

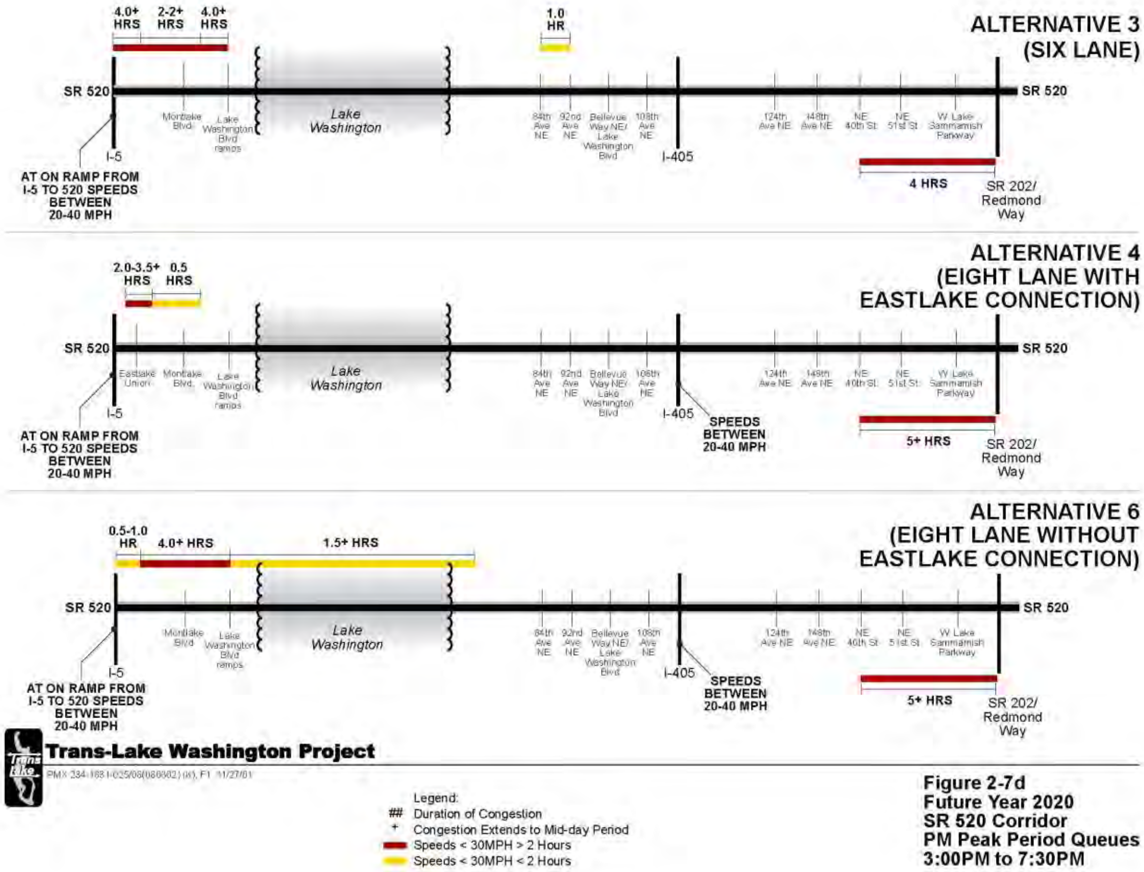


Figure 2-7d
Future Year 2020
SR 520 Corridor
PM Peak Period Queues
3:00PM to 7:30PM

Table 2-19.
Summary of Queue Analysis Results (SR 520)

Alternative	Major Queues by Direction	
	EB SR 520	WB SR 520
AM Peak		
Existing	Montlake to the lake (major) 108th to I-405 (moderate)	124th to the lake (severe) The lake to I-5 (major)
Alt. 1 No Action Alt. 2 Safety & Preservation	Montlake to the lake (major) 84th to I-405 (severe)	124th to the lake (severe) The lake to I-5 (severe)
Alt. 3 HOV & I-90 LRT Alt. 5 HOV &SR 520 HCT Alt. 7 HOV & SR 520 BRT	Montlake to the lake (minor) 84th to 92nd (minor)	Bellevue Way to the lake (moderate) The lake to I-5 (severe)
Alt. 4 HOV, GP & I-90 LRT Alt. 8 HOV, GP & SR 520 BRT	I-5 connector ramp (minor) 124th intechange (minor)	Lk. Washington Blvd. to I-5 (moderate)
Alt. 6 HOV, GP & SR 520 HCT w/o Eastlake/Fairview tunnel	I-5 connector ramp (minor) 124th intechange (minor)	I-405 to I-5 (severe)
PM Peak		
Existing	I-5 connector ramp (minor) Montlake to the lake (major) 92nd to Bellevue Way (minor) I-405 interchange (moderate)	I-405 interchange (moderate) Montlake to I-5 (moderate)
Alt. 1 No Action Alt. 2 Safety & Preservation	I-5 connector ramp (minor) Montlake to the lake (major) The lake to I-405 (major)	I-405 interchange (major) 106th to I-5 (severe)
Alt. 3 HOV & I-90 LRT Alt. 5 HOV & SR 520 HCT Alt. 7 HOV & SR 520 BRT	I-5 connector ramp (minor)	92nd to 84th (minor) Lk. Washington Blvd. To I-5 (major)
Alt. 4 HOV, GP & I-90 LRT Alt. 8 HOV, GP & SR 520 BRT	I-5 connector ramp (minor) I-405 interchange (minor)	Montlake to I-5 (moderate)
Alt. 6 HOV, GP & SR 520 HCT w/o Eastlake/Fairview tunnel	I-5 connector ramp (minor) I-405 interchange (minor)	The lake to I-5 (major)

Since the eight alternatives analyzed are basically four variations of SR 520 capacity, the operations analysis consolidates alternatives. The alternatives analyzed in detail included:

- Alternative 1: No Action, which also approximates the results of Alternative 2: SR 520 Safety and Preservation;
- Alternative 3: SR 520 HOV with I-90 LRT (six lanes), which also approximates the impacts of Alternatives 5 and 7 which have the same number of vehicle lanes;
- Alternative 4: SR 520 HOV and GP with I-90 LRT (eight lanes), which also approximates the impacts of Alternatives 8 which shares the same lane configuration; and
- Alternative 6: SR 520 HOV and GP and HCT, which was analyzed using the same traffic volumes as Alternative 4, but with the elimination of the Fairview Avenue/Eastlake Avenue tunnel.

The following are key findings from the queue analysis:

- The No-Action Alternative produces AM peak period queues that extend westbound from I-5 to 148th Avenue NE with similar PM peak queues. These queues are longer in extent and duration than existing conditions because of the increased volumes on the system and the lack of capacity improvements. The congestion in the general-purpose lanes and merging and weaving at interchanges across the existing HOV lanes which are located on the right side of the roadway produces severe congestion in the HOV lanes, even though they are theoretically below carrying capacity.

- Alternatives 3, which adds HOV lanes, reduces am peak period queues westbound somewhat as compared to No-Action because of several design features:
  - The addition of HOV lanes across Lake Washington eliminates the merge of HOV traffic into general-purpose lanes at the existing bridge and reduces delay substantially for both HOV and general-purpose traffic;
  - interchange ramps and weaving movement as are the existing HOV lanes on the right side;
  - A full shoulder is provided westbound east of Lake which increases driver comfort and traffic flow on adjacent lanes.

  Westbound AM peak queues which persist under Alternatives 3, are largely related to congestion at the Montlake interchange and the I-5 interchange.
- Alternative 3 produces longer and more persistent eastbound queues than No-Action in the PM peak at the eastern terminus of SR 520 because the increased volumes attracted to the corridor as the result of increased lane capacity exceeds the capacity of the non-freeway connecting roadways.
- Alternative 4 produces the shortest queues and reduced congestion on most sections of SR 520 for both the AM and PM peaks even with higher traffic demands. Alternative 4 incorporates several design features which reduce bottlenecks at interchanges including:
  - All four westbound lanes extend through the Montlake Blvd interchange to I-5 which eliminates the bottleneck of a dropped lane;
  - The westbound SR 520 Lake Washington Blvd off-ramp is retained, which diverts traffic from the mainline prior to the potential bottleneck at Montlake Blvd.
  - Queues at I-5 are less severe because a substantial volume of traffic exits via the proposed Eastlake/Fairview Avenues tunnel, thus avoiding the "Mercer weave" of traffic from the southbound SR 520 on-ramp on the left side of the roadway across several lanes to the Mercer Street off-ramp on the right side.
  - The queues at the eastern terminus of SR 520 which are more persistent than those experienced for Alternative result from the increase in demand resulting from increased lane capacity which exceeds the capacity of the non-freeway connecting roadways.
- Alternative 6, which adds one additional general-purpose lane and an additional HOV lane but does not include the tunnel to Eastlake/Fairview Avenues, generally experiences much longer and more persistent queues than Alternative 4. These include:
- Queues approaching I-5 westbound in both the AM and PM peaks, are substantially longer and more persistent as compared to Alternative 4. This is correlated with a larger component of traffic routed to the I-5 mainline which engages in the weaving maneuver from the westbound on-ramp from SR 520 on the left side of I-5 to the Mercer Street off-ramp on the right side as the result of the absence of the tunnel connection to Eastlake/Fairview Avenues.

- Queues approaching the eastern terminus of SR 520 at SR 202 during the PM peak result from the increased volumes attracted to the corridor because of increased lane capacity that exceed the capacity of the non-freeway connecting roadways.

Ratings were not assigned to this sub-criteria because queue lengths reflect the same results reported as part of the overall congestion ratings.

2.1.8.5 Travel Demand Reduction

Criteria Definition: *The anticipated AM-peak-period, PM-peak-period, and daily travel demand reduction will be quantified for each alternative.*

This criteria focuses on the overall effects of the alternatives in influencing travel demand, based on the model forecasts developed for the project. It does not reflect additional benefits of TDM strategies, which are discussed in more detail in the Transportation Demand Management Element Technical Report. Rating of the alternatives is found in Table 2-20.

Table 2-20. Travel Demand Reduction Ratings

1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & HCT	Alt 6: HOV & GP & HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
--	◐	◕	◕	◔	◕	◔	◕	◔

Rating Key

WORST				BEST
○	◔	◐	◕	●
Least Effective, Most Impacts	Low Effectiveness, Medium Impacts	Medium Effectiveness, Low Impacts	Increased Effectiveness, No Impact	Most Effective, Improved Conditions

The primary factors used in this criteria rating were traffic volumes, VMT/VHT and mode split criteria, all of which provided an initial indication of the influence that each of the alternatives would have on travel behavior in the corridor.

As noted in the person throughput, mode split and transit ridership criteria discussions, the forecasts for all of the alternatives have large increases in the number and percentage of people who will be traveling by HOV or transit by 2020, compared to 1995.

All of the build alternatives would provide key infrastructure and transit service improvements needed to help Trans-Lake reduce drive-alone trips. As a result, all alternatives increased the numbers of total trips made by HOV and transit. All of the alternatives would also support increased investment in TDM.

The greatest increase in HOV and transit usage in percentage terms was with Alternatives 3, 5 and 7. These alternatives had the most competitive travel times for HOV lanes and transit, compared to general-purpose travel, and they had the lowest increases in the use of non-HOV vehicles.

Alternatives 4, 6 and 8 also increased the number of people using transit and HOV, but there was also a large increase in the proportion and volume of general-purpose vehicles. In reducing total vehicles, these alternatives would be least effective. However, the improvements in transit and HOV facilities and usage provide an alternative to driving alone. They also tended to focus more travel on the SR 520 corridor, where it has a strong potential to be influenced by focused TDM programs.

All of the alternatives could further improve their trip reduction performance by imposing costs tied to the usage of the corridor. A separate evaluation addresses pricing strategies in more detail, but previous estimates have stated that up to 6 percent of vehicle trips could be eliminated through the use of tolls or other costs to the transportation user.

2.2 RELIABILITY AND SAFETY CRITERIA

2.2.1 Exclusive/Non-Exclusive Right-of-Way

Criteria Definition: *How much of the alternative is located within exclusive versus non-exclusive right-of-way? (This will be evaluated only for alternatives with an HCT component.)*

This criterion reflects a basic difference between the HCT and the BRT alternatives. Alternative 1 does not provide additional rights-of-way for HCT. Alternatives 2 through 6 provide exclusive rights of way for HCT on either a SR 520 or I-90 route. Alternatives 7 and 8 would have BRT on HOV lanes for most of the corridor, and a busway to downtown Seattle (Table 2-21).

Table 2-21. Exclusive/Non Exclusive Right-of-Way Ratings

1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & HCT	Alt 6: HOV & GP & HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
--	○	◕	●	●	●	●	◑	◑

Rating Key

WORST				BEST
○	◔	◑	◕	●
Least Effective, Most Impacts	Low Effectiveness, Medium Impacts	Medium Effectiveness, Low Impacts	Increased Effectiveness, No Impact	Most Effective, Improved Conditions

2.2.2 Safety

***Criteria Definition**: How effective will the alternative be in minimizing traffic accidents?*

The rating of the alternatives is found below in Table 2-22.

Table 2-22. Safety Ratings

1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & HCT	Alt 6: HOV & GP & HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
--	○	◔	◑	◕	◑	◕	◕	●

Rating Key

WORST				BEST
○	◔	◑	◕	●
Least Effective, Most Impacts	Low Effectiveness, Medium Impacts	Medium Effectiveness, Low Impacts	Increased Effectiveness, No Impact	Most Effective, Improved Conditions

As full design standards are assumed for Alternatives 2 through 8, they would all achieve higher safety ratings than the No Action alternative, which would leave the corridor unchanged. Many segments of the current corridor lack shoulders and have geometric features that would not meet current design standards.

Alternative 2 receives the next lowest rating because it would have limited improvements to the corridor. The bridge and viaducts across Lake Washington and Portage Bay would be improved and full shoulders are assumed, but no other major improvements would occur in the highway corridor. The HCT component of the alternative would be rated high because of its exclusive right-of-way, the same as the HCT component of Alternatives 3 through 6.

Alternatives 3 and 5 would further improve safety in the corridor by completing the HOV lanes, adding shoulders, and through other geometric and functional improvements, particularly approaching interchanges. The safety rating is lower than eight-lane alternatives because the expected levels of congestion in the two general-purpose lanes would have vehicles in those lanes moving much more slowly than HOV vehicles. Although all alternatives would have congested general-purpose lanes, the six-lane alternatives would have congestion for longer periods of time compared to the eight-lane alternatives.

Alternative 7, which includes BRT operations in a six-lane SR 520, had the highest rating for six-lane alternatives. It would add an additional 4-foot buffer between the HOV and GP lanes, reducing the degree of friction between HOV/BRT and other vehicles. This improvement would be offset slightly by the higher volumes of transit vehicles on SR 520, compared to HCT on an exclusive right-of-way.

Alternatives 4 and 6 also were rated for increased safety, similar to Alternative 7. The rating reflects the relative benefits to congestion offered by three general-purpose lanes each way, compared to two. Although congestion will still occur in general-purpose lanes, the congested periods would be shorter than a six-lane corridor, and would reduce the potential for conflicts between HOV and general-purpose vehicles.

Alternative 8, with BRT operations in an eight-lane SR 520, had the highest rating overall. As with Alternative 7, it would add an additional 4-foot buffer between the HOV and GP lanes, reducing the degree of friction between HOV/BRT and other vehicles. This improvement would be offset slightly by the higher volumes of transit vehicles on SR 520, compared to HCT on an exclusive right-of-way.

Alternatives 3 through 8 feature direct access options for HOV and transit vehicles, including at I-405, South Kirkland Park-and-Ride and other locations. These options offer a substantial safety (as well as travel time) benefit to HOV and transit vehicles, which would otherwise move through general-purpose lanes to enter and exit.

2.2.3 Travel Time Reliability

Criteria Definition: *How reliable is the travel time during different times of the day and year for both person and freight movement. This will qualitatively address how different design features associated with each alternative may affect the reliability of travel time from day to day.*

The ratings of the reliability criteria in Table 2-23 reflect differences among the alternatives when the relative benefits to each of the modes is considered. The discussion below is first by mode, and then secondly applied to the total rating for each of the alternatives.

Table 2-23. Travel Time Reliability Ratings

1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & HCT	Alt 6: HOV & GP & HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
--	○	◔	◑	◕	◑	◕	◔	◑

Rating Key

WORST				BEST
○	◔	◑	◕	●
Least Effective, Most Impacts	Low Effectiveness, Medium Impacts	Medium Effectiveness, Low Impacts	Increased Effectiveness, No Impact	Most Effective, Improved Conditions

The alternatives (Alternatives 3 through 8) that provided continuous HOV lanes in each direction on SR 520 would offer a substantial improvement in travel time reliability to bus transit and HOV users.

The general-purpose lanes, which would include commercial and freight traffic, would have substantial levels of congestion for all alternatives, which would result in lower travel time reliability across the board, compared to transit or HOV. However, the rates of congestion in general-purpose lanes would be worst with Alternatives 1 and 2, which offer no additional lanes to the corridor (neither HOV nor GP). Conditions would improve with an additional HOV lane, which would move HOV and transit from HOV lanes. An additional improvement would occur with the eight-lane alternatives. However, the forecasts and subsequent analysis show that congestion remains substantial because additional trips are attracted to the corridor when additional capacity is provided. Although GP congestion levels remain high for all alternatives, the eight-lane alternatives would carry more vehicles during the congested periods, and the periods of congestion would be somewhat shorter for an eight-lane SR 520 than for four-or-six-lane corridor.

High Capacity Transit would have higher reliability levels, particularly when the corridor is in an exclusive right-of-way (as it is in Alternatives 2 through 6). Travel times would be very predictable with high frequency HCT service, and the service would not be vulnerable to incidents or congestion on the roadway. The BRT alternatives (Alternatives 7 and 8) would have an additional 4 foot buffer between the HOV, which would offer an improvement in reliability compared to HOV alone. However, they would be considered less reliable than HCT in an exclusive right-of-way. On SR 520, incidents or congestion on the highway could still affect BRT. In addition, initial analysis indicates that BRT reliability would suffer as buses move through downtown Seattle and the University District, where on-street capacity for buses would be near capacity in 2020. (See Section 2.1.4 for more discussion.)

When considered cumulatively:

- Alternative 1 would result in the lowest rating due to the lack of reliability for all modes.
- Alternative 2 would be rated the next lowest, with a slight improvement for HOV or GP reliability, and a high rating for its HCT element, which would operate on the I-90 center roadway and then on other exclusive rights-of-way.
- Alternative 7 also had a low rating, reflecting the lower reliability for BRT on SR 520 and in areas with limited capacity for bus operations, such as downtown Seattle and University District; HOV reliability would be improved over Alternatives 1 and 2, and slightly better than other alternatives with HOV alone because of the additional buffer between GP and HOV lanes.
- Alternatives 3 and 5 had moderate improvement ratings, as they would improve HOV reliability and also have exclusive routes for HCT, but they would not markedly improve reliability for GP travel (still a substantial share of all travel).
- Alternative 8 also had a moderate rating, reflecting the benefit of addition of GP lanes but the lower rating for BRT. The issues for BRT are the same as noted for Alternative 7.
- Alternatives 4 and 6 had comparatively higher ratings, which would improve conditions for transit, HOV and commercial/GP travelers.

2.2.4 Incident Management

***Criteria Definition**: The extent to which the alternative maintains travel speeds in the SOV and HOV lanes after an incident will be summarized and compared.*

The ratings in Table 2-24 remains a qualitative assessment based on major physical factors assumed in the alternatives definition, as well as travel forecasts. Operating conditions at specific locations in the corridor were not considered in as much detail at this stage, but they would be factors in an EIS analysis. With the exception of BRT, the HCT component of the alternative was considered an even factor for the alternatives, with the same rating for all fixed guideway alternatives.

Table 2-24. Incident Management Ratings

1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & HCT	Alt 6: HOV & GP & HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
--	○	◔	◑	◑	◑	◑	◑	◑

Rating Key

WORST				BEST
○	◔	◑	◕	●
Least Effective, Most Impacts	Low Effectiveness, Medium Impacts	Medium Effectiveness, Low Impacts	Increased Effectiveness, No Impact	Most Effective, Improved Conditions

Overall, the ratings resemble those of the safety criterion, reflecting the addition of shoulders and/or buffers along the corridor, which would improve incident recovery times.

Alternative 1 received the lowest rating, as it would offer no corridor improvements. Alternative 2 received the next lowest rating because it would have limited improvements to the corridor. Alternatives 3 - 8 would further improve incident recovery because they would complete the HOV lanes and add shoulders and other geometric and functional improvements, particularly approaching interchanges, which would allow more room for incident recovery and a higher ability to continue traffic movement.

2.3 SYSTEM COMPATIBILITY CRITERIA

The criteria in this section were also applied in the initial screening as well as the modal analysis stages, and they have already helped to narrow the alternatives to established corridors (SR 520 or I-90).

Although there are substantial differences among multimodal alternatives, they have many similar elements when considered at a system level. Except for Alternatives 1 and 2, which would not expand the corridor, all of the alternatives would complete the regional HOV system. All of the alternatives would also provide high quality transit services across the lake, serving largely the same transit markets. All of the alternatives would implement a TDM program. The major difference that affects policy and plan-related criteria would be the addition of general-purpose capacity across the lake, which offers benefits to some aspects of the system and conflicts with others.

2.3.1 Compatibility with Regional and Local Transportation Plans and Improvement Projects

Criteria Definition: *Is the alternative compatible with regional and local plans and planned transportation improvement projects?*

The ratings in Table 2-25 primarily reflect the regionally planned programs included in the PSRC's Metropolitan Transportation Plan and the update, Destination 2030, the King County Plan, Sound Transit's Sound Move Program and its Long Range Vision Plan, and Washington State Department of Transportation's Puget Sound Regional HOV System Plan.

Table 2-25. Compatibility with Regional and Local Plans and Projects Ratings

1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & HCT	Alt 6: HOV & GP & HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
--	○	◔	●	◕	◕	◕	◔	◔

Rating Key

WORST				BEST
○	◔	◑	◕	●
Least Effective, Most Impacts	Low Effectiveness, Medium Impacts	Medium Effectiveness, Low Impacts	Increased Effectiveness, No Impact	Most Effective, Improved Conditions

Alternative 1 had the lowest ratings, reflecting no action to implement long standing regional and local plans to improve SR 520's transportation performance and to complete the regional HOV system plan. Alternative 2 had the next lowest rating, with no improvement to SR 520 but it would include I-90 HCT which would be consistent with the Sound Transit Long Range Vision. Alternative 3 would have the highest rating, as it would be consistent with regional plans that promote alternatives to non-HOV travel, and it would be consistent with Sound Transit's Long Range Vision. All of the alternatives with eight-lanes (including an added general-purpose lane) were rated as slightly lower, although they would still support HOV travel. Alternative 3 had the highest rating, reflecting consistency with regional highway plans and with Sound Transit's long range system plan. Alternative 5 and 6 would require a change to Sound Transit's long-range vision, but, as defined, still meet the transit capacity requirements and objectives of the long-range vision. Alternatives 7 and 8 would have lower ratings because BRT/HOV does not address long-range transit capacity constraints in downtown Seattle and the University District.

2.3.2 System Continuity

Criteria Definition: *Does the alternative maintain continuity and connectivity with the regional transportation system and eliminate or improve existing system bottlenecks?*

The ratings in Table 2-26 reflect continuity for the HOV and HCT systems and for overall traffic continuity on the freeway system.

Table 2-26. System Continuity Ratings

1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & HCT	Alt 6: HOV & GP & HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
--	○	○	◕	◕	◕	◑	◕	◑

Rating Key

WORST				BEST
○	◔	◑	◕	●
Least Effective, Most Impacts	Low Effectiveness, Medium Impacts	Medium Effectiveness, Low Impacts	Increased Effectiveness, No Impact	Most Effective, Improved Conditions

Alternatives 1 and 2 received the lowest ratings because they would not complete the regional HOV system, and would also represent a constraint for improving I-405 because there would be no additional receiving capacity on SR 520.

Alternatives 3, 5 and 7 all have higher ratings because they all would provide a continuous HOV connection across the lake. The HCT routes are assumed to have a similar continuity ratings, regardless of whether they would be I-90 or SR 520. Although an I-90 HCT route is assumed in long range operating scenarios for Sound Transit's Central Link system, the SR 520 routes as defined would also provide continuity within the system. They would involve continuous service between the Eastside and downtown Seattle and they effectively connect with Central Link as well as other transit services. However, the effectiveness of Alternative 7's BRT element (as noted earlier) depends on operating constraints on downtown Seattle and University District streets.

Alternatives 4 and 6 would have increased effectiveness ratings because they involve the same HOV and HCT components of Alternatives 3 and 5 and they add general-purpose lanes. Alternative 8 is rated lower because of the likelihood that the BRT system would ultimately be constrained by the limited capacity for buses on downtown Seattle and University District streets.

2.3.3 Compatibility with Statewide, Regional, and Local TDM and Land Use Plans and Programs

Criteria Definition: *Is the alternative consistent with statewide, regional, and local TDM and land use goals and policies?*

As shown in Table 2-27, Alternatives 1 and 2 would be rated lowest because planned population and employment growth in the region would outpace cross-lake capacity, particularly on SR 520, which is already unable to meet current demand. The other alternatives are all rated similarly because they differ only in the choice of route for HCT and whether or not added general-purpose capacity would be offered. The HOV and HCT elements would be consistent with plans at all levels. The general-purpose lanes included in the eight-lane alternatives would have a mixed rating for compatibility on its own. The added general-purpose lanes in Alternatives 4, 6 and 8 would be consistent with the levels of growth planned, and they are compatible with planning policies regarding effective commercial mobility. However, they are less compatible with regional and local planning policies that call for reduced reliance on general-purpose travel.

Table 2-27. Compatibility with Statewide, Regional and Local TDM and Land Use Plans and Programs

1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & HCT	Alt 6: HOV & GP & HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
--	○	○	◑	◑	◑	◑	◑	◑

Rating Key

WORST				BEST
○	◔	◑	◕	●
Least Effective, Most Impacts	Low Effectiveness, Medium Impacts	Medium Effectiveness, Low Impacts	Increased Effectiveness, No Impact	Most Effective, Improved Conditions

2.4 SUMMARY OF RATINGS

Table 2-28 compiles the ratings for all of the criteria that received ratings in the discussions above.

Table 2-28. Summary of Transportation Criteria Ratings

	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
Person Throughput	◔	◔	◑	●	◑	●	◑	●
Vehicle Volumes	◑	◑	◕	●	◕	●	◕	●
Mode Share	◑	◑	◑	◑	◑	◑	◑	◑
Transit Volumes	◕	◕	◕	◕	◕	◕	◕	◕
VHT/VMT	◑	◑	◕	◑	◕	◑	◕	◑
Travel Time	Not Rated							
Traffic Congestion (Regional)*	◔	◔	◑	◑	◔	◔	◑	◔
Traffic Congestion (Local)*	◑	◑	◕	◔	◕	◑	◕	◑
Travel Demand Reduction	◑	◕	◕	◔	◕	◔	◕	◔
Exclusive/Non Exclusive ROW	○	◕	●	●	●	●	◑	◑
Safety	○	◔	◑	◕	◑	◕	◕	●
Travel Time Reliability	○	◔	◑	◕	◑	◕	◔	◑
Incident Management	○	◔	◑	◑	◑	◑	◑	◑

Table 2-28.
Summary of Transportation Criteria Ratings (Continued)

	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
Compatibility (Regional/Local Trans. Plans & Projects)	○	○	◕	◕	◕	◑	◕	◑
System Continuity	○	◔	●	◕	◕	◕	◔	◔
Land Use/TDM Plan Compatibility	○	○	◑	◑	◑	◑	◑	◑

* Preliminary Ratings. Additional Analysis is being conducted.

Rating Key

WORST				BEST
○	◔	◑	◕	●
Least Effective	Low Effectiveness	Medium Effectiveness	Increased Effectiveness	Most Effective

3 ENVIRONMENTAL FINDINGS

The chapter summarizes the environmental findings for the multimodal alternatives for the Trans-Lake Washington Project. This summary is based on Appendix E to this report, which includes a detailed description of the affected environment; environmental consequences; and potential avoidance, minimization, or mitigation measures for 12 environmental analysis areas. The environmental findings are based on the screening criteria adopted by the Trans-Lake Washington Executive Committee on October 25, 2000. The screening criteria are described at the beginning of the discussion for each resource section. A ratings table for each environmental criterion is included at the end of each section. A summary table including the ratings for all environmental criteria is included at the end of this chapter.

3.1 AIR QUALITY

Screening Criteria: *A screening-level evaluation of potential effects of changes in emissions of nitrogen oxides (NO_X), carbon monoxide (CO), and volatile organic compounds (VOCs) from operation will be conducted based on professional judgment and the experience of other similar projects. Anticipated VMT, VHT, and average vehicle speed will be used to assess the potential for alternatives to demonstrate conformity with requirements of the Clean Air Act Amendments.*

3.1.1 Impacts of Each Alternative

All alternatives would involve high volumes of traffic and periods of congestion that would affect the degree of vehicle emissions. By the 2020 Baseline, regional air quality is projected to be within current federal standards, in part because vehicles will be required to operate more cleanly. For this multimodal analysis, the traffic data for the alternatives is not sufficient to assess the potential for each alternative to cause the region to exceed air quality thresholds. Therefore, this analysis does not focus on the regulatory threshold, but rather reflects the relative increase in emissions that would be expected.

All alternatives would result in some level of temporary construction impacts, consisting of fugitive dust, increases in particulate matter (PM_{10} and $PM_{2.5}$), and small amounts of construction machinery emissions (CO and NO_x).

3.1.1.1 Alternative 1 (No Action)

Alternative 1 is the alternative against which the projected daily traffic volumes, VHT, and average travel speed of all the other alternatives were compared in order to rank impacts on air quality. Primary emphasis was placed on daily traffic volume, using VHT and average travel speed to distinguish between two alternatives if their volumes were very close.

For reference, daily traffic volumes for the No Action Alternative in year 2020 are projected to be 28 percent greater than those in 1995. Likewise, VHT is projected to be 90.8 percent greater and average travel speed 30.4 percent lower. These numbers indicate that, unless substantial reductions are made in vehicle emissions, the No Action Alternative is likely to have some impact on air quality.

For this programmatic-level analysis, a qualitative comparison of the impacts relative to the No Action Alternative were made, recognizing that the traffic data upon which the comparison is based are in preliminary stages of development. Since this alternative had the second lowest projected daily volumes of all alternatives, it was assumed to carry a least impact rating.

3.1.1.2 Alternative 2 (Safety & Preservation, I-90 LRT)

Alternative 2 had the lowest projected daily volumes of all alternatives. It also had conflicting indicators of congestion, with VHT being higher than the No Action Alternative, but average travel speed also being slightly higher. For this reason, Alternative 2 was given the same rating as the No Action Alternative.

3.1.1.3 Alternative 3 (SR 520 HOV, I-90 LRT)

Alternative 3 had slightly higher projected daily volumes than the No Action Alternative. VHT and average traffic speed both indicated reduced congestion, with VHT being lower than the No Action Alternative, and average travel speed being slightly higher. For this reason, Alternative 3 was given the same rating as the No Action Alternative.

3.1.1.4 Alternative 4 (SR 520 HOV, GP, I-90 LRT)

Alternative 4 had the third highest traffic volumes of the multimodal alternatives. Both VHT and average travel speed are projected to increase slightly above the No Action Alternative. Therefore, Alternative 4 is assumed to have medium impacts.

3.1.1.5 Alternative 5 (SR 520 HOV, SR 520 HCT)

Alternative 5 had slightly higher projected daily volumes than the No Action Alternative. VHT and average travel speed both indicated reduced congestion, with VHT being lower than the No Action Alternative, and average travel speed being slightly higher. For this reason, Alternative 5 was given the same rating as the No Action Alternative.

3.1.1.6 Alternative 6 (SR 520 HOV, GP, SR 520 HCT)

Alternative 6 had the second highest traffic volumes. Both VHT and travel speed are projected to increase slightly above the No Action Alternative. Therefore, Alternative 6 is assumed to have medium impacts.

3.1.1.7 Alternative 7 (SR 520 HOV/BRT)

Alternative 7 had slightly higher projected daily volumes than the No Action Alternative. However, VHT is projected to increase slightly and travel speeds are projected to decrease as compared to the No Action Alternative. Therefore, Alternative 7 is assumed to have low impacts.

3.1.1.8 Alternative 8 (SR 520 HOV/BRT, GP)

Alternative 8 had the highest projected daily volumes of all alternatives. VHT is also projected to be higher than the No Action Alternative. Travel speed shows the largest improvement of all alternatives projected to decrease as compared to the No Action Alternative. However, based on the high daily traffic, Alternative 8 is assumed to have the most impacts of the multimodal alternatives.

3.1.2 Rating of Alternatives

Because of the programmatic-level of detail for this screening analysis, no mitigation is proposed for any operational impacts. Appropriate project-level mitigation will be identified during preparation of the environmental impact statement. Mitigation for construction impacts would be required. The multimodal alternatives were given two ratings: (1) relative impacts and mitigation required for each alternative, and (2) the feasibility of that mitigation. In addition, the alternatives were ranked based on the impacts associated with each alternative and the feasibility of mitigating those impacts. Each alternative was ranked relative to the other alternatives with Alternative 8 being the least impact to air quality resources, and Alternative 1 having the most impacts (Table 3-1).

Table 3-1. Air Quality Impact Rating

	Alternative							
Air Quality	**1: No Action**	**2: S&P, I-90 LRT**	**3: HOV, I-90 LRT**	**4: HOV, GP, I-90 LRT**	**5: HOV, 520 HCT**	**6: HOV, GP, 520 HCT**	**7: HOV/BRT**	**8: HOV/ BRT, GP**
Impacts and Extent of Mitigation Required	◑ least	◑ least	◑ least	◔ medium	◑ least	◔ medium	◑ least	○ most
Feasibility of Proposed Mitigation	NA	◑ medium feasibility	◑ medium feasibility	◑ medium feasibility	◑ medium feasibility	◑ medium feasibility	◑ medium feasibility	◑ medium feasibility
Ranking	7	8	6	3	5	2	4	1

RATING KEY

WORST → BEST				
○	◔	◑	◕	●
Most Impacts	Medium Impacts	Least Impacts	No Impact	Improved Environment

3.2 WATER RESOURCES

Screening Criteria: *A qualitative analysis of potential impacts on surface and ground water, including the State 303(d) list of water bodies that do not meet water quality standards, will be conducted. The amount of new pollution-generating surface will be estimated, with consideration of measures necessary to avoid untreated discharges. The relative availability of land to accommodate stormwater runoff treatment measures will be considered. In addition, existing flooding problems in receiving streams will be identified.*

3.2.1 Impacts of Each Alternative

The proposed alternatives have many of the same impacts on water resources. Alternative 6 would have the greatest overall impact because it would have the widest configuration in the SR 520 corridor. However, many of the impacts associated with width such as increased pollutant-generating impervious surface (PGIS) and total impervious area (TIA) are easily mitigated through the use of conventional water quality treatment and detention best management practices (BMPs) (except on the floating bridge). The substantial impacts associated with each alternative are summarized in Table 3-2.

3.2.2 Rating of Alternatives

As indicated in Table 3-3 Alternatives 3, 4, 5, and 6 would impact the greatest number of water resources. Alternative 6 would have the greatest impact on water quality and hydrology because it would create the most impervious surface area.

The multimodal alternatives were given two ratings: (1) relative impacts and mitigation required for each alternative, and (2) the feasibility of that mitigation. In addition, the alternatives were ranked based on the impacts associated with each alternative and the feasibility of mitigating those impacts. Each alternative was ranked relative to the other alternatives, with 8 being the least impact on water resources, and 1 being the alternative with the most impacts. In general, the alternative with the widest typical footprint would have the greatest impact.

Some impacts associated with Alternatives 3, 4, 6, 7, and 8 could be avoided by removing the cut-and-cover tunnel underneath the Montlake Cut. Impacts on Bear Creek associated with Alternatives 3, 4, 5, and 6 could be avoided by realigning the HCT segment and by placing fill south of the SR 520 alignment. Alternatives 7 and 8 could also avoid impacting water resources by placing fill south of the SR 520 alignment in the Redmond area.

Table 3-2. Summary of Substantial Water Resources Impacts

	Alternative							
Impacts	1: No Action	2: S&P, I-90 LRT	3: HOV, I-90 LRT	4: HOV, GP, I-90 LRT	5: HOV, 520 HCT	6: HOV, GP, 520 HCT	7: HOV/ BRT	8: HOV/ BRT, GP
Direct								
Place Yarrow Creek in a culvert or relocated channel			X	X	X	X	X	X
Extend Goff Creek culvert, put tributary in a pipe or relocate			X	X	X	X	X	X
Extend culvert North Branch Kelsey Creek			X	X	X	X		
Fill north of SR 520 in Bear Creek floodplain			X	X	X	X	X	X
New bridge over Bear Creek, fill in floodplain, loss of riparian vegetation, confined channel		X	X	X	X	X		
New bridge over the Sammamish River, fill in floodplain		X	X	X	X	X		

Table 3-2. Summary of Substantial Water Resources Impacts (continued)

Impacts	Alternative							
	1: No Action	2: S&P, I-90 LRT	3: HOV, I-90 LRT	4: HOV, GP, I-90 LRT	5: HOV, 520 HCT	6: HOV, GP, 520 HCT	7: HOV/ BRT	8: HOV/ BRT, GP
Construction								
Shoreline construction Foster Island and Portage Bay: increased turbidity and spills		X	X	X	X	X	X	X
Construction of cut-and-cover tunnel under Ship Canal: increased turbidity and spills			X	X	X	X	X	X
Nearshore construction/over-water work, Lake Washington: increased turbidity and spills		X	X	X	X	X	X	X
Yarrow Creek culvert extensions: increased turbidity and spills			X	X	X	X	X	X
Goff Creek culvert extensions, pipe/relocate tributary: temporary stream by-pass, increased turbidity and spills (north of SR 520)			X	X	X	X	X	X
Cut-and-cover tunnel under Goff Creek: temporary stream by-pass, increased turbidity and spills (south of SR 520)		X	X	X	X	X		
North Branch Kelsey Creek culvert extension: increased turbidity and spills			X	X	X	X		
Construction of a bridge, Sammamish River: increased turbidity and spills		X	X	X	X	X		
Modification of SR 520 bridge; Sammamish River: increased turbidity and spills		X	X	X	X	X		
Construction of aerial structure, Bear Creek:: increased turbidity and spills		X	X	X	X	X		

Table 3-3. Water Resources Impact Rating

Water Resources	Alternative							
	1: No Action	**2: S&P, I-90 LRT**	**3: HOV, I-90 LRT**	**4: HOV, GP, I-90 LRT**	**5: HOV, 520 HCT**	**6: HOV, GP, 520 HCT**	**7: HOV/BRT**	**8: HOV/ BRT, GP**
Impacts and Extent of Mitigation Required	◑ least	◔ medium	○ most	○ most	○ most	○ most	○ most	○ most
Feasibility of Proposed Mitigation	NA	○ least feasible	○ least feasible	○ least feasible	○ least feasible	○ least feasible	○ least feasible	○ least feasible
Ranking	8	7	3	2	4	1	6	5

RATING KEY

WORST →				BEST
○	◔	◑	◕	●
Most Impacts	Medium Impacts	Least Impacts	No Impact	Improved Environment

3.3 FISH-BEARING STREAMS/THREATENED AND ENDANGERED SPECIES

Screening Criteria: *A qualitative assessment of potential direct effects on Lake Washington and known, mapped streams bearing listed and proposed fish species will be conducted. Potential direct effects will be reported by numbers of streams and amount of waterbody affected. A qualitative rating will reflect the seriousness and probability of the potential direct and indirect effects and potential difficulty in complying with requirements of the Endangered Species Act.*

This analysis includes State sensitive and priority species and habitats, as well as State and federally listed threatened and endangered species per the request of Washington State Department of Fish and Wildlife (WDFW) (letter to K. Farley from WDFW, February 23, 2001).

3.3.1 Impacts of Each Alternative

The proposed alternatives have many of the same impact on water and fishery resources. Alternative 6 would have the greatest overall impact because it would have the widest configuration. The most substantial construction-related impacts on fishery resources are increased turbidity, sedimentation and erosion, potential pollutant loading from spills, and the disruption of riparian vegetation. Long-term impacts would occur because of increased runoff and pollutant loading from impervious surface areas and shading of aquatic habitat by aerial structures. However, many of the short- and long-term impacts can be mitigated through the use of conventional water quality treatment and detention BMPs (except on the floating bridge). The substantial impacts associated with each alternative are summarized in Table 3-4.

The impacts summarized in Table 3-4 would be difficult or impossible to mitigate and should be avoided, where possible.

Table 3-4. Summary of Substantial Fishery Resources Impacts

Impacts	Alternative							
	1: No Action	2: S&P, I-90 LRT	3: HOV, I-90 LRT	4: HOV, GP, I-90 LRT	5: HOV, 520 HCT	6: HOV, GP, 520 HCT	7: HOV/BRT	8: HOV/ BRT, GP
Direct Impacts								
Increased shading and/or predator fish habitat in Portage Bay/Foster Island area		X	X	X	X	X	X	X
Fill north of SR 520 in Bear Creek floodplain			X	X	X	X	X	X
New bridge over Bear Creek		X	X	X	X	X		
Modified SR 520 bridge over the Sammamish River, fill in floodplain			X	X	X	X	X	X
Modified HCT bridge over the Sammamish River, fill in floodplain		X	X	X	X	X		
Construction Impacts								
Shoreline construction Foster Island and Portage Bay		X	X	X	X	X	X	X
Construction cut and cover tunnel under Ship Canal			X	X		X	X	X
Nearshore construction/over-water work; Lake Washington		X	X	X	X	X	X	X
Construction of aerial structure; Bear Creek		X	X	X	X	X		

3.3.1.1 Alternative 1 (No Action)

The No Action Alternative would not have any new direct impact on fishery resources. Fish passage conditions at the existing culverts would not change and existing PGIS would not be retrofitted with water quality treatment and detention BMPs. Fishery resources would continue to be impacted by these factors.

3.3.1.2 Alternative 2 (Safety & Preservation, I-90 LRT)

Alternative 2 would replace the existing Portage Bay and SR 520 floating bridges, which would increase shading in the shallow water areas of Portage Bay and Foster Island. There would also be some in-water construction impacts in these areas during the removal of existing piers and the installation of new ones. However, the new bridge sections would require fewer support piers, potentially reducing the predator fish habitat.

The LRT facilities would impact the riparian vegetation of Goff and Valley creeks adjacent to SR 520 east of I-405, particularly if a cut-and-cover tunnel is constructed at Goff Creek. A bored tunnel would eliminate these impacts. The LRT structures crossing the Sammamish River, Bear Creek, and Valley Creek would result in additional shading to these streams. The LRT would also increase the runoff volumes to the area streams, although the pollutant loading would not increase because the fixed-guideway LRT is non-PGIS.

3.3.1.3 Alternative 3 (SR 520 HOV, I-90 LRT)

Potential impacts on fishery resources for Alternative 3 would be similar to those discussed for Alternative 2. However, the addition of HOV lanes along portions of SR 520 would produce a wider road surface, which would increase the runoff volumes and habitat losses at the stream crossings. Adequate stormwater retention/detention and treatment BMPs would minimize potential impacts on water quantity/quality in the area streams. Using retaining walls or elevated structures to minimize filling in areas adjacent to streams crossed by the alignment would minimize the loss of habitat.

Alternative 3 includes a cut-and-cover tunnel across the Montlake Cut, resulting in substantial in-water construction that could potentially impact resident fish and migration of adult salmonids returning to the Lake Washington watershed. Restricting in-water construction to the WDFW-approved window of time and providing continuous passage routes through the construction area for adult migrants would minimize impacts on anadromous fish.

The wider bridge section through Portage Bay and Foster Island would increase the shading effects in shallow water habitat. Despite the wider bridge section, the number of in-water supporting piers would decrease compared to the existing bridge. Therefore, habitat preferred by predator fish species is expected to decrease.

In addition to new LRT structures over the Sammamish River and Bear Creek, Alternative 3 would widen the SR 520 bridge over the Sammamish River and potentially require additional fill in the Bear Creek floodplain.

3.3.1.4 Alternative 4 (SR 520 HOV, GP, I-90 LRT)

Potential impacts on fishery resources for Alternative 4 would be similar to those discussed for Alternative 3. However, the addition of HOV and GP lanes along portions of SR 520 would produce a wider road surface, which would increase the runoff volumes and habitat losses at the stream crossings. The wider bridge sections through Portage Bay and Foster Island would increase the shading effects (compared to narrower bridge alternatives), although the number of in-water piers would decrease (compared to existing conditions). To minimize the impacts in the Foster Island area, some of the shallow water habitat could be modified to provide habitat better suited for juvenile salmonids than resident fish. These modifications could include capping the relatively steep-banked muddy shoreline habitat with sand or sand/gravel material to produce gradually sloping beaches.

The increased width proposed by Alternative 4 along the SR 520 corridor would require either extending the existing culverts under the highway, replacing the culverts with structures that improve fish passage (bottomless culvert, bridge, etc.), or supporting the additional width requirements with an aerial structure. However, all of these options would result in some loss of habitat.

3.3.1.5 Alternative 5 (SR 520 HOV, SR 520 HCT)

Potential impacts on fishery resources for Alternative 5 would be similar to those discussed for Alternative 3. However, Alternative 5 would have more impervious surface area along the SR 520 corridor between Lake Washington and I-405, which would increase runoff volumes and habitat losses at the stream crossings. This alternative would have a bored transit tunnel under the Montlake Cut, thereby eliminating a substantial amount of in-water construction work.

3.3.1.6 Alternative 6 (SR 520 HOV, GP, SR 520 HCT)

Potential impacts on fishery resources for Alternative 6 would be similar to those discussed for Alternative 4. However, the inclusion of HCT along the SR 520 corridor would result in the widest impervious surface area between I-5 and 130th Avenue NE of all the alternatives. This would produce the greatest runoff volumes and habitat losses at the stream crossings, as well as the greatest shading impacts in the shallow water habitat in Portage Bay, Foster Island, and Lake Washington.

3.3.1.7 Alternative 7 (SR 520 HOV/BRT)

Potential impacts on fishery resources for Alternative 7 would be similar to those discussed for Alternative 3, except that Alternative 7 would be about 8 feet wider to accommodate the separation between the BRT and the GP lanes. Alternative 7 does not have associated HCT crossings of the Sammamish River and Bear Creek, although the SR 520 Sammamish River bridge would be widened and fill would be added to the Bear Creek floodplain. This floodplain filling could be avoided by shifting the alignment south of the existing highway.

3.3.1.8 Alternative 8 (SR 520 HOV/BRT, GP)

Except for a slightly wider roadway to accommodate a separation between the GP and BRT lanes, Alternative 8 would have impacts similar to Alternative 4 west of West Lake Sammamish Parkway. East of that point, the impacts would be the same as Alternative 7.

3.3.2 Rating of Alternatives

The multimodal alternatives were given two ratings: (1) relative impacts and mitigation required for each alternative, and (2) the feasibility of that mitigation. In addition, the alternatives were ranked based on the impacts associated with each alternative and the feasibility of mitigating those impacts (Table 3-5). Each alternative was ranked relative to the other alternatives, with 8 being the alternative with the least impact on fish resources, and 1 being the alternative with the most impacts. In general, the alternative with the widest typical footprint could potentially have the greatest impact. The typical footprint was used as the primary measure of impacts for the following reasons (in order of importance):

- Wider footprints could potentially have greater direct impacts, such as culvert extensions, loss or modification of instream habitat, and shading, which would be difficult to mitigate.
- Wider footprints would create more total new impervious surface area, which could potentially impact streams through increased downstream erosion and sedimentation.
- Several of the proposed alternatives have approximately the same footprint, but would create different amounts of PGIS. Alternatives that create more PGIS would have greater potential impact on streams and lakes than alternatives that create less PGIS. However, these impacts could be mitigated through implementation of water quality treatment BMPs.

Table 3-5. Fishery Resources Impact Rating

	Alternative							
Fish-Bearing Streams	**1: No Action**	**2: S&P, I-90 LRT**	**3: HOV, I-90 LRT**	**4: HOV, GP, I-90 LRT**	**5: HOV, 520 HCT**	**6: HOV, GP, 520 HCT**	**7: HOV/BRT**	**8: HOV/ BRT, GP**
Impacts and Extent of Mitigation Required	◕ no	◑ least	◔ medium	◔ medium	◑ least	○ most	◑ least	◑ least
Feasibility of Proposed Mitigation	NA	◕ most feasible	◔ low feasibility	◔ low feasibility	◑ medium feasibility	○ least feasible	◑ medium feasibility	◑ medium feasibility
Ranking	8	7	4	2	3	1	6	5

RATING KEY

WORST				BEST
○	◔	◑	◕	●
Most Impacts	Medium Impacts	Least Impacts	No Impact	Improved Environment

Avoidance measures identified in the water resources section could also be used to avoid impacts on fishery resources. In addition, impacts on Goff and Valley creeks under Alternatives 2 through 6 could be avoided by crossing Goff Creek with a bored tunnel.

3.4 CRITICAL UPLAND HABITAT/THREATENED AND ENDANGERED SPECIES

Screening Criteria: *A qualitative assessment of potential direct and indirect effects on known, mapped critical upland habitat and listed threatened and endangered species will be prepared. Potential effects will be estimated using data from existing records and professional judgment. Results will be reported by area of habitat affected, along with a qualitative rating that reflects the seriousness and probability of the impacts and potential difficulty in complying with requirements of the Endangered Species Act.*

The analysis includes State sensitive and priority species and habitats, as well as State and federally listed threatened and endangered species, per the request of WDFW (letter to K. Farley from WDFW, February 23, 2001).

3.4.1 Impacts of Each Alternative

The proposed alternatives have many of the same impacts on priority habitats and species (PHS). Most of the alternatives have similar impacts in areas with concentrations of PHS locations (e.g., Portage Bay, Foster Island, Yarrow Bay, and Sammamish/Bear Creek). Alternative 6 would have the greatest overall impacts because it would have the widest configuration. Avoidance, minimization, and mitigation in many of these areas is difficult because the habitat is unique and because shifting the alignment to avoid impacts is often not possible because PHS locations are present on both sides of the proposed alignment.

The significant impacts associated with each alternative are summarized in Table 3-6. The impacts summarized in Table 3-6 would be difficult or impossible to mitigate and should be avoided, where possible.

Table 3-6. Summary of Substantial Impacts on PHS

	Alternative							
Impacts	**1: No Action**	**2: S&P, I-90 LRT**	**3: HOV, I-90 LRT**	**4: HOV, GP, I-90 LRT**	**5: HOV, 520 HCT**	**6: HOV, GP, 520 HCT**	**7: HOV/BRT**	**8: HOV/ BRT, GP**
Direct								
Fill north of SR 520 in PHS associated with Bear Creek			X	X	X	X	X	X
New bridge over priority habitat at Bear Creek, fill in priority habitat, loss of riparian vegetation, confined channel		X	X	X	X	X		
Direct impacts on PHS from new bridge over the Sammamish River, fill in priority habitat associated with floodplain		X	X	X	X	X		
Direct impacts on PHS at Portage Bay and Foster Island		X	X	X	X	X	X	X
Direct impacts on PHS at Fairweather Bay, Cozy Cove, Yarrow Bay		X	X	X	X	X	X	X
Construction (Indirect Impacts on PHS)								
Shoreline construction Foster Island and Portage Bay			X	X		X	X	X
Construction of cut-and-cover tunnel under Ship Canal			X	X	X	X	X	X
Nearshore construction/over-water work; Lake Washington		X	X	X	X	X	X	X
Construction of a bridge; Sammamish River		X	X	X	X	X		
Modification of SR 520 bridge; Sammamish River		X	X	X	X	X		
Construction of aerial structure; Bear Creek		X	X	X	X	X		

3.4.1.1 Alternative 1 (No Action)

The No Action Alternative would not have any new direct impacts on PHS. However, because it was assumed that the existing PGIS would not be retrofitted with water quality treatment and detention BMPs, PHS resources would continue to be indirectly impacted by stormwater runoff.

3.4.1.2 Alternative 2 (Safety & Preservation, I-90 LRT)

Alternative 2 would have long-term, but minor, direct impacts and construction impacts on PHS associated with Portage Bay, Union Bay/Foster Island, and Yarrow Bay. This alternative would include retrofitting SR 520 with water quality treatment BMPs, which means that Alternative 2 would have fewer indirect impacts on PHS than the No Action Alternative.

The I-90 LRT facilities would have substantial direct impacts on PHS associated with the Sammamish River and Bear Creek at the two proposed crossings.

3.4.1.3 Alternative 3 (SR 520 HOV, I-90 LRT)

Potential impacts on PHS for Alternative 3 would be similar to those discussed for Alternative 2. However, the addition of HOV lanes along SR 520 would have more direct impacts on PHS associated with Portage Bay, Union Bay/Foster Island, and Cozy Cove/Yarrow Bay and would also include direct impacts on PHS associated with Bear Creek. Alternative 3 would include construction of a cut-and-cover tunnel under the Montlake Cut, which would have substantial temporary water quality impacts and potential indirect impacts on PHS. This alternative would have minor indirect impacts on PHS downstream of Kelsey and Goff Creeks.

The I-90 LRT facilities would have the same impacts on PHS associated with the Sammamish River and Bear Creek as described for Alternative 2.

3.4.1.4 Alternative 4 (SR 520 HOV, GP, I-90 LRT)

Alternative 4 would include the addition of HOV and GP lanes along portions of SR 520, and would have similar, but greater, direct impacts on PHS associated with Portage Bay, Union Bay/Foster Island, Cozy Cove/Yarrow Bay, and Bear Creek than Alternative 3. Alternative 4 would include construction of a cut-and-cover tunnel under the Montlake Cut, which would have substantial temporary water quality impacts and potential indirect impacts on PHS, similar to Alternative 3. Alternative 4 would also have similar, but slightly greater, indirect impacts on PHS downstream of Kelsey and Goff Creeks as compared to Alternative 3.

The I-90 LRT facilities for Alternative 4 would have the same impacts on PHS associated with the Sammamish River and Bear Creek as described for Alternative 2.

3.4.1.5 Alternative 5 (SR 520 HOV, SR 520 HCT)

Potential impacts on PHS for Alternative 5 would be similar to those described for Alternative 3. However, Alternative 5 would include additional impacts on PHS from HCT facilities located in Union Bay/Foster Island and Cozy Cove/Yarrow Bay.

Alternative 5 would not include construction of a cut-and-cover tunnel under the Montlake Cut, and, therefore, would not have substantial temporary water quality impacts and potential indirect impacts on PHS.

This alternative would have similar, but slightly greater, indirect impacts on PHS downstream of Kelsey and Goff Creeks compared to Alternative 4.

The HCT facilities would have the same impacts on PHS associated with the Sammamish River and Bear Creek as Alternative 2.

3.4.1.6 Alternative 6 (SR 520 HOV, GP, SR 520 HCT)

Alternative 6 would have the greatest direct impacts on PHS because it would have the widest footprint across Portage Bay, Union Bay/Foster Island, Cozy Cove/Yarrow Bay, and Bear Creek.

Alternative 6 would have the greatest long-term indirect impacts on PHS associated with changes in water quality and hydrology due to increased area of impervious surface and pollutant loading. Alternative 6 would include construction of a cut-and-cover tunnel under the Montlake Cut, which would have substantial temporary water quality impacts and potential indirect impacts on PHS.

The HCT facilities would have substantial impacts on PHS associated with the Sammamish River and Bear Creek at the two proposed crossings.

3.4.1.7 Alternative 7 (SR 520 HOV/BRT)

Alternative 7 would have direct and indirect impacts on PHS associated with Portage Bay, Union Bay/Foster Island, Cozy Cove/Yarrow Bay, and Bear Creek that are similar, but slightly greater, than those under Alternative 3.

For Alternative 7, long-term indirect impacts on PHS associated with changes in water quality and hydrology due to increased impervious surface area and pollutant loading would be similar to, but greater than, those associated with Alternative 3.

Alternative 7 would not include HCT crossings of the Sammamish River and Bear Creek and would avoid the impacts on PHS at these locations.

3.4.1.8 Alternative 8 (SR 520 HOV/BRT, GP)

Alternative 8 would result in similar, but slightly greater (due to wider footprint), direct and indirect impacts on PHS compared to those of Alternative 7.

Alternative 8 does not include HCT crossings of the Sammamish River and Bear Creek and would avoid the impacts on PHS at these locations.

3.4.2 Ratings of Alternatives

Alternatives 4, 6, and 8 would have wider footprints and would potentially have the most substantial impacts on PHS.

The multimodal alternatives were given two ratings: (1) relative impacts and mitigation required for each alternative, and (2) the feasibility of that mitigation. In addition, the alternatives were ranked based on the impacts associated with each alternative and the feasibility of mitigating those impacts (Table 3-7). Each alternative was ranked relative to the other alternatives, with the ranking of 8 being the alternative with the least impacts on PHS, and the ranking of 1 being the alternative with the most impacts. In general, the alternative with the widest typical footprint would have the greatest impact.

Table 3-7. Priority Habitat and Species Impact Rating

	Alternative							
Critical Upland Habitat	**1: No Action**	**2: S&P, I-90 LRT**	**3: HOV, I-90 LRT**	**4: HOV, GP, I-90 LRT**	**5: HOV, 520 HCT**	**6: HOV, GP, 520 HCT**	**7: HOV/BRT**	**8: HOV/ BRT, GP**
Impacts and Extent of Mitigation Required	◑ least	◔ medium	◔ medium	○ most	◔ medium	○ most	◔ medium	○ most
Feasibility of Proposed Mitigation	NA	◑ medium feasibility	◔ low feasibility	○ least feasible	○ least feasible	○ least feasible	○ least feasible	○ least feasible
Ranking	8	7	6	2	3	1	5	4

RATING KEY

WORST →				BEST
○	◔	◑	◕	●
Most Impacts	Medium Impacts	Least Impacts	No Impact	Improved Environment

3.5 WETLANDS AND SHORELINES

Screening Criteria: *A preliminary quantitative estimate of potential direct effects on known, mapped wetlands and shorelines will be developed. The project effects will be enumerated by area and type of wetland affected (using currently available wetlands mapping), with qualitative evaluation of likely functional impacts. A broad-level analysis of habitat connectivity issues for non-ESA-listed species within the study area will also be included.*

3.5.1 Impacts of Each Alternative

Table 3-8 summarizes the approximate wetland impacts associated with each alternative.

Table 3-8. Estimated Wetland Impacts Summary [a,b] (in Acres), by Alternative

	Alternative [c]							
Wetland Category[d]	1: No Action	2: S&P, I-90 LRT	3: HOV, I-90 LRT	4: HOV, GP, I-90 LRT	5: HOV, 520 HCT	6: HOV, GP, 520 HCT	7: HOV/BRT	8: HOV/ BRT, GP
Category I	0	3.7	5.9	7.8	6.9	10.3	6.6	7.7
Category II	0	0	1.4	1.4	1.4	1.4	1.4	1.4
Category III	0	0.9	8.4	8.2	8.3	9.6	8.3	8.2
Category IV	0	0	1.0	0.4	1.0	0.4	0.9	0.3
Total	**0**	**4.6**	**16.7**	**17.8**	**17.6**	**21.7**	**17.2**	**17.6**

[a] All areas estimated from aerial photographs, USFWS National Wetland Inventory Maps, and Local Wetland Inventory Maps. Field investigations have only been performed along the SR 520 corridor. Impact footprints are based on preliminary design and do not reflect the limits of actual cut and fill.

[b] Calculated areas do not include unvegetated aquatic areas. These areas are not regulated as wetlands, but may still be regulated under Sections 401 and 404 of the CWA, Section 10 of the Rivers and Harbors Act, and HPA.

[c] Impact calculations for Alternatives 2 through 6 do not include HCT impacts on the Sammamish River and Bear Creek that would occur outside the SR 520 right-of-way.

[d] (Ecology 1993). Category I is the highest quality classification of wetlands.

3.5.1.1 Alternative 1 (No Action)

The No Action Alternative does not propose any new construction. As a result, no new environmental impacts would be expected.

3.5.1.2 Alternative 2 (Safety & Preservation, I-90 LRT)

Alternative 2 would have the second least impacts, although the impacts themselves would be considered high. Impacts on the wetlands associated with Portage Bay and Union Bay would cover a greater area than those proposed under Alternatives 3 and 7, but the overall area of impact would be by far the smallest (4.7 acres). There would be no impacts associated with the mitigation site at Yarrow Bay Creek. It might be feasible to mitigate the potential impacts on the other wetlands between Lake Washington and I-405. The impacts on the Sammamish River/Bear Creek area would be considered high, but would affect a small area.

The proposed HOV crossings of the Sammamish River and Bear Creek could be moved to existing structures or to the south side of SR 520.

The proposed LRT alignment for Alternative 2 would cross Lake Washington on the existing I-90 bridge and would not impact wetlands or shorelines in Seattle or Lake Washington. The alignment would be placed on the west side of Bellevue Way/112th Avenue NE to avoid impacts on Mercer Slough. There would be impacts in the Redmond area related to the new crossing of the Sammamish River and Bear Creek. Both of these streams are waters of statewide significance and have associated Category I wetlands. While the area of impact would be small, it would be very difficult to mitigate. Therefore, the impact would be considered high. These impacts would occur outside the area that was field verified, and are not included in the calculated impacts shown in Table 3-8.

3.5.1.3 Alternative 3 (SR 520 HOV, I-90 LRT)

Alternative 3 would have the third least impacts. Impacts in the Portage Bay/Union Bay area would be the smallest of any of the build alternatives, but there would be substantial impacts to wetlands associated with Yarrow Bay Creek, the Sammamish River, and Bear Creek. Because these wetlands provide unique ecological functions and are of sociocultural value, mitigation would be very difficult. The total area of wetland impact would be approximately 16.7 acres, and the overall impact rating would be high. Impacts from the LRT would be the same as those described for Alternative 2.

Recommendations for avoiding or minimizing impacts would be the same as those noted for Alternative 2.

3.5.1.4 Alternative 4 (SR 520 HOV, GP, I-90 LRT)

Alternative 4 would have the second most impacts. Impacts associated with this alternative would be similar to those described for Alternative 3 (high), but the total area of wetland impact would be larger, approximately 17.8 acres. Impacts from the LRT would be the same as those described for Alternative 2.

Recommendations for avoiding or minimizing impacts would be the same as those noted for Alternative 2.

3.5.1.5 Alternative 5 (SR 520 HOV, SR 520 HCT)

Alternative 5 would have the most impacts of the six-lane alternatives. Impacts associated with this alternative would be similar to those described for Alternative 3, but the total area of wetland impact would be larger, approximately 17.6 acres. Impacts on the Sammamish River and Bear Creek from the HCT alignment would be the same as those described for Alternative 2.

Recommendations for avoiding or minimizing impacts would be the same as those noted for Alternative 2.

3.5.1.6 Alternative 6 (SR 520 HOV, GP, SR 520 HCT)

Alternative 6 would have the greatest impacts of all of the alternatives. The wider footprint contributes to the greater impact. The impacts on wetlands associated with Portage Bay, Union Bay, Yarrow Bay Creek, the Sammamish River, and Bear Creek would be high and would be difficult to mitigate. Impacts from the HCT would be the same as those described for Alternative 5.

Recommendations for avoiding or minimizing impacts would be the same as those noted for Alternative 2.

3.5.1.7 Alternative 7 (SR 520 HOV/BRT)

Impacts associated with this alternative would be similar to those described for Alternative 3 (high), but the total area of wetland impact would be larger, approximately 17.2 acres.

Recommendations for avoiding or minimizing impacts would be the same as those noted for Alternative 2.

3.5.1.8 Alternative 8 (SR 520 HOV/BRT, GP)

Alternative 8 would have the third greatest impacts, after Alternatives 4 and 6. Impacts associated with this alternative would be similar to those described for Alternative 3 (high), but the total area of Category I wetlands impact would be larger, approximately 7.7 acres.

Recommendations for avoiding or minimizing impacts would be the same as those noted for Alternative 2.

3.5.2 Rating of Alternatives

Six of the eight alternatives are given the same rating which reflects the similar magnitude of wetland displacement among those alternatives. The eight-lane alternatives (Alternatives 4, 6, and 8) would have the greatest impacts on wetlands and shorelines, with Alternative 6 having the greatest impacts of all. Of the six-lane alternatives, Alternative 5 would have the greatest impacts.

As indicated in Table 3-9, the multimodal alternatives were given two ratings: (1) relative impacts and the mitigation required for each alternative, and (2) the feasibility of that mitigation. In addition, the alternatives were ranked based on the impacts associated with each alternative and the feasibility of mitigating those impacts. Each alternative was ranked relative to the other alternatives with a ranking of 8 being the alternative with the least impacts on wetlands and shorelines, and a ranking of 1 being the alternative with the most impacts. In general, the alternative with the widest typical footprint would have the greatest impact.

Table 3-9. Wetland and Shorelines Impact Rating

Wetlands and Shorelines	Alternative: 1: No Action	2: S&P, I-90 LRT	3: HOV, I-90 LRT	4: HOV, GP, I-90 LRT	5: HOV, 520 HCT	6: HOV, GP, 520 HCT	7: HOV/BRT	8: HOV/ BRT, GP
Impacts and Extent of Mitigation Required	◕ no	◔ medium	○ most	○ most	○ most	○ most	○ most	○ most
Feasibility of Proposed Mitigation	NA	◔ low feasibility	○ least feasible	○ least feasible	○ least feasible	○ least feasible	○ least feasible	○ least feasible
Ranking	8	7	6	2	4	1	5	3

RATING KEY

WORST →				BEST
○	◔	◑	◕	●
Most Impacts	Medium Impacts	Least Impacts	No Impact	Improved Environment

3.6 NOISE AND VIBRATION

Screening Criteria: *A qualitative screening-level analysis of potential effects of noise and vibration from operations will be conducted for selected neighborhoods and other known sensitive receptors that have the potential to be more seriously affected. Professional judgment and rules of thumb will be applied to identify the potential for substantial increases in noise and vibration based on estimated changes in traffic volumes and changes in proximity of noise and vibration sources to receptors.*

3.6.1 Impacts of Each Alternative

The change in the number of traffic noise impacts and noise levels between the alternatives is determined by the amount of roadway widening and projected traffic volumes. The combination of moving the roadway closer to the receivers during widening and allowing for additional traffic volumes would result in the highest noise levels and potential impacts. It should also be noted, however, that under the worst-case scenarios, Alternatives 4 and 8, noise levels are projected to increase by approximately 3 to 5 decibels (dBA), and to most people a 3 dBA change is barely perceptible, while a 5 dBA is usually noticeable.

Table 3-10 provides a count of the number of residences likely to be adversely impacted.

Table 3-10. Estimated Residential Noise Levels and Impacts
(Unshielded structures within 400 feet of SR 520/HCT corridor right-of-ways)

	Before Mitigation[a,b]				After Mitigation[b,c]			
	Noise Levels[d]		Number of Impacts		Noise Levels[d]		Number of Impacts	
Alternative	SR 520	HCT	SR 520	HCT	SR 520	HCT	SR 520[c]	HCT
1: No Action	65–78	N/A[f]	440–535	N/A[f]	--[g]	--[f,g]	--[g]	--[f,g]
2: S&P, I-90 LRT	65–78	43–56	440–535	<50	59–68	43–56	<50	None
3: HOV, I-90 LRT	65–78	43–56	595–710	<50	59–68	43–56	<50	None
4: HOV, GP, I-90 LRT	65–78	43–56	630–750	<50	59–68	43–56	<50	None
5: HOV, 520 HCT	66–79	51–66	595–710	NA	59–68	41–56	<50	None
6: HOV, GP, 520 HCT	67–80	51–66	630–750	NA	59–68	41–56	<50	None
7: HOV/BRT	65–78	NA	595–710	NA	59–68	NA	<50	None
8: HOV/ BRT, GP	66–79	NA	630–750	NA	59–68	NA	<50	None

a Worst-case assumptions: no lidded highways or other special noise-reducing design options considered.

b Estimated impacts and noise levels for residential land use within 400 feet of the SR 520 and HCT corridors.

c Mitigation measures include noise walls and berms for traffic, and noise walls, berms, and sound insulation for HCT.

d Traffic noise levels are given in peak-hour L_{eq}; HCT noise levels are given in 24-hour L_{dn}.

e Limited residual traffic noise impacts would be projected near main arterial roads for all alternatives.

f N/A = Not applicable to this alternative.

g If SR 520 is not changed, then areas exceeding the impact criteria may be added to the Type II noise abatement retrofit program. However, because there is no project with the No Action Alternative, no mitigation would be proposed.

The differences among the HCT alternatives are not expected to make a substantial difference in the noise or vibration impacts. The alternatives along SR 520 and I-90 are in established transportation corridors, and, therefore, are not projected to change the noise environment substantially. Alignments that would remain along SR 520 would have less potential for impacts than those alignments along Bellevue Way and 112th Avenue NE.

There are several methods of noise mitigation and design options currently under consideration for this project. Design methods such as noise walls, depressed roadways for traffic alignments, and minimum tunnel depths of 75 feet for HCT alignments would substantially reduce noise and vibration levels and impacts throughout the corridor. It is expected that noise levels could be reduced by as much as 8 to 12 dBA for all build alternatives that are projected to have noise impacts. This would reduce noise levels to less than existing conditions along the SR 520 corridor. In addition, mitigation measures for HCT alignments, such as noise walls, could reduce noise levels by as much as 6 to 12 dBA.

3.6.1.1 Alternative 1 (No Action)

Under the No Action Alternative, noise levels would remain at or above the current levels. No roadway work would be performed, and, therefore, no mitigation would be performed. At some point, WSDOT could add the impacted areas to the Type II retrofit list, and noise mitigation could be performed. Existing noise levels within the SR 520 corridor are greater than the noise threshold that would require mitigation, if SR 520 were built today.

3.6.1.2 Alternative 2 (Safety & Preservation, I-90 LRT)

Alternative 2 would have the same noise levels in most areas, with only slight increases in some areas due to roadway realignment and traffic increases. With mitigation, noise levels in virtually all areas could be reduced to within the WSDOT traffic noise criteria.

Mitigation for the LRT portions of the alternative might require noise walls and some residential sound insulation. No major LRT-related vibration problems would be projected.

3.6.1.3 Alternative 3 (SR 520 HOV, I-90 LRT)

Alternative 3 would result in noise and vibration impacts similar to those described under Alternative 2. Alternative 3 would include the addition of HOV lanes to portions of SR 520, thereby the noise source would be closer to sensitive receptors, and thereby resulting in a greater number of impacts prior to mitigation.

3.6.1.4 Alternative 4 (SR 520 HOV, GP, I-90 LRT)

Alternative 4 would result in noise and vibration impacts similar to those described under Alternative 2. However, Alternative 4 would have a greater number of impacts before mitigation because this alternative would add HOV and GP lanes to SR 520, thereby moving the noise source closer to sensitive receptors.

3.6.1.5 Alternative 5 (SR 520 HOV, SR 520 HCT)

Alternative 5 would result in noise and vibration impacts similar to those described under Alternative 2. This alternative would include addition of HOV lanes to portions of SR 520, and would impact the same number of sensitive receptors as Alternative 3. However, the HCT alignment would follow SR 520 west of I-405. Therefore, Alternative 5 would impact more sensitive receptors than Alternative 3.

3.6.1.6 Alternative 6 (SR 520 HOV, GP, SR 520 HCT)

Alternative 6 would result in noise and vibration impacts that would be similar, but slightly higher than, those described under Alternative 2. This alternative would impact a similar number of sensitive receptors as Alternative 4.

3.6.1.7 Alternative 7 (SR 520 HOV/BRT)

Alternative 7 would have the same general impacts as Alternative 3. Alternative 7 would not have noise and vibration impacts from HCT. However, traffic noise from the SR 520 corridor would be the primary noise impact, and, therefore, the difference between Alternatives 3 and 7 would be minimal.

3.6.1.8 Alternative 8 (SR 520 HOV/BRT, GP)

Alternative 8 has the same general impacts as Alternative 7, but would impact a greater number of sensitive receptors due to the wider footprint.

3.6.2 Rating of Alternatives

As shown in Table 3-11, the noise and vibration impacts of Alternatives 2 through 7 would be similar. Alternatives with the widest footprints (Alternatives 4, 6, and 8) would move the noise source closer to sensitive receptors, and would, therefore, impact the greatest number of sensitive receptors before mitigation. After mitigation, all build alternatives would have similar noise levels.

The multimodal alternatives were given two ratings: (1) relative impacts and the mitigation required for each alternative, and (2) the feasibility of that mitigation. In addition, the alternatives were ranked based on the impacts associated with each alternative and the feasibility of mitigating those impacts. Each alternative was ranked relative to the other alternatives with a ranking of 8 being the alternative with the least noise and vibration impacts, and a ranking of 1 being the alternative with the most impacts. In general, the alternative with the widest typical footprint would have the greatest impact.

Table 3-11. Noise Impact Rating

	Alternative							
Noise and Vibration	**1: No Action**	**2: S&P, I-90 LRT**	**3: HOV, I-90 LRT**	**4: HOV, GP, I-90 LRT**	**5: HOV, 520 HCT**	**6: HOV, GP, 520 HCT**	**7: HOV/BRT**	**8: HOV/ BRT, GP**
Impacts Before Mitigation	◑ least	◑ least	◔ medium	○ most	◔ medium	○ most	◔ medium	○ most
Impacts After Mitigation	NA	◑ least	◑ least	◑ least	◑ least	◑ least	◑ least	◑ least
Feasibility of Proposed Mitigation	NA	◔ low feasibility	◔ low feasibility	◔ low feasibility	◔ low feasibility	◔ low feasibility	◑ medium feasibility	◑ medium feasibility
Ranking	8	7	5	3	4	1	6	2

RATING KEY

WORST →				BEST
○	◔	◑	◕	●
Most Impacts	Medium Impacts	Least Impacts	No Impact	Improved Environment

3.7 LAND USE

Screening Criteria: *A qualitative analysis has been done to examine the direct and indirect effects of each alternative on the pattern of growth in the study area and consistency with regional and local land use plans.*

3.7.1 Impacts of Each Alternative

The following analysis considers the potential impacts on land uses along the corridor due to the construction and operation at the facility. Direct impacts would include the effects of property acquisition, loss of access, and other physical changes to land uses. Indirect impacts reflect the potential that other impacts such as increased noise, air quality degradation, traffic, or visual changes would have on land uses.

Table 3-12 presents a comparison of direct impacts for the alternatives. When combined, public and vacant lands compose the majority of acreage required for any of the alternatives. Of the developed private land uses, mostly commercial property would be affected, followed by industrial land. Direct impacts on residential uses would primarily occur within the Medina and Bellevue areas.

Table 3-12. Comparison of Estimated Direct Land Use Impacts in Acres[a]

	Alternatives							
Existing Land Use Type	1: No Action	2: S&P, I-90 LRT	3: HOV, I-90 LRT	4: HOV, GP, I-90 LRT	5: HOV, 520 HCT	6: HOV, GP, 520 HCT	7: HOV/BRT	8: HOV/ BRT, GP
Single-Family Residential	0.0	2.7	3.8	6.8	2.7	4.2	3.3	5.8
Multi-Family Residential	0.0	0.1	0.3	1.1	0.7	0.5	1.1	1.4
Commercial	0.0	8.9	13.5	28.4	18.9	26.6	7.3	18.4
Industrial	0.0	2.9	4.6	7.7	6.4	9.1	1.4	4.5
Public[b]	0.0	11.7	18.6	16.4	23.6	26.2	14.8	16.5
Other[c]	0.0	0.2	0.4	1.4	0.2	0	0.2	0.8
Vacant	0.0	6.9	11.6	14.6	14.9	19.6	8.8	10.1
Total	**0.0**	**33.4**	**52.8**	**76.4**	**67.4**	**86.2**	**36.9**	**57.5**
Percent Outside SR 520 Corridor[d]	**--**	**45%**	**28%**	**21%**	**36%**	**28%**	**0**	**0**

[a] Acreage is shown to the tenth place by land use in order to show a complete range of potential impacts; however, these numbers only represent gross estimates based on potential alignments, and will be further refined in the EIS phase.

[b] Public includes all lands that are publicly owned, such as parks, universities, government land, etc.

[c] Other includes religious institutions.

[d] Alternatives 7 and 8 would only deviate from the highway in alignment and would directly impact only a minimal amount of property.

3.7.1.1 Alternative 1 (No Action)

The No Action Alternative would have no direct or indirect impacts. This alternative would be inconsistent with the transportation policies of many jurisdictions because it could encourage traffic to seek alternative routes on lesser arterials. The No Action Alternative would also fail to support communities' transit policies. No mitigation is proposed.

3.7.1.2 Alternative 2 (Safety & Preservation, I-90 LRT)

Alternative 2 would have the least direct impacts. This alternative would be both consistent and inconsistent with local comprehensive plan policies. It would be inconsistent in that it might not provide adequate capacity on SR 520. It would be consistent with regional, Bellevue, Seattle, Mercer Island, and Redmond transit policies, but would not address Medina's policies and would not fulfill Seattle's desire to connect its neighborhood centers.

Direct impacts resulting from elevated and at-grade LRT facilities could be minimized by placing structures in the existing right-of-way.

3.7.1.3 Alternative 3 (SR 520 HOV, I-90 LRT)

Alternative 3 would have low direct and indirect impacts. This alternative would be both consistent and inconsistent with local comprehensive plan policies. The proposed highway facilities would be consistent with Seattle and Medina Comprehensive Plans. It could be inconsistent with the City of Bellevue policies regarding adequate GP capacity and cut-through traffic. The Alternative 3 LRT alignment would have the same high level of consistency with regional and local plans as Alternative 2. Direct impacts resulting from elevated and at-grade LRT facilities could be minimized by placing them in the existing right-of-way.

3.7.1.4 Alternative 4 (SR 520 HOV, GP, I-90 LRT)

Alternative 4 would have the second highest direct impacts of the multimodal alternatives. Primarily commercial land would be affected. Indirect impacts would mostly be the intensification of commercial development around certain interchanges. For the most part this development would be consistent or would not conflict with local comprehensive plans. Like Alternatives 2 and 3, Alternative 4 would have a high level of consistency with regional and local transit policies.

3.7.1.5 Alternative 5 (SR 520 HOV, SR 520 HCT)

Direct land use impacts from Alternative 5 would be moderate. Indirect impacts would be minimal. Alternative 5 would have HCT on SR 520, as opposed to regional plans that include HCT on I-90. While this would be inconsistent for the location of HCT, HCT on SR 520 would serve many of the same goals and objectives of regional plans. This alternative would be consistent and inconsistent with local comprehensive plan policies. Alternative 5 would not increase GP capacity, which would be consistent with Seattle and Medina Comprehensive Plan policies but inconsistent with Bellevue policy. Alternative 5 would provide onramps and offramps to the Overlake Advanced Technology Center, which would be consistent with Redmond policies. In terms of transit policy, Alternative 5 would be consistent with Seattle, Medina, and Redmond policies. It would not fulfill Bellevue's stated desire to connect its neighborhoods with HCT as well as Alternatives 2, 3, and 4 would.

Mitigation would be similar to the other alternatives: use the existing right-of-way for highway improvements as much as possible, and keep HCT facilities in existing right-of-way where possible.

3.7.1.6 Alternative 6 (SR 520 HOV, GP, SR 520 HCT)

Alternative 6 would have the greatest direct and indirect impacts. Primarily commercial land would be affected. Indirect impacts would mostly be the intensification of commercial development around certain interchanges. For the most part this development would be consistent or would not conflict with local comprehensive plans. Like Alternative 5, the HCT alignment would be mostly consistent with regional, Seattle, Medina, and Redmond policies, but would not fulfill Bellevue's stated desire to connect its neighborhood with HCT as well as Alternatives 2, 3, and 4.

3.7.1.7 Alternative 7 (SR 520 HOV/BRT)

Alternative 7 would have low direct and indirect impacts. Alternative 7 in the Montlake area could be inconsistent with Seattle plans and policies. By emphasizing HOV facilities, Alternative 7 would be consistent with Seattle and Medina Comprehensive Plan policies, but inconsistent with those of Bellevue. The HCT facilities would be consistent with regional and local policies, except that direct access to transit would not be provided at the Overlake Advanced Technology Center, as envisioned by the Redmond Comprehensive Plan. In addition, Alternative 7 would not meet long-term transit capacity requirements in downtown Seattle.

3.7.1.8 Alternative 8 (SR 520 HOV/BRT, GP)

The direct impacts resulting from Alternative 8 would be moderate. Indirect impacts would mostly be the intensification of commercial development around certain interchanges. For the most part this development would be consistent or would not conflict with local comprehensive plans. The HCT facilities would be consistent with regional and local policies, except that direct access to transit would not be provided at the Overlake Advanced Technology Center, as envisioned by the Redmond Comprehensive Plan.

3.7.2 Rating of Alternatives

Alternative 6, which would have eight lanes and a fixed HCT guideway, would have the greatest direct impact of all the alternatives by requiring acquisition of more than 86 acres of land. Alternative 4, which would also have eight lanes but a different fixed HCT guideway alignment, would require approximately 76 acres of land. Even though Alternative 5 would only accommodate six lanes and includes a fixed HCT guideway, it would require approximately 67 acres; this would be a greater impact than Alternative 8 (approximately 57 acres), which would be an eight-lane highway facility incorporating HCT through shared HOV/BRT lanes and flyer stops. Alternative 3 would have a direct impact on land uses comparable to Alternative 8, by requiring approximately 52 acres of land for right-of-way. Finally, Alternatives 2 and 7 would have comparable direct impacts. Alternative 2 would require approximately 33 acres and Alternative 7 would need approximately 37 acres.

The multimodal alternatives were given two ratings: (1) relative impacts and mitigation required for each alternative, and (2) the feasibility of that mitigation. In addition, the alternatives were ranked based on the impacts associated with each alternative and the feasibility of mitigating those impacts. Each alternative was ranked relative to the other alternatives with 8 being the alternative with the least land use impacts, and 1 being the alternative with the most impacts. In general, the alternative with the widest typical footprint would have the greatest impact.

A rating of the relative impacts of the alternatives is found in Table 3-13.

Table 3-13. Land Use Impact Rating

Land Use	Alternative							
	1: No Action	**2: S&P, I-90 LRT**	**3: HOV, I-90 LRT**	**4: HOV, GP, I-90 LRT**	**5: HOV, 520 HCT**	**6: HOV, GP, 520 HCT**	**7: HOV/BRT**	**8: HOV/ BRT, GP**
Impacts and Extent of Mitigation Required	◕ no	◑ least	◑ least	◔ medium	◔ medium	○ most	◑ least	◔ medium
Feasibility of Proposed Mitigation	NA	○ least feasible	○ least feasible	○ least feasible	○ least feasible	○ least feasible	○ least feasible	○ least feasible
Ranking	8	7	5	2	3	1	6	4

RATING KEY

WORST →				BEST
○	◔	◑	◕	●
Most Impacts	Medium Impacts	Least Impacts	No Impact	Improved Environment

3.8 PARKLANDS

Screening Criteria: *A qualitative analysis of potential impacts on known Section 4(f) resources, including publicly owned parks, trails, and recreation areas and wildlife and waterfowl refuges.*

3.8.1 Impacts of Each Alternative

All potential impacts on parklands would occur within the SR 520 corridor. Any park impact that could not be avoided would be subject to evaluation under the guidelines of Section 4(f) of the U.S. Department of Transportation Act of 1966. As part of Section 4(f) Evaluation, avoidance alternatives would need to be considered and selected if found to be feasible and prudent. The potentially substantial impacts associated with each alternative are summarized in Table 3-14.

Table 3-14. Summary of Potential Impacts on Parklands

Area of Impacts (in acres)	Alternative							
	1: No Action	2: S&P, I-90 LRT	3: HOV, I-90 LRT	4: HOV, GP, I-90 LRT	5: HOV, 520 HCT	6: HOV, GP, 520 HCT	7: HOV/BRT	8: HOV/ BRT, GP
Direct Impacts								
I-5 Open Space				X[a]			X	X
10th Avenue East and Roanoke Street Park			0.2	0.2	0.1	0.1	0.3	0.3
Bagley Viewpoint		0.004	0.03	0.08	0.03	0.03	0.14	0.1
Montlake Bike Path			X	X	X	X	X	X
McCurdy Park		0.6	1.5	1.5	1.5	1.5	1.5	1.5
East Montlake Park		0.2	1.2	1.4	0.3	0.9	0.8	1.6
Washington Park / Arboretum		2.5	0.9	2.3	2.1	3.5	1.1	1.6
Fairweather Nature Preserve		0.1	0.1	0.3		0.4		0.3
Points Loop Trail		X	X	X	X	X	X	X
SR 520 Trail		X[c]	X[c]	X[c]	X[c]	X[c]	X	X
Sammamish River Park and Trail		X	X	X	X	X		
Town Center Open Space and Trail		X	X	X	X	X		
Proximity Impacts (Potential Constructive Use)								
BNSFRR Right-of-Way Path					X	X		
Total Number of Park Facilities	**0**	**9**	**11**	**12**	**11**	**12**	**9**	**10**
Total Number of Impacts	**0**	**9**	**15**	**16**	**12**	**15**	**11**	**12**
Range of Area of Impact, in Acres [b]	**0**	**3.0-3.5**	**3.5-4.0**	**5.6-6.0**	**4.0-4.4**	**6.1-6.5**	**3.4-3.9**	**5.1-5.5**

[a] Trail is impacted by alternative; however, the area is too small to calculate at this level of analysis.

[b] Does not include trails or paths.

[c] Highway improvements would cause direct impact to trail. HCT alignment would cause either direct or proximity impact to trail.

3.8.1.1 Alternative 1 (No Action)

No parklands would be impacted under the No Action Alternative.

3.8.1.2 Alternative 2 (Safety & Preservation, I-90 LRT)

Alternative 2 would result in the fewest direct impacts (9) affecting the fewest distinct park facilities (Bagley Viewpoint, McCurdy Park, East Montlake Park, Washington Park, Fairweather Nature Preserve, Points Loop Trail, SR 520 Trail, Sammamish River Park and Trail, and Town Center Open Space and Trail). Six of the nine direct impacts are related to proposed highway improvements along SR 520, whereas the remaining three direct impacts are associated with the LRT alignment.

3.8.1.3 Alternative 3 (SR 520 HOV, I-90 LRT)

Alternative 3 would result in 15 direct impacts affecting 11 distinct park facilities (10th Avenue East and East Roanoke Street Park, Bagley Viewpoint, Montlake Bike Path, McCurdy Park, East Montlake Park, Washington Park, Fairweather Nature Preserve, Points Loop Trail, SR 520 Trail, Sammamish River Park and Trail, and Town Center Open Space and Trail). Twelve of the 15 direct impacts are related to proposed highway improvements, whereas the remaining three direct impacts are associated with the LRT alignment.

3.8.1.4 Alternative 4 (SR 520 HOV, GP, I-90 LRT)

Alternative 4 would result in 16 direct impacts affecting 12 distinct park facilities (in addition to the impacted parklands listed above in Alternative 3, the I-5 Open Space between I-5 and South Lake Union would be affected). Thirteen of the 16 direct impacts are related to proposed highway improvements, whereas the remaining three direct impacts are associated with the LRT alignment.

3.8.1.5 Alternative 5 (SR 520 HOV, SR 520 HCT)

Alternative 5 would result in 12 direct impacts affecting 11 distinct park facilities (the same parks listed above in Alternative 3). In addition, a proximity impact in the proposed Burlington Northern Santa Fe Railroad (BNSFRR) right-of-way could be considered a constructive use. Nine of the 12 direct impacts are related to proposed highway improvements, whereas the remaining three direct impacts are associated with the HCT alignment.

3.8.1.6 Alternative 6 (SR 520 HOV, GP, SR 520 HCT)

Alternative 6 would result in 15 direct impacts affecting 11 distinct park facilities (the same parks as noted in Alternative 5, including the possible constructive use of the proposed BNSFRR right-of-way). Twelve of the 15 direct impacts are related to proposed highway improvements, whereas the remaining three direct impacts are associated with the HCT alignment.

3.8.1.7 Alternative 7 (SR 520 HOV/BRT)

Alternative 7 would result in 11 direct impacts affecting nine distinct park facilities (I-5 Open Space, 10th Avenue East and East Roanoke Street Park, Bagley Viewpoint, Montlake Bike Path, McCurdy Park, East Montlake Park, Washington Park, Points Loop Trail, and the SR 520 Trail). All 11 direct impacts are related to proposed highway improvements.

3.8.1.8 Alternative 8 (SR 520 HOV/BRT, GP)

Alternative 8 would result in 12 direct impacts affecting ten distinct park facilities (the same facilities noted above in Alternative 7, plus Fairweather Nature Preserve). All 12 direct impacts are related to proposed highway improvements.

3.8.2 Rating of Alternatives

The comparative rating of the alternatives in Table 3-15 is based on the number of direct impacts, possible constructive use, and affected park facilities. As noted, Alternative 2 has the lowest level of impacts; Alternatives 5, 7, and 8 have a medium level of impacts; and Alternatives 3, 4, and 6 have the most impacts. The ranking of the alternatives is based on a nonquantitative approach that incorporates both the number of potential impacts and the magnitude of the impacts (depicted as the total acreage of parkland affected by each alternative).

The multimodal alternatives were given two ratings: (1) relative impacts and mitigation required for each alternative, and (2) the feasibility of that mitigation. In addition, the alternatives were ranked based on the impacts associated with each alternative and the feasibility of mitigating those impacts. Each alternative was ranked relative to the other alternatives with 8 being the alternative with the least impacts on parklands, and 1 being the alternative with the most impacts. In general, the alternative with the widest typical footprint would have the greatest impact.

Table 3-15. Parklands Impact Rating

Parklands	Alternative							
	1: No Action	**2: S&P, I-90 LRT**	**3: HOV, I-90 LRT**	**4: HOV, GP, I-90 LRT**	**5: HOV, 520 HCT**	**6: HOV, GP, 520 HCT**	**7: HOV/BRT**	**8: HOV/ BRT, GP**
Impacts and Extent of Mitigation Required	◕ no	◑ least	◔ medium	○ most	◔ medium	○ most	◑ least	◔ medium
Feasibility of Proposed Mitigation	NA	○ least feasible	○ least feasible	○ least feasible	○ least feasible	○ least feasible	○ least feasible	○ least feasible
Ranking	8	7	4	2	5	1	6	3

RATING KEY

WORST	→			BEST
○	◔	◑	◕	●
Most Impacts	Medium Impacts	Least Impacts	No Impact	Improved Environment

3.9 CULTURAL RESOURCES

Screening Criteria: *Section 106 resources to be evaluated include recorded historic districts, buildings, objects, and archaeological sites.*

3.9.1 Impacts of Each Alternative

During the EIS phase, any Section 106 resources potentially impacted by any of the project alternatives will be evaluated to have one of three possible determinations: no effect, no adverse effect, or adverse effect. A no effect determination would be used if the project alternative was not close to a historic property and construction would have no effect on the property. A no adverse effect determination would be used if the project alternative would have an effect on a historic property, but would not diminish the historical qualities of the property. It is likely that most of the potential impacts identified in this second level screening phase could receive either a no effect or no adverse effect determination.

All of the potential impacts on cultural resources that are located outside the SR 520 corridor are due to the HCT alignments. The potentially substantial impacts associated with each alternative are summarized in Table 3-16.

Table 3-16. Summary of Potential Cultural Resources Impacts

Potential Impacts	Alternative							
	1: No Action	2: S&P, I-90 LRT	3: HOV, I-90 LRT	4: HOV, GP, I-90 LRT	5: HOV, 520 HCT	6: HOV, GP, 520 HCT	7: HOV/BRT	8: HOV/ BRT, GP
SR 520 Corridor Impacts								
Seward School				X		X		
Arboretum Sewage Trestle					X	X	X	X
Montlake Bridge			X		X	X	X	X
Outside SR 520 Corridor Impacts (HCT Only)								
Mount Baker Ridge Tunnel		X	X	X				
Pioneer Square Historic District		X	X	X				
Frederick W. Winters House		X	X	X				
Total Potential Number of Cultural Resources Impacted	**0**	**3**	**4**	**4**	**2**	**3**	**2**	**2**

3.9.1.1 Alternative 1 (No Action)

No impacts on cultural resources other than those associated with normal wear, maintenance, or lack of maintenance are expected from the No Action Alternative.

3.9.1.2 Alternative 2 (Safety and Preservation, I-90 LRT)

Alternative 2 would have potential direct or indirect impacts on three previously recorded cultural resources due to the I-90 LRT alignment: the Mount Baker Ridge Tunnel on I-90, the Pioneer Square Historic District, and the Frederick W. Winters House on Bellevue Way.

3.9.1.3 Alternative 3 (SR 520 HOV, I-90 LRT)

Alternative 3 would have potential direct or indirect impacts on four previously recorded cultural resources. In addition to the resources impacted under Alternative 2, Alternative 3 would also potentially impact the Montlake Bridge due to highway improvements.

3.9.1.4 Alternative 4 (SR 520 HOV, GP, I-90 LRT)

Alternative 4 would have the same potential direct or indirect impacts as Alternative 2, plus a potential impact to the Seward School in Eastlake due to highway improvements.

3.9.1.5 Alternative 5 (SR 520 HOV, SR 520 HCT)

Alternative 5 could have potential direct or indirect impacts on two previously recorded cultural resources: the Montlake Bridge and the Arboretum Sewage Trestle located on Lake Washington Boulevard.

3.9.1.6 Alternative 6 (SR 520 HOV, GP, SR 520 HCT)

Alternative 6 would have potential direct or indirect impacts on three previously recorded cultural resources: the Montlake Bridge, the Seward School in Eastlake, and the Arboretum Sewage Trestle located on Lake Washington Boulevard.

3.9.1.7 Alternative 7 (SR 520 HOV/BRT)

Alternative 7 would have similar potential direct or indirect impacts on previously recorded cultural resources as Alternative 5.

3.9.1.8 Alternative 8 (SR 520 HOV/BRT, GP)

Alternative 8 would have similar potential direct or indirect impacts on previously recorded cultural resources as Alternative 5.

3.9.2 Rating of Alternatives

As indicated in Table 3-17 Alternatives 3 and 4 have the potential to impact the greatest number of previously recorded cultural resources (four), and Alternatives 2 and 6 would impact the second greatest number of cultural resources (three). Alternatives 5, 7, and 8 would potentially impact the same previously recorded cultural resources (two). Since historic properties, particularly in urban settings, have fixed, tangible boundaries, impact avoidance can often be achieved through small design changes. Any historic properties could also be considered Section 4(f) properties. Therefore, any historic property impacts that could not be avoided could be subject to evaluation under the guidelines of Section 4(f) of the U.S. Department of Transportation Act of 1966. As part of the Section 4(f) Evaluation, avoidance alternatives would need to be considered and selected if found to be feasible and prudent.

The multimodal alternatives were given two ratings: (1) relative impacts and mitigation required for each alternative, and (2) the feasibility of that mitigation. In addition, the alternatives were ranked based on the impacts associated with each alternative and the feasibility of mitigating those impacts. Each alternative was ranked relative to the other alternatives with 8 being the alternative with the least impacts on previously recorded cultural resources, and 1 being the alternative with the most impacts.

Table 3-17. Cultural Resources Impact Rating

Cultural Resources	Alternative							
	1: No Action	2: S&P, I-90 LRT	3: HOV, I-90 LRT	4: HOV, GP, I-90 LRT	5: HOV, 520 HCT	6: HOV, GP, 520 HCT	7: HOV/BRT	8: HOV/ BRT, GP
Impacts and Extent of Mitigation Required	◕ no	◔ medium	○ most	○ most	◑ least	◔ medium	◑ least	◑ least
Feasibility of Proposed Mitigation	NA	◔ low feasibility	◔ low feasibility	◔ low feasibility	◕ medium feasibility	◔ low feasibility	◕ medium feasibility	◕ medium feasibility
Ranking	8	4	2	1	6	3	7	5

RATING KEY

WORST →				BEST
○	◔	◑	◕	●
Most Impacts	Medium Impacts	Least Impacts	No Impact	Improved Environment

3.10 DISPLACEMENTS AND DISRUPTION

***Screening Criteria:** Planning-level estimates of the number of displacements by general type of land use (residential, commercial, public).*

3.10.1 Impacts of Each Alternative

For this programmatic level of analysis, displacements identified are only potential displacements and will become more accurate as the alternatives are further defined in the EIS.

Table 3-18 includes planning-level estimates of potential displaced properties for each build alternative.

Table 3-18. Total Existing Structures Potentially Affected by Alternative

Existing Land Uses	Alternative							
	1: No Action	2: S&P, I-90 LRT	3: HOV, I-90 LRT	4: HOV, GP, I-90 LRT	5: HOV, 520 HCT	6: HOV, GP, 520 HCT	7: HOV/ BRT	8: HOV/ BRT, GP
SR 520 Corridor								
Multi-Family	-	-	-	1	-	-	3	5
Single-Family	-	2	3	3	5	6	5	4
Commercial	-	2	8	17	9	12	9	16
Industrial	-	-	-	1	-	1	-	1
Public	-	2	2	2	2	2	2	2
Sub-Total	**0**	**6**	**13**	**24**	**16**	**21**	**19**	**28**
Outside SR 520 Corridor (HCT Only)								
Multi-Family	-	-	-	1	-	-	-	-

Table 3-18.Total Existing Structures Potentially Affected by Alternative (continued)

Existing Land Uses	Alternative							
	1: No Action	2: S&P, I-90 LRT	3: HOV, I-90 LRT	4: HOV, GP, I-90 LRT	5: HOV, 520 HCT	6: HOV, GP, 520 HCT	7: HOV/ BRT	8: HOV/ BRT, GP
Single-Family	-	3	3	3	-	-	1	1
Commercial	-	7	8	8	19	19	9	9
Industrial	-	3	3	3	10	10	9	9
Public	-	-	-	-	-	-	-	-
Sub-Total	**0**	**13**	**14**	**11**	**29**	**29**	**19**	**19**
Alternative Total[a]	**0**	**19**	**27**	**35**	**45**	**50**	**38**	**47**

[a] These totals are estimates based on aerial photographs.

3.10.1.1 Alternative 1 (No Action)

No displacements would occur under the No Action Alternative.

3.10.1.2 Alternative 2 (Safety & Preservation, I-90 LRT)

Alternative 2 would result in the least level of potential displacements. Alternative 2 would result in low level potential displacements to public facilities in the vicinity of Montlake area and single-family residences in the Medina area as a result of the north realignment of SR 520, and low level commercial displacements as a result of the elevated LRT segment traversing an established commercial area south of SR 520 as the alignment departs the BNSFRR right-of-way.

3.10.1.3 Alternative 3 (SR 520 HOV, I-90 LRT)

Alternative 3 would result in a medium level of potential displacements. Alternative 3 would result in low level potential displacements similar to Alternative 2 in the Montlake area. Similar low level single-family displacements compared to Alternative 2 would occur as SR 520 realigns north, but additional low level displacements would occur from the redeveloped SR 520/I-405 interchange. LRT displacements to commercial facilities in the vicinity of the BNSFRR right-of-way and SR 520 would be similar to Alternative 2.

3.10.1.4 Alternative 4 (SR 520 HOV, GP, I-90 LRT)

Alternative 4 would result in medium level potential displacements. Alternative 4 would result in low level potential displacements similar to Alternative 2 in the Montlake area, but would also include commercial and multi-family displacements as a result of the Fairview/Eastlake connector tunnel. Similar low level single-family displacements compared to Alternative 2 would occur as SR 520 realigns north, but additional medium level displacements would occur from the redeveloped Bellevue Way/SR 520 interchange and the extensive redevelopment of the SR 520/I-405 interchange (which includes HOV and GP onramps and offramps). LRT displacements to commercial facilities in the vicinity of the BNSFRR right-of-way and SR 520 would be similar to Alternative 2.

3.10.1.5 Alternative 5 (SR 520 HOV, SR 520)

Alternative 5 would result in medium level potential displacements. Alternative 5 would result in low level potential displacements similar to Alternative 2 in the Montlake area, but also would include medium level displacements near South Lake Union as the HCT segment of the alternative transitions from a below-grade to an elevated alignment in two locations. Single-family displacements would occur similar to Alternative 3 as SR 520 realigns northward; low level commercial displacements would also occur at the Bellevue Way/SR 520 interchange as the HCT portion of this alternative veers north from the SR 520 corridor to the BNSFRR right-of-way (west of I-405), and low level commercial displacements would occur as the SR 520/I-405 interchange is redesigned. HCT displacements to commercial facilities in the vicinity of the BNSFRR right-of-way (east of I-405) and SR 520 would be similar to Alternative 2. Few commercial displacements would occur north of West Lake Sammamish Parkway near the Central Business District of Redmond.

3.10.1.6 Alternative 6 (SR 520, GP, SR 520 I-90)

Alternative 6 would result in the most potential displacements. Alternative 6 would result in low level potential displacements similar to Alternative 5 in Montlake and South Lake Union. Single-family and commercial displacements similar to Alternative 5 would occur as SR 520 is realigned farther north and the HCT segment of the alternative veers north to the BNSFRR right-of-way (west of I-405). Commercial impacts would occur at the SR 520/I-405 interchange similar to Alternative 4 and low level commercial displacements would occur near the NE 40th Street/SR 520 interchange. HCT displacements to commercial facilities in the vicinity of the BNSFRR right-of-way (east of I-405) and SR 520 would be similar to Alternative 2.

3.10.1.7 Alternative 7 (SR 520 HOV/BRT)

Alternative 7 would result in a medium level of potential displacements. Alternative 7 would result in moderate level potential commercial, multi-family, and single-family displacements in the Fairview/Eastlake area as a result of the BRT/HOV cut-and-cover connector tunnel. Single-family and commercial displacements would occur similar to Alternative 5 as SR 520 realigns north and the SR 520/I-405 interchanged is redesigned. No displacements would occur east of the SR 520/I-405 interchange.

3.10.1.8 Alternative 8 (SR 520 HOV/BRT, GP)

Alternative 8 would result in the second most potential displacements. Alternative 8 would result in moderate level potential commercial, multi-family, and single-family displacements in the Fairview/Eastlake area similar to Alternative 7, but also would include the additional impact of the Fairview/Eastlake cut-and-cover connector with a GP as well as a BRT/HOV lane. Single-family and commercial displacements would be similar to Alternative 6 as SR 520 realigns north and the SR 520/I-405 interchange is redesigned. Low level commercial displacements would occur east of the SR 520/I-405 interchange near the NE 40th Street/SR 520 interchange.

3.10.2 Rating of Alternatives

As indicated in Table 3-19 Alternative 6 would have the greatest potential number of displacements, closely followed by Alternative 8. After the No Action Alternative, Alternatives 2 and 3 would have the fewest displacements.

The multimodal alternatives were given two ratings: (1) relative impacts and mitigation required for each alternative, and (2) the feasibility of that mitigation. In addition, the alternatives were ranked based on the impacts associated with each alternative and the feasibility of mitigating those impacts. Each alternative was ranked relative to the other alternatives with 8 being the alternative with the least impacts, and 1 being the alternative with the most impacts. In general, the alternative with the widest typical footprint would have the greatest impact.

Table 3-19. Displacement and Disruption Impact Rating

Displacements and Disruption	Alternative							
	1: No Action	**2: S&P, I-90 LRT**	**3: HOV, I-90 LRT**	**4: HOV, GP, I-90 LRT**	**5: HOV, 520 HCT**	**6: HOV, GP, 520 HCT**	**7: HOV/BRT**	**8: HOV/ BRT, GP**
Impacts and Extent of Mitigation Required	◕ no	◑ least	◔ medium	◔ medium	◔ medium	○ most	◔ medium	○ most
Feasibility of Proposed Mitigation	NA	○ least feasible	○ least feasible	○ least feasible	○ least feasible	○ least feasible	○ least feasible	○ least feasible
Ranking	8	7	6	5	3	1	4	2

RATING KEY

WORST →				BEST
○	◔	◑	◕	●
Most Impacts	Medium Impacts	Least Impacts	No Impact	Improved Environment

3.11 NEIGHBORHOODS

Screening Criteria: *A qualitative screening level evaluation of potential neighborhood quality of life impacts will be conducted through a preliminary assessment of displacements, traffic issues, noise and vibration, and changes in access related to each project alternative. This will also address the demographic characteristics of affected areas. The evaluation will use the findings and data sources identified for the other criteria that are related to neighborhood disruption.*

3.11.1 Impacts of Each Alternative

Potential mitigation measures would be common for all alternatives and would generally be feasible. Implementing proposed mitigation measures for displacements, traffic, noise, land use, and visual quality would help to minimize overall impacts on neighborhoods. To ensure neighborhood connectivity, key neighborhood streets should be maintained as necessary by preserving overcrossings and undercrossings. Where feasible, pedestrian and bicycle bridges should be provided across the highway/HCT profile to provide additional connections between portions of bisected neighborhoods.

3.11.1.1 Alternative 1 (No Action)

The No Action Alternative could have neighborhood impacts by failing to provide adequate transportation capacity. The lack of SR 520 congestion relief in several areas may result in traffic seeking alternative routes through neighborhoods. Additional neighborhood traffic could hinder inter- and intra-neighborhood movement. Increased congestion also could result in higher air emissions from vehicle exhaust. No land use or displacement impacts would occur. The overall impact on area neighborhoods would be low.

3.11.1.2 Alternative 2 (Safety & Preservation, I-90 LRT)

Most of the impacts associated with Alternative 2 would result from the LRT alignment. Most of the proposed highway improvements would occur within the existing right-of-way and would not impact neighborhoods. Most of the LRT alignment would operate within existing rights-of-way along I-90 and SR 520, however it would also traverse through portions of the Southeast Bellevue, Bel-Red/Northup, and Overlake neighborhoods. These neighborhoods would experience land use acquisitions, displacements, and possible visual impacts. Neighborhoods near the LRT alignment would be closer to existing noise because of the widened right-of-way accommodating the alignment. Air quality and traffic impacts are expected to be similar to the No Action Alternative. Since nearly all of these impacts would occur on the periphery of the neighborhoods, they would not fragment communities. Overall neighborhood impacts would be low compared to other alternatives.

Alternative 2 would pass by several neighborhoods with areas that have minority populations greater than 50 percent. These neighborhoods include the International District, North Rainier, Central Area, Mercer Island, Lakeview, West Bellevue, Overlake and South Redmond. No areas with low-income populations greater than 50 percent would be affected by this alternative.

3.11.1.3 Alternative 3 (SR 520 HOV, I-90 LRT)

Alternative 3 would require widening SR 520 in places to accommodate an additional HOV lane and the LRT alignment east of I-405. This would result in the acquisition of land, a few displacements, and the movement of noise impacts closer to existing uses. Traffic volumes along SR 520 would be higher, which would also result in increased delay times at intersections near the corridor. Land use, noise, and traffic impacts would mainly occur near Seattle neighborhoods. These impacts would be isolated along the edges of neighborhoods, which would reduce the magnitude of their impacts. LRT impacts would be the same as in Alternative 2. Overall neighborhood impacts would be low.

Alternative 3 would affect the same minority and low-income areas as Alternative 2.

3.11.1.4 Alternative 4 (SR 520 HOV, GP, I-90 LRT)

Alternative 4 would require widening throughout the SR 520 corridor. This would result in more extensive land use, displacement, and noise impacts along the entire corridor. Also, the carrying capacity of SR 520 would deliver substantially more traffic to the area, which could increase the amount of cut-through traffic in nearby neighborhoods in Seattle, Medina, Hunts Point and Clyde Hill. Still, these impacts mostly would be isolated along the edges of neighborhoods, which would reduce the magnitude of their impacts. One exception would be the Montlake neighborhood, where additional traffic and a new interchange configuration would increase the scale of the SR 520 facility and would create a larger physical barrier through the neighborhood. Also, considerably more traffic would be delivered into the Southeast Redmond neighborhood via the highway's terminus. LRT impacts would be the same as in Alternative 2. Overall neighborhood impacts would be high compared to the other alternatives.

Alternative 4 would affect the same minority and low-income areas as Alternative 2.

3.11.1.5 Alternative 5 (SR 520 HOV, SR 520 HCT)

Alternative 5 would concentrate neighborhood effects along the SR 520 corridor instead of dispersing them between SR 520 and I-90. Fewer total neighborhoods would be affected because transportation improvements would be constrained to a single corridor. Most of the HCT alignment through Seattle would be below-grade, minimizing neighborhood impacts. Once the HCT alignment joins the SR 520 right-of-way, this alternative would have a widened corridor, which would result in additional land use acquisition and displacements along the SR 520 corridor. Highway noise would be closer to existing land uses because of the wider footprint but may not be noticeable given the extent of existing noise and small degree of anticipated impact. With the exception of the HCT alignment through Bel-Red/Northup and Overlake, impacts created by Alternative 5 would originate from within the SR 520 corridor and would impact the outskirts of neighborhoods. This would minimize the magnitude of the impacts and have a low impact on neighborhoods overall.

Alternative 5 would pass by several neighborhoods with areas that have minority populations greater than 50 percent. These neighborhoods include Denny Triangle, South Lake Union, Fremont, University, Lakeview, West Bellevue, Overlake and South Redmond. No areas with low-income populations greater than 50 percent would be affected by this alternative.

3.11.1.6 Alternative 6 (SR 520 HOV, GP, SR 520 HCT)

Like Alternative 5, Alternative 6 would concentrate neighborhood effects along the SR 520 corridor. Because the highway would be two lanes wider, neighborhood impacts would be greater throughout the corridor than in Alternative 5. Also, the carrying capacity of SR 520 would deliver substantially more traffic to the area, which could increase the amount of cut-through traffic in nearby neighborhoods. Still, these impacts would be isolated along the edges of neighborhoods, which would reduce the magnitude of their impacts. Overall neighborhood impacts would be high compared to the other alternatives.

Alternative 6 would affect the same minority and low-income areas as Alternative 5.

3.11.1.7 Alternative 7 (SR 520 HOV/BRT)

Alternative 7 would have impacts throughout the SR 520 corridor similar to Alternative 3. The main difference between those two alternatives is the alignment of the BRT lanes which start in downtown Seattle, extend through the Eastlake neighborhood, and then stay within the SR 520 and I-405 rights-of-way. Because the BRT alignment does not stray from existing right-of-way from I-5 to the east, the number of neighborhoods that would be impacted, as well as the magnitude of impacts, is substantially reduced. Overall neighborhood impacts would be low compared to other alternatives.

Alternative 7 would pass by several neighborhoods with areas that have minority populations greater than 50 percent. These neighborhoods include Denny Triangle, South Lake Union, Eastlake, Lakeview, West Bellevue, Overlake and South Redmond. No areas with low-income populations greater than 50 percent would be affected by this alternative.

3.11.1.8 Alternative 8 (SR 520 HOV/BRT, GP)

Alternative 8 would have all of the same impacts as Alternative 7, except to a greater degree. This is due to the additional GP lane in each direction on SR 520. The wider footprint would result in a greater degree of land acquisition, displacements, and noise impacts. Because impacts are concentrated within the SR 520 corridor, Alternative 8 has a lesser impact than the other two eight-lane alternatives, Alternatives 4 and 6. Still, the carrying capacity of this alternative could create cut-through traffic problems in nearby neighborhoods. The overall neighborhood impact for this alternative would be moderate.

Alternative 8 would affect the same minority and low-income areas as Alternative 7.

3.11.2 Rating of Alternatives

The magnitude of neighborhood impacts indicated in Table 3-20 is generally related to the carrying capacity of the alternative and the increases in noise and traffic that would likely accompany capacity increases. In addition, alternatives with wider footprints physically intrude more into the neighborhoods, causing greater impacts. Many neighborhood effects are dampened somewhat by the fact that, in general, most improvements would take place within existing transportation corridors.

Because impacts on neighborhoods are largely a compilation of impacts on other resources, avoidance, minimization, and mitigation measures identified in other sections (primarily noise, air quality, and visual quality) would also apply to neighborhoods. Mitigation measures that knit the neighborhoods together to create a greater sense of community would primarily include lidding and tunneling of highway facilities.

Table 3-20. Neighborhoods Impact Rating

Neighborhoods	Alternative							
	1: No Action	2: S&P, I-90 LRT	3: HOV, I-90 LRT	4: HOV, GP, I-90 LRT	5: HOV, 520 HCT	6: HOV, GP, 520 HCT	7: HOV/BRT	8: HOV/ BRT, GP
Impacts and Extent of Mitigation Required	◔ medium	◑ least	◑ least	○ most	◑ least	○ most	◑ least	◔ medium
Feasibility of Proposed Mitigation	NA	◑ medium feasibility	◑ medium feasibility	◑ medium feasibility	◑ medium feasibility	◑ medium feasibility	◑ medium feasibility	◑ medium feasibility
Ranking	1	6	5	2	4	1	7	3

RATING KEY

WORST →				BEST
○	◔	◑	◕	●
Most Impacts	Medium Impacts	Least Impacts	No Impact	Improved Environment

3.12 VISUAL QUALITY

Screening Criteria: *A qualitative assessment of visual impacts will include identification of sensitive receptors and impacts on significant visual resources or scenic views.*

3.12.1 Impacts of Each Alternative

A description of impacts for each of the alternatives assumes a level of impact that is based on the impacts generated by the previous alternative.

3.12.1.1 Alternative 1 (No Action)

Because the No Action Alternative does not include proposed improvements, it generates no visual impacts.

3.12.1.2 Alternative 2 (Safety & Preservation, I-90 LRT)

Replacement of the Portage Bay Bridge and the SR 520 floating bridge would generate moderate to high-level visual impacts. The LRT structures would have low to moderate impacts in Seattle and across Lake Washington, however impact levels in the Bellevue, Overlake, and Redmond areas would be moderate to high.

Impacts could be mitigated by replanting removed vegetation, screening views of proposed transportation-related structures, and minimizing the heights of structures where possible. Impacts from stations and station entries could be mitigating by designing them to fit the character of their surroundings.

Impacts in the Overlake and Redmond areas could be greatly avoided and minimized by utilizing the SR 520 corridor where possible.

3.12.1.3 Alternative 3 (SR 520 HOV, I-90 LRT)

In addition to the impacts described for Alternative 2, Alternative 3 would create moderate to high level impacts in the Seattle area by building a wider highway cross section, reworking surface streets in the Montlake neighborhood and University of Washington, and reworking I-5 lanes.

Mitigation would be similar to that described for Alternative 2.

3.12.1.4 Alternative 4 (SR 520 HOV, GP, I-90 LRT)

In addition to the impacts described for Alternatives 2 and 3, Alternative 4 would result in additional low to high level visual impacts because of a wider highway cross section, major reworking surface streets in the Eastlake neighborhood, and extensive reworking of I-5 lanes.

Mitigation would be similar to that described for Alternative 2.

3.12.1.5 Alternative 5 (SR 520 HOV, SR 520 HCT)

In addition to impacts described for Alternatives 2 and 3, Alternative 5 would create additional low to moderately high level visual impacts because of the HCT alignment from downtown Seattle, through the Queen Anne, Fremont, Wallingford, and University District neighborhoods. Although the HCT facilities would generate additional impacts within the SR 520 corridor in Seattle, these impacts would be offset somewhat by the lack of HCT facilities in the south part of Bellevue, which would reduce the impacts for this alternative. HCT alignments in the SR 520/I-405 interchange area would generate additional low to moderate level impacts. Reworking of the I-5 corridor would not be as extensive as Alternatives 3 and 4.

Mitigation would be similar to that described for Alternative 2.

3.12.1.6 Alternative 6 (SR 520 HOV, GP, SR 520 HCT)

Alternative 6 would result in similar visual impacts as described for Alternative 5, with the exception of the visual impacts associated with the reworking of the I-5 corridor. Visual impacts in the I-5 corridor would be similar to Alternative 4.

Mitigation would be similar to that described for Alternative 2.

3.12.1.7 Alternative 7 (SR 520 HOV/BRT)

Because Alternative 7 utilizes existing highway corridors more than any other build alternative, it generates the fewest and lowest level visual impacts.

Impacts could be mitigated by replanting removed vegetation, screening views of proposed transportation-related structures, and minimizing the heights of structures where possible.

3.12.1.8 Alternative 8 (SR 520 HOV/BRT, GP)

Alternative 8 is similar to Alternative 7, however its wider highway cross section would generate slightly higher visual impact levels.

Mitigation would be similar to that described for Alternative 7.

3.12.2 Rating of Alternatives

As indicated in Table 3-21 Alternatives 2, 3, and 4 would result in the greatest impacts on visual quality, whereas Alternatives 7 and 8 would result in the least impacts of the build alternatives. In general, HCT alignments in new corridors would have greater visual quality impacts than widening existing highway corridors.

The multimodal alternatives were given two ratings: (1) relative impacts and mitigation required for each alternative, and (2) the feasibility of that mitigation. In addition, the alternatives were ranked based on the impacts associated with each alternative and the feasibility of mitigating those impacts. Each alternative was ranked relative to the other alternatives with 8 being the alternative with the least impacts on visual resources, and 1 being the alternative with the most impacts.

Table 3-21. Visual Quality Impact Rating

	Alternative							
Visual Quality	**1: No Action**	**2: S&P, I-90 LRT**	**3: HOV, I-90 LRT**	**4: HOV, GP, I-90 LRT**	**5: HOV, 520 HCT**	**6: HOV, GP, 520 HCT**	**7: HOV/BRT**	**8: HOV/ BRT, GP**
Impacts and Extent of Mitigation Required	◕ no	○ most	○ most	○ most	◔ medium	◔ medium	◑ low	◑ low
Feasibility of Proposed Mitigation	NA	○ least feasible	○ least feasible	○ least feasible	◑ medium feasibility	◑ medium feasibility	◕ most feasible	◕ most feasible
Ranking	1	6	7	8	4	5	2	3

RATING KEY

WORST →				BEST
○	◔	◑	◕	●
Most Impacts	Medium Impacts	Least Impacts	No Impact	Improved Environment

3.13 OVERALL COMPARATIVE SUMMARY

Table 3-22 provides a comparative summary of the level of impacts for each alternative by environmental resources.

Table 3-22. Environmental Criteria Ratings Summary

Criteria	Alternative							
	1: No Action	2: S&P, I-90 LRT	3: HOV, I-90 LRT	4: HOV, GP, I-90 LRT	5: HOV, 520 HCT	6: HOV, GP, 520 HCT	7: HOV/BRT	8: HOV/ BRT, GP
Air Quality	◑ least	◑ least	◑ least	◔ medium	◑ least	◔ medium	◑ least	○ most
Water Resources	◑ least	◔ medium	○ most	○ most	○ most	○ most	○ most	○ most
Fish-Bearing Streams	◕ no	◑ least	◔ medium	◔ medium	◑ least	○ most	◑ least	◑ least
Critical Upland Habitat	◑ least	◔ medium	◔ medium	○ most	◔ medium	○ most	◔ medium	○ most
Wetlands and Shorelines	◕ no	◔ medium	○ most	○ most	○ most	○ most	○ most	○ most
Noise and Vibration	◑ least	◑ least	◔ medium	○ most	◔ medium	○ most	◔ medium	○ most
Land Use	◕ no	◑ least	◑ least	◔ medium	◔ medium	○ most	◑ least	◔ medium
Parklands	◕ no	◑ least	◔ medium	○ most	◔ medium	○ most	◑ least	◔ medium
Cultural Resources	◕ no	◔ medium	○ most	○ most	◑ least	◔ medium	◑ least	◑ least
Displacements and Disruption	◕ no	◑ least	◔ medium	◔ medium	◔ medium	○ most	◔ medium	○ most
Neighborhoods	◔ medium	◑ least	◑ least	○ most	◑ least	○ most	◑ least	◔ medium
Visual Quality	◕ no	○ most	○ most	○ most	◔ medium	◔ medium	◑ least	◑ least

RATING KEY

WORST →				BEST
○	◔	◑	◕	●
Most Impacts	Medium Impacts	Least Impacts	No Impact	Improved Environment

4 COST ESTIMATES

The cost estimates are provided in three sections: 1) Capital Costs, 2) Annual Costs, and 3) Other Potential Costs,

- Capital costs represent the initial cost investment in the alternatives for construction and certain type of mitigation.
- Annual costs are those that will be incurred on a yearly basis. These costs include operation and maintenance for the alternatives. It also includes costs for the TDM element. For comparison purposes, the costs for private vehicles caused through gas consumption and wear on the vehicles is also provided as annual costs.
- Other potential costs include stormwater, environmental mitigation, noise mitigation, and lidding. These costs are known to exist but the exact nature and impact is unknown in many cases, and may vary greatly depending on future environmental regulations.
- Life cycle analysis examines all these different cost elements and looks at how these alternatives would be implemented to provide a way of comparing all the different cost elements. These different costs are summarized in Table 4-1a and 4-1b.

4.1 CAPITAL COST

The Capital Cost Opinions provided in this report reflect a wide range of assumptions based on the preliminary information developed to date. These cost opinions represent the cost of construction in 2001 dollars. Capital costs may vary substantially due to changes in inflation, rate of construction and years of expenditure. It is important to recognize that this is a planning-level cost opinion developed for the different alternatives. Capital costs are developed here for use in the Life Cycle Analysis.

4.1.1 Inclusions

The multimodal capital cost opinion represents the complete scope of the project as implied in the definition of the alternatives report and includes the following items:

- Related civil and traffic work,
- High capacity transit guideway, including trackwork,
- Rail and BRT transit stations,
- System support elements for alignments and stations,
- Light rail and bus transit vehicles,
- Cost of Park and Ride upgrades,
- Right-of-way, and
- Agency costs.

Table 4-1a. Multimodal Alternative Cost Summary
(In millions of 2001 dollars)

	1 No Action	2 Safety and Preservation, I-90 HCT	3 HOV and I-90 HCT	4 HOV+GP and I-90 HCT	5 HOV and SR 520 HCT	6 HOV+GP and SR 520 HCT	7 HOV/BRT	8 HOV/BRT+GP
Total Alternative Capital Cost Opinion	$0	$4,290	$5,950	$7,450	$7,370	$8,940	$4,350	$5,460
Annual Cost Elements	$0	$109	$55	$114	$54	$106	$31	$81
Other Costs	$0	$340 to $4,070	$760 to $4,740	$1,740 to $6,020	$740 to $5,050	$1,640 to $6,270	$820 to $4,700	$1,850 to $6,000

Table 4-1b. Multimodal Alternative Cost Summary
Comparison Analysis: Change from No Action

	1 No Action	2 Safety and Preservation, I-90 HCT	3 HOV and I-90 HCT	4 HOV+GP and I-90 HCT	5 HOV and SR 520 HCT	6 HOV+GP and SR 520 HCT	7 HOV/BRT	8 HOV/BRT+GP
Life Cycle Analysis[a] (NPV)	$0	$3,025	$3,104	$4,630	$4,021	$4,761	$2,576	$4,134
Index, Low Cost = 100 (or 100%)		117	121	180	156	185	100	160

[a] Includes estimated cost of noise walls, stormwater mitigation, local street improvements. Environmental mitigation assumed to be 5percent of capital cost. Does not include the cost of freeway lids.

4.1.2 Exclusions

- Operating and maintenance cost, and
- Improvements outside those described in the engineering documents.

4.1.3 Limitations

This is a Class 5 cost opinion as defined by the Association for the Advancement of Cost Engineering. The expected accuracy range of this estimate is -30 percent to +50 percent or greater based on information available at the planning level. This planning-level cost opinion is intended only for the purpose of economic comparison of the different alternatives based on information available at the time of preparation. Because of the preliminary nature of this cost opinion, final project costs will vary from those shown and will depend on actual costs for labor, construction equipment, disposal, and materials as well as surface and subsurface conditions, regulatory constraints, approach to corridor mitigation, labor productivity, competitive market conditions, final project scope, schedule, and other factors. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

4.1.4 Contingencies

There is insufficient detail contained in the design documents to provide precise cost opinions. Therefore the estimators use design, construction, and scope contingencies to address cost elements that are known to exist but cannot be easily quantified. These contingencies reflect incomplete design and project staging information, uncertainties about the evolution of the design, and changes in the construction market conditions. There are three different contingencies used in establishing the capital cost opinion. These contingencies are:

- **Design contingency.** The design contingency is used to account for incomplete design information, design changes during the evolution of the project, and changing construction market conditions. For the highway cost methodology the individual design elements carry an inherent design contingency built into their unit prices. A detailed chart of how the design contingency is applied to the HCT costs is shown below.
- **Construction contingency.** The construction contingency accounts for unforeseen conditions that are encountered during construction. For the highway cost methodology the construction contingency is taken at 15 percent. Construction contingency for the HCT portion of the cost opinion is shown below in Table 4-2.
- **Scope contingency.** The scope contingency accounts for the scope evolution during the project development period. In the multimodal estimate the highway scope contingency will be applied to each segment and is taken to be 20 percent. HCT scope contingency is included in the unit prices for each segment or section.

Table 4-2. Cost Contingencies.

Project Component	Design Contingency (percentage of extended cost)	Construction Contingency (percentage of contingency)
Submerged Floating Tunnel	50	25
Floating/Movable Bridge	35	15
Tunnel Guideway & Stations	35	15
Aerial Guideway & Stations	30	10
At-Grade Guideway & Stations	25	10
Specialty Items	35	10
Vehicles & Maintenance Base	15	10

4.1.5 Summary of Cost Findings

The multimodal alternatives under consideration show a large range of capital cost, with Alternative 2 having the lowest cost opinion of $4.29 billion up to Alternative 6 which has the highest cost opinion of $8.9 billion. These costs are summarized in Table 4-3. As expected, HCT along the SR 520 corridor is substantially more expensive than converting the center lane of I-90 for HCT transit usage. BRT capital costs are also lower than either light rail alternative. Alternatives with eight lanes or BRT facilities are more expensive than six lane alternatives due to the increased complexity required at interchanges.

4.2 ANNUAL COSTS

Annual costs are those costs not included in the capital cost but result from the increases in infrastructure and include Operations and Maintenance (O&M), annual TDM costs, and private costs. Annual cost will occur at different times for different alternatives due to the differing lengths of construction for each alternative. Therefore annual costs are assigned to begin at different dates. In order to understand the affect of annual costs between alternatives they should be evaluated in the Life-Cycle Analysis.

4.2.1 Operation and Maintenance Costs

Operation and maintenance includes the cost of keeping the highway, tunnels and HCT guideway in good repair and the cost of operating the transit system and monitoring tunnels. These costs represent the cost of O&M of these alternatives in 2001 dollars. Actual implementation if the alternatives can change these costs based on inflation, rate of construction, and year of expenditure assumptions.

4.2.1.1 Inclusions

- Roadway Maintenance,
- Bridge Maintenance,

Table 4-3. Multimodal Alternative Capital Cost Opinion Summary
(In millions of 2001 dollars)

	1 No Action	2 Safety and Preservation, I-90 HCT	3 HOV and I-90 HCT	4 HOV+GP and I-90 HCT	5 HOV and SR 520 HCT	6 HOV+GP and SR 520 HCT	7 HOV/BRT	8 HOV/BRT+GP
Hwy Multimodal Capital Cost Opinion	$0	$1,480	$2,590	$4,100	$2,550	$3,530	$2,760	$3,900
Transit Multimodal Capital Cost Opinion	$0	$2,810	$3,360	$3,350	$4,820	$5,410	$1,590	$1,560
Total Alternative Capital Cost Opinion	**$0**	**$4,290**	**$5,950**	**$7,450**	**$7,370**	**$8,940**	**$4,350**	**$5,460**
Index, Low Cost = 100		100	139	174	172	208	101	127

[a] Transit capital cost include HCT fixed guideway, cost for all BRT only structures, roadway and stations plus Park and Ride upgrade costs.

- Vehicle Operations,
- Vehicle Maintenance,
- Facilities Maintenance, and
- HCT or BRT Administration and Support.

4.2.1.2 Summary of Operation and Maintenance Findings

A summary of O&M costs can be found on Table 4-4. These cost are shown as an incremental increase over the No Action Alternative. O&M for tunnel is a large portion of the overall O&M cost for highway alternatives. This is due the high cost of staff for monitoring and maintaining the electrical and mechanical for the tunnels. The table also shows that the O&M cost for operating Rail in the SR 520 corridor are slightly lower than for the I-90 corridor, but the O&M cost associated with BRT are considerably less expensive than either HCT option. On options where O&M is shown as a negative number this means that the O&M cost associated with that alternative is lower than the current projected No Action Alternative.

4.2.2 Annual TDM Costs

The cost estimates for TDM reflect a proposed level of investment in the programs and actions described in the Initial TDM Element Definitions Report (May 2001). The relative emphasis of different categories in the TDM element are still being determined, but the estimates are based on an overall assumption that the investment in TDM would be similar to other current regional proposals for TDM. The PSRC's Destination 2030 (Draft) proposed a long-range regional program for TDM with costs of $2.35 billion through 2030. This was the primary source for predicting costs for the Trans-Lake program. For comparison purposes, the cost estimates for the TDM element of the I-405 EIS were also used.

The Trans-Lake TDM element cost elements were developed by applying the Destination 2030 investment levels to the Trans-Lake corridors, based on the corridors' share of regional transit/HOV travel. The corridors would include SR 520, SR 522 and I-90. The PSRC travel demand model applied for the Trans-Lake project provided the regional and corridor forecasts that were used.

The costs for the TDM element have been annualized, but they were developed based on an assumed program that would provide TDM actions and services in the Trans-Lake corridors through the year 2020. These costs are shown in Table 4-4.

4.2.3 Annual Private Cost

Private costs represent the cost of owning and operating private vehicles including fuel, oil, maintenance, tires, depreciation, finance charges, tax and license, and insurance. As part of the multimodal cost evaluations, private costs are estimated for each highway alternative by multiplying total VMT by automobiles and trucks by per-mile private costs.

Table 4-4. Multimodal Alternative Annual Cost Summary

Multimodal Alternative Annual O&M Cost Opinion
(In millions of 2001 dollars)

	1 No Action	2 Safety and Preservation, I-90 HCT	3 HOV and I-90 HCT	4 HOV+GP and I-90 HCT	5 HOV and SR 520 HCT	6 HOV+GP and SR 520 HCT	7 HOV/BRT	8 HOV/BRT+GP
Highway O&M Annual Costs								
Tunnel	$0	$0	$0.74	$1.79	$0.00	$1.28	$1.69	$3.03
Other	$0	$0.18	$0.67	$1.43	$0.65	$1.37	$0.81	$1.23
Transit O&M Annual Costs								
Rail	$0	$48.4	$48.4	$48.4	$47.1	$47.1	$0	$0
Bus	$0	$2.0	$2.5	$2.4	-$2.9	-$3.1	$15.6	$15.6
Incremental Annual O&M Cost Opinion vs. Alternative 1	**$0**	**$50.58**	**$52.31**	**$54.02**	**$44.85**	**$46.65**	**$18.10**	**$19.86**

Note: All O&M cost are incremental costs vs. the No Action alternative.

Multimodal Alternative Annual TDM Cost Opinion
(In millions of 2001 dollars)

	1 No Action	2 Safety and Preservation, I-90 HCT	3 HOV and I-90 HCT	4 HOV+GP and I-90 HCT	5 HOV and SR 520 HCT	6 HOV+GP and SR 520 HCT	7 HOV/BRT	8 HOV/BRT+GP
Annual TDM Cost	0	$6.75	$7.70	$8.34	$7.54	$8.42	$7.79	$8.66

Note: Represents average annual TDM costs based on proposed TDM investments through 2020. The 2020 TDM costs were projected based on PSRC Destination 2030 transportation plan. Actual implementation costs may vary annually.

Multimodal Alternative Annual Private Cost Opinion
(In millions of 2001 dollars)

	1 No Action	2 Safety and Preservation, I-90 HCT	3 HOV and I-90 HCT	4 HOV+GP and I-90 HCT	5 HOV and SR 520 HCT	6 HOV+GP and SR 520 HCT	7 HOV/BRT	8 HOV/BRT+GP
Annual Private Costs	$0	$52	-$5	$52	$2	$51	$5	$52

Note: Private costs are incremental cost vs. the No Action alternative. These costs are based on 2020 travel projections.

Total vehicle miles traveled for each alternative are taken from the travel model results. Consistent with the assumption made during analysis conducted for the I-405 EIS, it is assumed that 95 percent of non-transit vehicle miles are driven by automobiles and 5 percent are driven by trucks.

The per-mile private costs used for this analysis are as follows:

- $0.39 per mile for automobiles (includes fuel, oil, maintenance, tires, depreciation, finance charges, tax and license, and insurance).
- $1.29 per mile for trucks (includes same costs as automobile: excludes labor cost of driver).

Private costs can be seen in Table 4-4. These costs show that those alternatives with increased VMT have a higher private cost associated with them. Thus the eight-lane alternatives such as 4, 6 and 8 have higher private costs than the six-lane alternatives 3, 5, and 7.

4.3 OTHER POTENTIAL COSTS

These cost deal with noise, stormwater, local streets improvements, environmental mitigation and lidding issues, but can include other mitigation or enhancements not listed here but necessary for a project of this nature. These costs can vary greatly depending on current environmental regulations, alternative elements included, and decisions on lidding options.

4.3.1 Noise Walls

It is assumed that noise walls will be constructed along the SR 520 corridor to help with noise mitigation. Alternatives 2 through 8 include noise walls along 90 percent of the westside corridor from I-5 to Lake Washington. This includes a noise wall along the Portage Bay Bridge. These alternatives also include noise walls along 90 percent of the corridor from Lake Washington to I-405. Alternatives 3 through 8 include noise walls along 60 percent of the corridor from I-405 to SR 202. Noise wall costs have been included in Table 4-5 and in the Life-Cycle Analysis Table 4-6.

4.3.2 Stormwater Mitigation

In the SR 520 corridor treating and detaining water will be a large cost. Stormwater Mitigation costs were established using the stormwater treatment requirements from the Sea-Tac Third Runway project to come up with a cost per lane mile for the alternatives. This cost includes treatment of the stormwater run-off and water retention facilities. These regulations are subject to change and could substantially change the mitigation costs. The projected stormwater mitigation costs have been included in the Life-Cycle Analysis.

Table 4-5. Other Potential Costs
(In millions of 2001 dollars)

Alternatives	1 No Action	2 Safety and Preservation, I-90 HCT	3 HOV and I-90 HCT	4 HOV+GP and I-90 HCT	5 HOV and SR 520 HCT	6 HOV+GP and SR 520 HCT	7 HOV/BRT	8 HOV/BRT+GP
Noise Walls[a]	$0	$30	$60	$60	$60	$60	$60	$60
Stormwater Mitigation[b]	$0	$90	$330	$570	$320	$560	$340	$570
Local Street Improvements[c]	$0	$40	$180	$900	$150	$800	$240	$1,030
Environmental Mitigation[d]	$0	$50 to $430	$60 to $600	$80 to $750	$80 to $740	$90 to $900	$50 to $440	$60 to $550
Lids[e]	$0	$130 to $3480	$130 to $3570	$130 to $3740	$130 to $3780	$130 to $3950	$130 to $3620	$130 to $3790

a Noise walls for Alt. 2-8 are assumed along 90% of the westside mainline, 90% of the corridor from Lake Washington to I-405, and for Alt. 3-8 along 60% of the corridor from I-405 to SR 202. These cost are included in the life cycle analysis.

b Stormwater cost were modeled off the Sea-Tac Third runway stormwater requirements. Any changes in stormwater regulation from can cause these costs to vary. These cost are included in the life cycle analysis.

c Local street improvements are taken as a percentage of the highway construction costs. This percentage ranges from 3% for alternative 2, to 6% for the six-lane alternative and 20% for the eight-lane alternatives. These costs are included in the life cycle analysis.

d Environmental Mitigation includes wetland mitigation, habitat restoration, park mitigation, etc. It may range from 1-10% of the capital cost for each alternative. For purposes of the Life Cycle analysis the environmental mitigation cost was taken at 5%.

e Lid cost are not included in the life cycle analysis.

Table 4-6. Multimodal Alternative Life Cycle Analysis
(Net Present Value of Costs over 30 years, in millions of 2001 dollars)

Alternatives	1 No Action	2 Safety and Preservation, I-90 HCT	3 HOV and I-90 HCT	4 HOV+GP and I-90 HCT	5 HOV and SR 520 HCT	6 HOV+GP and SR 520 HCT	7 HOV/BRT	8 HOV/BRT+GP
Capital Costs[a]	$0	$2,194	$2,844	$3,936	$3,672	$4,218	$2,368	$3,621
Private Costs[b]								
Auto	$0	$366	-$25	$308	$11	$259	$35	$266
Truck	$0	$64	-$4	$54	$2	$45	$6	$46
TDM	$0	$47	$37	$44	$48	$36	$50	$61
O&M Costs[c]								
Roadway[d]	$0	$1	$7	$17	$4	$11	$16	$30
Transit[e]	$0	$353	$245	$271	$284	$190	$100	$109
Total Costs	**$0**	**$2,919**	**$3,104**	**$4,630**	**$4,021**	**$4,761**	**$2,576**	**$4,134**
Index, Low Cost = 100		117	121	180	156	185	100	160

a Includes estimated cost of noise walls, stormwater mitigation, local street improvements. Environmental mitigation assumed to be 5% of capital cost. Does not include the cost of freeway lids.

b Total private costs are shown for no build and build alternatives. Other costs shown are differences from the no build.

c O&M and private costs begin in year of implementation.

d "Roadway" includes O&M costs for fixed bridges, floating bridges, highway, and tunnel.

e "Transit" includes O&M costs for buses, rail cars, rail structures, and rail operations.

4.3.3 Local Street Improvement

A project of this size will have local street improvements. The exact magnitude of these local street impacts is unknown at this time but is taken as a percentage of the total capital cost. Eight-lane alternatives will have a substantially higher impact on local streets than a six-lane alternative due to increased volumes of traffic coming on and off the freeway. These costs include but are not limited to street widening, lane arterial lanes and turn lanes, new signals, sidewalks, landscaping, and additional stormwater upgrades. The projected local street improvement costs have been included in the Life-Cycle Analysis.

4.3.4 Environmental Mitigation

Environmental mitigation costs in Table 4-5 include wetland mitigation, habitat restoration, park mitigation, fisheries, etc. The impact of the corridor and these costs is not yet known, but is assumed to be substantial. These cost can also vary depending upon future environmental regulations. Environmental Mitigation costs are projected to range from 1 to 10 percent of the total capital cost for each alternative. For purposes of comparing alternatives in the Life Cycle Analysis the cost for environmental mitigation was taken to be 5 percent of the capital costs.

4.3.5 Lidding Opinions and Opportunities

Lidding costs in Table 4-5 are shown as a range based on the “Draft Lidding Options and Opportunities Report”. Costs for lid opinions vary due to length, width, ventilation, fire suppression, and regrading necessary for each concept within an alternative. Lid costs are not included in the Capital Cost Opinion or Life Cycle Analysis for the different alternatives.

4.4 LIFE-CYCLE ANALYSIS

Life-Cycle Analysis accounts for the cost of a project over its entire useful life. It allows for the comparison of alternatives that are phased in over different time periods. In a Life-Cycle Analysis, costs in each year are discounted back to the present, which enables a comparison of alternatives based on the present value of the stream of expenditures over a consistent evaluation period. For this analysis, the basis for comparison of alternatives will be the net present value of costs over a 30-year time horizon.

4.4.1 Assumptions

Life-cycle costs are estimated on the basis of the following assumptions:

- All costs are estimated in year 2001 dollars.
- The net present value of costs is calculated using a 4 percent real discount rate.
- In each alternative, all capital cost estimates are assumed to be spent during the mid-point year of construction. Private costs and O&M costs begin during the year of implementation.
- The remaining useful life of capital expenditures is included at the end of the analysis period as a negative cost assuming straight line depreciation.

- The analysis period is from 2001 to 2030.
- Project implementation dates are estimated using the following annual capital expense burn rate:
  - if the project capital costs are less than $7 billion, the burn rate is $500 million/year.
  - if the project capital costs are greater than or equal to $7 billion, the burn rate is assumed to be $750 million/year.

4.4.2 Results

The results presented in Table 4-6 reflect the difference in cost of each build alternative when compared to the no-build alternative. The net present value of the cost of the build alternatives ranges from approximately $2.5 billion for Alternative 7 to approximately $4.8 billion for Alternative 6. The present value of costs are also shown as an index whereby the low cost build alternative (Alternative 7) is set to 100 and all other alternatives are shown as multiple of that cost. For example, Alternative 8 has an index number of 134, which means the present value of costs for Alternative 8 is 34 percent higher than for Alternative 7.

The present value of the capital costs accounts for the majority of the project costs for all alternatives. Notice that the present value of the capital costs is not the same, and is less than, the estimated project construction costs in 2001 dollars (Table 4-3). This is because the present value analysis discounts future expenditures at an annual rate of 4 percent, and the remaining useful life of the assets is included in the present value of capital costs as a negative cost in 2031. This is done to ensure that alternatives that are implemented at a different pace can be compared on a common basis.

The private cost of vehicle operation is included in order to ensure that the cost of operating private vehicles and transit vehicles are both included. Private costs are highest for those alternatives that include the highest VMT. Roadway and O&M costs include the cost of maintaining roads, related structures, and bus O&M costs. Rail O&M includes the cost of maintaining rail track and structures, and the cost of operating and maintaining rail vehicles. A negative O&M cost occurs if the O&M cost for the build alternative is less than the existing O&M cost for Alternative 1.

5 RESULTS OF ADDITIONAL ANALYSIS

Several additional studies were also conducted in support of the Trans-Lake Multimodal Analysis. After the initial publication of the Multimodal Alternatives Evaluation Report (Committee Discussion Draft, June 2001), several questions remained about the performance of elements of some of the alternatives. In addition, some of the regional system assumptions that were made for the analysis were also being reconsidered as other major regional projects on I-90 and I-405 were moving forward. This section discusses the findings of additional analysis of potential changes to the multimodal alternatives, and to other system changes.

5.1 EFFECTS OF I-90 AND I-405 SYSTEM CHANGES

When the initial results of the multimodal alternatives analysis were published in June 2001, the project committees requested more information on several underlying system assumptions that had been made for travel demand forecasting. The key assumptions in those initial forecasts:

- The I-405 corridor's capacity would remain unchanged.
- If the I-90 center roadway would be converted to rail, the displaced HOV lanes would be relocated to the outer roadways. HOV lane operations would be two-way compared to the reversible operations assumed in the No Action Alternative, but the total number of lanes available for vehicle travel on I-90 would be unchanged.

The committees were interested in learning more about the possible changes in the multimodal alternatives performance if these assumptions changed. In response, the project team ran two modeling sensitivity tests on Alternative 4, which originally involved eight lanes on SR 520 and I-90 LRT operations. Alternative 4 was selected for the sensitivity test because it had the potential to show the highest changes in demand on SR 520 if other facilities were changed.

The team re-modeled Alternative 4 with these changes:

- Scenario 1: The I-405 corridor's capacity would increase by two additional lanes each way. On I-90, rail would still be assumed in the I-90 center roadway, but with no HOV lanes on the outer roadway. This would reduce the total lanes available for vehicle travel on I-90 by two lanes.
- Scenario 2: I-90 with rail still assumed in the I-90 center roadway, but with no HOV lanes assumed on the outer roadway.

The complete report for this analysis is included in Appendix F.

5.1.1 Findings

The results are show in Tables 5-1 through 5-6. Tables 5-1 and 5-2 show PM peak and daily travel demand for Alternative 4 with the expanded I-405 and no HOV lanes on I-90. Tables 5-3 and 5-4 show demand for Alternative 4 with no HOV lanes on I-90. Tables 5-5 and 5-6 show travel demand for Alternative 4 as originally modeled.

Table 5-1.
PM Peak Period Vehicle and Person Trip Volumes and Modal Split
2020 Alternative 4 (with two additional lanes on I-405 and no HOV lanes on I-90 outer roadway)

	PM Peak Period Vehicle Volumes				PM Peak Period Person Trip Volumes					
Roadway Facility	**Non-HOV**	**HOV (3+)**	**Commercial**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Bus Transit**	**Rail Transit**	**Total**
SCREENLINE A (TRANSLAKE)										
SR 522 (West of 61st Ave.NE)	19,800	300	1,300	21,400	26,400	1,000	1,300	1,400	N/A	30,100
Modal Share (%)					87.7%	3.3%	4.3%	4.7%		100.0%
SR 520 (L. Wash. Bridge)	39,300	5,400	5,500	50,200	52,300	17,100	5,500	7,000	N/A	81,900
Modal Share (%)					63.9%	20.9%	6.7%	8.5%		100.0%
I-90 (West Bridge)	35,900	1,000	4,500	41,400	47,800	3,200	4,500	400	10,500	66,400
Modal Share (%)					72.0%	4.8%	6.8%	0.6%	15.8%	100.0%
Total Trans-Lake	**95,000**	**6,700**	**11,300**	**113,000**	**126,500**	**21,300**	**11,300**	**8,800**	**10,500**	**178,400**
Modal Share (%)					**70.9%**	**11.9%**	**6.3%**	**4.9%**	**5.9%**	**100.0%**

NOTES:
- The information presented in this table was directly produced by the model without any post-processing analysis.
- Non-HOVs represent auto vehicles with driver or one passenger. An average occupancy factor of 1.33 was used to convert vehicle volumes to person volumes for Non-HOV trips.
- HOVs represent auto vehicles with 3 or more occupants. An average occupancy factor of 3.15 was used to convert vehicle volumes to person volumes for HOV trips.
- Note that the 3+ elegible HOVs predicted under the No-Action Alternative are relatively higher than the 1995 estimate of 3+ HOVs. This is caused due to congestion on general-purpose lanes parallel to nearly free flow HOV lanes.

Table 5-2.
Daily Vehicle and Person Trip Volumes and Modal Split
2020 Alternative 4 (with two additional lanes on I-405 and no HOV lanes on I-90 outer roadway)

	Daily Vehicle Volumes				Daily Person Trip Volumes					
Roadway Facility	**Non-HOV**	**HOV (3+)**	**Commercial**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Bus Transit**	**Rail Transit**	**Total**
SCREENLINE A (Translake)										
SR 522 (West of 61st Ave.NE)	56,700	900	8,400	66,000	75,500	2,900	8,400	3,800	N/A	90,600
Modal Share (%)					83.3%	3.2%	9.3%	4.2%		100.0%
SR 520 (L. Wash. Bridge)	118,700	13,000	38,200	169,900	157,900	41,000	38,200	20,000	N/A	257,100
Modal Share (%)					61.4%	15.9%	14.9%	7.8%		100.0%
I-90 (West Bridge)	108,200	3,200	32,100	143,500	144,000	10,100	32,100	1,300	31,200	218,700
Modal Share (%)					65.8%	4.6%	14.7%	0.6%	14.3%	100.0%
Total Trans-Lake	**283,600**	**17,100**	**78,700**	**379,400**	**377,400**	**54,000**	**78,700**	**25,100**	**31,200**	**566,400**
Modal Share (%)					**66.6%**	**9.5%**	**13.9%**	**4.4%**	**5.5%**	**100.0%**

NOTES:

- The information presented in this table was directly produced by the model without any post-processing analysis.
- Non-HOVs represent auto vehicles with driver or one passenger. An average occupancy factor of 1.33 was used to convert vehicle volumes to person volumes for Non-HOV trips.
- HOVs represent auto vehicles with 3 or more occupants. An average occupancy factor of 3.15 was used to convert vehicle volumes to person volumes for HOV trips.
- Note that the 3+ elegible HOVs predicted under the No-Action Alternative are relatively higher than the 1995 estimate of 3+ HOVs. This is caused due to congestion on general-purpose lanes parallel to nearly free flow HOV lanes.

Table 5-3.
PM Peak Period Vehicle and Person Trip Volumes and Modal Split
2020 Alternative 4 (with no HOV lanes on I-90 outer roadway)

Roadway Facility	PM Peak Period Vehicle Volumes				PM Peak Period Person Trip Volumes					
	Non HOV	HOV (3+)	Commercial	Total	Non-HOV	HOV (3+)	Commercial	Bus Transit	Rail Transit	Total
SCREENLINE A (TransLake)										
SR 522 (West of 61st Ave.NE)	21,600	300	1,500	23,400	28,800	1,000	1,500	1,400	N/A	32,700
Modal Share (%)					88.1%	3.1%	4.6%	4.3%		100.0%
SR 520 (L. Wash. Bridge)	41,400	5,400	5,700	52,500	55,100	17,100	5,700	6,900	N/A	84,800
Modal Share (%)					65.0%	20.2%	6.7%	8.1%		100.0%
I-90 (West Bridge)	39,500	900	4,500	44,900	52,600	2,900	4,500	400	10,400	70,800
Modal Share (%)					74.3%	4.1%	6.4%	0.6%	14.7%	100.0%
Total Trans-Lake	**102,500**	**6,600**	**11,700**	**120,800**	**136,500**	**21,000**	**11,700**	**8,700**	**10,400**	**188,300**
Modal Share (%)					**72.5%**	**11.2%**	**6.2%**	**4.6%**	**5.5%**	**100.0%**

NOTES:

- The information presented in this table was directly produced by the model without any post-processing analysis.
- Non-HOVs represent auto vehicles with driver or one passenger. An average occupancy factor of 1.33 was used to convert vehicle volumes to person volumes for Non-HOV trips.
- HOVs represent auto vehicles with 3 or more occupants. An average occupancy factor of 3.15 was used to convert vehicle volumes to person volumes for HOV trips.
- Note that the 3+ elegible HOVs predicted under the No-Action Alternative are relatively higher than the 1995 estimate of 3+ HOVs. This is caused due to congestion on general-purpose lanes parallel to nearly free flow HOV lanes.

Table 5-4.
Daily Vehicle and Person Trip Volumes and Modal Split
2020 Alternative 4 (with no HOV lanes on I-90 outer roadway)

	Daily Vehicle Volumes				Daily Person Trip Volumes					
Roadway Facility	**Non HOV**	**HOV (3+)**	**Commercial**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Bus Transit**	**Rail Transit**	**Total**
SCREENLINE A (TransLake)										
SR 522 (West of 61st Ave.NE)	62,900	800	9,400	73,100	83,700	2,600	9,400	3,800	N/A	99,500
Modal Share (%)					84.1%	2.6%	9.4%	3.8%		100.0%
SR 520 (L. Wash. Bridge)	125,800	13,100	39,300	178,200	167,400	41,300	39,300	19,500	N/A	267,500
Modal Share (%)					62.6%	15.4%	14.7%	7.3%		100.0%
I-90 (West Bridge)	114,500	3,000	32,500	150,000	152,300	9,500	32,500	1,300	30,900	226,500
Modal Share (%)					67.2%	4.2%	14.3%	0.6%	13.6%	100.0%
Total Trans-Lake	**303,200**	**16,900**	**81,200**	**401,300**	**403,400**	**53,400**	**81,200**	**24,600**	**30,900**	**593,500**
Modal Share (%)					**68.0%**	**9.0%**	**13.7%**	**4.1%**	**5.2%**	**100.0%**

NOTES:

- The information presented in this table was directly produced by the model without any post-processing analysis.
- Non-HOVs represent auto vehicles with driver or one passenger. An average occupancy factor of 1.33 was used to convert vehicle volumes to person volumes for Non-HOV trips.
- HOVs represent auto vehicles with 3 or more occupants. An average occupancy factor of 3.15 was used to convert vehicle volumes to person volumes for HOV trips.
- Note that the 3+ elegible HOVs predicted under the No-Action Alternative are relatively higher than the 1995 estimate of 3+ HOVs. This is caused due to congestion on general-purpose lanes parallel to nearly free flow HOV lanes.

Table 5-5.
PM Peak Period Vehicle and Person Trip Volumes and Modal Split
2020 Alternative 4

	Daily Vehicle Volumes				Daily Person Trip Volumes					
Roadway Facility	Non HOV	HOV (3+)	Commercial	Total	Non-HOV	HOV (3+)	Commercial	Bus Transit	Rail Transit	Total
SCREENLINE A (TransLake)										
SR 522 (West of 61st Ave.NE)	21,300	300	1,400	23,000	28,400	1,000	1,400	1,400	N/A	32,200
Modal Share (%)					88.2%	3.1%	4.3%	4.3%		100.0%
SR 520 (L. Wash. Bridge)	39,200	4,600	5,200	49,000	52,200	14,500	5,200	7,200	N/A	79,100
Modal Share (%)					66.0%	18.3%	6.6%	9.1%		100.0%
I-90 (West Bridge)	44,700	1,700	4,900	51,300	59,500	5,400	4,900	1,200	10,300	81,300
Modal Share (%)					73.2%	6.6%	6.0%	1.5%	12.7%	100.0%
Total Trans-Lake	**105,200**	**6,600**	**11,500**	**123,300**	**140,100**	**20,900**	**11,500**	**9,800**	**10,300**	**192,600**
Modal Share (%)					**72.7%**	**10.9%**	**6.0%**	**5.1%**	**5.3%**	**100.0%**

NOTES:

- The information presented in this table was directly produced by the model without any post-processing analysis.
- Non-HOVs represent auto vehicles with driver or one passenger. An average occupancy factor of 1.33 was used to convert vehicle volumes to person volumes for Non-HOV trips.
- HOVs represent auto vehicles with 3 or more occupants. An average occupancy factor of 3.15 was used to convert vehicle volumes to person volumes for HOV trips.
- Note that the 3+ elegible HOVs predicted under the No-Action Alternative are relatively higher than the 1995 estimate of 3+ HOVs. This is caused due to congestion on general-purpose lanes parallel to nearly free flow HOV lanes.

Table 5-6.
Daily Vehicle and Person Trip Volumes and Modal Split
2020 Alternative 4

	Daily Vehicle Volumes				Daily Person Trip Volumes					
Roadway Facility	**Non HOV**	**HOV (3+)**	**Commercial**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Bus Transit**	**Rail Transit**	**Total**
Screenline A (TransLake)										
SR 522 (West of 61st Ave.NE)	62,500	900	9,400	72,800	83,200	2,900	9,400	3,800	N/A	99,300
Modal Share (%)					83.8%	2.9%	9.5%	3.8%		100.0%
SR 520 (L. Wash. Bridge)	124,600	11,900	37,600	174,100	165,800	37,500	37,600	20,300	N/A	261,200
Modal Share (%)					63.5%	14.4%	14.4%	7.8%		100.0%
I-90 (West Bridge)	121,000	4,600	32,500	158,100	161,000	14,500	32,500	3,500	30,600	242,100
Modal Share (%)					66.5%	6.0%	13.4%	1.4%	12.6%	100.0%
Total Trans-Lake	308,100	17,400	79,500	405,000	410,000	54,900	79,500	27,600	30,600	602,600
Modal Share (%)					68.0%	9.1%	13.2%	4.6%	5.1%	100.0%

NOTES:
- The information presented in this table was directly produced by the model without any post-processing analysis.
- Non-HOVs represent auto vehicles with driver or one passenger. An average occupancy factor of 1.33 was used to convert vehicle volumes to person volumes for Non-HOV trips.
- HOVs represent auto vehicles with 3 or more occupants. An average occupancy factor of 3.15 was used to convert vehicle volumes to person volumes for HOV trips.
- Note that the 3+ elegible HOVs predicted under the No-Action Alternative are relatively higher than the 1995 estimate of 3+ HOVs. This is caused due to congestion on general-purpose lanes parallel to nearly free flow HOV lanes.

Scenario 1 (added I-405 capacity and the removal of I-90 HOV lanes) would lower overall east-west travel demand on SR 522, SR 520 and I-90, compared to Alternative 4 as originally modeled. Trans-Lake vehicle trips and person trips during the PM peak would be 9.1 percent and 9.2 percent lower, and daily trips would be 9.3 percent and 9.4 percent lower, respectively, than Alternative 4. Most of these drops in volumes would occur on SR 522 and I-90. I-90's HOV and GP demand would drop due to the increased attractiveness of the I-405 corridor, and because I-90's lower capacity would reduce its desirability for both GP and HOV travelers. (Mercer Island GP travelers have access to the center roadway, so the roadway accommodates a mix of HOV and GP vehicles.) There would be lower but not substantial changes in vehicle and person trip volumes on SR 520. Its PM peak period vehicle volumes would be 2 percent higher than Alternative 4 (nearly all in HOV trips), or just over 1,000 vehicles higher at peak. SR 520's daily vehicle volumes would be 3 percent lower. Person trips on SR 520 would show a similar pattern: 3.5 percent higher at peak, but 2 percent lower on a daily basis.

Scenario 2 (the removal of I-90 HOV lanes) would also lower overall east-west travel demand compared to Alternative 4, but more modestly than in Scenario 1. Trans-Lake vehicle trips would be lowered by 2 percent at the peak, and by 1 percent on a daily basis. Person trips would drop similarly. On I-90, the volumes of vehicles and people decrease for both HOV and GP travelers. As noted above, this is due to the elimination of capacity and travel time advantages for HOV travelers, and to the reduced capacity for GP travelers as Mercer Island traffic moves to the outer lanes. On SR 520, the volumes increase. There would be 7 percent more vehicle trips at peak (or 3,500), 2/3 of which would be added non-HOV. Person trips would increase by a similar amount at peak. Daily vehicle volumes would increase by 2 percent, indicating that the peak period would be the period most affected, which is reasonable with the loss of HOV lanes, which are most heavily utilized at peak.

Based on these results, the following conclusions can be made:

- Added I-405 capacity would not appear to create additional demand for SR 520. The greatest change that would occur would be in non-HOV trips, where travelers may be choosing other destinations up and down the I-405 corridor in lieu of trips across the lake.
- The loss of I-90 HOV capacity would increase the burden on SR 520, mostly at peak periods. The added capacity on I-405 appears to reduce this effect to SR 520. About half of the 10,000 people and 6,500 vehicles lost from I-90 during the peak (using Scenario 2) appear to migrate to SR 520 lanes. In Scenario 2, there is a higher drop on I-90 during the peak, but a lower amount of migration to SR 520 as travelers find that I-405 is a more attractive option.

5.2 I-405/SR 520 INTERCHANGE OPTIONS ANALYSIS

Additional engineering and environmental review of I-405/SR 520 interchange design options was conducted for alternatives that would expand the general-purpose and HOV capacity of the SR 520 corridor. This work was performed to supplement the analysis of eight multimodal alternatives on a corridor-wide basis, as documented in the Multimodal Alternatives Evaluation Report (Discussion Draft, June 2001).

This supplemental analysis focused primarily on revised options for the I-405/SR 520 interchange. The original option analyzed would reconstruct the interchange to allow the expanded SR 520 mainline and add full HOV connections between SR 520 and I-405, as well as to the nearby South Kirkland Park-and-Ride facility. Subsequent engineering analysis and comments from design reviewers led to revisions on the conceptual design (Appendix F). The supplemental analysis in this report updates the environmental and cost information to reflect the revised interchange design option, and assesses whether it would substantially change the environmental or cost findings for any of the eight-lane alternatives.

The revised I-405 interchange did not substantially change the transportation functions to be provided, compared to the original option.

5.2.1 Findings

A redesigned I-405 interchange would substantially improve operations on SR 520 for both six-lane and eight-lane alternatives. A preferred design for the interchange would include moving HOV lanes to the inside, and eliminating the short distance weaving maneuver in either direction between I-405 and 124th Avenue NE, both of which create a substantial bottleneck. Weaving maneuvers could also be eliminated by prohibiting access between I-405 and 124th Avenue NE via SR 520. These improvements appear to alleviate up to twelve (12) hours of congestion on SR 520 near the I-405 interchange. The interchange design could also be combined with reconstruction of the 124th Street interchange and a realignment of 124th Street, Northup Way and 116th Street, consistent with the City of Bellevue's Downtown Access plan and related projects.

Continued study of interchange options would be needed to determine the configuration of HOV direct access movements at the interchange. Although movements in all directions could be accommodated, a consideration of costs, impacts and benefits of the action should be considered before determining a preferred design.

The original environmental review of eight-lane alternatives determined that all were in the highest range of impacts of the alternatives under consideration. The interchange options being considered would not change the alternatives' environmental ratings overall. The new options would results in similar impacts to the environment as those originally identified in the multimodal analysis, although additional property impacts were identified for the interchange area. In particular, a higher number of commercial property acquisitions would occur.

The cost of the interchange would remain in the same range as provided for the original alternatives, although future design decisions could substantially reduce the cost. The original cost opinion for the interchange was $660 million, and if local street improvements were included the cost would be $690 million. By comparison, the revised interchange design options would be as low as $490 million, and up to $840 million with the 124th Street Interchange revisions and associated street improvements.

The complete report for this analysis is included in Appendix H.

5.3 I-5/SR 520 INTERCHANGE ANALYSIS

This analysis of I-5/SR 520 provides additional information on I-5/SR 520 interchange options for alternatives that would expand the general-purpose capacity of the SR 520 corridor. This work was performed to supplement transportation analysis of the eight multimodal alternatives.

This supplemental analysis focused on the SR 520 corridor approaching I-5, and on segments of the I-5 mainline to the north and south of the interchange. The Federal Highway Administration has commented that alternatives that expand SR 520 should not create adverse impacts to I-5 operations. This supplemental analysis is intended to indicate the likelihood and severity of impacts to I-5, and also to determine whether the impacts could be minimized or avoided through different design approaches. It also reviews environmental and cost factors to determine if the revised interchange design would substantially change the environmental or cost findings for any of the eight-lane alternatives.

Alternatives 4, 6 and 8 featured additional general-purpose and HOV capacity on SR 520. However, none of the I-5 interchange options included in these alternatives increased the capacity of general-purpose connections between SR 520 and I-5 mainline. Instead, they terminated the added general-purpose capacity at new connections to Eastlake or Montlake, and HOV connections were made to the I-5 express lanes. The new interchange option considered in this report would expand the capacity of connections between I-5 and SR 520, and does not include the Eastlake connection. The HOV connections would allow for full movements between SR 520 and the I-5 express lanes.

5.3.1 Findings

The best operating conditions for the eight-lane alternatives were under an option that reduced SR 520's capacity by adding and dropping a lane at the Montlake interchange, subsequently lowering overall demand from SR 520 to I-5. This option would result in I-5 conditions that are similar or better than No Action (Alternative 1). However, higher volumes to and from I-5 and SR 520 would occur in an option that provided eight-lanes continuously across the lake and through Montlake, and this higher demand could impact some segments of I-5.

The I-5/SR 520 interchange configurations that appear capable of handling the additional volumes of an eight-lane SR 520 would require complete reconstruction, and would also require improvements and modifications to the I-5 mainline. This would include moving the SR 520 to I-5 southbound ramp to the right, moving the southbound I-5 to SR 520 ramp to the right, and providing additional lanes on I-5 southbound from SR 520 to Mercer street. Although further study is needed of northbound I-5 operations between Mercer and SR 520, conditions on I-5 could also benefit by eliminating the weave movements in that location.

The original environmental review of eight-lane alternatives determined that all were in the highest range of impacts of the alternatives under consideration. The interchange options being considered would not change the alternatives' environmental ratings overall. The new options would results in similar impacts to the environment as those originally considered in the multimodal analysis. In most cases, the impacts of the added features of the interchange were offset by the elimination of a new connection to the Eastlake area.

The cost estimating analysis found that the costs for the I-5 mainline option would be lower than alternatives that required a new Eastlake tunnel connection. The original I-5 interchange (Option A) for Alternative 4 was estimated to be $770 million, including the Eastlake connection. The new interchange option(s) would cost approximately $350 million.

The full report is provided in Appendix I.

5.4 ADDITIONAL I-90 HCT EVALUATIONS

When the initial results of the multimodal alternatives analysis were published in June 2001, Sound Transit and other project participants suggested more study of an I-90 LRT route. The key issues were:

- Whether I-90's floating bridge could actually accommodate light rail.
- Whether there were alternatives to using the center roadway, such as a parallel route along I-90.
- Whether light rail and HOV would both be accommodated on the I-90 bridge, and what additional highway and traffic issues are involved.

Appendix J documents the additional engineering and environmental study conducted for an I-90 parallel route for HCT, including the associated costs and environmental effects.

5.4.1 I-90 Parallel Route

The new route would provide a separate crossing for LRT along the I-90 corridor. It would involve subway sections from Rainier Avenue S. with a new tunnel under Mt. Baker, and then transition to an aerial structure on the west shoreline to a new floating bridge to the north of the existing I-90 bridges. It would transition again to an aerial nearing Mercer Island, and again be in subway after reaching Mercer Island, and would transfer to the median of I-90 approaching and across the East Channel Bridge. From there, the alternative would be the same as assumed for Alternatives 2, 3, and 4.

The study found that an I-90 parallel route would be a reasonable option to the I-90 route defined for the Trans-Lake multimodal alternatives 2 through 4, and that it could avoid a potential loss of center roadway capacity for I-90. The primary findings:

- Costs for the parallel route would be up to $700 million higher than the HCT components of Alternatives 2, 3 or 4 in the original alternatives. This would still be nearly $1.5 billion less than a comparable SR 520 HCT route.
- Environmental impacts for an I-90 parallel route would be slightly higher than the I-90 HCT route using the center roadway, but overall there would be little difference in environmental performance. The difference in impacts would be in shoreline areas where new aerial structures would transition between the bridge and tunnel sections. Shoreline and potential bald eagle habitat would be affected.
- The transit ridership and reliability performance of the parallel route is assumed to be similar to the original I-90 route alternatives, although transit ridership would be influenced by the final configuration of the I-90 roadway.

5.4.2 I-90 Center Roadway Conversion Engineering and Traffic Analysis

WSDOT also conducted an additional study of the traffic and engineering effects of placing LRT in the center roadway, and potentially moving the HOV facilities to the center roadways. The study was conducted by HNTB Corporation, which is currently conducting the I-90 two-way transit operations project for Sound Transit and WSDOT.

The I-90 LRT configuration in Trans-Lake Alternatives 2, 3, and 4 all assumed HOV on the outer roadways, similar to a two-way transit configuration being evaluated in the I-90 project (Alternative R-8A).

An EIS is currently being conducted at R-8A and other alternatives. Both light rail and Alternative R-8A would involve corridor-wide deviations, including change to shoulders, lane widths, access points (particularly HOV direct access), geometrics, and taper or auxiliary lanes. However, LRT in the center roadway would provide some improvements to the configuration of I-90 with Alternative R-8A. However, 60 percent of the corridor would not have significant improvements to Alternative R-8A corridor-wide deviations with LRT operations in the center of the roadway. LRT operations in the center roadway would not preclude Alternative R-8A, and the geometric feasibility of Alternative R-8A would be slightly improved with LRT in the center roadway.

5.4.3 Additional Considerations

There are a number of other issues that could still affect a decision to place HCT on the I-90 center roadway or on a parallel route, but they would not substantially affect the choice of whether I-90 or SR 520 would be the preferred HCT route across the lake. A final decision on an I-90 HCT route would require EIS-level analysis. Nearer term, the I-90 route options could be further refined following decisions for Sound Transit's I-90 Two-Way Transit Operations Project. That project is exploring highway design alternatives that would allow additional lanes on the outer roadways if the center roadway is converted for two-way transit.

5.4.4 I-90 HCT Retrofit

Sound Transit has studied whether the existing center roadway can be retrofitted to allow HCT operations. The studies concluded that rail could be built and operated on the bridge, with some modifications needed to ensure that the bridge maintained an adequate height above the waterline, and that it would not cause the bridge to list or be overstressed. The study was conducted by KPFF consulting engineers, and is entitled Homer Hadley (Interstate I-90) Floating Bridge Draft Structural Feasibility Study of Light Rail Conversion and is available through Sound Transit.

Appendix B – Trans-Lake Washington Project: Sound Transit Memo re: Trans-Lake Alternatives Recommendation (November 2001)

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PROJECT: A52002A
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ADMINISTRATIVE RECORD

DRAFT MEMO

November 15, 2001

TO: Sound Transit Boardmembers and Directors

FROM: Barbara Gilliland, Program Manager

SUBJECT: Trans-Lake Transit Alternatives Recommendation

The Trans-Lake project is in a screening phase to define and select alternatives to be analyzed in a SR 520 EIS. In early 2002, the Trans-Lake Executive Committee, Sound Transit Board, and the Washington State Transportation Commission will need to select which transit alternatives to carry into the SR 520 EIS.

The Board may elect to retain the current Sound Transit Long-Range Vision, including rail in the I-90 corridor, or to examine greater levels of transit investment in the SR 520 corridor – enhanced bus service, a BRT/HOV system, and/or a SR 520 fixed guideway investment.

Recommendation

Staff recommends that the Sound Transit Long-Range Vision be revised to add a BRT/HOV system to the SR 520 corridor. We recommend retaining I-90 as the corridor for a potential rail extension across Lake Washington.

Improved Trans-Lake bus operations should continue to be a priority

In the near term improved bus service is the most cost-effective way to increase Trans-Lake transit ridership. Sound Transit currently operates three regional bus routes in the SR 520 corridor and two routes in the I-90 corridor. Service frequencies and hours of operation on these routes will be improved over the next five years with implementation of the Regional Express service plan.

Implementation of the I-90 two-way transit project would provide the first reliable two-way transit corridor across Lake Washington and help support the projected doubling of Trans-Lake transit ridership over the next 20 years. Adding a BRT/HOV lane to the SR 520 corridor across Lake Washington would also provide a substantial benefit to transit service. It would remove buses from general purpose congestion thereby lowering bus operating costs and provide a faster and more reliable commute for bus passengers.

Design the SR 520 HOV Lane for BRT Operation

The SR 520 BRT/HOV lane should continue to include a 4' buffer to improve bus/HOV reliability. Such a buffer appears to offer the potential of shielding bus service from the effects of incidents and congestion in the general purpose lanes, at a lower cost and with less right-of-way than would be required for a barrier separated HOV lane. HOV direct access connections should be

SoundTransit

DRAFT MEMO

studied at the University District, South Kirkland, I-405 and Overlake. Additionally, the design should continue to replace the function provided by the current flyer stops at Montlake, Evergreen Point, and Yarrow Point. The South Lake Union busway connection should not be advanced further due to the cost, impacts, and capacity constraints of the alternative. However, connections to/from the I-5 reversible express lanes should be included.

Long-term buses face capacity constraints in Seattle and University District

The Trans-Lake no-action alternative in 2020 approaches the estimated bus operating capacity for transit on downtown Seattle surface streets. To address long term Trans-Lake transit demand a higher capacity transit system than the BRT/HOV system will eventually be needed. Providing one rail and one bus corridor across the Lake would meet this need by providing substantial opportunities for bus restructuring on the Eastside.

I-90 remains the preferred crossing for a Trans-Lake rail line

An I-90 rail crossing of Lake Washington is preferable to an SR 520 crossing for several reasons:

- An I-90 rail line would provide better service within the Eastside, because rail lines from Kirkland and Redmond would travel through downtown Bellevue before crossing Lake Washington.
- An I-90 rail line has similar ridership to a SR 520 crossing with capital costs $1.8 billion to $2.3 billion lower.
- An I-90 rail line provides for better rail system operations through downtown Seattle by balancing high passenger demand from the north with the demand from the south and east.

The long-term capital costs of a SR 520 crossing are higher than an I-90 crossing because it requires building a new rail corridor between downtown Seattle and SR 520. A SR 520 rail line could not be merged with the Central Link line because the long-range ridership demand north of downtown Seattle is too high to accommodate both a future light rail extension into Snohomish County and an extension to the Eastside in the SR 520 corridor.

If light rail where extended across Lake Washington in the SR 520 corridor and the Central Line were extended north into Snohomish County, the combined volumes on these two lines would approach 14,000 passengers per hour in 2020. This demand could be accommodated in 2020 by running trains every 2 minutes through downtown Seattle using four car trains north of the University District. However, with this operations pattern, there would be very little capacity for growth beyond 2020, because trains would already be operating at their maximum length and frequency.

Concerns have been raised over the last year few years about the feasibility of converting the I-90 center roadway to light rail. These concerns have included questions about the structural ability of the I-90 floating bridge to support light rail and questions about the traffic impacts of converting the center roadway to transit usage. To address these concerns the Trans-Lake project conducted additional analysis this summer and concluded that:

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- The Homer Hadley bridge can structurally accommodate LRT with modest strengthening measures
- The traffic impacts of placing LRT in the I-90 center lanes are much less severe than identified in previous Trans-Lake analysis due to the addition of an HOV lane to the outer roadway
- In a worst case scenario, the cost of building a light rail only bridge in the I-90 corridor appears to be less than the cost of a new rail corridor between downtown Seattle and SR 520.

<u>520 HCT ROW Preservation</u>

The question has also been raised as to whether two rail corridors would ever be needed across Lake Washington. Demand analysis indicates that in 2020 with full implementation of the Sound Transit Long-Range Vision a rail line across Lake Washington would carry approximately 4,500 passengers per hour in the peak direction. The capacity of a rail line in the I-90 corridor would be over 8,000 passengers per hour per direction. Thus, a single rail line across Lake Washington would well exceed projected demand and allow for substantial future growth.

Some Trans-Lake Executive Committee members have suggested that Trans-Lake is a 50-100 year decision and irrespective of the 2020 demand estimates the corridor should be design to accommodate a future transitway. A 50-100 year time period is beyond the range of reasonable technical analysis. However, to help support a discussion of this policy issue the Trans-Lake project team is now examining the EIS implications of preserving, accommodating or not precluding transit ROW in the SR 520 corridor.

Some preliminary staff discussion of this issue has raised issues with the number of alternatives likely to be needed in the EIS as well as legal questions about purchasing ROW for a future use. The project team will be prepared to provide information on what affect this issue has on the EIS and the project.

Appendix C – Trans-Lake Washington Project: Summary of HCT Screening Process (2002) (forthcoming)

Trans-Lake Washington Project

Summary of HCT Screening Process: Evaluations and Recommendations

Prepared for

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ACRONYMS

BR	basic rail
BRT	bus rapid transit
CBD	central business district
DMU	diesel multiple unit
DSTT	downtown Seattle transit tunnel
EIS	environmental impact statement
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GP	general purpose
HCT	high-capacity transit
HOV	high-occupancy vehicle
LR	light rail
LRT	light rail transit
LRV	light rail vehicle
O&M	operation and maintenance
PSRC	Puget Sound Regional Council
PSTC	Puget Sound Transit Consultants
TCRP	Transit Cooperative Research Program
TDM	transportation demand management
VHT	vehicle hours of travel
VMT	vehicle miles of travel
WSDOT	Washington State Department of Transportation

1. INTRODUCTION

The purpose of this report is to summarize the analyses that have been conducted as part of the Trans-Lake Washington Project regarding high-capacity transit (HCT) and bus rapid transit (BRT) on the SR 520 and I-90 corridors. This report focuses on the first- and second-level screening for the project. These screening efforts evaluated transportation effectiveness, environmental impacts, and estimated costs of potential alternatives. A summary of these analyses and the resulting recommendations are shown in Table 1. This report also places these analyses in the context of other regional planning processes and I-90 studies that have informed the Trans-Lake Washington Project.

The report is organized by the following sections:

Planning Context

- Sound Transit Long-Range Vision and System Plan
- Trans-Lake Washington Study

Simultaneous Planning Projects

- I-90 Two-Way Transit and HOV Operations Project
- I-405 Corridor Program and Plan
- Central Link Light Rail Transit Project

Trans-Lake Washington Project

- First-level Screening Evaluation
- First-Level Screening: HCT Modal Evaluation
- Second-Level Screening: Multi-Modal Evaluation

Supplemental Trans-Lake Washington Studies

- High-Capacity Technology Options
- I-90 Structural Feasibility Study for Light Rail Conversion
- I-90 Structural Analysis Study for Light Rail Conversion
- I-90 Separate Bridge Crossing Evaluation
- Transportation Forecast Sensitivity Results
- Accommodating High-Capacity Transit in the SR 520 Corridor
- 2030 Transit System Definition

References and Bibliography

Table 1
Trans-Lake Washington Project Analytical Stages

Documentation	Recommendations
Alternatives from Trans-Lake Washington Study and Scoping—October 1999	
Trans-Lake Washington Study Overview	The Study Committee made the following recommendations regarding HCT: • Passenger ferry options across Lake Washington (a separate study on cross-lake ferry service was performed by Sound Transit) • EIS should evaluate the following combination of SR 520 improvements: - One HOV lane in each direction - One HOV lane in each direction and high-capacity transit - One HOV lane in each direction and one general purpose lane in each direction - One HOV lane in each direction, high-capacity transit, and one general purpose lane in each direction • EIS should also evaluate for SR 520 a No Action alternative and a Minimum Footprint alternative (maintain existing four lanes while improving transit, HOV, and bicycle/pedestrian access, and providing a median barrier and minimum roadway shoulders). • During EIS process specify locations of additional lanes, necessary modifications to I-5 and I-405 interchanges, potential reconfigurations of aerial connections to SR 520, and qualification of SR 520 as best cross-lake high-capacity transit route. • Continue to study Sound Transit's proposal to establish two-way HOV transit operation on I-90. • Preference should be placed on high-capacity transit in the SR 520 corridor.

Table 1
Trans-Lake Washington Project Analytical Stages

Documentation	Recommendations
First Level Screening Analysis—October 2000-May 2001	
A. Identification and evaluation of potential alignment corridors: • Preliminary Definition of Alternatives for First Level Screening (Project Team, September 28, 2000) • First Level Screening Evaluation Results—Technical Steering Committee Review Draft with Comments (Project Team, October 12, 2000). The evaluation was based on three factors of transportation effectiveness (ridership potential, reliability/system capacity, and system and plan compatibility), five critical types of environmental impacts, and a qualitative cost comparison.	The Executive Committee made the following recommendations: • Continue to analyze: - Alternative C1—HCT in SR 520 Corridor - Alternative C2—HCT in I-90 Corridor - Alternative C3—HCT in Mid-Lake Corridor (between SR 520 and I-90) • Do not analyze further: - Alternative C4.2—New North Lake Corridor: Sand Point Juanita Kirkland - Alternative C4.1—New North Lake Corridor: Madison to Kirkland Alternatives C4.1 and C4.2 were eliminated because of their potential high costs and uncertain feasibility.
B. Evaluation of HCT within selected alignment corridors that considered two types of transit: fixed guideway and bus rapid transit. The evaluation was based on conceptual costs for major elements and more specific transportation effectiveness measures and a greater number of environmental elements than the initial step of the first-level analysis. The purpose of the screening was to determine which alternatives performed the best and should be analyzed further in the multi-modal evaluation. The Project Team prepared the following documents for this evaluation: • High-Capacity Transit Modal Evaluation Initial Findings (March 9, 2001) • High-Capacity Transit Modal Evaluation: Transportation, Environmental, and Cost Findings (April 10, 2001) • Definition of HCT Alternatives for Modal Evaluation (April 11, 2001) • Environmental Analysis: Appendix B to HCT Alternatives Evaluation Report (May 10, 2001)	The Executive Committee made the following recommendations: • Exclude the following HCT modal alternatives or elements from the multi-modal alternatives: - Bus-only lanes - Mid-lake crossing - Pure BRT alternatives • The HCT modal alternatives were packaged into the following multi-modal alternatives: - Alternative 2—SR 520 Safety and Preservation with I-90 LRT - Alternative 3—SR 520 HOV with I-90 LRT - Alternative 4—SR 520 HOV and GP with I-90 LRT - Alternative 5—SR 520 HOV and HCT - Alternative 6—SR 520 HOV and GP and HCT - Alternative 7—SR 520 HOV with BRT Connections - Alternative 8—SR 520 HOV with BRT Connections and GP

Table 1
Trans-Lake Washington Project Analytical Stages

Documentation	Recommendations
Second-Level Screening Analysis—April 2001-January 2002	
The Second-Level Screening Analysis examined the multi-modal alternatives. Like the first-level analysis, the second-level analysis looked at transportation performance, environmental impacts, and costs; however, the analysis was to a greater level of detail. The Project Team prepared the following documents for this evaluation: • Preliminary Definition of Multi-Modal Alternatives for Second Level Screening. (May 14, 2001) • Multi-Modal Alternatives Evaluation Report, (June 6, 2001) • Multi-Modal Alternatives Evaluation – Environmental Findings (June 7, 2001) • Final Multi-Modal Cost Methodology and Multi-Modal Cost Opinions for Alternative Analysis (July 11, 2001) The Multi-Modal Alternatives Evaluation Report was updated to include all elements of the analysis as well as additional information (April 12, 2002).	The Executive Committee made the following recommendations for the alternatives to be considered in a Draft EIS: • Carry forward the No Action alternative. • Continue to analyze the four-lane safety and preservation alternative. • Examine the six-lane SR 520 alternative with a combined HOV/BRT lane (with and without an additional Montlake Cut crossing). • Carry forward the eight-lane SR 520 alternative that consists of three GP lanes and one HOV/BRT lane with a 4-foot buffer. • Support the current Sound Transit Long-Range Vision that places fixed guideway transit in the I-90 corridor, and support inclusion of BRT for the SR 520 corridor in Sound Transit's Long-Range Vision. Consider whether the SR 520 alternatives should include provisions to accommodate HCT within the SR 520 corridor in the distant future.
Refinement of Draft EIS Alternatives—February 2002-September 2002	
Based on the recommendations of the Executive Committee at the conclusion of the Second-Level Screening analysis, the Project Team examined options for accommodating a future HCT alignment in SR 520 corridor. The HCT accommodation report (Accommodating High-Capacity Transit in the SR520 Corridor [July 29,2002]) examined four possible scenarios: (1) no HCT accommodation; (2) HCT accommodation on the floating bridge, approach structures, and the lid located at Evergreen Point Road; (3) HCT Accommodation on entire lake crossing, same as scenario 2, plus adjustments to key structures east of the Evergreen Point lid. (4) HCT Envelope Preservation between Montlake Boulevard in Seattle and the Redmond terminus.	Following the completion of the HCT Accommodations Report, the Executive Committee acted on the Preliminary Preferred Alternative, which included selection of an HCT accommodation scenario. The Executive Committee recommended a six-lane option with expandability for HCT only. This option would reconstruct the SR 520 corridor from I-5 to SR 202, providing a continuous corridor for two general purpose lanes and one HOV lane in each direction. Other improvements would occur within the corridor and to I-5 south of SR 520. The floating bridge and fixed approaches would be designed to allow a future widening of 30 feet to accommodate HCT only.

2. PLANNING CONTEXT

The Trans-Lake Washington Project is being conducted within the context of existing transportation plans and ongoing planning projects. These plans and projects have helped to shape the decisions made in defining and analyzing the alternatives considered for the Trans-Lake Washington Project. The plans and projects discussed in this section are Sound Transit's *Regional Transit Long-Range Vision* (Long-Range Vision; Sound Transit, May 1996a) and *Ten-Year Regional Transit System Plan* (System Plan; Sound Transit, May 1996b), and the Trans-Lake Washington Study.

2.1 SOUND TRANSIT LONG-RANGE VISION AND SYSTEM PLAN

In May 1996, the Central Puget Sound Regional Transit Authority (Sound Transit) adopted its Long-Range Vision and System Plan. These two documents represent the culmination of years of intensive planning and public involvement, and present Sound Transit's proposal for an HCT system in urban King, Pierce, and Snohomish counties.

2.1.1 Long-Range Vision

As stated in the Long-Range Vision, Sound Transit foresees a combined rail and regional express bus system. The vision is to expand the capacity of the region's major transportation corridors by adding new high-capacity transportation services and facilities. In addition to increasing the people-carrying capacity of the region's most heavily used transportation corridors, the system would also support growth management policies, limit sprawl, and provide mobility needed for a vital economy. The Long-Range Vision includes a mix of transportation improvements—high-occupancy vehicle (HOV) expressways, regional express bus routes, commuter rail, and light rail. The vision includes community "gateways"—connections in urban and suburban areas for communities to link with the rest of the region. The Long-Range Vision also includes support services and facilities needed to put such a system in place.

Of particular relevance to the Trans-Lake Project, the Long-Range Vision map identifies an east-west light rail extension across Lake Washington from the main north-south Central Link line (Figure 1). This extension is proposed to use the I-90 floating bridge across Lake Washington, with branch lines on the east side serving Bellevue, Redmond, Kirkland, and Issaquah. Both the I-90 and SR 520 floating bridges would serve regional express bus routes across Lake Washington.

It was within this planning context that in 1998 the Trans-Lake Washington Study began looking at options to address mobility concerns across and around Lake Washington. Sound Transit was particularly interested in either confirming I-90 as the preferred cross-lake corridor to serve the east side or defining a better crossing location, which would require an update to the Long-Range Vision.

2.1.2 System Plan

To move toward implementation of the Long-Range Vision in the short term (10 years), the System Plan features a network of frequent, convenient, and dependable services that can be used with a single ticket; the services are tailored to the unique needs of the diverse subareas within the region. The 1996 System Plan map identifies a mix of facilities across Lake Washington within the SR 520 and I-90 corridors (Figure 2). On SR 520, the System Plan map shows regional express bus service. On I-90, the facilities shown on the System Plan map include an HOV expressway, regional express bus service, and a flyer stop and direct access ramp in conjunction with a Mercer Island park-and-ride lot.

2.2 TRANS-LAKE WASHINGTON STUDY

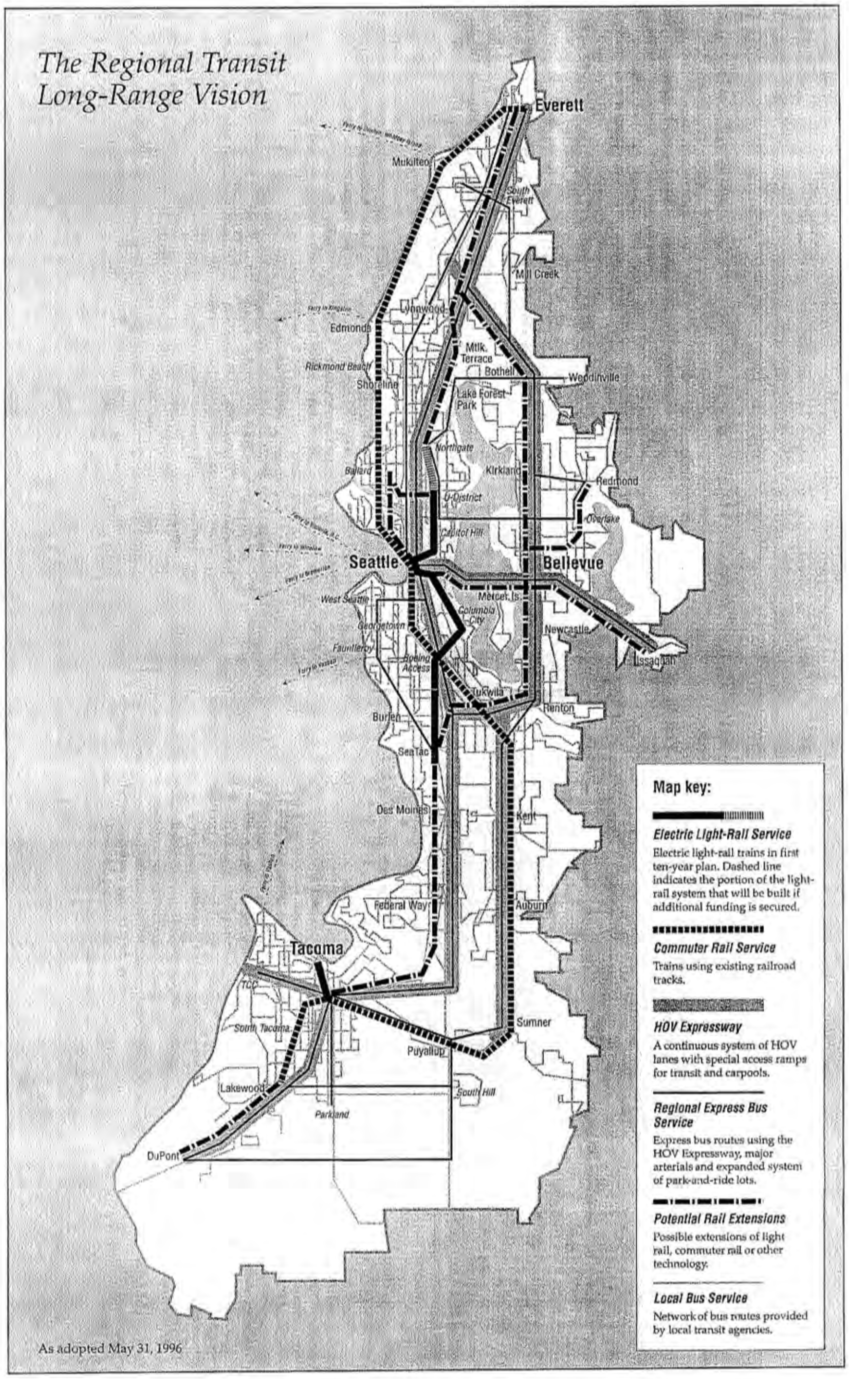
The Trans-Lake Washington Study, the precursor to the Trans-Lake Washington Project, was conducted between May 1998 and July 1999 to identify a set of reasonable and feasible solutions to improve mobility across and/or around Lake Washington. Although the study was motivated by congestion on SR 520, improvements were considered within an area from I-90 on the south to SR 522 on the north, and from west of I-5 to the eastern end of SR 520. A 47-person committee (composed of local governments and neighborhood, business, and advocacy interests) was created in May 1998 to recommend a set of solutions.

To develop the solutions, a three-step process was followed. The first step was to develop a problem statement to set the parameters for the study and the criteria to be used in assessing solutions. The second step was to identify and evaluate specific concepts for improving mobility, and—in a parallel effort—options for minimizing environmental impacts. The final step was to bring together transit and roadway options, demand management, nonmotorized improvements, and environmental mitigation concepts into a set of integrated solutions.

The committee identified four problems that Trans-Lake solutions should address. These problems, which exist today and will become more critical in the future, are summarized below:

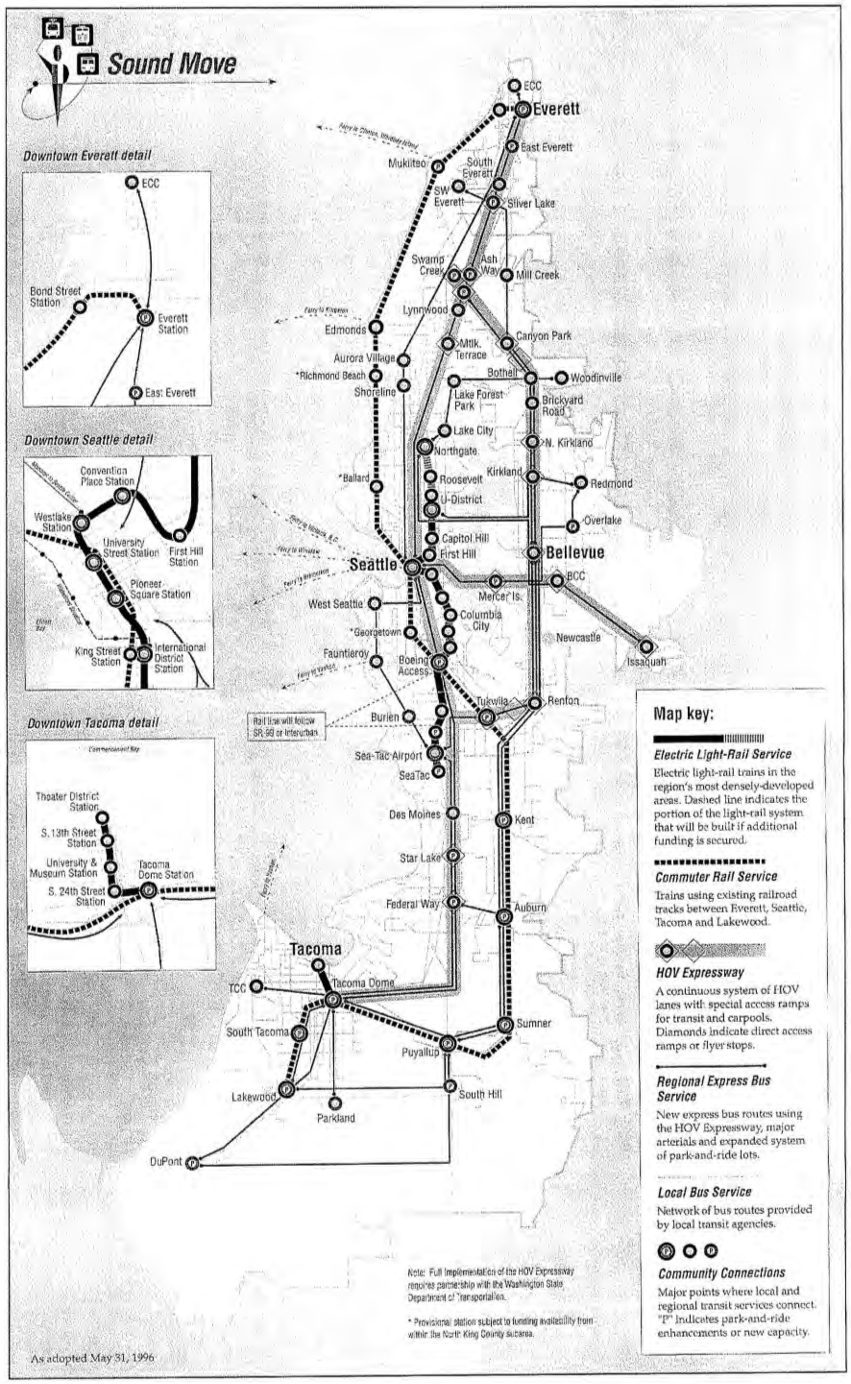
- Land use and transportation systems are not integrated in their planning and implementation.
- The transportation system suffers from extensive congestion.
- Reliability and safety of the system are impaired.
- Neighborhoods, business centers, and the environment are impacted by congestion.

The next step in developing solutions was to provide the building blocks: individual actions, programs, or projects that could contribute to improving mobility. The ideas generated went far beyond expanding existing bridges—they included car and passenger ferries, brand-new crossings on bridges or submerged tubes, many HOV and transit options (including various rail technologies), demand management measures, and land use changes.



Trans-Lake Washington Project
Summary of HCT Screening Process

Figure 1
TRANS-LAKE WASHINGTON PROJECT
Sound Transit's Regional Long-Range Vision



Trans-Lake Washington Project
Summary of HCT Screening Process

Figure 2
TRANS-LAKE WASHINGTON PROJECT
Sound Transit's Ten-Year System Plan

Based on the individual mobility concepts, draft solution sets (shown in Figure 3) were developed to address the full range of Trans-Lake issues. Briefly, the draft solution sets were as follows:

- No Action: Combined limited transit and HOV lane improvements with moderate TDM measures and improvements to bike and pedestrian facilities.
- MTP 98: Closely followed the elements of the Puget Sound Regional Council's (PSRC's) 1998 Metropolitan Transportation Plan (MTP 98), which focuses on concentrating housing and employment in activity centers served by transit and HOV systems as a way to minimize congestion.
- MTP Flipped: Similar to MTP 98, but MTP Flipped included rail transit on SR 520 instead of I-90 as proposed as part of MTP 98.
- Roadway/Rail: Emphasized rail connections to the Eastside, including a light rail line on SR 520.
- New Crossing: Featured a new Lake Washington bridge from Sand Point to Kirkland, with arterial connections on either side of the lake.
- Roadway/Bus: Focused on roadway capacity for single-occupant vehicles and freight, with buses as the primary mode of transit, and included a new crossing connecting I-405 and I-5.
- Maximize Alternatives: Sought to increase "alternative choices for mobility by focusing on aggressive land use changes and transportation pricing, increased use of rail, and HOV system improvements.

The draft solution sets were evaluated in terms of transportation effectiveness, environmental impacts, and costs to identify the best overall components. The results of the evaluation are portrayed graphically in Figure 4.

Based on the results of the evaluation, the study committee provided recommendations regarding community enhancement and mitigation, improvements in specific corridors (SR 522, Kirkland/Sand Point, SR 520, and I-90), HCT, and transportation demand and system management. The following lists verbatim the committee's recommendations pertaining to HCT.

- *Recommendations for SR 522*
  - *Transit lanes, signal priority, bicycle, pedestrian and safety improvements along SR 522, as called for by the SR 522 Multimodal Corridor study, and east-west connectors to and from I-5, as appropriate, should be implemented.*

	SR 522	Sandpoint/ Kirkland	SR 520	I-90	All
No Action	Limited transit lane improvements	No Action	East of 104th has one HOV lane each way; Westbound HOV lane from 104th remains the same	Keep as is; Reversible express lanes stay in place	Moderate TDM / Improve bike and pedestrian facilities
MTP 98	Transit lanes in several segments; Signals with transit priority	No Action	Add HOV each way; Consider adding transit-only lane each way	Seattle / Bellevue / Overlake light rail route replaces center lanes; No other modes allowed in centerlanes	Aggressive TDM / Improve bike and pedestrian facilities
MTP Flipped	Transit lanes in several segments; Signals with transit priority	No Action	Add HOV each way; Light rail from Seattle/University District/Bellevue/ Overlake uses SR 520 crossing	Center roadway would provide 2-way continuous HOV operations	Aggressive TDM / Improve bike and pedestrian facilities
Roadway/Rail	Transit lanes in several segments; Signals with transit priority	No Action	Add one General Purpose lane each way. Light rail from Redmond to University District to Ballard uses SR 520 crossing and is generally along SR 520 to Redmond	Seattle / Bellevue / Totem Lake light rail route replaces center lanes; No other modes allowed in center lanes	Aggressive TDM / Improve bike and pedestrian facilities
New Crossing	Transit lanes between I-405 & SR 523; Signals with transit priority on SR 522 & SR 523	Kirkland / Sandpoint arterial – a new 4-lane bridge connecting Sandpoint Way to NE 124th in Kirkland; Light rail route from Redmond to University District would use new crossing	Add HOV lane each way	Seattle / Bellevue / Redmond light rail route replaces center lanes; No other modes allowed in center lanes	Aggressive TDM / Improve bike and pedestrian facilities
Roadway/Bus	Add HOV lanes from I-405 to SR 523. Add HOV lanes on SR 523	Two General Purpose lanes and one HOV lane from I-5 to I-405 each way on a new floating bridge (tunnels connect bridge to I-5 and I-405); Kirkland to Sandpoint bus ferry	Add one HOV lane each way; Add one General Purpose lane each way	Center lanes provide continuous 2-way HOV operations	Aggressive TDM / Improve bike and pedestrian facilities
Maximize Alternatives	Transit lanes in both directions; Signals with transit priority	Kirkland/Montlake passenger-only ferry	One lane each way is converted to HOV	Seattle/Bellevue/ Redmond light rail route replaces center lanes; No other modes allowed in center lanes	Very Aggressive TDM / Improve bike & pedestrian facilities; Congestion pricing/ tolls on trans-lake crossings

Trans-Lake Washington Project
Summary of HCT Screening Process
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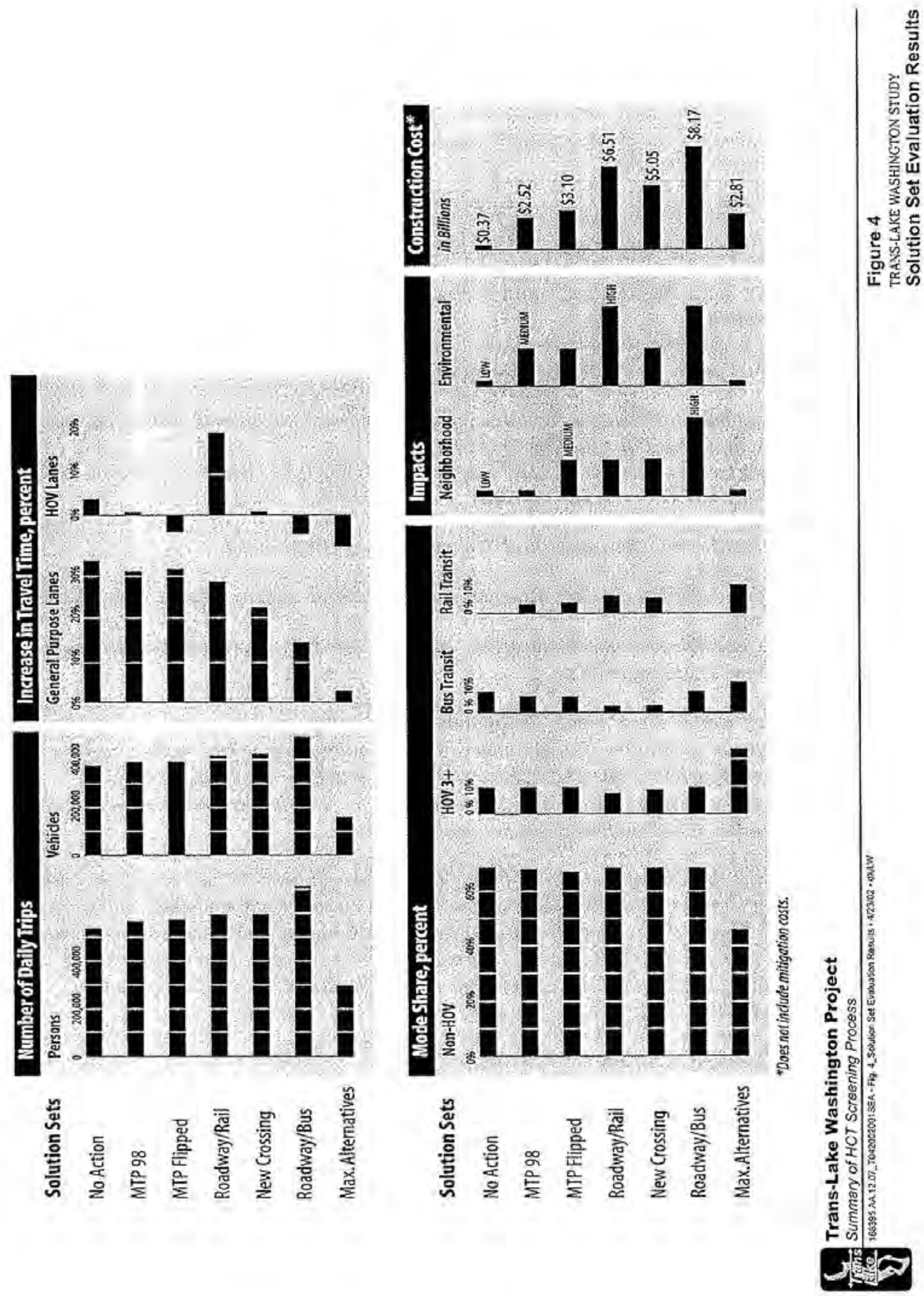
Figure 3
TRANS-LAKE WASHINGTON STUDY
Draft Solution Sets


Solution Sets
No Action
MTP 98
MTP Flipped
Roadway/Rail
New Crossing
Roadway/Bus
Max. Alternatives
Number of Daily Trips
Persons
Vehicles
Increase in Travel Time, percent
General Purpose Lanes
HOV Lanes
Mode Share, percent
Non-HOV
HOV 3+
Bus Transit
Rail Transit
Impacts
Neighborhood
Environmental
LOW
MEDIUM
HIGH
Construction Cost*
In Billions
$0.37
$2.52
$3.10
$6.51
$5.05
$8.17
$2.81
*Does not include mitigation costs.
Trans-Lake Washington Project
Summary of HCT Screening Process
Figure 4
TRANS-LAKE WASHINGTON STUDY
Solution Set Evaluation Results

- *Recommendations for the Kirkland/Sand Point Corridor. . . .*
  - *The committee has examined the possibility of a third Trans-Lake crossing from the Kirkland to Sand Point areas, but does not recommend that a new crossing be evaluated in the EIS.*
  - *The Trans-Lake Study showed that car or bus ferries would have significant impact at loading points, and passenger-only ferries would not substantially enhance people-moving capacity. The committee recommends, however, that passenger ferry options across Lake Washington should be studied further, with emphasis on private operation.*
- *Recommendations for the SR 520 Corridor. . . .*
  - *The EIS should evaluate the following combinations of additional transportation elements in each direction on SR 520:*
    - *One HOV lane in each direction*
    - *One HOV lane in each direction and high-capacity transit*
    - *One HOV lane in each direction and one general purpose lane in each direction*
    - *One HOV lane in each direction, high-capacity transit, and one general-purpose lane in each direction*
  - *These combinations should be evaluated along with a No Action and a Minimum Footprint alternative. The Minimum Footprint alternative would include maintaining the existing four lanes while improving transit and HOV access to SR 520, bicycle/pedestrian access, and providing for a median barrier and minimum roadway shoulders while maintaining a minimal footprint.*
  - *During the EIS process, each of these options should be more fully specified. Those specifications would identify where added lanes would begin and end, whether the SR 520 corridor is the best route for a cross-lake high-capacity transit route, whether and how I-5 and I-405 freeway interchanges to SR 520 should be modified, and whether and how arterial connections to SR 520 should be modified, added, or removed.*
- *Recommendations for the I-90 Corridor*
  - *There should be continued study of Sound Transit's proposal to establish two-way HOV/transit operation on I-90. I-90 should remain convertible to include HCT in the future. . . .*

- *Recommendations for High-Capacity Transit*
  - *Preference should be placed on high-capacity transit in the SR 520 corridor. In the event that technical constraints limit consideration of high-capacity transit as an integral SR 520 structural component, other alignments, including an exclusive right-of-way for high-capacity transit, should be considered. Provision of high-capacity transit does not eliminate the need for other Trans-Lake improvements, and implementation of high-capacity transit should not result in reduced Trans-Lake HOV capacity overall. . . .*

These recommendations were made by the Trans-Lake Washington Study Committee on July 16, 1999, and were carried forward into the subsequent Trans-Lake Washington Project.

3. SIMULTANEOUS PLANNING PROJECTS

As planning and development of the Trans-Lake Washington Project continues, other transportation projects are also in the planning stages. As the project progresses, compatibility with these other projects must be taken into consideration. The following briefly describes the projects of import: the I-90 Two-Way Transit and HOV Operations Project (I-90 Two-Way Transit project), the I-405 Corridor Program and Plan, and the Central Link Light Rail Transit Project.

3.1 I-90 TWO-WAY TRANSIT AND HOV OPERATIONS PROJECT

Sound Transit's proposed I-90 Two-Way Transit project would improve regional transit service by providing reliable two-way transit service on I-90 between Seattle and Bellevue. Congestion on I-90 slows traffic between Bellevue and Seattle. As described in the *I-90 Two-Way Transit and HOV Scoping Report* (Sound Transit, February 2002), up to 40 percent of buses run late on eastbound service in the morning, and 60 to 65 percent run late on westbound service in the evening because they are forced to use the general purpose (GP) lanes on the outer roadways. If buses run late, customers miss connections and do not view buses as reliable transportation to work, school, or other activities. Sound Transit intends to provide high-quality transit service that is responsive to ridership demands and maintains reliable service and efficient travel times.

Sound Transit began to identify alternatives to address I-90 transit delays in 1998. Sound Transit, and the other lead agencies (Washington State Department of Transportation [WSDOT], Federal Highway Administration [FHWA], and Federal Transit Administration [FTA]) held scoping meetings for an environmental impact statement (EIS) in December 2001. The draft EIS is expected to be published by late 2002. Six alternatives are currently being considered: one no-build and five build alternatives. (The alternatives are not considered final, and may change prior to publication of the draft EIS.) The build alternatives would all improve transit travel times and reliability compared to the no-build (do nothing) scenario. However, each alternative would have varying effects on other users of the I-90 corridor between Seattle and Bellevue, such as single-occupant vehicles, freight, bicycles, and pedestrians.

None of the alternatives being considered would widen I-90 outside of the existing right-of-way. With some of the alternatives, minor roadway widening would occur on Mercer Island and in Seattle, in conjunction with reconfiguration of lane and shoulder widths throughout the corridor. The I-90 floating bridges would not be significantly widened in any of the alternatives being considered. Instead, lane and shoulder widths would be reconfigured, and widening would be evaluated to retain the bicycle/pedestrian path on the Homer M. Hadley (westbound) floating bridge at its existing width.

The I-90 Two-Way Transit project is a short-term solution to improving regional transit service. As noted in the discussion of Sound Transit's Long-Range Plan, light rail transit (LRT) is the long-term future envisioned for the I-90 lake crossing. The Trans-Lake Washington Project is evaluating this vision for I-90 LRT, and has taken into consideration the effects the I-90 Two-Way Transit project would have on the transportation performance of the Trans-Lake

Washington Project multi-modal alternatives (see "Transportation Forecast Sensitivity Results" in Section 5 of this report).

3.2 I-405 CORRIDOR PROGRAM AND PLAN

In mid-1999, WSDOT undertook the I-405 Corridor Program, which applies to the entire corridor, from Tukwila to Lynnwood. The purpose of the program was to identify, evaluate, and develop a consensus on a preferred strategy to meet the transportation needs of the corridor for the next 20 years (WSDOT 2002a). Over the next 2 years, the Project Team and committees explored options and prepared an EIS. In November 2001, the I-405 Corridor Program's Executive Committee reached an agreement on a comprehensive strategy to reduce traffic congestion and improve mobility and safety; this decision is based on a draft EIS. The I-405 Plan identifies an efficient, integrated, and comprehensive system of investments for all transportation users. The plan will do the following:

- Add as many as to two lanes in each direction to I-405, including HOV freeway-to-freeway ramps at all interchanges.
- Implement a corridor-wide BRT system by adding new transit stations and building new park-and-ride lots, including some in the SR 520 and I-90 corridors
- Create the potential for a high-capacity transit system in the central eastside area
- Fix bottlenecks at key locations such as the I-90 and SR 520 interchanges
- Create 1,700 new vanpools and develop other demand management strategies (WSDOT 2002b)

The improvements for I-405 are being taken into consideration for the traffic forecasting for the Trans-Lake Washington Project, as well as for the design of the I-405/SR 520 interchange.

3.3 CENTRAL LINK LIGHT RAIL TRANSIT PROJECT

The Central Link Light Rail Project is a 21-mile light rail line that will connect the Cities of Seattle, Tukwila, and SeaTac. In November 1999, the *Central Link Light Rail Transit Project Final Environmental Impact Statement* was released by Sound Transit. Following its issuance, the Sound Transit Board selected alignments, station locations, and a maintenance base site (original project). Since then, the project has been refined.

In November 2001, the *Central Link Light Rail Transit Project Final Supplemental Environmental Impact Statement—Tukwila Freeway Route* was issued by Sound Transit, which evaluated a new alternative for the portion of the project located between south Seattle and Tukwila. The Sound Transit Board has decided to develop the Central Link Project in segments. The first segment will provide light rail service over a 14-mile alignment from Convention Place in downtown Seattle to South 154th Street near Seattle-Tacoma International Airport (Initial

Segment). The Initial Segment will follow the original project alignment between Convention Place and the Boeing Access Road, and will follow the Tukwila Freeway Route from the Boeing Access Road to South 154th Street.

Westlake Station will serve as the northern passenger terminus for the Initial Segment. Convention Place will serve as the northern rail terminus. The Initial Segment will provide for joint bus/rail operations in the downtown Seattle transit tunnel. Construction of the Initial Segment will begin in 2002 and light rail service will commence in 2009.

Over the next 2 years, Sound Transit is also undertaking further study of alternatives for the north segment, from downtown Seattle to Northgate, in a supplemental EIS. Some of these alternatives cross very close to the improvements proposed for the Trans-Lake Washington Project in the Montlake and University District neighborhoods, and will require close coordination as the two projects move forward. Construction to the north of downtown is expected to start as early as 2006 and passenger service is expected to begin in late 2012.

The transportation performance of the Trans-Lake Washington Project HCT alternatives is tied to the compatibility of the alternatives with the Central Link Project. For example, the capacity of the Central Link light-rail line north of downtown Seattle may not be large enough to accommodate riders transferring from a light-rail line in the SR 520 corridor.

4. TRANS-LAKE WASHINGTON PROJECT

In May 2000, the Trans-Lake Washington Study Committee recommended a multi-modal solution for improving mobility across Lake Washington. The purpose of the Trans-Lake Washington Project is to evaluate further and refine the recommendations made by the Study Committee with the intent of identifying a set of feasible alternatives to be evaluated in an EIS, to prepare the EIS, and to decide what to design, build, and implement as supporting programs. The Trans-Lake Washington Project evaluation has considered which highway corridor and lake crossing would be optimal for fixed guideway transit and for BRT, potential eastside and westside routes for HCT and BRT, the number and configuration of lanes and other interchanges along SR 520, and transportation demand management (TDM) strategies. The Trans-Lake Washington Project completed its evaluation of the Study Committee's recommendations in late 2001 and, in January 2002, identified alternatives for analysis in an EIS.

The Trans-Lake Washington Project established a two-level screening process to select alternatives for evaluation in an EIS (Figure 5). The first-level screening analysis had two stages. The first examined potential alignment corridors. Based on the selected corridors, the second stage looked at alternatives for the two transportation modes, highway/HOV and transit, separately. The alternatives were evaluated in terms of transportation effectiveness, environmental impacts, and costs. Based on the results of the modal analysis, multi-modal alternatives were developed, pulling together the best modal elements. The second-level analysis evaluated the alternatives for the same factors as the first-level analysis in greater detail. The results of these analyses are presented below.

The Trans-Lake Washington Project is complex, requiring the support and involvement of multiple agencies (highway; transit; local governments; and state and federal agencies). WSDOT, Sound Transit, FHWA, and FTA are the lead agencies for the Trans-Lake Washington Project. As with the Trans-Lake Washington Study, public involvement is critical to the success of the project. Three committees guide the project—the Executive Committee (elected officials from affected communities and agency officials), the Technical Committee (technical staff from local jurisdictions and transportation and regulatory agencies), and the Advisory Committee (community representatives, businesses, and interest groups). The committees are involved with developing alternatives for evaluation in an EIS, recommending a preferred alternative to the implementing agencies, and helping to address the need for cooperation, communication, and public involvement. The Technical and Advisory Committees advise and make recommendations to the Executive Committee, which makes final recommendations to the lead agencies regarding how the project should progress.

4.1 FIRST-LEVEL SCREENING ANALYSIS

The results of the first-level screening analysis are presented in *First-Level Screening Evaluation Results-Technical Steering Committee Review Draft with Comments* (Trans-Lake Washington Project Team [Project Team], October 12, 2000).

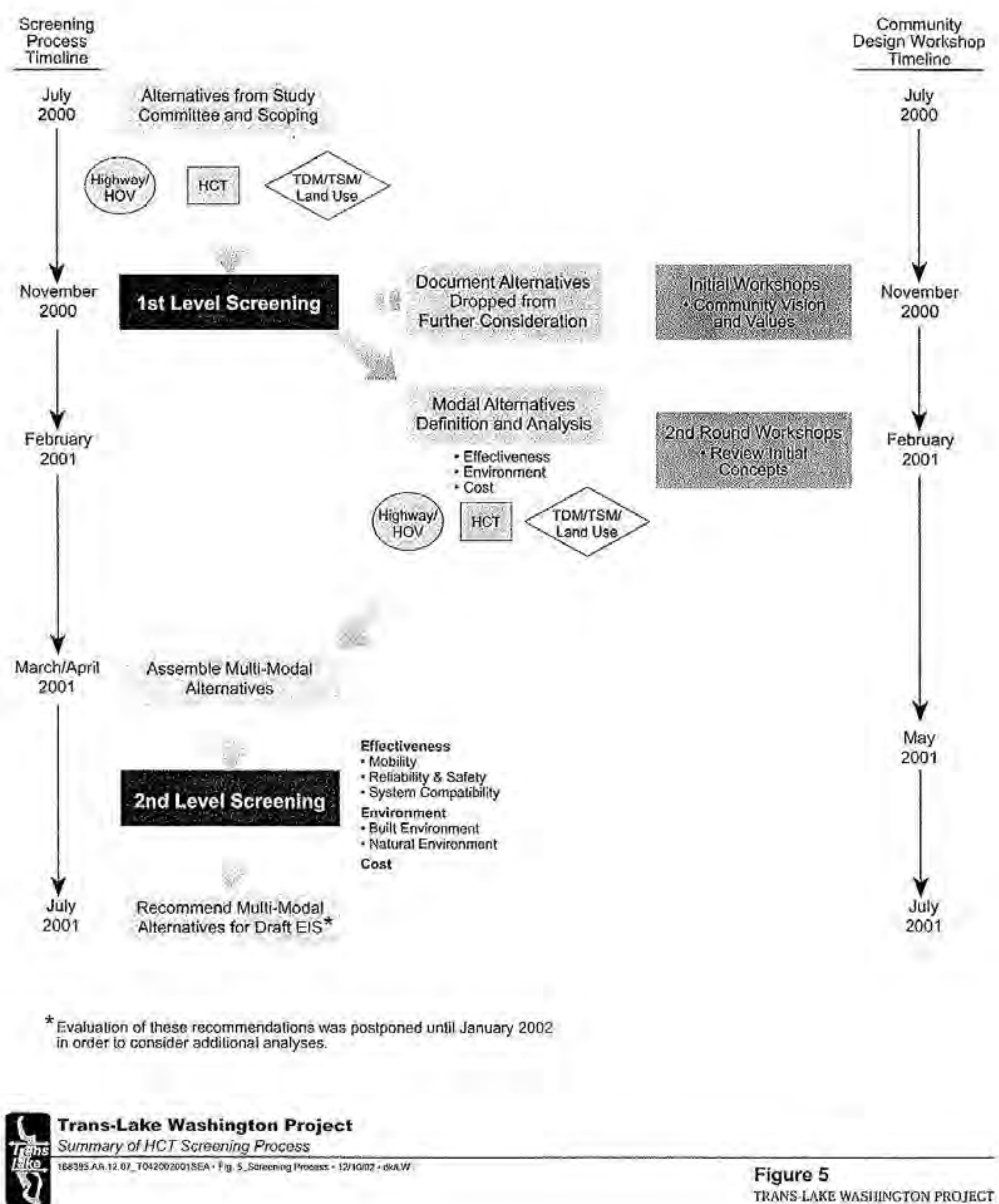


Figure 5
TRANS-LAKE WASHINGTON PROJECT
Screening Process

4.1.1 Definition of Alternatives

Five HCT alternatives were considered as part of this analysis. The alternatives are defined in *Preliminary Definition of Alternatives for First Level Screening* (Project Team, September 28, 2000), and are summarized below and shown in Figures 6 and 7.

4.1.1.1 Alternative C1 (HCT in SR 520 Corridor)

In the SR 520 corridor, an HCT facility would be constructed as part of a new or expanded multi-modal facility in or adjacent to the existing SR 520 bridge (Figure 6). A number of alignments are possible on both the west and east sides of Lake Washington. In the City of Seattle, the HCT route could run directly to downtown, or a longer loop route could serve additional Seattle areas such as the University District, Wallingford, Fremont, and South Lake Union before connecting to Central Link in downtown Seattle. East of Lake Washington, the alignment would most likely follow the SR 520 corridor to near I-405 where it would split to the north (Kirkland and Totem Lake), south (Bellevue central business district [CBD], Eastgate, and Issaquah), and east (Redmond).

4.1.1.2 Alternative C2 (HCT in I-90 Corridor)

Within the I-90 corridor, HCT facilities would be constructed adjacent to the I-90 travel lanes or within the freeway median between the International District Station in Seattle and the Bellevue Way interchange just east of the East Channel Bridge (Figure 6). At this point, branch lines would begin. A north branch would serve downtown Bellevue, northeast Bellevue, and Redmond, and could include a secondary branch to Kirkland and Totem Lake. An east branch from Bellevue Way would generally continue along the I-90 corridor and would serve Eastgate and Issaquah.

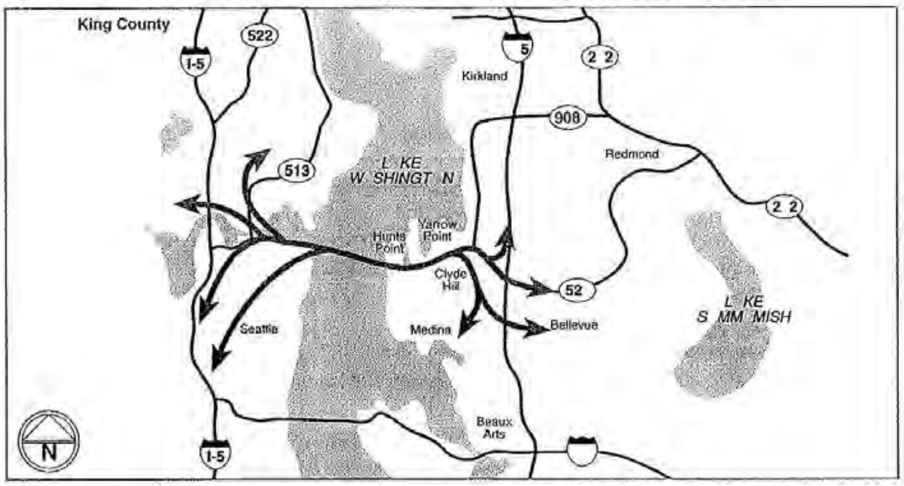
4.1.1.3 Alternative C3 (HCT in Mid-Lake Corridor [between SR 520 and I-90])

The mid-lake crossing would be an exclusive HCT facility and would be constructed in an entirely new transportation corridor. The cross-lake portion of Alternative C3 would be located between the SR 520 and I-90 floating bridges (Figure 7). Generally, the potential lake crossing would be between Medina and Madison Park/Madrona. On the west side, the alignment would most likely extend directly into downtown Seattle via Capitol Hill from the lake crossing. The most likely eastside alignment would be from the lake eastward to downtown Bellevue. Like the other previous alternatives, there could be branch lines: a branch north serving Kirkland and Totem Lake, a branch east serving Redmond, and a branch south and east serving Eastgate and Issaquah. Depending on the engineering feasibility, the crossing might be a tunnel or a bridge, or a combination of the two.

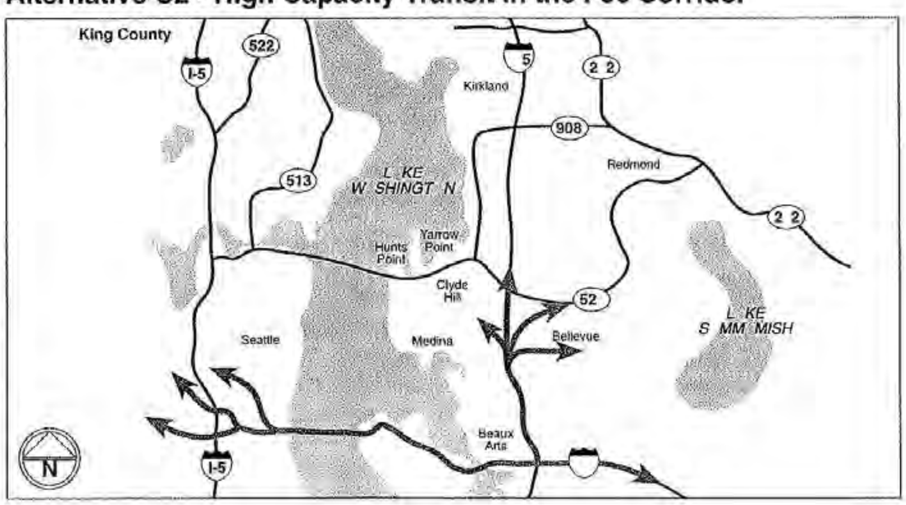
4.1.1.4 Alternative C.4.1 (HCT in New North Lake Corridor: Sand Point Juanita Kirkland)

Alternative C.4.1 would include either an HCT facility that is part of a new multi-modal bridge across Lake Washington or an HCT-only bridge north of the SR 520 corridor in the general area between Kirkland and Sand Point (Figure 7). Depending on an investigation of

Alternative C1 - High Capacity Transit in the SR-520 Corridor



Alternative C2 - High Capacity Transit in the I-90 Corridor



Trans-Lake Washington Project
Summary of HCT Screening Process
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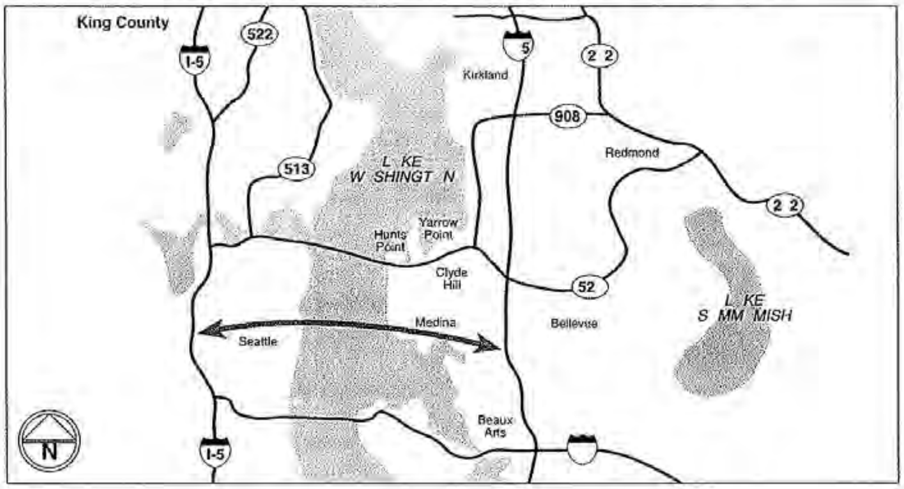
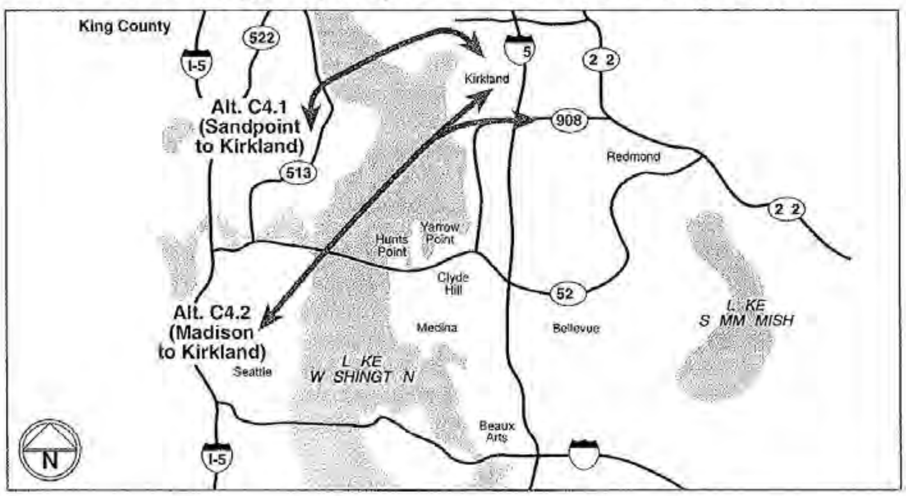
Figure 6
PRELIMINARY DEFINITION OF ALTERNATIVES FOR FIRST LEVEL SCREENING
HCT Alternatives C1 and C2

Alternative C3 - High Capacity Transit in a Mid-Lake Corridor



Alternative C4 - High Capacity Transit in a North-Lake Corridor



Trans-Lake Washington Project
Summary of HCT Screening Process
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Figure 7
PRELIMINARY DEFINITION OF ALTERNATIVES FOR FIRST LEVEL SCREENING
HCT Alternatives C3 and C4

the engineering feasibility, an HCT-only tunnel crossing might be possible. On the west side of Lake Washington, the HCT line would run south and west in the general Sand Point Way/NE 45th Street corridor. From there, the alignment could have a large number of routing options to the west, south, or both. On the east side of Lake Washington, the line would branch to the north, east, and south, connecting with Kirkland (Totem Lake), Redmond (in the general NE 85th Street corridor), Bellevue CBD, Eastgate, and Issaquah.

4.1.1.5 Alternative C.4.2 (HCT in New North Lake Corridor: Madison to Kirkland)

Alternative C.4.2 includes an HCT-only lake crossing from Kirkland to Madison Park/Capitol Hill (Figure 7). Engineering studies would be needed to determine the feasibility of the lake crossing, which would cover a substantial distance in a tunnel or tube and would intersect with the SR 520 floating bridge on a diagonal. A large number of routing options are available on both sides of the lake. On the west side of Lake Washington, Alternative C.4.2 would most likely go directly to Downtown Seattle, bypassing north and south Seattle neighborhoods. On the east side of Lake Washington, this alternative could serve the same areas as the other alternatives, like Totem Lake, Redmond, Bellevue, and Eastgate.

4.1.2 Transportation Considerations

The results of the transportation evaluation are summarized in Table 2. Alternatives C1, C2, and C3 all received a rating of 4—increased effectiveness. These alternatives have strong ridership potential because each would connect the major regional centers of Seattle and Bellevue. The potential for the alternatives to reduce traffic congestion could vary. At the time of the first-level screening, it was not clear if Alternative C2 would require the reconfiguration of I-90 travel lanes, thereby reducing capacity. All of the alternatives, including Alternatives C.4.1 and C.4.2, would have the capacity to serve a high number of travelers, particularly if the HCT facility is in an exclusive right-of-way.

If light rail transit (LRT) technology is used, a direct connection to the Central Link line under Alternative C1 could impact system capacity. Based on demand anticipated for the Central Link line, the north line, in which Alternative C1 would meet the Central Link line, would have very little capacity for growth beyond 2020 because trains would already be operating at their maximum frequency and length. An SR 520 system could be built initially from a transfer station in the University District to the east side, with the second connection to downtown Seattle provided when required by system extensions and ridership growth (Gilliland, March 13, 2001).

Table 2
Transportation Effectiveness Summary: First-Level Screening Analysis

Alternative	Ridership Potential	Reliability: System Capacity	System and Plan Compatibility	Overall Rating
C1 SR 520	Strong Connects high number of urban centers Slightly reduces traffic congestion	Serves high number of travelers Offers reliable and competitive travel times Could impact capacity if direct Central Link connection is provided	Not fully consistent with Sound Transit Long Range Plan for HCT within I-90 corridor Could require substantial changes to plan Consistent in that it connects major centers	4
C2 I-90	Strong Connects Seattle CBD and Bellevue CBD Potential to reduce congestion depends on lane configuration (study underway)	Serves high number of travelers Offers reliable and competitive travel times Could reduce highway capacity if lanes are used for HCT	Consistent with Sound Transit Long Range Plan Complements Central Link	4
C3 Mid-Lake	High levels Connects Seattle CBD (incl. Colman Dock) and Bellevue CBD	Serves high number of travelers Offers reliable and competitive travel times	Not included in Sound Transit Long Range Plan	4
C.4.1 New North Lake Corridor: Sand Point Juanita Kirkland	Limited Does not connect major urban centers directly, increased travel times	Serves high number of travelers Offers reliable and competitive travel times	Least consistent with Sound Transit Long Range Plan Connections are not planned urban growth areas Doesn't supplement transit services	2
C.4.2 (New North Lake Corridor: Madison to Kirkland)	Limited Does not connect major urban centers directly, increased travel times	Comparable to other alternatives	Not consistent with Sound Transit Long Range Plan Connections are not regional urban centers	2

RATING SCALE

WORST →				BEST
○	◔	◑	◕	●
Least Effective	Low Effectiveness	Moderate Effectiveness	Increased Effectiveness	Most Effective

Alternative C2 would be the most complementary with the Central Link system. If light rail were extended across Lake Washington on I-90, the east and south rail lines would merge just south of the International District Station in downtown Seattle. The combined volumes on these lines would equal 10,600 passengers per hour and would evenly balance with the 11,000 passengers per hour entering the downtown tunnel on the north line. With LRT on I-90, the regional rail system would be able to accommodate nearly a 50 percent growth in ridership beyond 2020 by shortening the headways through the downtown Seattle transit tunnel from 2.5 to 2 minutes and by lengthening all trains to four cars (Gilliland, March 13, 2001).

Alternative C2 would be consistent with Sound Transit's System Plan and Long-Range Vision. Alternatives C1 and C3 would also be consistent because they connect major urban centers. Alternatives C.4.1 and C.4.2 would be the least consistent because they would not connect major urban centers. Alternatives C.4.1 and C.4.2 received overall ratings of 2—lower effectiveness.

4.1.3 Environmental Considerations

4.1.3.1 Alternative C1 (HCT in SR 520 Corridor)

Table 3 summarizes the results of the environmental evaluation. Alternatives C3, C.4.1, and C.4.2 received ratings of 1—most impacts. Each alternative represents a new transportation corridor. These alternatives could result in a high number of displacements and disruption to neighborhoods. The impacts of these alternatives on wetlands, fish, and bald eagles would vary depending on the alignment. Alternative C1 received a rating of 2—medium impacts. Alternative C1 could impact wetlands near Foster Island, Cozy Cove, Fairweather Bay, and Yarrow Bay. An expanded right-of-way would cause less impact on juvenile fish than a new corridor. Bald eagle habitat could be impacted on both sides of the lake. Many structures could be displaced and neighborhoods disrupted by new right-of-way, stations, and accompanying traffic. Alternative C2 received a rating of 3—low impact. Assuming the new facilities stayed within the existing right-of-way, there would be little or no impact on wetlands, habitats, and parks. Displacements would be unlikely; however, neighborhoods could be disrupted.

4.1.4 Cost Considerations

Actual dollar values were not estimated for the first-level screening analysis. The definition of the alternatives included a number or unknown factors, primarily whether or not tunneling would be feasible across the lake. As a result, a qualitative cost comparison was done. For purposes of discussion, the costs were discussed in terms of the lake crossing, the west side alignment, and the eastside alignment (Table 4). The new crossings (Alternatives C.3, C.4.1, and C.4.2) would have the highest lake crossing costs. Alternative C2 (I-90 Corridor) would have the lowest lake crossing cost. On the east side of the lake, the alternatives would have comparable costs; however, Alternative C3 could have the lowest cost because it would cover the least distance. On the west side, Alternative C2 would be the least costly because it would use the existing transitway. The other alternatives would be costly because they would go through dense urban areas and require tunneling. Alternative C.4.1 would likely be the most costly because it would cover the greatest distance. Overall, the I-90 corridor would be the least costly.

Table 3
Potential Environmental Impacts Summary: First-Level Screening Analysis

Alt.	Wetlands	Habitat	Historic, Cultural, Parks	Displacements	Neighborhoods	Overall Rating
C1 SR 520	Vicinity of Foster Island, Cozy Cove, Fairweather Bay, and Yarrow Bay	Less impact on migrating juvenile chinook than new corridor Bald eagle habitat both sides of lake	Up to 9 parks	Many structures	Increased noise cause disruptions Right-of-way acquisition for stations could create barriers and increase traffic	2
C2 I-90	Limited impacts if stay within existing right-of-way	Limited impacts if stayed within existing right-of-way	Up to 3 parks if stay within existing right-of-way	Few or no structures if stayed within existing right-of-way	Visual quality change from landscaping alteration Increased noise cause disruptions	3
C3 Mid-Lake	Not enough info to evaluate	Not enough info to evaluate	Depends on alignment, up to 11 parks and 2 historic structures	Depends on alignment, high number of structures	Increased noise cause disruptions Increased traffic to stations	1
C.4.1	Vicinity of 124th NE in Kirkland	Migrating juvenile chinook Bald eagle habitat west side of lake	Up to 2 parks	5-10 structures west of the lake 30-40 structures east of the lake	New transportation corridor Barrier created Increased noise and traffic	1
C.4.2	North side of Madison, southeast of arboretum	Limited impacts on migrating juvenile chinook Bald eagle habitat west side of lake	Up to 6 parks	High number of displacements	New transportation corridor Barrier created Increased noise and traffic	1

RATING SCALE

WORST →				BEST
○	◔	◑	◕	●
Most Impacts	Medium Impacts	Low Impacts	No Impact	Improved Environment

Table 4
Cost Summary: First-Level Screening Analysis

Alt.	Lake Crossing	East Side	West Side
C1 SR 520	Costly—opportunities to share costs and gain economies if shared HCT/SR 520 bridge is constructed Options outside existing alignment very costly	Costs comparable to other alternatives (assumes HCT can be built jointly with SR 520 until I-405 at least)	Costly—significant amounts of tunneling and station construction in densely populated areas and difficult soil conditions
C2 I-90	Least expensive of all alternatives, even if significant modifications to I-90 are needed to maintain capacity	Costly—no transitway exists, and tunnel would be required in southern Bellevue	Least expensive of all alternatives because of existing transitway
C3 Mid-Lake	Very costly—no opportunity to share costs and gain economies Tunnel feasibility not known; bridge costly due to right-of-way acquisition for approaches on both sides of lake	Costs comparable or less than other options because total length of route could be shortest Most costly section would be through Bellevue CBD and possible tunnel west toward lake	Costly—significant amounts of tunneling and station construction in densely populated areas and difficult soil conditions
C.4.1	Potentially least costly of new crossing because shortest, still significantly more than I-90 crossing	Costly—for most part cannot take advantage of existing freeway right-of-way If a route went through the Bellevue CBD, it would be the most costly section	Likely most costly because longest length, could require tunneling (feasibility unknown)
C.4.2	Potentially most costly—longest lake crossing	Costly—for most part cannot take advantage of existing freeway right-of-way If a route went through the Bellevue CBD, it would be the most costly section	Costly—significant amounts of tunneling and station construction in densely populated areas and difficult soil conditions

4.1.5 Recommendations

The Executive Committee recommended including Alternatives C1, C2, and C3 in the second-level screening analysis. The Executive Committee was initially split on its recommendation to continue further analysis of Alternative C3; however, it eventually decided that it would like more information before it made a decision on this corridor. The committee recommended excluding Alternatives C.4.1 and C.4.2 from further consideration because of their potential costs and uncertain feasibility.

4.2 FIRST-LEVEL SCREENING ANALYSIS: HCT MODAL EVALUATION

The primary decision to be made for HCT, as part of the overall Trans-Lake Washington Project, was to determine which corridor (SR 520, mid-lake, or I-90) should be used for an extension of HCT across Lake Washington to serve eastside residents. Each lake crossing provided a variety of route options to connect locations within Seattle and between Bellevue, Redmond, Kirkland, or Issaquah. The Project Team defined the alternatives to illustrate how major route options would affect transportation performance, environmental impacts, and costs for the corridor alternatives. The alternatives or elements of the alternatives that performed best for these factors were then selected for analysis in the multi-modal evaluation.

The HCT modal evaluation included two technology options—fixed guideway[1] and BRT.[2] Even though the fixed guideway facilities would not necessarily be rail, the fixed guideway facilities were assumed to have similar characteristics (access, right-of-way, profile, station footprints, operations, and costs). In addition, although the modal evaluation characterized HCT as a fixed guideway in the I–90 corridor, the necessity for I-90 HCT to be compatible with the Central Link line meant that LRT would be the only reasonable HCT technology alternative for that corridor. A particular technology was not selected for SR 520 because Sound Transit was in the process of conducting a transit technology assessment. (This assessment was documented in the *Trans-Lake Washington Project: High Capacity Transit Technology Options* report prepared by PB Farradyne [October 2001]. The technology options report is summarized in Section 5 of this report). The BRT system was assumed to include a busway in an exclusive right-of-way either within or adjacent to the SR 520 corridor, with direct connections to stations and transfer centers. BRT vehicles could also operate on surface streets or freeway HOV facilities beyond the exclusive busway.

4.2.1 Definition of Alternatives

The following definitions and figures (Figures 8 through 12) provide an overview of the HCT alternatives considered during the modal evaluation. The HCT alternatives were defined in detail in a two volume report, *Trans-Lake Washington Project: Definition of HCT Alternatives for Modal Evaluation* (Project Team, April 10, 2001). The figures from this report are provided in Appendix A.

4.2.1.1 Alternative C1.1 Fixed Guideway in the SR 520 Corridor

Alternative C1.1 would encompass the fixed guideway alternatives within the SR 520 corridor. In the short term, these alternatives could potentially merge into the Central Link line, but long-range systems operations would require light rail or other fixed guideway transit in the SR 520 corridor to be extended in a separate corridor to downtown Seattle due

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[1] A fixed guideway is assumed to be a rail or rubber-tired transit system that operates predominantly in an exclusive right-of-way at, below, or above grade.

[2] BRT would be an express/limited stop, rubber-tired transit system operating predominantly in a "managed lane" roadway environment. This would include bus-only lanes, HOV 3+ lanes (restricted to vehicles with three or more occupants), or HCT lanes (restricted to vehicles with three or more occupants or vehicles paying tolls).

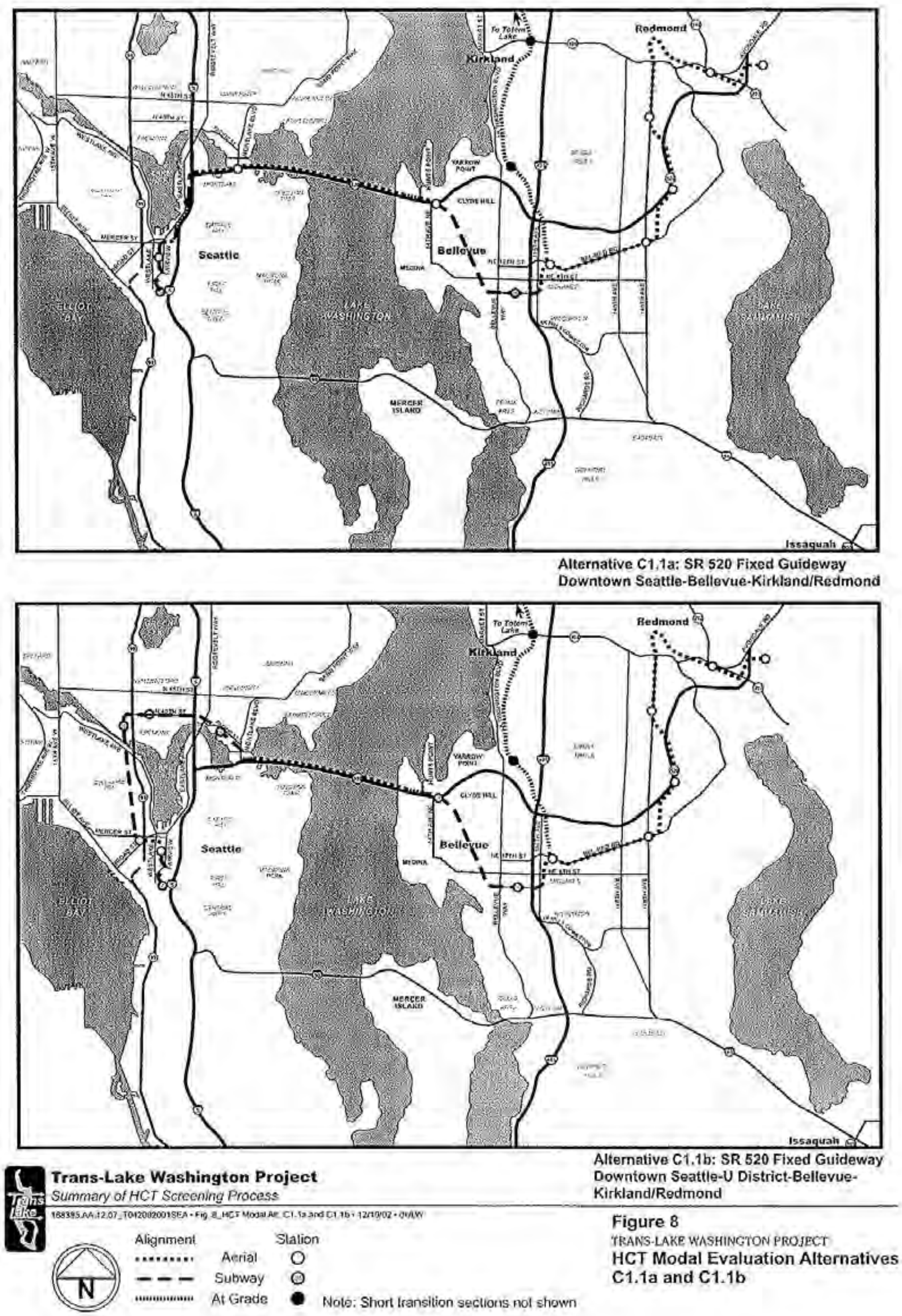
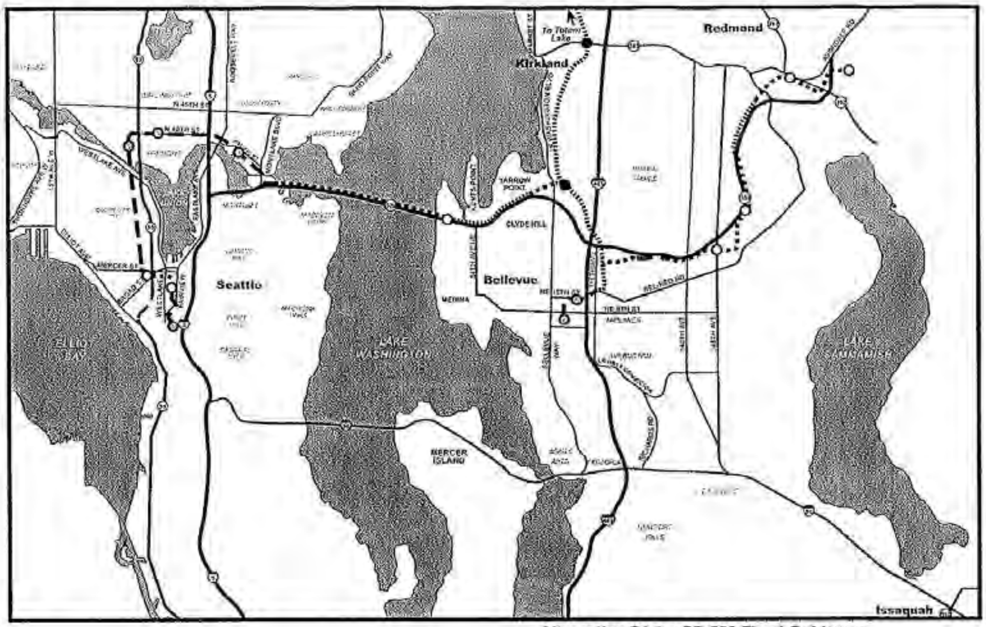
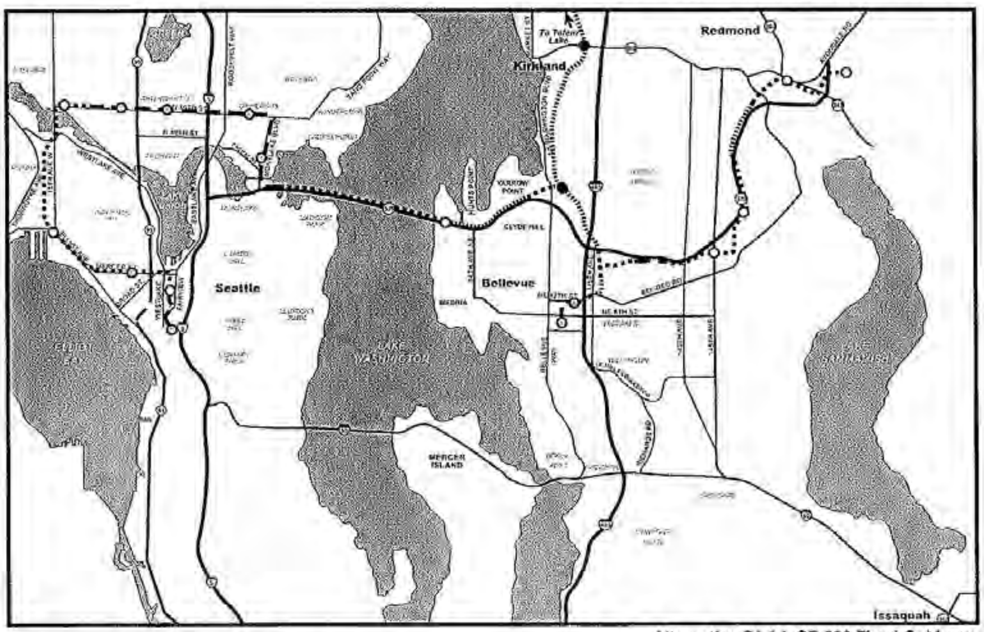


Figure 8
TRANS-LAKE WASHINGTON PROJECT
HCT Modal Evaluation Alternatives C1.1a and C1.1b



Alternative C1.1c: SR 520 Fixed Guideway
Downtown Seattle-U District-Kirkland/Redmond/Bellevue



Alternative C1.1d: SR 520 Fixed Guideway
Downtown Seattle-Ballard-U District-Kirkland/Redmond/Bellevue

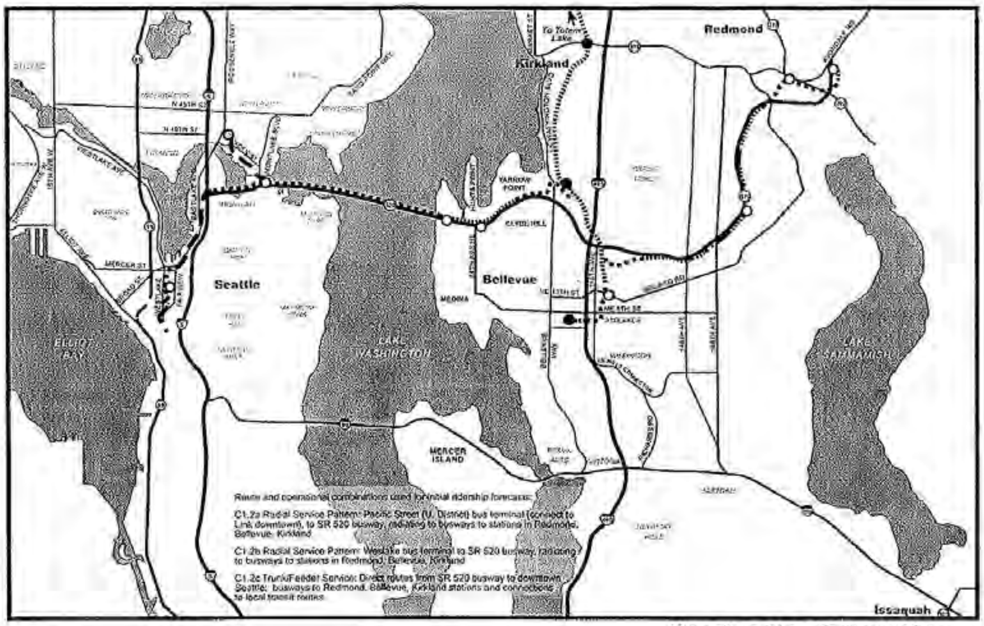
Trans-Lake Washington Project

Summary of HCT Screening Process

Alignment		Station
Aerial		○
Subway		◎
At Grade		●

Note: Short transition sections not shown

Figure 9
TRANS-LAKE WASHINGTON PROJECT
HCT Modal Evaluation Alternatives C1.1c and C1.1d



Alternatives C1.2a, C1.2b and C1.2c:
SR 520 Bus Rapid Transit Route Options

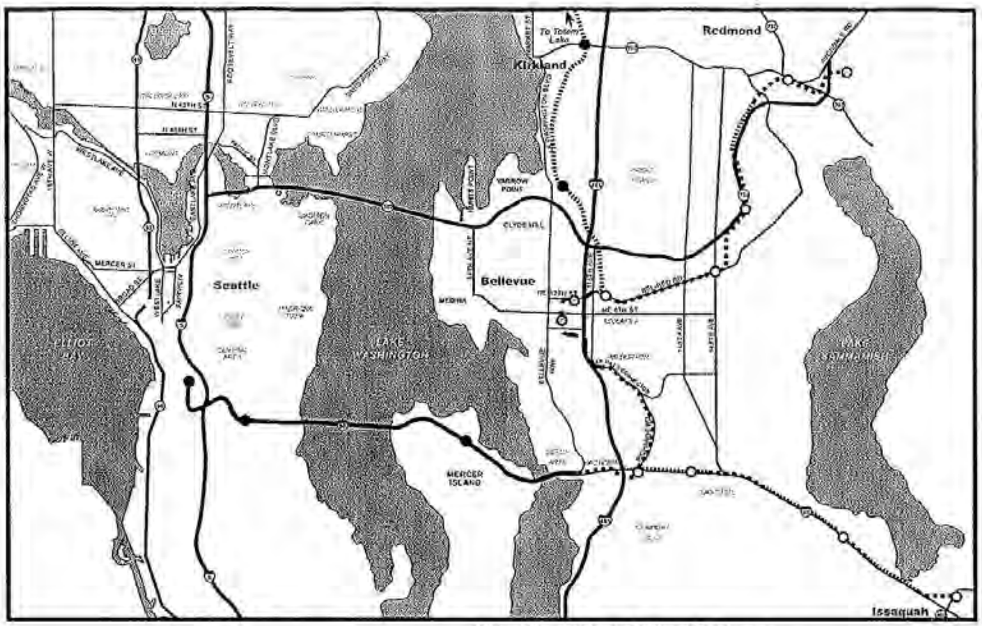
Trans-Lake Washington Project
Summary of HCT Screening Process

168395.AA.12.07_T042002001SEA - Fig. 10_HCT Modal Alt. C1.2a, C1.2b, C1.2c - 12/10/02 - cjd/LW

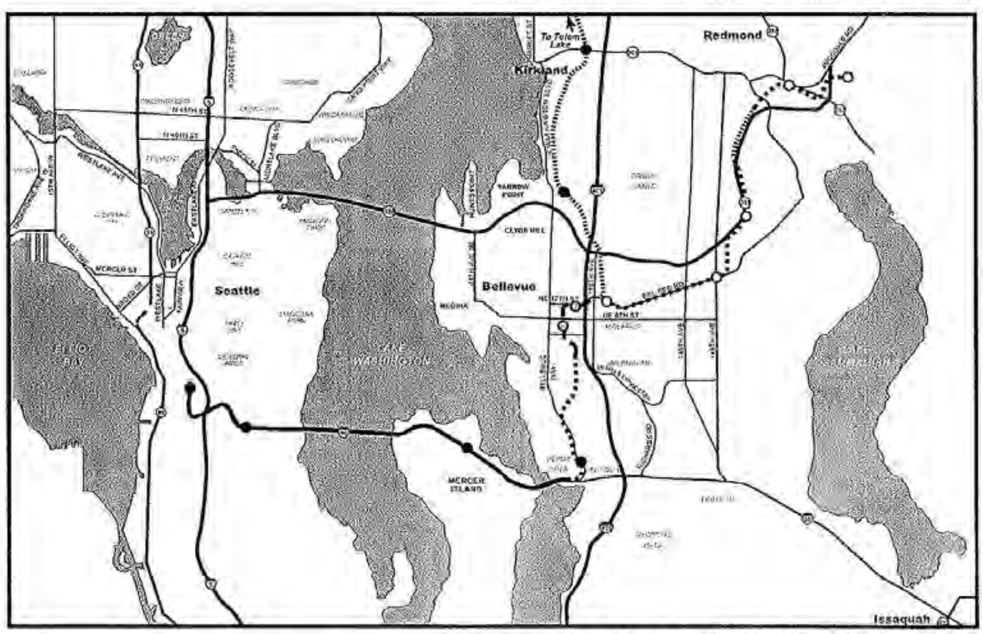
Alignment		Station
·········	Aerial	○
— — —	Subway	◎
·········	At Grade	●

Note: Short transition sections not shown

Figure 10
TRANS-LAKE WASHINGTON PROJECT
HCT Modal Evaluation Alternatives C1.2a, C1.2b and C1.2c



Alternative C2.1a: I-90 Fixed Guideway
Downtown Seattle-Factoria-Issaquah/Bellevue-Kirkland/Redmond

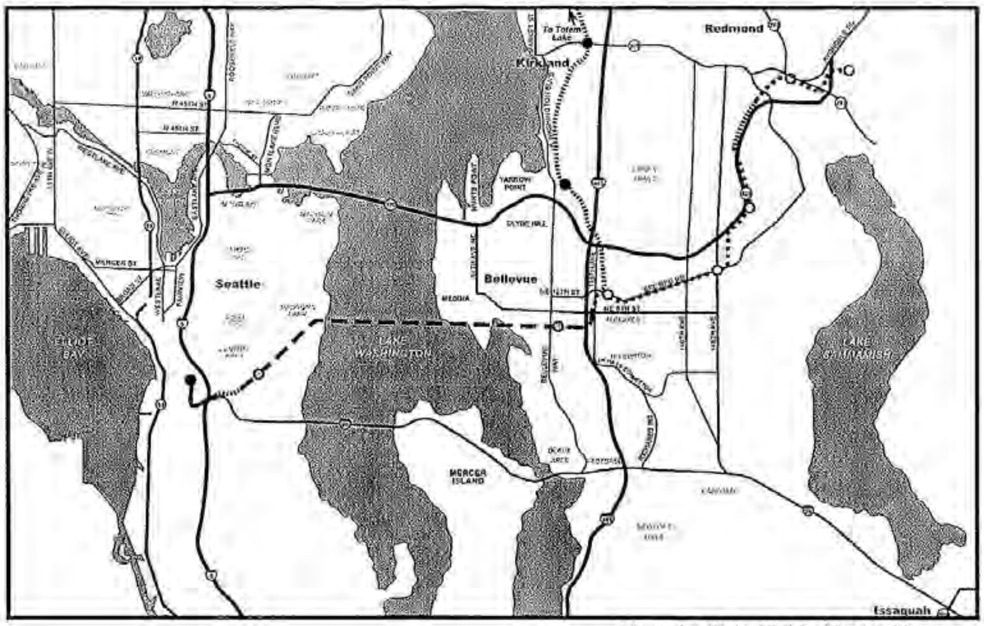


Alternative C2.1b: I-90 Fixed Guideway
Downtown Seattle-Bellevue-Kirkland/Redmond

Trans-Lake Washington Project
Summary of HCT Screening Process

Alignment — Aerial, Subway, At Grade
Station — Aerial, Subway, At Grade
Note: Short transition sections not shown

Figure 11
TRANS-LAKE WASHINGTON PROJECT
HCT Modal Evaluation Alternatives C2.1a and C2.1b



Alternative C3.1a: Midlake Fixed Guideway
Downtown Seattle-Bellevue-Kirkland/Redmond

Trans-Lake Washington Project
Summary of HCT Screening Process

Alignment		Station
·········	Aerial	○
— — —	Subway	◎
··········	At Grade	●

Note: Short transition sections not shown

Figure 12
TRANS-LAKE WASHINGTON PROJECT
HCT Modal Evaluation Alternative C3.1a

to capacity constraints on the Central Link line (Gilliland, March 13, 2001).[3] Alternative C1.1 has four subalternatives representing different routing options on both the east and west sides of Lake Washington:

- Alternative C1.1a—Downtown Seattle–Bellevue–Kirkland/Redmond
- Alternative C1.1b—Downtown Seattle–University District–Bellevue–Kirkland/Redmond
- Alternative C1.1c—Downtown Seattle–University District–Kirkland/Redmond/Bellevue
- Alternative C1.1d—Downtown Seattle–Ballard–University District–Kirkland/Redmond/Bellevue

As shown in Figures 8 and 9, each option would include aerial, subway, and at-grade segments. Each alternative would include a lake crossing within the SR 520 right-of-way with HCT on an aerial structure.

4.2.1.2 Alternative C1.2 Bus Rapid Transit in the SR 520 Corridor

Alternative C1.2 would encompass the BRT alternatives within the SR 520 corridor. This alternative has three subalternatives representing different routing options and bus service scenarios:

- Alternative C1.2a—SR 520 BRT, Radial Service Pattern, Pacific Street Intercept
- Alternative C1.2b—SR 520 BRT, Radial Service Pattern, Westlake Intercept
- Alternative C1.2c—SR 520 BRT, Trunk/Feeder Service Pattern, Direct Routing through Downtown Seattle

Two bus service scenarios were developed, which would affect busway connections in Seattle:

- Radial bus service on the east side with intercepts at Seattle light rail stations, providing direct connections to either the Pacific Station (Alternative C1.2a) or to the Westlake Station via a South Lake Union busway (Alternative C1.2b).
- Trunk/feeder bus service on the east side with direct routing through downtown Seattle via a South Lake Union busway (Alternative C1.2c).

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[3] As noted previously, given demand anticipated for the Central line, the north line would have very little capacity for growth beyond 2020 because trains would already be operating at their maximum frequency and length. An SR 520 system could be built initially from a transfer station in the University District to the Eastside, with the second connection to downtown Seattle provided when required by system extensions and ridership growth.

As shown in Figure 10, each option would include aerial, subway, and at-grade segments. Each alternative included a lake crossing within the SR 520 right-of-way that would be at the same grade as the highway crossing. (The lake crossing is shown as aerial on the accompanying figures because it would be slightly raised above the surface of the lake.).

4.2.1.3 Alternative C2: Fixed Guideway in the I-90 Corridor

Alternative C2.1 would encompass the fixed guideway alternatives within the I-90 corridor (Figure 11). This alternative has two subalternatives representing different routing options on the east side:

- Alternative C2.1a: I-90 Fixed Guideway, Downtown Seattle–Factoria–Issaquah/Bellevue–Kirkland/Redmond
- Alternative C2.1b: I-90 Fixed Guideway, Downtown Seattle–Bellevue–Kirkland/Redmond

Both I-90 fixed guideway alternatives would use the D-2 roadway from the downtown Seattle transit tunnel to the I-90 center roadway across Lake Washington.

4.2.1.4 Alternative C3: Mid-Lake Fixed Guideway

The mid-lake fixed guideway alternative would include a lake crossing in either a submerged floating tunnel or a bored tunnel under the lake bottom. On the east side, the mid-lake alternative would have two branches, one connecting to Bellevue and Kirkland and the other to Redmond (Figure 12). In Seattle, the alternative would connect to the downtown transit tunnel via a tunnel under the Central District.

4.2.2 Transportation Performance

The transportation performance findings for the modal analysis are presented in *High Capacity Transit Modal Evaluation: Transportation, Environmental, and Cost Findings* (Project Team, April 10, 2001). This analysis used evaluation criteria to reflect critical differences in transportation performance among HCT alternatives. The following three mobility criteria were used:

- Transit ridership across Lake Washington[4]—Ridership is a primary indicator of the attractiveness of a transit service or services. Ridership forecasts across Lake Washington specifically addressed the attractiveness of each alternative for trips by transit between Seattle and the eastside communities.
- HCT boardings[4]—This criterion provided insight into the total number of riders using the entire route alignment of the Trans-Lake HCT alternatives, which provides an indication of the effectiveness of the HCT alternatives in serving trips internal to both Seattle and the eastside communities, in other words, non-lake crossing trips.

[4] Sound Transit's EMME/2 regional model was used to calculate data for the ridership and boarding criteria.

- Travel time[5]—This is a measure of convenience and quality of services for HCT patrons.

Table 5 summarizes the results of the transportation evaluation for all of the alternatives.

Cross-Lake Ridership. Daily transit ridership across Lake Washington in 2020 would vary among the alternatives, but not significantly, ranging from a low of approximately 46,000 to a high of approximately 54,000 daily riders (two-way). 2020 PM peak period ridership across Lake Washington would also vary among the alternatives but would be relatively consistent between corridors. A new HCT Trans-Lake service would result in total two-way transit ridership across Lake Washington between 17,000 and 21,000 during the PM peak period of travel.

The variation among the three primary corridors in terms of ridership is relatively small, considering their significant route differences. This result is not entirely surprising, because every alternative serves the major travel markets of downtown Seattle, Bellevue, Kirkland, and Redmond. Given the level of accuracy of the regional model forecasting tool, it was concluded that the corridor alternatives perform similarly in terms of cross-lake transit ridership.

Of the SR 520 fixed guideway alternatives, Alternative C1.1b, which has the most direct connection to downtown Bellevue coupled with a west side alignment serving the University District, Wallingford, Fremont, and east Queen Anne, exhibits, by a slight margin, the highest westbound PM peak period cross-lake ridership. Alternative C1.1c, which is similar to Alternative C1.1b except for an indirect downtown Bellevue connection, would have similar PM peak cross-lake period ridership but somewhat lower daily cross-lake ridership than Alternative C1.1b.

Cross-lake ridership focuses on trips that originate on one side of Lake Washington and conclude on the other, whereas HCT boardings take into consideration trips that cross the lake as well as trips that start and finish on the same side of the lake, thereby providing a look at overall HCT use.

In fact, the cross-lake daily ridership for Alternative C1.1d, which would serve neighborhoods as far west as Ballard, would be almost the same as the ridership for Alternative C1.1a, which has a direct connection to downtown Seattle. Cross-lake ridership differences between the SR 520 fixed guideway Alternatives C1.1a and C1.1c are not considered significant. Alternative C1.1d, which would serve more west side markets than Alternative C1.1c, but would have indirect connections to both downtown Seattle and downtown Bellevue, would have the lowest daily cross-lake ridership of the SR 520 fixed

[5] The travel time estimates were based on vehicle run-time estimates and excluded walk times at either end of the trip or the wait time for the first vehicle, but included estimated transfer times. The estimates represent peak period travel times for either the AM or PM peak periods. The average travel time for passengers using fixed guideway systems or BRT in exclusive bus lanes would be far more consistent than average travel times using regular transit services that mix with other traffic and are subject to congestion.

Table 5
Transportation Effectiveness Summary: Modal Evaluation

	2020 Transit Trips Across Lake Washington		2020 System-Wide Daily HCT Boardings[a]	2020 Peak Period Travel Times for HCT Passengers Between Selected Origin-Destination Pairs (min.)		
Alternative	Daily Cross-Lake Ridership (2-way)	Percentage Daily Ridership During PM Peak Period (2-way)	Total Boardings	Bellevue Station to University Street Station (Seattle CBD)	Bear Creek Station (Redmond) to Westlake Station (Seattle CBD)	Kirkland to University District
No Action—No Trans-Lake HCT Facilities	39,700	39%	--			
SR 520 Fixed Guideway Alternatives						
C1.1a—Downtown Seattle–Bellevue–Kirkland/Redmond	50,600	37%	50,000	19.8	33.5	24.5
C1.1b—Downtown Seattle–University District–Bellevue–Kirkland/Redmond	55,300	37%	81,400	24.3	38.1	18.3
C1.1c—Downtown Seattle–University District–Kirkland/Redmond/Bellevue	51,000	37%	86,000	29.1	34.0	13.5
C1.1d—Downtown Seattle–Ballard–University District–Kirkland/Redmond/Bellevue	49,500	37%	100,400	36.3	41.2	15.4
SR 520 Bus Rapid Transit Alternatives						
C1.2a—SR 520 BRT, Radial Service Pattern, Pacific Street Intercept	55,200	39%	47,100	26.1	33.5	13.9

Table 5
Transportation Effectiveness Summary: Modal Evaluation

	2020 Transit Trips Across Lake Washington		2020 System-Wide Daily HCT Boardings[a]	2020 Peak Period Travel Times for HCT Passengers Between Selected Origin-Destination Pairs (min.)		
Alternative	Daily Cross-Lake Ridership (2-way)	Percentage Daily Ridership During PM Peak Period (2-way)	Total Boardings	Bellevue Station to University Street Station (Seattle CBD)	Bear Creek Station (Redmond) to Westlake Station (Seattle CBD)	Kirkland to University District
C1.2b—SR 520 BRT, Radial Service Pattern, Westlake Intercept	53,500	39%	50,300	23.8	27.5	16.8
C1.2c—SR 520 BRT, Trunk/Feeder Service Pattern, Direct Routing through Downtown Seattle	54,200	38%	53,500	25.0	30.0	16.8
I-90 Fixed Guideway Alternatives						
C2.1a—I-90 Fixed Guideway, Downtown Seattle–Factoria–Issaquah/Bellevue–Kirkland/Redmond	45,500	37%	51,400	23.1	39.2	44.6
C2.1b—I-90 Fixed Guideway, Downtown Seattle–Bellevue–Kirkland/Redmond	51,400	38%	51,500	20.1	36.2	38.1
Mid-Lake Fixed Guideway Alternatives						
C3.1a—Mid-Lake Fixed Guideway, Downtown Seattle–Bellevue–Kirkland/Redmond	49,000	42%	44,400	13.9	29.3	31.9

[a] These figures are in addition to the boardings forecasted for the No Action Alternative, which includes the extension of the Central Link line to Everett and Tacoma.

guideway alternatives. In terms of cross-lake transit ridership for the SR 520 fixed guideway alternatives, Alternative C1.1b would perform best and Alternative C1.1d would perform worst. Overall, the SR 520 fixed guideway alternatives with relatively direct connections between downtown Seattle and downtown Bellevue and directly serve the University District (Alternatives C1.1b and C1.1c) would have higher cross-lake daily transit ridership than those that do not.

The BRT daily cross-lake ridership forecasts are almost exactly the same for all three SR 520 BRT alternatives, and are among the highest of all the HCT modal alternatives. The SR 520 BRT alternatives perform well because of the modeling assumptions that (1) travel times for BRT alternatives with exclusive busways would be very similar to those associated with the fixed guideway alternatives, and (2) that BRT service also would be provided in the I-90 corridor as well as the SR 520 corridor. In addition, the impact of congestion in the University District and downtown Seattle on BRT operations and capacity was not taken into consideration; the report recommended that the impact of surface street congestion on BRT service be assessed.

The I-90 corridor would generate slightly lower daily and PM peak period ridership than the SR 520 corridor alternatives because the I-90 alternatives do not serve west side markets north of downtown Seattle, such as the University District, Ballard, and Wallingford. The two I-90 fixed guideway alternatives have the most significant variation in cross-lake ridership of all the alternatives within each corridor. Alternative C2.1b performs better than Alternative C2.1a in terms of cross-lake trips because of its direct connection to downtown Bellevue, rather than diverting to service Factoria. Transit service across the lake would be better served by providing a faster connection to Bellevue and Redmond. In addition, the alignment and stations considered would not provide significant ridership to Issaquah for 2020.

The mid-lake alternative would have the next to lowest daily cross-lake ridership and a PM peak period ridership similar to the other alternatives.

Systemwide HCT Boardings. SR 520 Fixed Guideway Alternative C1.1a, SR 520 BRT Alternative C1.2b, and I-90 Fixed Guideway Alternative C2.1b would all have direct connections between downtown Seattle and downtown Bellevue with very similar daily boarding projections. SR 520 Fixed Guideway Alternatives C1.1b through C1.1d, which would serve northern Seattle neighborhoods, could have nearly twice as many daily boardings as the other alternatives. The higher boardings are primarily due to substantial intra-Seattle transit market in the northern Seattle neighborhoods. There are no significant differences in total daily boardings for the SR 520 BRT alternatives. The I-90 corridor alternatives have lower east and west side boardings compared to the SR 520 alternatives, indicating that they are less attractive for intra-Seattle and intra-eastside trips; however, the results show that I-90 and SR 520 alternatives with similar connections to major transit markets (Alternatives C2.1b and C1.1a) would not vary substantially in terms of total daily boardings. This indicates that when the same markets are served, there is little difference between the alternatives that use the I-90 corridor and those that use the SR 520 corridor. The mid-lake fixed guideway alternative is expected to have the lowest daily boardings of all the lake crossing alternatives, primarily due to low eastside transit boardings; this finding is due to the lack of stations between downtown Seattle and downtown Bellevue.

The HCT boardings shown in Table 5 are in addition to those associated with the extension of Central Link light rail north to Everett and south to Tacoma. Completion of the Central Link light rail is expected to result in over 250,000 daily rail boardings between Everett and Tacoma by 2020, without a Trans-Lake HCT system in place.

Travel Times. Average travel times for transit trips between major markets in the region vary significantly among alternatives. Also, alternatives that require more transfers typically would have higher travel times for the same trip. The travel times between downtown Seattle and downtown Bellevue or Redmond would be similar for the SR 520 and I-90 corridors. Travel times between the University District and most of the eastside communities would be much faster with an SR 520 crossing. The mid-lake corridor would have the fastest travel times between downtown Seattle and both Bellevue and Redmond.

Alternative C1.1a would provide the quickest travel time between downtown Bellevue and downtown Seattle because it would have the most direct connection between the two locations. Alternatives C1.1b, C1.1c, and C1.1d would offer faster travel times between the University District and eastside communities than Alternative C1.1a, which would require between 6 and 11 minutes due to a transfer to a city bus. The SR 520 fixed guideway alternatives would generally result in the longest travel times between southern downtown Seattle and Kirkland/Redmond.

The SR 520 BRT alternatives, which would use exclusive bus lanes and busways, would be fastest for trips between Kirkland/Redmond and the University District, and between Redmond/Kirkland and downtown Seattle. Transit trips between downtown Seattle and downtown Bellevue would generally be faster on I-90 bus routes than on one of the SR 520 BRT alternative routes.

The I-90 fixed guideway alternatives would generally offer the fastest travel times between south downtown Seattle and Redmond, and the second fastest travel times between downtown Bellevue and downtown Seattle; however, they would have the longest travel times between other eastside and westside locations.

Overall, the mid-lake fixed guideway alternative would provide either the shortest or very competitive travel times, except between the University District and eastside communities.

Further investigation into the size of the various travel markets and the overall impact on person hours of travel within the study area is warranted, rather than relying solely on travel times to establish the preferred west side and eastside alignments.

4.2.3 Environmental Impacts

For the modal evaluation, twelve elements of the environment were examined from each alternative. The environmental findings are based on the screening criteria for each element adopted by the Trans-Lake Washington Executive Committee on October 25, 2000. These criteria are listed in *Environmental Analysis: Appendix B to HCT Alternatives Evaluation*

Report(Project Team, May 10, 2001). The environmental findings are summarized in Table 6. The findings were categorized as most impacts, medium impacts, low impacts, no impacts, and improved environment.

In general, all of the SR 520 alternatives had more "most impact" ratings on fish migration, bald eagles, wetlands, and parks than the I-90 or mid-lake alternatives, with SR 520 fixed guideway alternatives having a most impact rating more often than the SR 520 BRT alternatives. Impacts on fish, bald eagles, and their habitat would primarily occur in the Montlake area. On the west side, four parks (including the Arboretum) could be impacted. On the east side, Yarrow Bay wetlands, Kelsey Creek, Marymoor Park, the Sammamish River, and Bear Creek could have potential impacts.

The I-90 corridor on the west side would face fewer impacts than the SR 520 alternatives because the current bus-only facility would be used. On the east side, Mercer Slough, which encompasses a major park, wetland habitat, historic buildings, and Pickering Farms, could suffer impacts.

The mid-lake alternative, which would be located mostly in a tunnel, received the lowest impact ratings. Impacts from this alternative would include construction impacts at the waterline, as well impacts resulting from portals and ventilation structures.

4.2.4 Cost Considerations

The conceptual capital cost opinions include the following major elements.[6]

- HCT guideway, including regular and specialty track work
- Related civil and traffic work (traffic signals and gates, stormwater management, etc.)
- Rail stations, including architectural finishes and electrical/mechanical
- System elements for alignments and stations (power supply, communications, etc.)
- Operations and maintenance facilities
- Light rail transit vehicles
- Right-of-way, including relocation, administration, and legal costs
- Agency costs (environmental analysis, engineering, construction management, etc.)

The conceptual cost opinions do not include:

- Operating costs (utilities, labor)
- Improvements outside those described in engineering documents (e.g., betterments)
- Environmental mitigation (e.g., wetlands, hazardous material remediation, lids, etc.)

[6] The costs shown involve broad assumptions about the design requirements for the facilities and related features. They also include large factors for contingency.

Table 6
Environmental Criteria Ratings Summary: Modal Evaluation

Criteria	No Action	SR 520 Fixed Guideway				SR 520 BRT			I-90		Mid-Lake
		C1.1a	C1.1b	C1.1c	C1.1d	C1.2a	C1.2b	C1.2c	C2.1a	C2.1b	C3.1a
Air Quality	3	5	5	5	5	4	4	4	1	1	5
Water Resources	4	2	2	2	2	2	2	2	1	2	2
Fish-Bearing Streams	4	2	2	2	2	2	2	2	1	3	3
Critical Upland Habitat	4	1	1	1	1	1	1	1	2	2	3
Wetlands and Shorelines	4	1	1	1	1	1	1	1	2	2	2
Noise and Vibration	4	2	2	2	1	3	3	3	1	2	2
Land Use	4	3	3	3	2	3	3	3	3	3	3
Parklands	4	2	2	2	1	1	1	1	3	3	3
Cultural Resources	4	3	4	4	2	4	3	3	1	2	4
Displacement and Disruption	4	1	1	2	1	3	2	2	2	2	2
Neighborhood	4	2	2	2	2	2	2	1	3	3	3
Visual Quality	4	2	2	2	2	2	1	1	3	3	3

RATING SCALE

WORST				BEST
○	◔	◑	◕	●
Most Impacts	Medium Impacts	Low Impacts	No Impact	Improved Environment

Trans-Lake Washington Project
Summary of HCT Screening Process

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The cost opinions, based on preliminary sketch-level information, are accurate in the range of plus 30 percent and minus 25 percent. The cost opinions provide a means for comparing the alternatives; they are not appropriate for programming or project budgeting purposes. The costs for each of the modal alternatives could change substantially if facilities are defined differently.

The HCT alternatives have a substantial range of capital costs, as shown in Table 7. The I-90 HCT alternatives (C2) have the lowest costs—$2.7 to $3.2 billion. The costs of the SR 520 fixed guideway alternatives (C1.1) range from $3.7 to $5.2 billion. The costs of the SR 520 BRT alternatives (C1.2) range from $3.7 to $4.8 million. The costs for the mid-lake alternative range from $3.9 to $4.2 billion, depending on the type of tunnel constructed.

Table 7
Cost Summary: Modal Evaluation
Conceptual Capital Cost Estimates
(Millions of 2001 Dollars)

	HCT Facility Capital Cost[a]			HCT Operations Capital Costs[a]		Total Capital Costs
Alternative	West Side	Lake Crossing	East Side	Vehicles	Maintenance Base	
SR 520 Fixed Guideway Alternatives						
C1.1a—Downtown Seattle–Bellevue–Kirkland/Redmond	740	190	2,420	300	140	3,800
C1.1b—Downtown Seattle–University District–Bellevue–Kirkland/ Redmond	1,840	190	2,420	340	140	4,900
C1.1c—Downtown Seattle–University District–Kirkland/Redmond/ Bellevue	1,840	190	1,890	330	150	4,400
C1.1d—Downtown Seattle–Ballard–University District–Kirkland/ Redmond/ Bellevue	2,580	190	1,890	140	160	5,200
SR 520 Bus Rapid Transit Alternatives						
C1.2a—SR 520 BRT, Radial Service Pattern, Pacific Street Intercept	1,160	340	2,020	70	70	3,700
C1.2b—SR 520 BRT, Radial Service Pattern, Westlake Intercept	2,230	340	2,020	80	80	4,800
C1.2c—SR 520 BRT, Trunk/Feeder Service Pattern, Direct Routing Through Downtown Seattle	1,630	340	2,020	70	70	4,100

Table 7
Cost Summary: Modal Evaluation
Conceptual Capital Cost Estimates
(Millions of 2001 Dollars)

	HCT Facility Capital Cost[a]			HCT Operations Capital Costs[a]		
Alternative	West Side	Lake Crossing	East Side	Vehicles	Maintenance Base	Total Capital Costs
I-90 Fixed Guideway Alternatives						
C2.1a—I-90 Fixed Guideway, Downtown Seattle–Factoria–Issaquah/Bellevue–Kirkland/Redmond	50	90	2,710	300	140	3,300
C2.1b—I-90 Fixed Guideway, Downtown Seattle–Bellevue–Kirkland/Redmond	50	90	2,090	260	140	2,700
Mid-Lake Fixed Guideway Alternatives						
C3.1a—Mid-Lake Fixed Guideway, Downtown Seattle–Bellevue–Kirkland/Redmond	620	1,040 (submerged floating tunnel) 1,340 (deep tunnel)	1,890	190	120	3,900 (submerged floating tunnel) 4,200 (deep tunnel)

[a] The following design and construction contingencies were applied to address cost elements that are know to exist but cannot be easily quantified, reflecting income design and project staging information, uncertainties about the evolution of the design, and changes in construction market conditions.

Project Component	Design Contingency (percentage of extended costs)	Construction Contingency (percentage of extended costs)
Submerged floating tunnel	50 percent	25 percent
Floating/movable bridge	35 percent	15 percent
Tunnel guideway and stations	35 percent	15 percent
Aerial guideway and stations	30 percent	10 percent
At-grade guideway and stations	25 percent	10 percent
Specialty items	35 percent	10 percent
Vehicles and maintenance base	15 percent	10 percent

The cost opinions reflect a complete system based on the Long-Range Vision, with 22 to 32 miles of HCT facilities. A complete system was used for the cost opinions to provide consistent comparison among the alternatives. In many cases, shorter and less extensive interim systems would be possible, resulting in lower costs; however, some outlying segments, particularly with the SR 520 routes connecting to Seattle, would be required for feasible long-range HCT system operations.

4.2.5 Conclusions and Recommendations

The results of the modal evaluation provided the following conclusions for refining the HCT alternatives and developing the multi-modal alternatives.

- SR 520 Fixed Guideway Alternatives
  - Drop the west side alignment that would go to Ballard (Alternative C1.1d) in favor of the alignment that would go to Fremont (Alternative C1.1c), given the increased cost of the far west alignment and its comparatively low transportation effectiveness.
  - Drop the eastside alignment that would go directly to downtown Bellevue through a tunnel underneath Clyde Hill (Alternatives C1.1a and C1.1b) because the benefits of a direct connection to downtown Bellevue would not outweigh the substantial costs and risks.
- SR 520 BRT Alternatives
  - Reduce the costs and environmental impacts of the BRT alternatives by having BRT vehicles share HOV lanes in the SR 520 corridor east of the University District instead of constructing a right-of-way exclusively for buses.
  - Consider Alternative C1.2a, with the Pacific Street Intercept, as a possible interim phase and investigate the need and timing for a southward BRT extension to downtown Seattle, due to potential capacity constraints on the Central Link line between the University District and downtown Seattle.
- I-90 Fixed Guideway Alternatives
  - Drop the alignment that would go to Factoria (Alternative C2.1a) because cross-lake ridership would be less for this alternative than for the others.
- Mid-Lake Fixed Guideway Alternative
  - Drop the mid-lake alternative because ridership for this alternative would be very similar to or less than alternatives in the SR 520 and I-90 corridors, which would not have the costs or construction risks.
  - On April 25, 2001, the Trans-Lake Project Team presented the results of the modal analysis to the Trans-Lake Washington Project Executive Committee. The following recommendations for the multi-modal analysis were made to the Executive Committee, which endorsed them.

Exclude the following HCT modal alternatives or elements from the multi-modal alternatives:

- Bus-only lanes

- Mid-lake crossing
- Pure BRT alternatives

The HCT modal alternatives were packaged into the following multi-modal alternatives:

- Alternative 2—SR 520 Safety and Preservation with I-90 LRT
- Alternative 3—SR 520 HOV with I-90 LRT
- Alternative 4—SR 520 HOV and GP with I-90 LRT
- Alternative 5—SR 520 HOV and HCT
- Alternative 6—SR 520 HOV and GP and HCT
- Alternative 7—SR 520 HOV with BRT Connections
- Alternative 8—SR 520 HOV with BRT Connections and GP

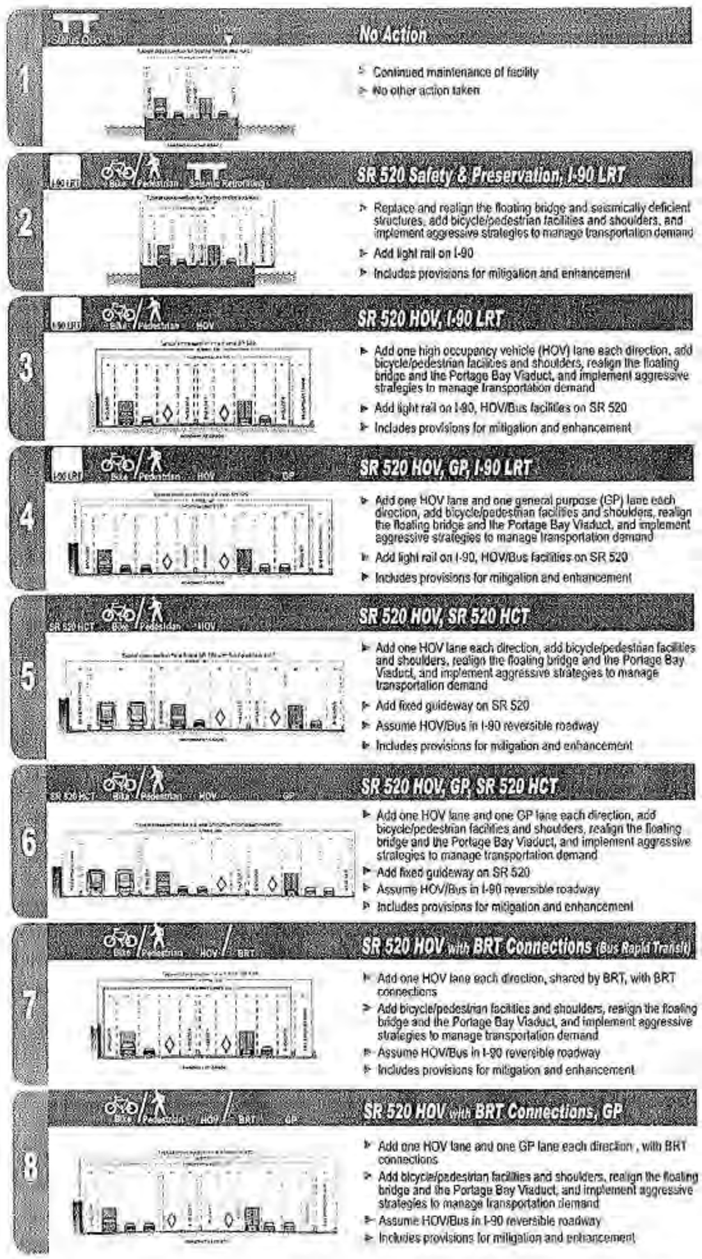
The alignments chosen for the alternatives reflect the findings of the modal analysis; these alignments are described as part of the description of the multi-modal alternatives (in the following section).

4.3 SECOND-LEVEL SCREENING ANALYSIS: HCT MULTI-MODAL EVALUATION

As shown above, seven alternatives were developed based on the results of modal evaluations and were carried forward into the multi-modal evaluation. These alternatives represented the range of SR 520 highway, cross-lake HCT, and transportation demand management (TDM) improvements being considered between downtown Seattle and Redmond. The analysis was conducted to assist the Trans-Lake Washington committees with selecting alternatives for further examination in an EIS focused on SR 520. The analysis considered the comparative benefits, impacts, and costs of using I-90 or SR 520 as a route for HCT across Lake Washington to assist Sound Transit in reviewing its current Long-Range Vision for HCT across Lake Washington via I-90.

4.3.1 Definition of Alternatives

The following are overviews of the multi-modal alternatives. Detailed descriptions of the HCT elements are presented in a technical memorandum, *HCT Alternatives Descriptions: Revised April 27, 2001* (Farquharson, May 1, 2001; updated November 28, 2001). The multi-modal alternatives are also described in *Preliminary Definition of Multi-Modal Alternatives for Second-Level Screening* (Project Team, May 14, 2001). The alignments described for the alternatives represent general routes and not precise locations because the second-level screening analysis was intended to help select the best HCT corridor rather than to optimize the alignments. Figure 13 summarizes the elements of the proposed multi-modal alternatives



(As approved by the Executive Committee April 25, 2001)

Trans-Lake Washington Project
Summary of HCT Screening Process

Figure 13
TRANS-LAKE WASHINGTON PROJECT
Proposed Multi-Modal Alternatives

and Figures 14 through 21 present schematic representations of the alternatives. Figures 22 and 23 identify the routes and station locations for the I-90 LRT and SR 520 HCT, respectively. The BRT route for Alternatives 7 and 8 is shown in Figure 24. Appendix B presents orthographic photographs of the HCT alternative alignments.

4.3.1.1 Alternative 2: SR 520 Safety and Preservation with I-90 LRT

Under Alternative 2, no major capacity improvements would occur, but the floating bridge and all seismically substandard bridges on SR 520 would be replaced. A 12-foot bicycle and pedestrian path would be provided along SR 520 between Lake Washington Boulevard in Seattle and 84th Avenue NE in Medina.

As illustrated in Figure 22, light rail would be located in the I-90 corridor and would connect downtown Seattle to Bellevue. Across Lake Washington and Mercer Island, the LRT facilities would occupy the center roadway. In downtown Bellevue the light rail line would split into two branches: one connecting to Kirkland and the other to Redmond. The proposed route and station locations are shown in Figure 15. Although the majority of Trans-Lake transit riders would be focused to the I-90 light rail system, regional bus routes would still use SR 520 to serve riders between the University District and Bellevue, Kirkland, and Redmond. A route from central Kirkland to downtown Seattle would also use SR 520.

4.3.1.2 Alternative 3: SR 520 HOV with I-90 LRT

On SR 520, a continuous HOV lane would be provided in each direction between I-5 and SR 202/Redmond Way (Figure 16). This would provide two GP lanes and one HOV lane each way for a total of six lanes. The Portage Bay and Lake Washington bridges would be replaced and realigned up to 200 feet to the north.

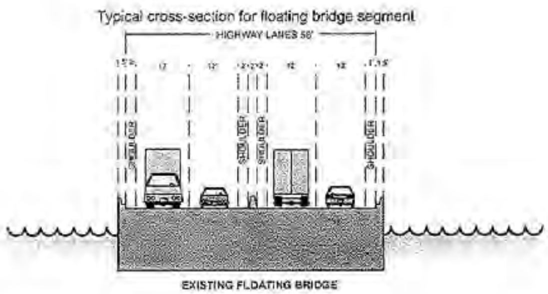
Like Alternative 2, regional bus routes from Bellevue, Kirkland, and Redmond would use SR 520 to provide service to the University District, as would service between Kirkland and downtown Seattle. Unlike Alternative 2, buses and HOV would have a direct route to Pacific Street in the University District through a Montlake area tunnel under the Montlake Cut.

The I-90 light rail system would be the same as described in Alternative 2 and illustrated in Figure 22.

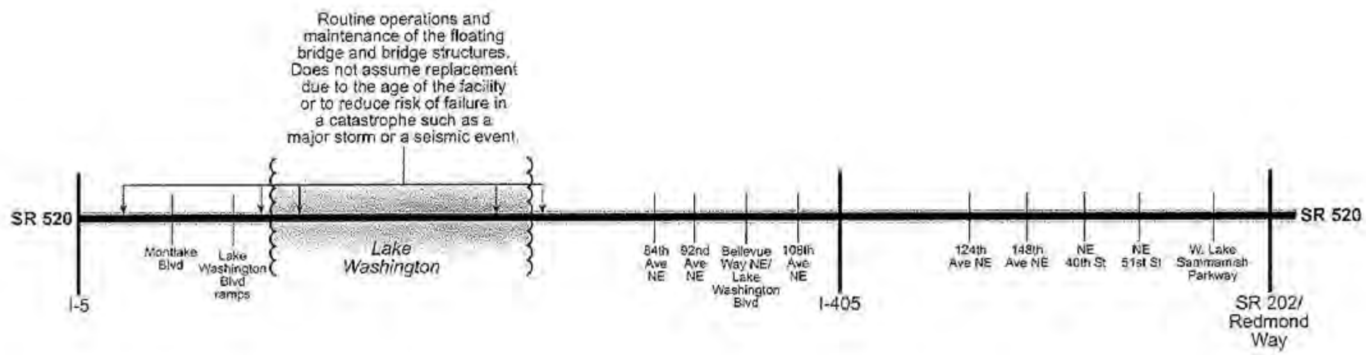
4.3.1.3 Alternative 4: SR 520 HOV and GP with I-90 LRT

On SR 520, Alternative 4 (Figure 17) would add one HOV lane and one GP lane in each direction between I-5 and West Lake Sammamish Parkway, for a total of eight lanes. The new GP lanes would end at West Lake Sammamish Parkway on the east. The added HOV lanes would continue east to SR 202/Redmond Way. Buses and HOV would have a direct route to Pacific Street in the University District through a Montlake area tunnel under the Montlake Cut.

The I-90 light rail system would be the same as described in Alternative 2 and illustrated in Figure 22.

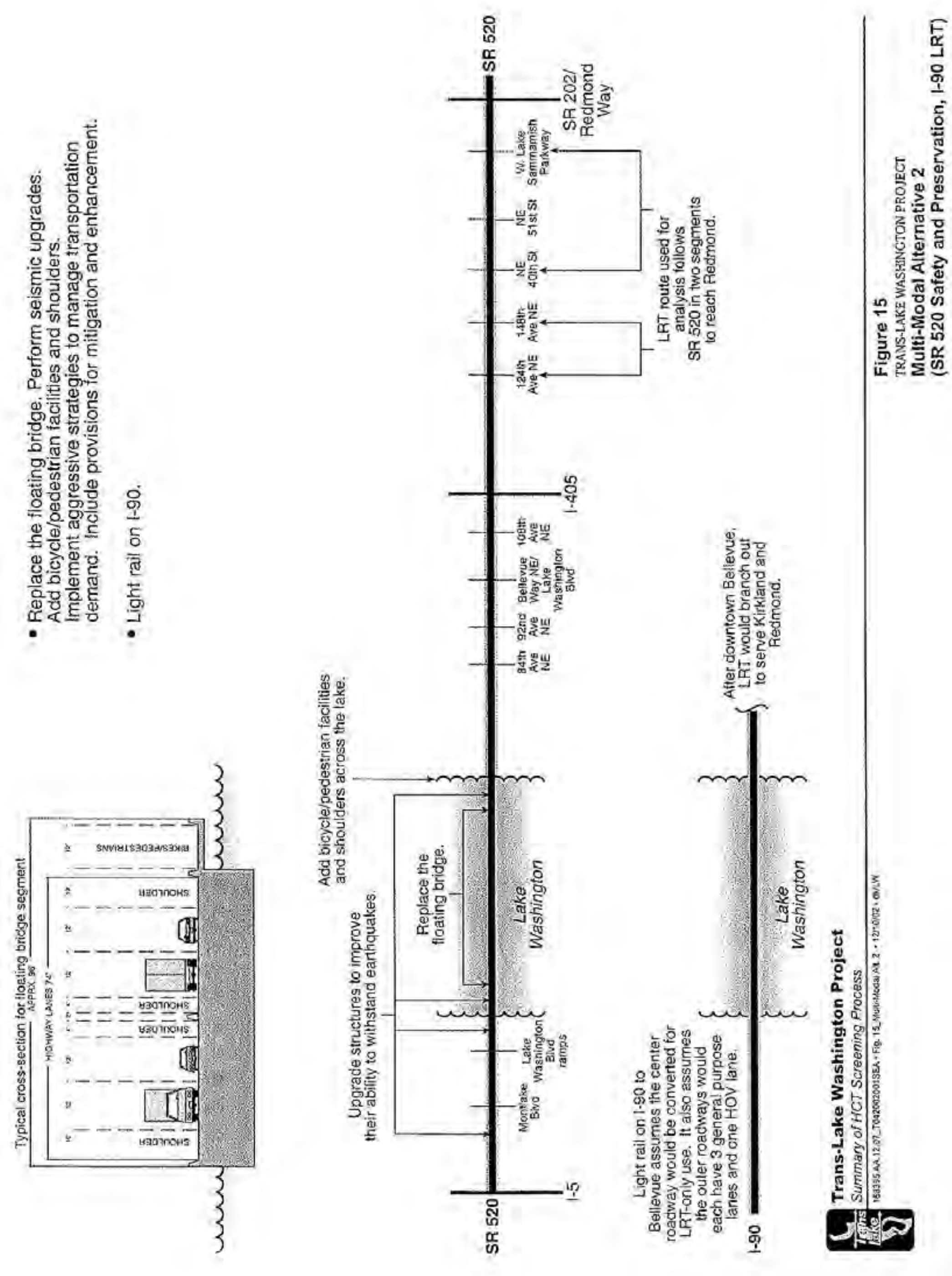


- No major changes or improvements to SR 520. Only continued maintenance of facility
- Assume I-90 would continue reversible center roadway operations.
- Other committed regional projects and services would be implemented, but no substantial action on SR 520.



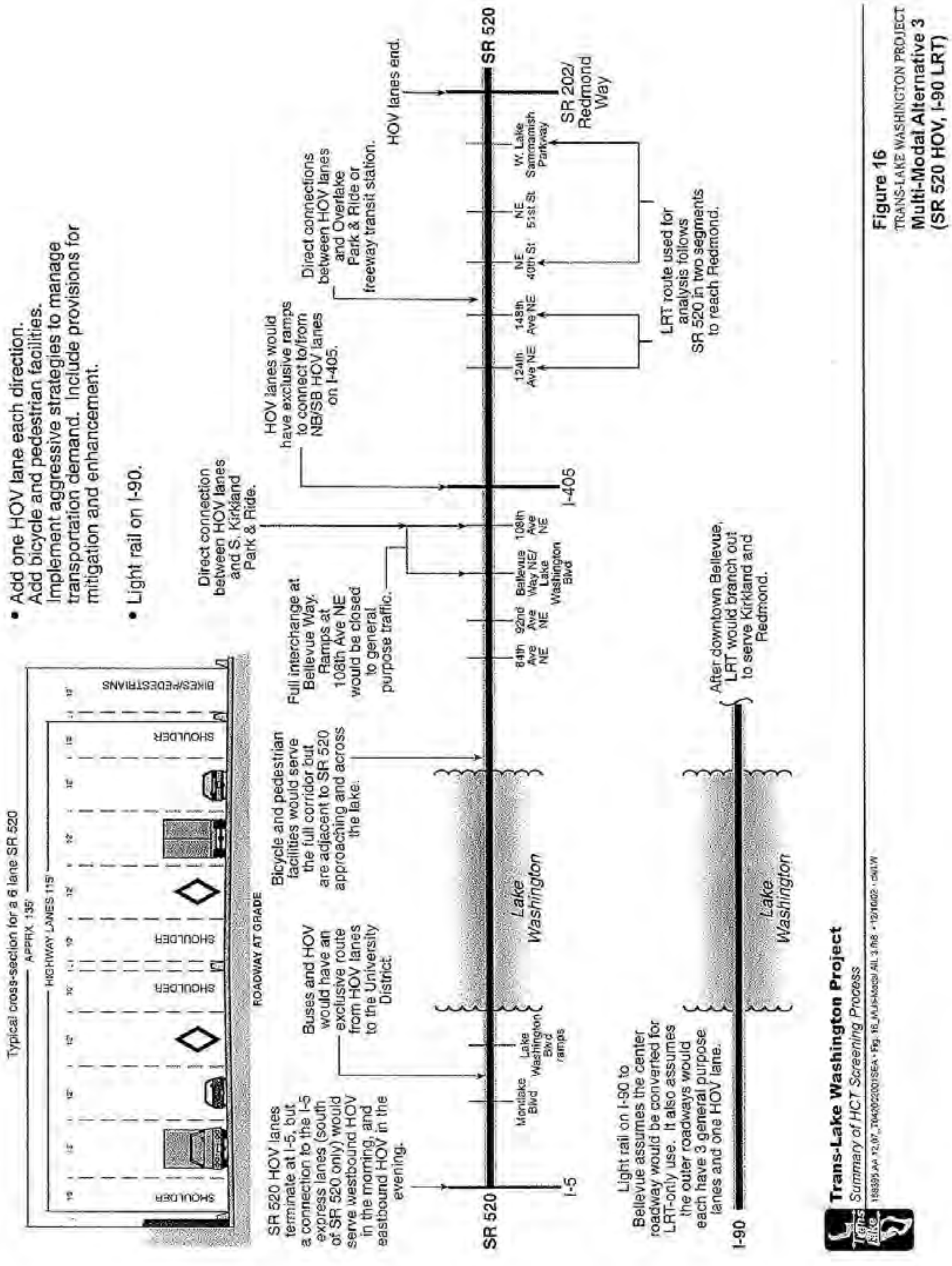
Trans-Lake Washington Project
Summary of HCT Screening Process
168395.A5.12.07_T042002001SEA • Fig. 14_Multi-Modal Alt. 1 (no action) • 12/10/02 • dk/LW

Figure 14
TRANS-LAKE WASHINGTON PROJECT
Multi-Modal Alternative 1 (No Action)



Trans-Lake Washington Project
Summary of HCT Screening Process

Figure 15
TRANS-LAKE WASHINGTON PROJECT
Multi-Modal Alternative 2
(SR 520 Safety and Preservation, I-90 LRT)


Typical cross-section for a 6 lane SR 520
APPRX. 135'
HIGHWAY LANES 115'
SHOULDER
SHOULDER
SHOULDER
SHOULDER
BIKES/PEDESTRIANS
ROADWAY AT GRADE
• Add one HOV lane each direction.
Add bicycle and pedestrian facilities.
Implement aggressive strategies to manage transportation demand. Include provisions for mitigation and enhancement.
• Light rail on I-90.
SR 520 HOV lanes terminate at I-5, but a connection to the I-5 express lanes (south of SR 520 only) would serve westbound HOV in the morning, and eastbound HOV in the evening.
Buses and HOV would have an exclusive route from HOV lanes to the University District.
Bicycle and pedestrian facilities would serve the full corridor but are adjacent to SR 520 approaching and across the lake.
Full interchange at Bellevue Way. Ramps at 108th Ave NE would be closed to general purpose traffic.
Direct connection between HOV lanes and S. Kirkland Park & Ride.
HOV lanes would have exclusive ramps to connect to/from NB/SB HOV lanes on I-405.
Direct connections between HOV lanes and Overlake Park & Ride or freeway transit station.
HOV lanes end.
SR 520
I-5
Montlake Blvd
Lake Washington Blvd ramps
Lake Washington
84th Ave NE
92nd Ave NE
Bellevue Way NE/ Lake Washington Blvd
108th Ave NE
I-405
124th Ave NE
148th Ave NE
NE 40th St
NE 51st St
W. Lake Sammamish Parkway
SR 202/ Redmond Way
SR 520
LRT route used for analysis follows SR 520 in two segments to reach Redmond.
Light rail on I-90 to Bellevue assumes the center roadway would be converted for LRT-only use. It also assumes the outer roadways would each have 3 general purpose lanes and one HOV lane.
I-90
Lake Washington
After downtown Bellevue, LRT would branch out to serve Kirkland and Redmond.
Trans-Lake Washington Project
Summary of HCT Screening Process
Figure 16
TRANS-LAKE WASHINGTON PROJECT
Multi-Modal Alternative 3
(SR 520 HOV, I-90 LRT)

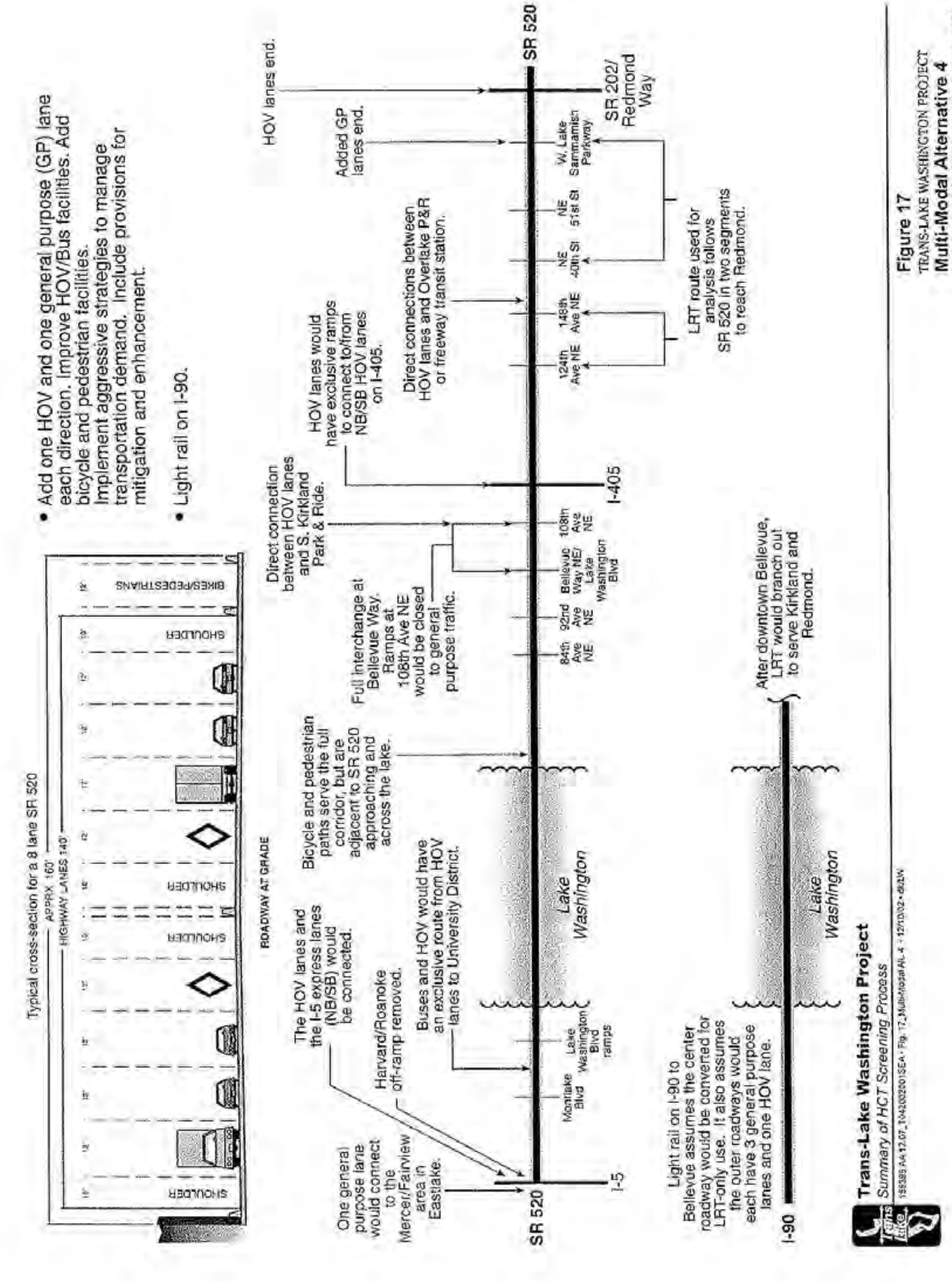


Figure 17
TRANS-LAKE WASHINGTON PROJECT
Multi-Modal Alternative 4 (SR 520 HOV+GP, and I-90 LRT)

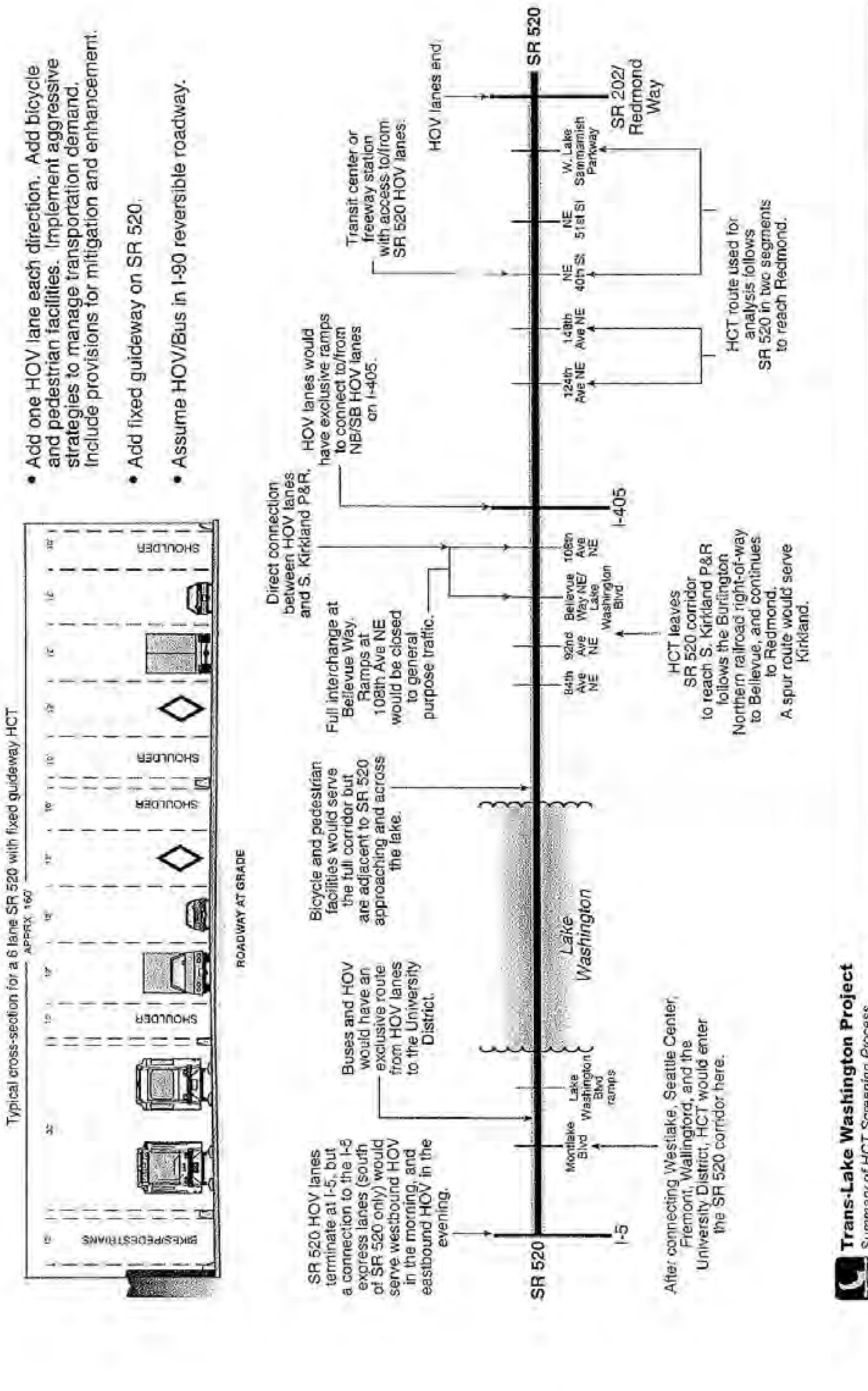
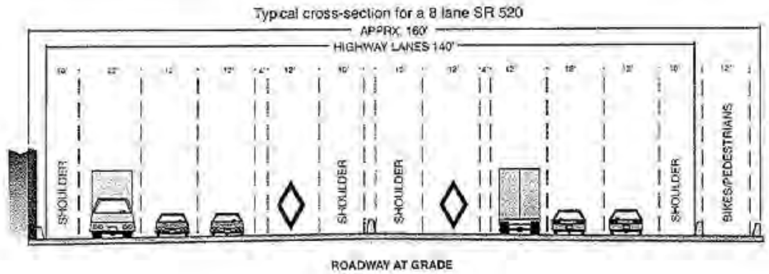
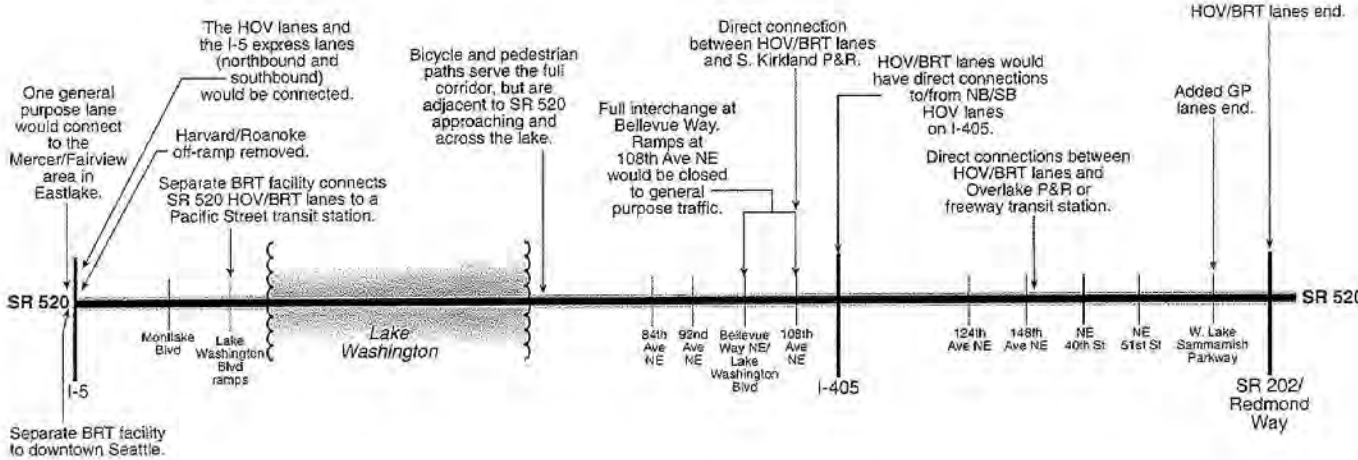


Figure 18
TRANS-LAKE WASHINGTON PROJECT
Multi-Modal Alternative 5
(SR 520 HOV, SR 520 HCT)



- Add bicycle and pedestrian facilities. Implement aggressive strategies to manage transportation demand. Include provisions for mitigation and enhancement.
- Add one HOV/Bus Rapid Transit(BRT) lane with 4-foot buffer each way on SR 520.
- Assume bus/HOV in I-90 convertible center roadway.



Trans-Lake Washington Project
Summary of HCT Screening Process
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Figure 21
TRANS-LAKE WASHINGTON PROJECT
Multi-Modal Alternative 8
(SR 520 HOV/Bus Rapid Transit+GP)

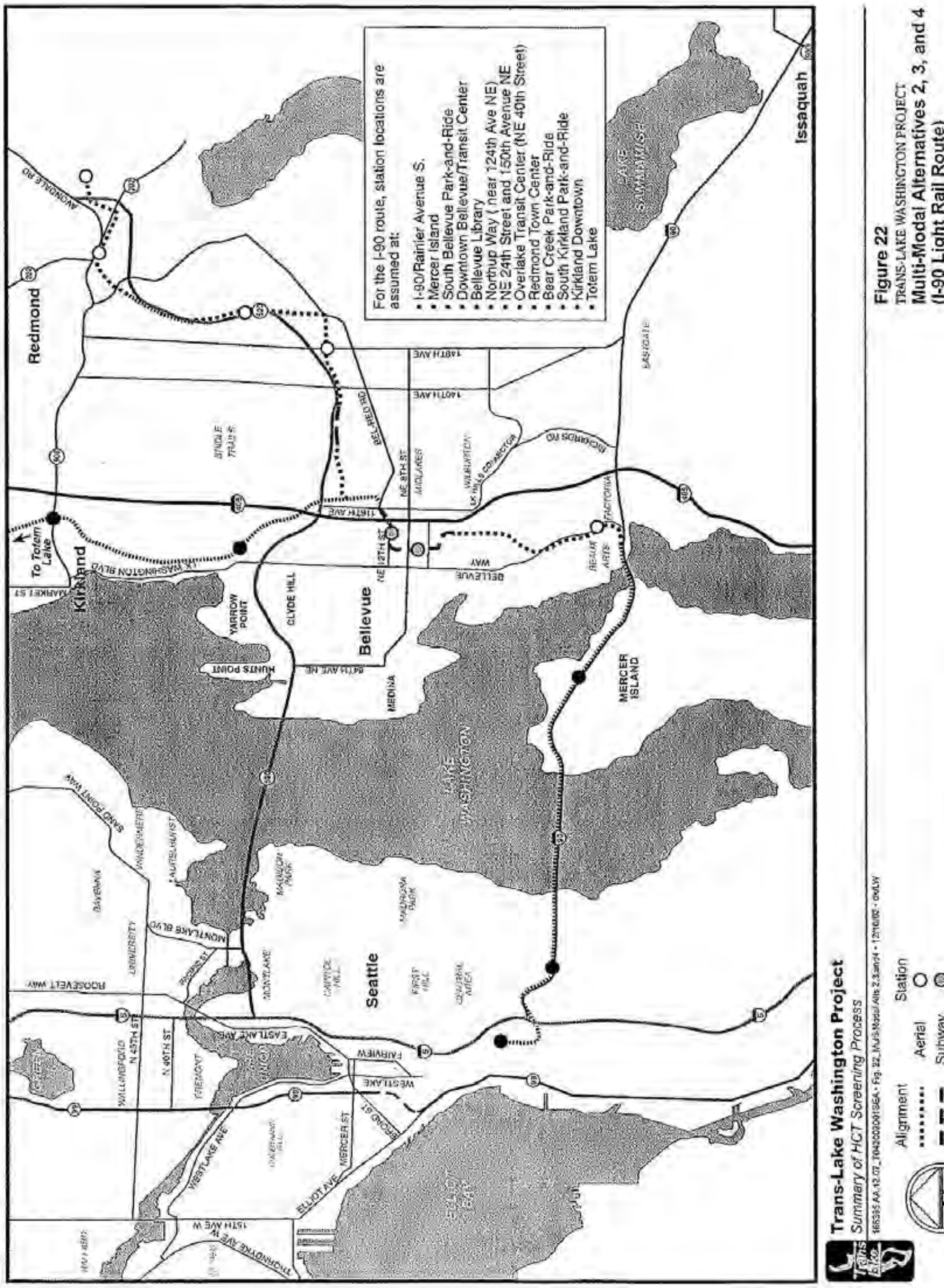


Figure 22
TRANS-LAKE WASHINGTON PROJECT
Multi-Modal Alternatives 2, 3, and 4 (I-90 Light Rail Route)

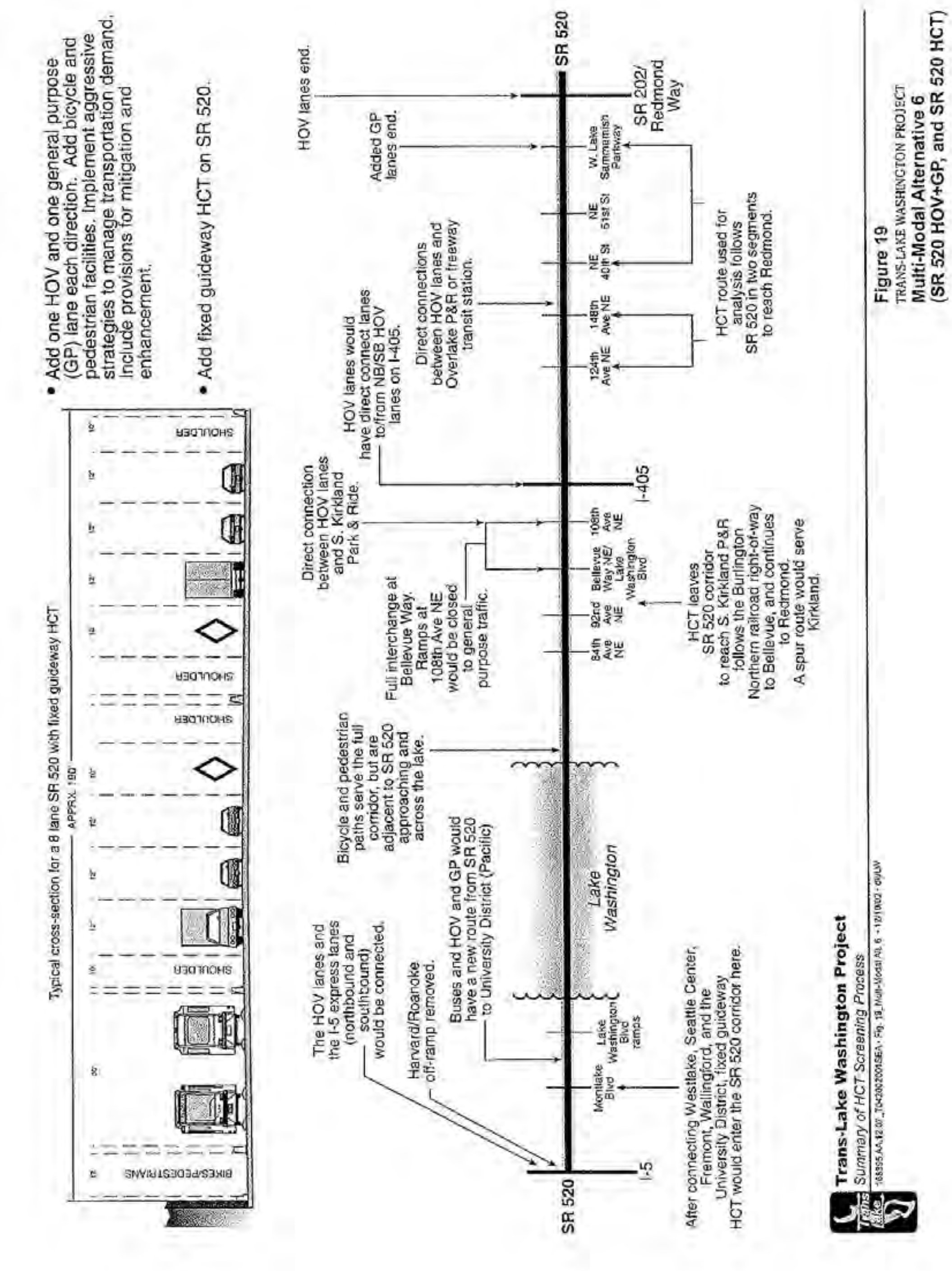
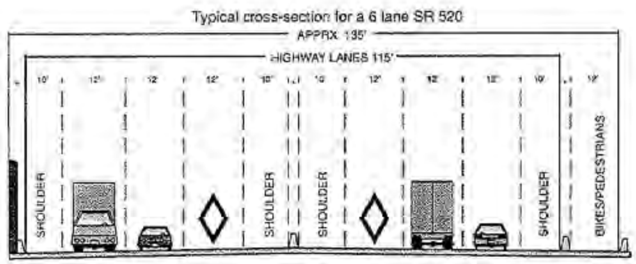
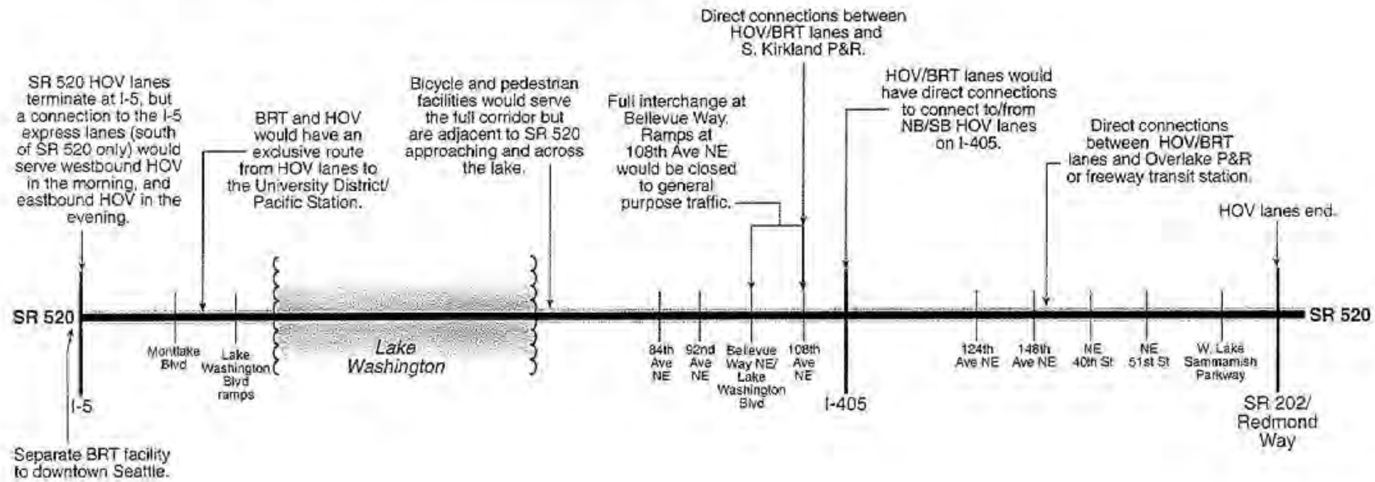


Figure 19
TRANS-LAKE WASHINGTON PROJECT
Multi-Modal Alternative 6
(SR 520 HOV+GP, and SR 520 HCT)

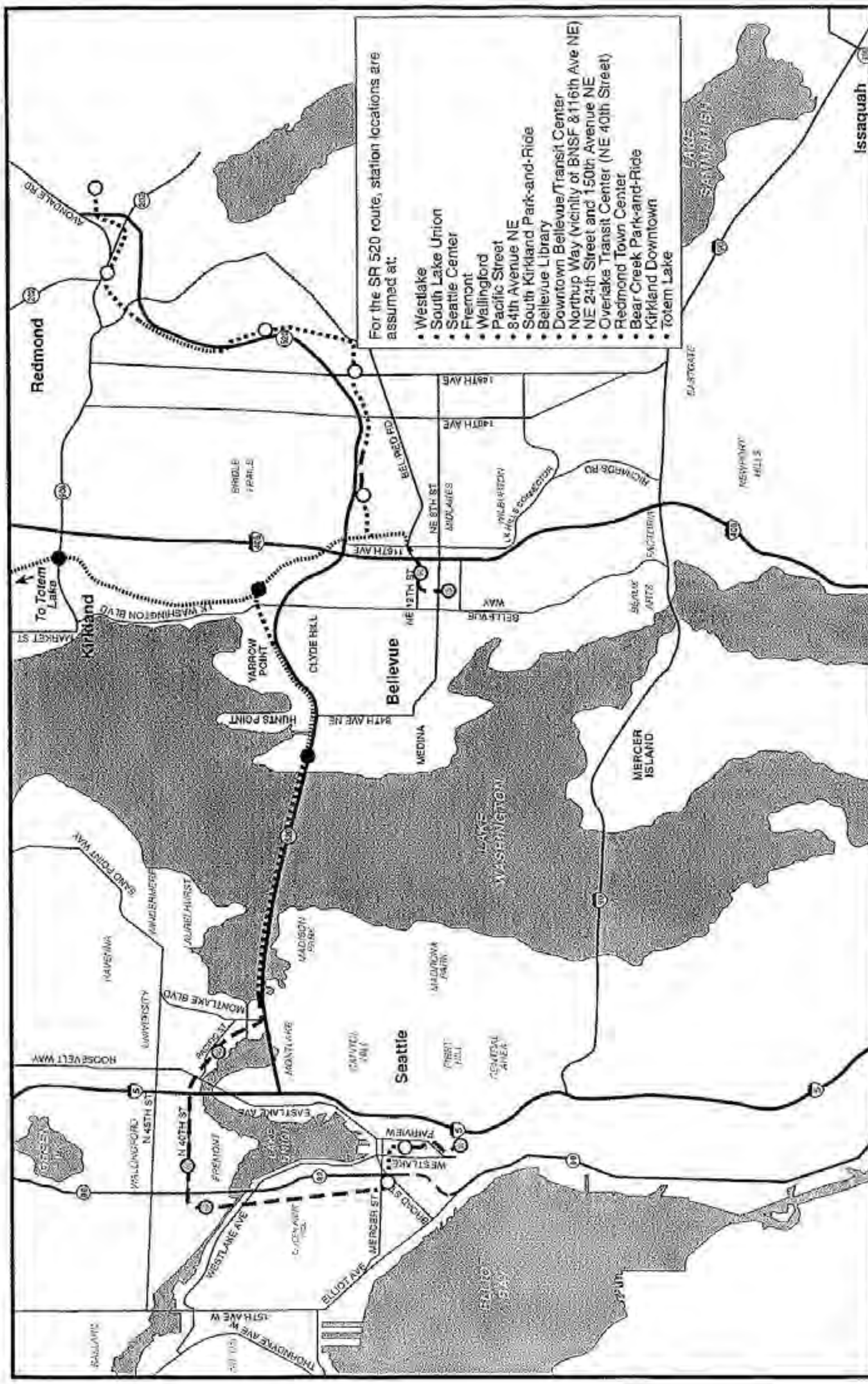


- Add bicycle and pedestrian facilities. Implement aggressive strategies to manage transportation demand. Include provisions for mitigation and enhancement.
- Add one HOV/Bus Rapid Transit(BRT) lane with 4-foot buffer each way on SR 520.
- Assume bus/HOV in I-90 convertible center roadway.



Trans-Lake Washington Project
Summary of HCT Screening Process

Figure 20
TRANS-LAKE WASHINGTON PROJECT
Multi-Modal Alternative 7
(SR 520 HOV/Bus Rapid Transit (BRT))



Trans-Lake Washington Project

Summary of HCT Screening Process

153395.AA.12.07_T042002001SEA - Fig. 23_Multi-Modal Alts 5,6 - 12/10/02 - dulW

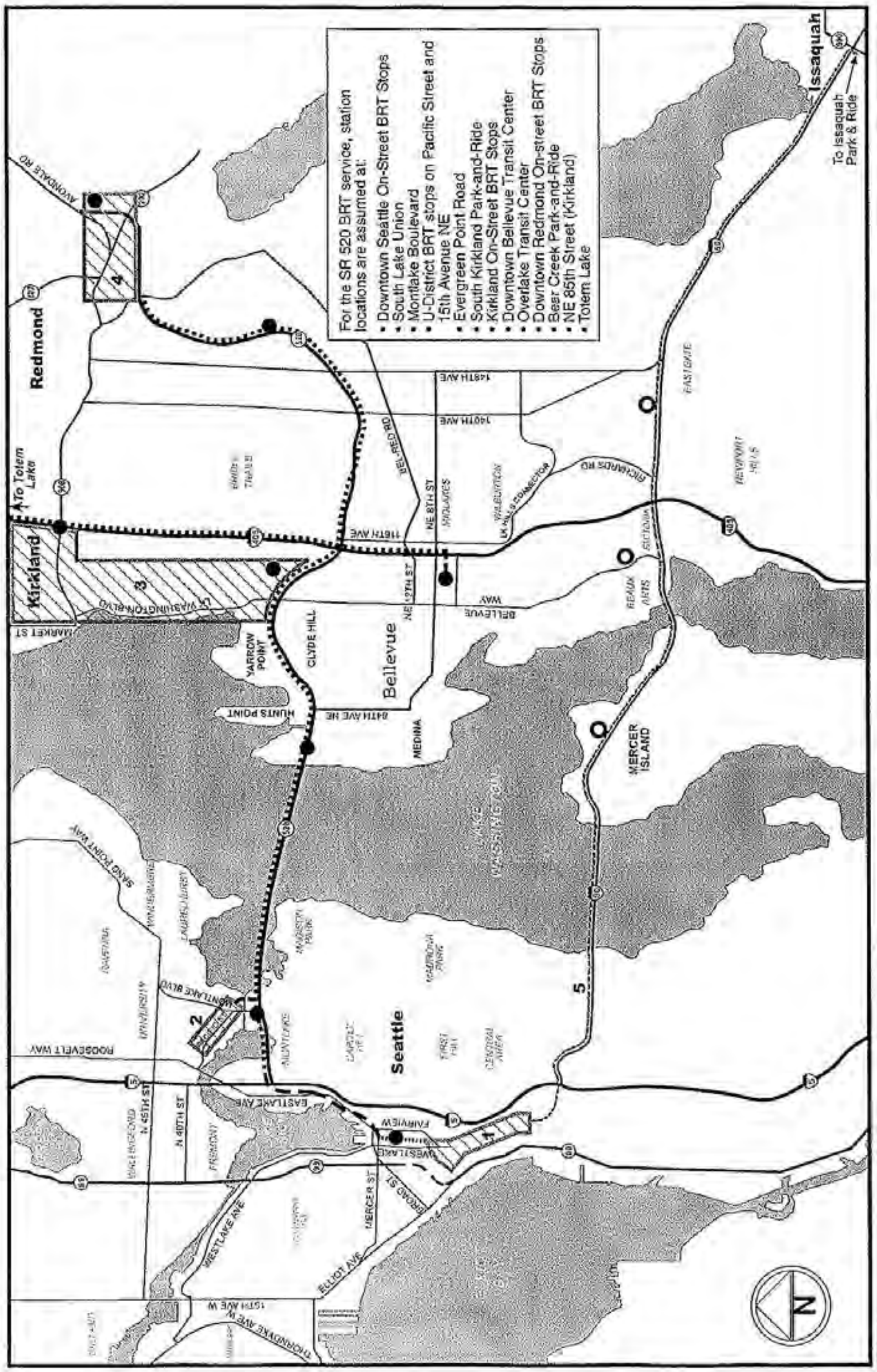
Alignment		Station
·········	Aerial	○
— — —	Subway	◎
▬▬▬	At Grade	●

Note: Short transition sections not shown

Figure 23

TRANS-LAKE WASHINGTON PROJECT

Multi-Modal Alternatives 5 and 6 (SR 520 Fixed Guideway Route) Downtown Seattle-U District-Kirkland/Redmond/Bellevue



Trans-Lake Washington Project

Alignment
- BRT in Shared HOV Lanes with 4-foot Buffer
- HOV/BRT Exclusive Right-of-Way
- BRT Exclusive Right-of-Way
- I-90 BRT Service
- BRT On-street with General Traffic Flow

Station
- SR 520 Corridor BRT Station
- I-90 Corridor BRT Station

1 BRT service would use 2nd Ave. southbound from Lenora St. to So. Jackson St. and 4th Ave. northbound from So. Jackson St. to Virginia St.

2 BRT service would use stops on Pacific St. and 15th Ave. NE.

3 BRT service would utilize arterial roads between Totem Lake, downtown Kirkland, and SR 520, as well as direct service from Totem Lake along I-405 and SR 520. Access to Kirkland and South Kirkland Park-and-Ride from SR 520 HOV lanes would be via 108th Ave. NE.

4 BRT service would exit at Lake Sammamish Parkway and make stops in downtown Redmond enroute to Bear Creek Park and Ride.

5 I-90 BRT service would use the I-90 reversible HOV lanes, and would serve south Bellevue, Eastgate, Issaquah, and the southern I-405 corridor.

Figure 24
TRANS-LAKE WASHINGTON PROJECT
Multi-Modal Alternatives 7 and 8 (BRT Services)

4.3.1.4 Alternative 5: SR 520 HOV and HCT

The Alternative 5 highway improvements to SR 520 would be the same as described for Alternative 3, with continuous HOV lanes provided between I-5 and SR 202/Redmond Way (Figure 18). Buses and HOV would not have a direct tunnel to the University District.

A fixed guideway line would begin in downtown Seattle and pass through Fremont and Wallingford to the University District. At Montlake Boulevard NE, the alignment would cross under the Montlake Cut to meet with and then follow the SR 520 corridor across Lake Washington. The main line would proceed to Redmond, with a branch to downtown Bellevue and a shuttle between Kirkland and Bellevue. Although most transit riders crossing the lake would be focused to the SR 520 HCT line, some riders would continue to use I-90 into downtown Seattle. Bus service would also be provided from the I-405 south corridor into downtown Seattle via I-90. (The I-90 center roadway was assumed to maintain current operations with this alternative, with the center roadway operating reversibly.)

4.3.1.5 Alternative 6: SR 520 HOV and GP and HCT

The highway improvements to SR 520 for Alternative 6 would be similar to Alternative 4, with an eight-lane highway providing three GP lanes and one HOV lane each way (Figure 19). Unlike Alternative 4, the west side terminus for the added GP lanes would be at Montlake.

The SR 520 HCT facilities would be the same as those described for Alternative 5.

4.3.1.6 Alternative 7: SR 520 HOV with BRT Connections

SR 520 would be a six-lane highway with continuous HOV lanes between I-5 and SR 202/Redmond Way, similar to Alternative 3; however, HOV lanes would be shared by BRT vehicles.

A BRT/HOV tunnel would connect SR 520 to Eastlake and Fairview Avenues. Near this location, BRT would enter a separate, exclusive busway facility that would run southwards through the South Lake Union area and over Denny Way. BRT routes to the University District would either use the proposed HOV direct access connection from SR 520 to Pacific Street or the Montlake interchange ramps to Montlake Boulevard. The route would facilitate transfers to the Link Pacific Station (see Figure 20).

BRT transit centers and flyer stops in the SR 520 corridor would be as follows:

- Downtown Seattle on-street stops
- South Lake Union
- University District: Pacific Street and 15th Avenue NE
- Downtown Bellevue Transit Center
- Overlake Transit Center
- Downtown Redmond on-street stops

- Montlake Boulevard
- Evergreen Point Road
- South Kirkland Park-and-Ride
- Kirkland on-street stops
- Bear Creek Park-and-Ride
- NE 85th Street (Kirkland)
- Totem Lake

4.3.1.7 Alternative 8: SR 520 HOV with BRT Connections, GP

SR 520 would be an eight-lane highway including one additional HOV lane and one additional GP lane each way (Figure 21), similar to Alternative 4.

BRT services and facilities would be the same as Alternative 7, except for slight differences in access to the Overlake Transit Center.

4.3.2 Transportation Performance

The transportation performance findings for the multi-modal analysis are presented in the *Multi-Modal Alternatives Evaluation Report* (Project Team, June 6, 2001). This analysis used twelve mobility criteria and three reliability and safety criteria. Table 8 summarizes the ratings for selected criteria (not all criteria lent themselves to summary or could be distinguished by a rating). A description of the findings for each criteria follows.

4.3.2.1 Mobility Criteria

Person Throughput. As shown in Table 9, the alternatives with the most lanes would carry the most people (Alternatives 4, 6, 8). From 1995 to 2020, daily Trans-Lake person trips would grow by 40 percent (Alternative 1) to 70 percent (Alternative 8). Daily HOV and transit trips would grow the most under the six-lane alternatives (3, 5, and 7).

Adding more HOV capacity to the SR 520 corridor (Alternatives 3, 5, and 7) would shift HOV users from I-90 to SR 520, indicating that a substantial number of HOV users in the Trans-Lake area would prefer the SR 520 corridor if HOV facilities were available. The effect of including HCT on either I-90 or SR 520 is more subtle, based on the forecasts and the alternatives as defined. If HCT were placed within the SR 520 corridor rather than within the I-90 corridor (Alternatives 5, 6, 7, and 8) the proportion of total daily cross-lake person trips on the SR 520 corridor would increase by about 3 to 4 percent, but the total number of daily cross-lake person trips on SR 520 and I-90 combined would remain similar. A similar proportional increase would occur on I-90 when that corridor had HCT. Based on this analysis, the route chosen for the fixed guideway system would not materially affect the potential to increase total daily cross-lake person trips.

Table 8
Transportation Performance Summary: Multi-Modal Evaluation[a]

Alternative	Alt 1; No Action	Alt 2: S&P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/ I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
Mobility Criteria								
Person Throughput	2	2	3	5	3	5	3	5
Traffic Volumes	3	3	4	5	4	5	4	5
Mode Share	3	3	3	3	3	3	3	3
Transit Ridership	2	3	4	4	3	4	4	4
Vehicle Miles Traveled and Vehicle Hours Traveled	3	3	4	3	4	3	4	3
Travel Demand Reduction	3	4	4	2	4	2	4	2
Reliability and Safety Criteria								
Exclusive/Nonexclusive Right-of-Way	1	4	5	5	5	5	3	3
Safety	1	2	3	4	3	4	4	5
Travel Time Reliability	1	2	3	4	3	4	2	3
Incident Management	1	2	3	4	3	4	3	4
System Compatibility Criteria								
Compatibility with Regional, and Local Transportation Plans and Improvement Projects	1	2	5	3	5	3	4	2
System Continuity	1	1	4	3	4	3	3	2
Compatibility with Statewide, Regional, and Local TDM and Land Use Plans and Programs	1	1	3	3	3	3	3	3

[a] Ratings are based on the following scale:

WORST →				BEST
○	◔	◑	◕	●
Least Effective	Low Effectiveness	Moderate Effectiveness	Increased Effectiveness	Most Effective

Trans-Lake Washington Project
Summary of HCT Screening Process

4-45

Trans-Lake Washington Project
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Table 9. Person Throughput
Daily and Peak Period Demand Forecasts for Person Trips on SR 520 and I-90

Facilities	1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV / BRT	Alt 8: HOV / BRT & GP
DAILY PERSON TRIPS									
SR 520									
Person Trips	144,600	183,200	173,200	200,700	261,200	212,225	284,190	215,200	293,600
I-90									
Person Trips	164,900	245,900	255,700	256,675	242,060	230,700	229,300	236,100	232,400
Total	**309,500**	**429,100**	**428,900**	**457,375**	**503,260**	**442,925**	**513,490**	**451,300**	**526,000**
PEAK PERIOD PERSON TRIPS									
SR 520									
Person Trips	42,400	54,900	51,000	64,100	78,900	66,330	87,250	68,000	92,400
I-90									
Person Trips	51,400	77,200	79,600	75,590	81,430	71,700	71,000	72,700	72,700
	93,800	**132,000**	**130,600**	**139,690**	**160,330**	**138,030**	**158,250**	**140,700**	**165,100**

Alternatives 7 and 8, the BRT alternatives, would have the highest number of daily cross-lake person trips for their respective lane configurations, six and eight lanes, respectively. The performance of these two BRT alternatives would depend in large part on competitive travel times. Travel times could slow as more buses are added to already congested streets in downtown Seattle and the University District, potentially leading to decreased BRT ridership.

Traffic Volumes. From 1995 to 2020, daily cross-lake person trips could increase by 25 percent (Alternative 1) to 50 percent (Alternative 8). Traffic-volume growth would be lower than person trip growth, indicating transit and HOV would play larger roles in all alternatives compared to today. Table 10 shows the daily Trans-Lake vehicle volumes by alternative, facility, and mode.

Table 9. Person Throughput
Daily and Peak Period Demand Forecasts for Person Trips on SR 520 and I-90

Facilities	1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV / BRT	Alt 8: HOV / BRT & GP
DAILY PERSON TRIPS									
SR 520									
Person Trips	144,600	183,200	173,200	200,700	261,200	212,225	284,190	215,200	293,600
I-90									
Person Trips	164,900	245,900	255,700	256,675	242,060	230,700	229,300	236,100	232,400
Total	**309,500**	**429,100**	**428,900**	**457,375**	**503,260**	**442,925**	**513,490**	**451,300**	**526,000**
PEAK PERIOD PERSON TRIPS									
SR 520									
Person Trips	42,400	54,900	51,000	64,100	78,900	66,330	87,250	68,000	92,400
I-90									
Person Trips	51,400	77,200	79,600	75,590	81,430	71,700	71,000	72,700	72,700
	93,800	**132,000**	**130,600**	**139,690**	**160,330**	**138,030**	**158,250**	**140,700**	**165,100**

Alternatives 7 and 8, the BRT alternatives, would have the highest number of daily cross-lake person trips for their respective lane configurations, six and eight lanes, respectively. The performance of these two BRT alternatives would depend in large part on competitive travel times. Travel times could slow as more buses are added to already congested streets in downtown Seattle and the University District, potentially leading to decreased BRT ridership.

Traffic Volumes. From 1995 to 2020, daily cross-lake person trips could increase by 25 percent (Alternative 1) to 50 percent (Alternative 8). Traffic-volume growth would be lower than person trip growth, indicating transit and HOV would play larger roles in all alternatives compared to today. Table 10 shows the daily Trans-Lake vehicle volumes by alternative, facility, and mode.

Table 10. Daily Trans-Lake Vehicle Volumes by Alternative, Facility, and Mode

Facilities	1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & HCT	Alt 6: HOV & GP & HCT	Alt 7: HOV / BRT	Alt 8: HOV / BRT & GP
SR 520									
Non-HOV	82,600	89,900	86,700	88,800	124,600	89,100	128,200	90,200	134,200
Commercial	23,700	29,600	29,600	29,500	37,600	30,100	40,000	30,400	41,600
HOV (3+)	700	4,800	4,200	11,100	11,900	11,200	12,900	11,100	12,300
Total Vehicle Trips	107,000	121,300	120,500	129,400	174,100	130,400	181,100	131,700	188,100
I-90									
Total Vehicle Trips	124,100	165,700	165,600	172,300	158,100	162,800	160,600	164,600	159,800
Totals	**231,100**	**287,000**	**286,100**	**301,700**	**332,200**	**293,200**	**341,700**	**296,300**	**347,900**

Source: PSRC Regional Forecasting Model

An LRT line within the I-90 corridor (Alternative 2) would not substantially affect the number of daily cross-lake vehicle trips compared to the No Action Alternative. Although the frequency, convenience, and reliability associated with HCT encourages people to switch to transit, the number of vehicle trips would not decline because more vehicles would be attracted to the corridor as capacity becomes available. All alternatives with LRT on I-90 assumed that HOV lanes would be placed on the outer roadways. If this does not occur, I-90 capacity would in effect be reduced to six lanes, reducing the number of vehicle trips that could be served during the peak periods of demand.

If GP and HOV lanes were added to SR 520, (Alternatives 4, 6, and 8), the total daily vehicle volumes across the lake in both corridors would increase about 45,000 to 60,000. On SR 520, the highest daily traffic volumes would occur with Alternative 8 (SR 520 HOV with BRT connections and GP), which would have 188,100 daily vehicle trips on SR 520 (55 percent more than No Action. The other eight-lane alternatives (4 and 6) would have similar traffic growth. In addition to increased capacity, the traffic growth for the eight-lane alternatives appears to be related to design options that would provide GP access to the University District and to Fairview Avenue North/Eastlake Avenue North. The effect of HCT in the I-90 center roadway also affects daily and peak period traffic volumes across the lake, as reversible operations would cease and HOV lanes would be, as assumed, on the outer roadways.

If HCT facilities were within the SR 520 corridor rather than the I-90 corridor (Alternatives 5 through 8), the proportion of daily vehicle volumes across the lake on SR 520 would not change significantly. As people switched from driving to transit, new vehicle trips would be attracted to the corridor.

Mode Share. All alternatives would have large increases in HOV and transit use from now to 2020 (Table 11). None of the alternatives would reduce the volume of non-HOV/commercial trips compared to Alternative 1, but they would reduce the proportion of all daily cross-lake trips that are made by non-HOV/commercial vehicles. Transit use would move from 5 percent in 1995 to 10 to 11 percent in 2020, depending on the alternative. Additional general purpose capacity would not adversely affect transit share. HOV use would increase from 2 percent in 1995 to 9 to 11 percent in 2020, depending on the alternative.

Table 11
Daily Cross-Lake Mode Share Summary
Based on Year 2020 Daily Person Trip Forecasts: Multi-Modal Evaluation

Facilities	1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV / BRT	Alt 8: HOV / BRT & GP
SR 520									
Non-HOV	76.0%	63.1%	66.6%	58.9%	63.5%	55.9%	60.5%	55.8%	60.8%
Commercial	16.4%	16.2%	17.1%	14.7%	14.4%	14.2%	14.2%	14.1%	14.2%
HOV 3+	1.6%	8.3%	7.7%	17.4%	14.4%	16.6%	14.4%	16.3%	13.2%
Transit	6.0%	12.4%	8.6%	9.0%	7.8%	13.3%	10.9%	13.8%	11.8%
I-90									
Non-HOV	77.6%	66.2%	63.9%	67.4%	66.5%	70.9%	70.4%	70.1%	69.1%
Commercial	16.4%	14.3%	13.8%	14.8%	13.4%	15.3%	15.0%	15.1%	14.7%
HOV 3+	1.6%	10.5%	9.3%	5.3%	6.0%	6.5%	6.6%	6.1%	6.8%
Transit	4.4%	9.0%	13.0%	12.5%	14.1%	7.4%	7.9%	8.7%	9.4%

Source: PSRC Regional Forecasting Model

Mode share would show noticeable change in the I-90 corridor by alternative. Transit use would increase substantially on I-90 with Alternatives 2 through 4, because I-90 is used for HCT and the majority of east-west transit users would be focused to I-90 (dropping the usage levels on SR 520). Similarly, transit use on SR 520 would increase substantially with Alternatives 4 through 8, which would provide either HCT or BRT facilities, and transit use on I-90 would decrease. The use of HOV on I-90 is affected by assumptions for the center roadway's operation with or without HCT, and by the addition of HOV lanes on SR 520, which attracts more carpool/vanpool users to the SR 520 corridor.

Transit Ridership. Relative increases in daily cross-lake transit ridership over the No Action alternative were forecasted as shown in Table 12.

Table 12
Daily Cross-Lake Transit Ridership Increase: Multi-Modal Evaluation

	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV / BRT	Alt 8: HOV / BRT & GP
Percent Increase	7%	12%	21%	1%	14%	12%	26%

In 2020, the alternative with the highest daily cross-lake transit ridership forecasts is Alternative 8 (Table 13). Alternative 7, which also provided BRT, had relatively high daily cross-lake transit ridership for a six-lane SR 520 configuration, but the forecasts were similar to Alternative 3, which would provide HCT on I-90. The alternative with the next lowest daily cross-lake transit ridership in 2020 is Alternative 2. The lowest is Alternative 5. These forecasts confirm the findings of the modal evaluation that high-quality transit service is needed in both corridors; however, forecasts may overstate the daily transit ridership for Alternatives 7 and 8 (the BRT alternatives).

Table 13
Daily Cross-Lake Transit Trip Forecasts: Multi-Modal Evaluation

Facilities	1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV / BRT	Alt 8: HOV / BRT & GP
SR 520									
Bus Transit	8,700	22,800	14,900	18,000	20,300	700	700	--	--
HCT	--	--	--	--	--	27,525	32,190	29,800	34,700
All Transit	8,700	22,800	14,900	18,000	20,300	28,225	32,890	29,800	34,700
I-90									
Bus Transit	7,200	22,100	3,600	3,400	3,500	17,100	18,200	20,500	21,900
HCT	--	--	29,700	28,675	30,560	--	--	--	--
All Transit	7,200	22,100	33,300	32,075	34,060	17,100	18,200	20,500	21,900
All Cross-Lake Routes									
Bus Transit	15,900	44,900	18,500	21,400	23,800	17,800	18,900	20,500	21,900
HCT	--	--	29,700	28,675	30,560	27,525	32,190	29,800	34,700
All Transit	15,900	44,900	48,200	50,075	54,300	45,325	51,090	50,300	56,600
Regional System Total									
Transit	281,553	652,710	659,826	656,748	652,710	651,426	648,048	655,288	653,048

Ridership for Alternatives 7 and 8 could be viewed as optimistic because daily transit ridership could be negatively affected by reliability, as well as operating constraints. In particular, there are long-term challenges for operating BRT on downtown Seattle and University District streets. If buses are subjected to large and unpredictable delays as a result of congestion in the Seattle CBD and/or the University District, BRT would be less likely to attract and accommodate the levels of ridership forecast. The BRT options might also require significant additional improvements to allow reliable bus operations in the Seattle CBD and the University District. No Action Alternative bus volumes approach the estimated operating capacity for transit on the downtown and University District surface streets in 2020, and there would be little or no room for future growth. Accommodating the additional volume of buses from BRT alternatives would likely require actions such as peak period restrictions on Third Avenue, joint bus/rail operations in the downtown Seattle transit tunnel, or bus intercept terminals. Outside of the University District and downtown Seattle, BRT vehicles would be expected to share lanes with HOVs, which could negatively affect travel speeds and reliability if the HOV lanes become congested.

Other observations for the transit forecasts are:

- Daily 2020 Trans-Lake transit ridership for the build alternatives ranges is forecasted to range from 45,000 to 57,000, or 0 percent to 23 percent higher than the "No Action" alternative.
- In general, the alternatives with the SR 520 Fixed Guideway alignment have lower cross-lake ridership (about 45,000 and 51,000 per day), and the I-90 Fixed Guideway and SR 520 BRT alternatives have higher levels of ridership (between 50,000 and 57,000 per day). It appears that the longer westside HCT alignment associated with Alternatives 5 and 6 result in less attractive transit service for cross-lake trips. Also, the I-90 LRT alternatives improve the frequency of service for the Central Link route, due to through routing of trains between Northgate and the Eastside, which increased ridership in the downtown tunnel stations and Capitol Hill. (See Table 15 for more detail on station boardings.)

Table 14 presents the PM peak period transit volumes.

Table 14
PM Peak Period[a] Cross-Lake Transit Trip Volumes: Multi-Modal Evaluation

Facilities	1995	Alt 1: No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV / BRT	Alt 8: HOV / BRT & GP
SR 520									
Transit	3,100	8,300	5,400	6,400	7,200	9,130	10,651	10,400	12,000
I-90									
Transit	2,800	7,400	11,200	10,790	11,630	6,300	6,300	6,900	7,400
All Cross-Lake Routes									
Transit	5,900	15,700	16,600	17,190	18,830	15,430	16,951	17,300	19,400

[a] For purposes of this analysis the PM peak period occurs from 3:00 p.m. to 6:00 p.m.

HCT Boardings. Table 15 presents the daily HCT station boardings. On the east side, most of the alternatives had similar daily ridership levels at both the station area and the total eastside levels. Downtown Seattle boardings increased with all HCT alternatives. The highest increases were with I-90 routes, which would increase the frequency of Central Link stations from the International District Station to Northgate, improving ridership.

The fixed guideway alternatives across the lake (Alternatives 2 through 6) appeared to increase overall daily boardings at Central Link stations in the downtown Seattle transit tunnel. The BRT alternatives did not have that effect, and resulted in the lowest levels of combined boardings for both sides of the lake.

Table 15
Trans-Lake Daily HCT Station Boardings:
Multi-Modal Evaluation

Station	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV / BRT	Alt 8: HOV / BRT & GP
Westside Station Areas							
Northeast Seattle	4,100	4,100	4,100				
University District	6,500	6,500	6,500	17,200	17,200	9,700	12,100
Capitol Hill/First Hill	11,100	11,100	11,100				
Downtown Seattle	28,900	28,900	28,900	10,400	10,400	17,000	17,900
South Seattle	1,300	1,300	1,300	400	400		
Seattle Center/ South Lake Union				12,300	12,300	2,800	2,800
North Seattle				12,400	12,400		
HCT Westside Totals	**51,900**	**51,900**	**51,900**	**52,700**	**52,700**	**29,500**	**32,800**

Source: PSRC Regional Forecasting Model

Vehicle Miles Traveled and Vehicle Hours Traveled. Overall, all of the alternatives would have vehicle miles of travel (VMT) and vehicle hours of travel (VHT) similar to Alternative 1 (No Action) at the regional level. The eight-lane alternatives (4, 6, and 8) are the only alternatives that would change VMT and VHT by a significant amount. The six-lane alternatives (3, 5, and 7) would result in minor increase in VMT, indicating a small increase in distance traveled, a reduction in the number of vehicles used per person to make the trip, or both. Alternatives 3 and 5 reduce VHT, which indicates shorter trips, improved travel times, or both.

Travel Time. HOV and transit vehicles have travel times 25 to 30 percent faster than non-HOV vehicles for all alternatives, or up to 10 minutes faster than non-HOV vehicles. Based on a representative trip from Seattle to Redmond, all of the alternatives with HOV lanes (3, 5, and 7) and no new GP lanes would provide travel time savings of up to 3 to 5 minutes for HOV travelers, compared to Alternative 1. Alternatives 4, 6, and 8 would improve travel times for general purpose vehicles and for HOVs. Table 16 shows a comparison of the travel times between designated districts.

Table 16
Trans-Lake Travel Time Comparison
Weighted Average PM Peak Period Travel Time (minutes)
Between Designated Districts: Multi-Modal Evaluation

(Year 2020 Forecasts for all available highway routes, including SR 520, I-90, and SR 522, and for bus, HCT, and BRT routes. Transit times are for in-vehicle travel only.)

District-to-District Pair		1995	Alt 1 No Action	Alt 2: S & P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/ I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV / BRT	Alt 8: HOV / BRT & GP
Downtown Seattle to Bellevue	GP	29.5	32.4	32.3	32.7	29.3	32.3	31.6	32.7	31.6
	HOV	25.7	25.2	25.0	23.8	23.1	24.4	24.0	24.4	24.4
	Transit	25.9	24.1	25.1	24.3	24.4	23.3	23.4	23.7	23.9
Downtown Seattle to Redmond	GP	37.4	44.8	44.6	45.0	41.0	44.6	43.0	44.9	42.8
	HOV	33.7	35.3	35.0	31.1	31.3	32.6	31.4	32.6	32.7
	Transit	38.8	37.4	39.0	36.8	36.8	35.1	35.2	35.8	36.6
Downtown Seattle to Issaquah	GP	38.8	44.1	44.0	44.4	41.1	43.9	43.6	44.4	43.6
	HOV	35.8	37.7	37.5	37.4	36.4	37.7	38.0	37.7	37.9
	Transit	37.2	31.2	33.7	33.7	33.6	30.9	30.9	31.0	31.0
Downtown Seattle to Kirkland	GP	32.0	37.3	37.1	37.5	34.5	37.2	36.4	37.5	36.1
	HOV	29.5	30.1	29.9	25.7	25.8	27.4	26.1	27.3	27.4
	Transit	31.2	31.1	30.7	26.8	26.7	27.1	27.3	28.9	29.0
University District to Redmond	GP	34.2	41.5	41.3	42.0	38.1	41.4	37.9	41.8	38.7
	HOV	33.4	36.9	36.8	29.8	30.1	29.6	29.2	29.6	29.4
	Transit	32.6	31.1	33.8	30.3	30.3	26.3	26.6	26.0	26.7

Transit travel times were competitive with general purpose travel times for most alternatives and most locations. For the most part, all of the alternatives offered the same advantages in terms of HOV facilities, the location of transit, and transit travel times. The areas most likely to be affected by changes in transit travel time were located north of SR 520 or south or east of I-90, where transfers or longer routes would be involved.

Travel Demand Reduction. The primary factors used in this criteria rating were traffic volumes, VMT/VHT, and mode split criteria, all of which provide an initial indication of the influence that each of the alternatives would have on travel behavior in the corridor. The greatest increase in HOV and transit usage in percentage terms was Alternatives 3, 5, and 7. These alternatives had the most competitive travel times for HOV lanes and transit compared to general purpose travel, and they had the lowest increase in the use of non-HOV vehicles. Alternatives 4, 6, and 8 also increased the number of people using transit and HOV, but there also was a large increase in the proportion and volume of general purpose vehicles. In reducing total vehicles, these alternatives would be least effective; however, improvements in transit and HOV facilities and usage provide an alternative to driving alone. They also tended to focus more travel on the SR 520 corridor, where it has a strong potential to be influenced by focused TDM programs. TDM programs could reduce vehicle trips by up to 6 percent through the use of tolls or other costs to transportation users.

4.3.2.2 Reliability and Safety Criteria

Exclusive/Nonexclusive Right-of-Way. This criterion reflects a basic difference between the HCT and BRT alternatives. Alternatives 2 through 6 provide exclusive rights-of-way for HCT on either an SR 520 or I-90 route. Alternatives 7 through 8 would have BRT mixed with HOVs for most of the SR 520 corridor, and mixed with GP traffic in downtown Seattle and the University District. Alternatives 3 through 6 would be the most effective for increasing reliability and safety, while Alternatives 7 and 8 would have medium effectiveness.

Safety. Alternatives 2 through 8 would be safer than Alternative 1 (No Action) because many segments of the current corridor lack shoulders and have geometric features that would not meet current design standards. The HCT components of Alternatives 2 through 6 were given high ratings because they would use an exclusive right-of-way. The BRT components of Alternatives 7 and 8 received similar high ratings. Alternatives 7 and 8 would add an additional 4-foot buffer between the BRT/HOV and GP lanes, reducing the degree of friction between non-HOVs and BRT and HOVs. This improvement would be offset slightly by the higher volumes of transit vehicles on SR 520 compared to HCT in an exclusive right-of-way.

Travel Time Reliability. Alternatives 3 through 8, which provide continuous HOV lanes in each direction on SR 520, would offer a substantial improvement in travel time reliability to transit and HOV users compared to the No Action alternative. HCT would have high reliability levels because an exclusive right-of-way would be included in Alternatives 2 through 6. With Alternatives 7 and 8, incidents or congestion on SR 520 could reduce the reliability of BRT. In addition, initial analysis indicates that BRT reliability would suffer as buses move through downtown Seattle and the University District, where on-street capacity for buses would be near capacity in 2020. Alternatives 4 and 6, which would improve conditions for transit, HOV, and commercial/general purpose travelers, had the highest ratings of the alternatives.

Incident Management. Overall, the ratings resemble those of the safety criterion, reflecting the addition of wider shoulders and/or buffers along the corridor, which would improve incident recovery times. Alternatives 4, 6, and 8 had the highest ratings, reflecting the benefits offered by three GP lanes on SR 520 9 in each direction, allowing more room for incident recovery, and an improved ability to maintain adequate traffic flow during periods of congestion caused by incidents.

4.3.2.3 System Compatibility Criteria

Compatibility with Regional and Local Transportation Plans and Improvement Projects. Alternative 1 had the lowest ratings, reflecting no action to implement long-standing regional and local plans. Alternative 2 had the next lowest rating, with no improvement to SR 520, but it would include I-90 HCT, which would be consistent with Sound Transit's Long-Range

Vision. Alternative 3 had the highest rating, reflecting consistency with regional highway plans and Sound Transit's Long-Range Vision. Alternatives 5 and 6 would require a change to Sound Transit's Long-Range Vision, but, as defined, still meet the transit capacity requirements and objectives of that vision. Alternatives 7 and 8 had lower ratings because the BRT/HOV elements would not address long-range transit capacity constraints in downtown Seattle and the University District.

System Continuity. Alternatives 1 and 2 received the lowest rating because they would not complete the regional HOV system, and would constrain improvements to I-405 by limiting the receiving capacity on SR 520. Alternatives 3, 5, and 7 received higher ratings than Alternatives 4, 6, and 8 because they not only would each provide a continuous HOV connection across the lake, but also would have greater ability to accept additional travel related to proposed I-405 improvements. The HCT routes were given similar continuity ratings, regardless of corridor location (SR 520 or I-90). Although an I-90 HCT route was assumed in Sound Transit's Long-Range Vision, the SR 520 routes as defined would also provide continuity within the system.

Compatibility with Statewide, Regional, and Local TDM and Land Use Plans and Programs. Alternatives 1 and 2 were rated lowest because planned population and employment growth in the region would outpace cross-lake capacity, particularly on SR 520, which does not currently meet demand. The other alternatives are all rated similarly. Consistent with plans at all levels, Alternatives 3 through 8 all offer HOV and HCT elements. The eight-lane alternatives (4, 6, and 8) would have a mixed rating because the additional GP lane is not completely compatible with regional and local planning policies that call for reduced reliance on general purpose travel.

4.3.3 Environmental Impacts

The environmental impacts of the multi-modal alternatives are presented in *Multi-Modal Alternatives Evaluation—Environmental Findings* (Project Team, June 7, 2001). Table 17 summarizes the impacts on 12 elements of the environment by alternative. The following provides a brief description of potential impacts by element. In some cases the environmental analyses were able to distinguish impacts resulting from highway and transit facilities, in others they were not; when possible, the following discussion highlights impacts resulting from transit elements of the alternatives.

4.3.3.1 Air Quality

Differences in overall air quality impacts would be small. Most impacts would be caused by increased vehicle miles traveled under alternatives that increase general purpose capacity (Alternatives 4, 6, and 8).

Table 17
Environmental Criteria Ratings Summary: Multi-Modal Evaluation

Criteria	Alt 1: No Action	Alt 2: S&P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/ I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV/BRT	Alt 8: HOV/BRT & GP
Air Quality	3 least	3 least	3 least	2 medium	3 least	2 medium	3 least	1 most
Water Resources	3 least	2 medium	1 most	1 most	1 most	1 most	1 most	1 most
Fish-Bearing Streams	4 no	3 least	2 medium	2 medium	3 least	1 most	3 least	3 least
Critical Upland Habitat	3 least	2 medium	2 medium	1 most	2 medium	1 most	2 medium	1 most
Wetlands and Shorelines	4 no	2 medium	1 most	1 most	1 most	1 most	1 most	1 most
Noise and Vibration	3 least	3 least	2 medium	1 most	2 medium	1 most	2 medium	1 most
Land Use	4 no	3 least	3 least	2 medium	2 medium	1 most	3 least	2 medium
Parklands	4 no	3 least	2 medium	1 most	2 medium	1 most	3 least	2 medium
Cultural Resources	4 no	2 medium	1 most	1 most	3 least	2 medium	3 least	3 least
Displacement and Disruption	4 no	3 least	2 medium	2 medium	2 medium	1 most	2 medium	1 most
Neighborhood	2 medium	3 least	3 least	1 most	3 least	1 most	3 least	2 medium
Visual Quality	4 no	1 most	1 most	1 most	2 medium	2 medium	3 least	3 least

RATING SCALE

WORST →				BEST
○	◔	◑	◕	●
Most Impacts	Medium Impacts	Low Impacts	No Impact	Improved Environment

Trans-Lake Washington Project
Summary of HCT Screening Process

4-55

Trans-Lake Washington Project
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4.3.3.2 Water Resources

Impacts to water resources would be influenced by the amount of impervious surface area created by each alternative. The wider the footprint of the alternative, the greater the amount of impervious surface area that would be created, leading to more stormwater runoff which affects water resources. More impervious surface area requires greater volumes of stormwater detention and treatment. Alternative 6 would have the greatest impact on water quality and hydrology because it would create the most impervious surface area. Alternatives 3 through 6 would impact the greatest number of water resources.

4.3.3.3 Fish-Bearing Streams

The proposed alternatives have many of the same impacts on water and fishery resources. Alternative 6 would have the greatest overall impact because it would have the widest configuration. The most significant construction-related impacts on fishery resources are increased turbidity, sedimentation and erosion, potential pollutant-loading from spills, and disruption of riparian vegetation. Long-term impacts would occur because of increased runoff and pollutant loading from impervious surface areas and shading of aquatic habitat by aerial structures.

4.3.3.4 Critical Upland Habitat

The proposed alternatives have many of the same impacts on priority habitat and species. Most of the alternatives have similar impacts in areas with concentrations of priority and habitat species locations, such as Portage Bay, Foster Island, Yarrow Bay, and Sammamish/Bear Creek. Alternative 6 would have the greatest overall impact because it would have the widest configuration. Avoidance, minimization, and mitigation in many of these areas is difficult because the habitat is unique and because shifting the alignment to avoid impacts is often not possible because locations of priority habitat and species are present on both sides of the alignment.

4.3.3.5 Wetlands

Alternative 6 would impact the greatest area of wetlands (21.7 acres). Most of the alternatives (Alternatives 3, 4, 5, 7, and 8) would impact 16.7 to 17.8 acres of wetlands because of the widened highway right-of-way. Alternative 2, which would not add additional highway lanes but would add LRT to I-90, would only impact 4.6 acres of wetlands. (Impact calculations for Alternatives 2 through 6 do not include HCT impacts on the Sammamish River and Bear Creek that would occur outside the SR 520 right-of-way.)

4.3.3.6 Noise and Vibration

The highest noise levels and potential impacts would result from the combination of moving the roadway closer to the receivers during widening and allowing for additional traffic volumes. The alternatives with the greatest impacts, Alternatives 4 and 8, could increase noise levels by approximately 3 to 5 dBA. To most people a 3 dBA change is barely perceptible, while a 5 dBA is usually noticeable.

The differences among the HCT alternatives are not expected to make a significant difference in the noise or vibration impacts. The alternatives along SR 520 and I-90 are in established transportation corridors, and, therefore, are not projected to change the noise environment significantly. Alignments to Redmond that would remain along SR 520 would have less potential for impacts than those alignments along Bellevue Way and 112th Avenue NE.

4.3.3.7 Land Use

Direct impacts to land use would include the effects of property acquisition, loss of access, and other physical changes. The eight-lane alternatives with HCT, Alternatives 4 and 6, would require the acquisition of the greatest amount of property, 76.4 and 86.2 acres, respectively. Alternatives 5 and 6, which both have HCT in the SR 520 corridor, would require the greatest amount of land acquisition outside of the highway corridor—approximately 24 acres. Table 18 summarizes the direct land use impacts.

Table 18
Direct Land Use Impacts

	Alt 1: No Action	Alt 2: S&P w/ I-90 LRT	Alt 3: HOV w/ I-90 LRT	Alt 4: HOV & GP w/ I-90 LRT	Alt 5: HOV & 520 HCT	Alt 6: HOV & GP & 520 HCT	Alt 7: HOV/ BRT	Alt 8: HOV/ BRT & GP
Total Acquisition	0.0	33.4	52.8	76.4	67.4	86.2	36.9	57.5
Percent Outside Highway Corridor*	0.0	15.0	14.8	16.	24.3	24.1	0.0	0.0

* Alternatives 7 and 8 would only deviate from the highway within the corridor alignment; therefore, only a minimal amount of property would be impacted by BRT facilities and not highway facilities.

4.3.3.8 Parklands

All potential impacts on parklands would occur within the SR 520 corridor. The number of parks affected would range from 9 direct impacts affecting 9 park facilities (Alternative 2) to 16 direct impacts affecting 12 distinct parks (Alternative 4). All direct impacts for Alternatives 7 and 8 would be related to proposed highway improvements. For Alternatives 2 through 6, three direct impacts would be associated with the LRT alignment.

4.3.3.9 Cultural Resources

Alternatives 2 through 8 could affect two to four cultural resources. Alternatives 3 and 4 would affect the greatest number of resources. The alternatives with light rail on I-90 (Alternatives 2, 3, and 4) would effect three cultural resources outside of the SR 520 corridor: Mount Baker Ridge Tunnel, Pioneer Square Historic District, and Frederick W. Winters House.

4.3.3.10 Displacements and Disruptions

The number of structures that could be displaced by the alternatives ranges from 19 to 50,[7] of which 13 to 29 would be attributable to HCT facilities outside of the SR 520 corridor. Alternatives 5 and 6 would each displace 29 structures as a result of the HCT facilities, and Alternatives 7 and 8 would displace 19. Alternative 4 would displace the least number of structures (11) as a result of HCT facilities.

4.3.3.11 Neighborhoods

The LRT elements of Alternatives 2, 3, and 4 would impact the Southeast Bellevue, Bel-Red/Northup, and Overlake neighborhoods through property acquisitions, displacements, and possible visual impacts. Because nearly all of these impacts would occur on the periphery of the neighborhoods, they would not fragment communities. In addition, these alternatives would pass by several neighborhoods with areas that have minority populations greater than 50 percent, including the International District, North Rainier, Central Area, Mercer Island, Lakeview, West Bellevue, Overlake, and South Redmond. For Alternatives 5 and 6, most of the HCT alignment through Seattle would be below grade, minimizing neighborhood impacts. Once the HCT alignment joins the SR 520 right-of-way, the widened corridor would result in additional property acquisition and displacements, particularly affecting the Bel-Red/Northup and Overlake communities. Alternatives 7 and 8 would not impose additional impacts on communities as a result of HCT facilities.

4.3.3.12 Visual Quality

Alternatives 2 through 4 would have the greatest impact on visual quality and Alternatives 7 and 8 would have the least. The LRT structures constructed for Alternatives 2, 3, and 4 would have low to moderate impacts in Seattle and across Lake Washington; impact levels in Bellevue, Overlake, and Redmond would be moderate to high. Alternatives 5 and 6 would create additional low to moderately high-level visual impacts because of the HCT alignment from downtown Seattle through the Queen Anne, Fremont, Wallingford, and University District neighborhoods, even though the alignment would be in a tunnel. Although the HCT facilities would generate additional impacts within the SR 520 corridor in Seattle, these impacts would be offset somewhat by the lack of HCT facilities (and impacts) in south Bellevue.

4.3.4 Costs

The cost opinions for the multi-modal alternatives are presented in *Final Multi-Modal Cost Methodology and Multi-Modal Cost Opinions for Alternative Analysis* (Project Team, July 11, 2001). Following the preparation of these cost opinions, additional analyses concerning the structural feasibility of supporting LRT on the I-90 bridge approach structures and transition spans and a separate I-90 bridge crossing were completed that affected the cost opinions for Alternatives 2 through 4 (HCT on I-90). The multi-modal cost opinion tables included in this

[7] After the multi-modal evaluation, the I-405/SR 520 interchange design changed, which increased the number of potential displacements.

report have been updated to reflect the costs identified through these additional analyses. The reasons for these revised cost opinions are described in Section 5 of this report.

The results of the multi-modal cost analysis are presented in Tables 19 through 24. The cost opinions developed for the multi-modal alternatives are Class 5 cost opinions (as defined by the Association for the Advancement of Cost Engineering). The expected accuracy range of the cost opinions is –30 percent to +50 percent or greater based on information available at the planning level. These planning-level cost opinions are only intended for the purpose of comparing the different alternatives and not for the purpose of making financial decisions or establishing budgets.

The methodology used to arrive at those cost opinions is summarized below and presented in detail in *Final Multi-Modal Cost Methodology and Multi-Modal Cost Opinions for Alternative Analysis* (Project Team, July 11, 2001).

4.3.4.1 Capital Costs

The capital cost opinion includes related civil and traffic work (roadway and intersection improvements, traffic signals and gates, drainage, stormwater management, utility relocations); right-of-way, including relocation and administrative and legal costs; and agency costs (e.g., environmental analysis, engineering, construction management, administration). The capital cost opinion excludes operating costs (utilities, labor), improvements not described in engineering documents (e.g., betterments), and environmental mitigation (e.g., wetlands, hazardous materials).

The total multi-modal cost for each alternative is the combination of costs calculated separately for each alternative's highway and HCT elements. Highway costs include all costs directly related to placing new lane, ramps, and interchange modifications for GP lanes in the SR 520 corridor, including associated right-of-way costs. Shared HOV access, bus flyerstops, and all other BRT costs, including BRT stations, are reported as part of the HCT cost package. HCT costs also include all costs for HCT outside of the SR 520 corridor; all costs for fixed guideway within the corridor alignments; HCT station costs, including right-of-way; any extra right-of-way costs associated with placing a fixed guideway within the corridor alignments; and bridge widening costs to accommodate the fixed guideway. The cost opinions for all of the alternatives, except Alternative 1, include bicycle/pedestrian facilities along the alignment and an aggressive TDM package. Elements such as noise walls, stormwater mitigation, local street improvements, environmental mitigation, and lid costs are reported separately from the capital costs; assumptions regarding this costs are provided in *Final Multi-Modal Cost Methodology and Multi-Modal Cost Opinions for Alternative Analysis* (Project Team, July 11, 2001).

Details regarding construction costs (construction units, allowances, contingencies and sales tax, and right-of-way) are also provided in the *Final Multi-Modal Cost Methodology and Multi-Modal Cost Opinions for Alternative Analysis* (Project Team, July 11, 2001).

Table 19
Multi-Modal Alternative Cost Summary
(in millions of 2001 dollars)

	Alt 1: No Action	Alt 2:[a] Safety and Preservation, I-90 HCT Conversion	Alt 2A:[b] Safety and Preservation, New I-90 HCT Bridge	Alt 3:[a] HOV and I-90 HCT Conversion	Alt 3A:[b] HOV and New I-90 HCT Bridge	Alt 4:[a] HOV+GP and I-90 HCT Conversion	Alt 4A:[b] HOV+GP and New I-90 HCT Bridge	Alt 5:[a] HOV and SR 520 HCT	Alt 6:[a] HOV+GP and SR 520 HCT	Alt 7:[a] HOV/BRT	Alt 8:[a] HOV/BRT+GP
Total Alternative Capital Cost Opinion	$0	$4,260	$4,920	$5,920	$6,580	$7,420	$8,080	$7,260	$8,830	$4,350	$5,460
Annual Cost Elements	$0	$109	$109	$55	$55	$114	$115	$54	$106	$31	$81
Other Costs	$0	$350 to $4,080	$350 to $4,150	$770 to $4,740	$780 to $4,810	$1,770 to $6,040	$1,780 to $6,110	$740 to $5,040	$1,660 to $6,280	$830 to $4,710	$1,880 to $6,030
Life Cycle Analysis[c] (NPV)	$0	$3,065	$3,175	$3,161	$3,395	$4,682	$5,079	$4,052	$4,777	$2,604	$3,403

[a] Project Team (July 11, 2001).
[b] Farquharson (February 13, 2002).
[c] Includes estimated cost of noise walls, storm water mitigation, local street improvements. Environmental mitigation assumed to be 5% of capital cost. Does not include the cost of freeway lids.

Multi-Modal Cost Summary
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Table 20
Multi-Modal Alternative Capital Cost Opinion Summary
(In millions of 2001 dollars)

	Alt 1: No Action	Alt 2:[a] Safety and Preservation, I-90 HCT Conversion	Alt 2A:[b] Safety and Preservation, New I-90 HCT Bridge	Alt 3:[a] HOV and I-90 HCT Conversion	Alt 3A:[b] HOV and New I-90 HCT Bridge	Alt 4:[a] HOV+GP and I-90 HCT Conversion	Alt 4A:[b] HOV+GP and New I-90 HCT Bridge	Alt 5:[a] HOV and SR 520 HCT	Alt 6:[a] HOV+GP and SR 520 HCT	Alt 7:[a] HOV/BRT	Alt 8:[a] HOV/BRT+GP
Highway Capital Cost Opinion	$0	$1,480	$1,480	$2,590	$2,590	$4,100	$4,100	$2,550	$3,530	$2,780	$3,900
HCT Transit Capital Cost Opinion[c]	$0	$2,780	$3,440	$3,330	$3,990	$3,320	$3,980	$4,710	$5,300	$1,590	$1,560
Total Alternative Capital Cost Opinion	$0	$4,260	$4,920	$5,920	$6,580	$7,420	$8,080	$7,260	$8,830	$4,350	$5,460
Capital Cost Index, Low Cost = 100		100	115	139	154	174	190	170	207	102	128

[a] Project Team (July 11, 2001).
[b] Farquharson (February 13, 2002).
[c] This cost includes any direct LRT or BRT cost plus Park and Ride expansion costs and HOV Access and flyerstop costs.

Capital Cost Opinion Summary
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Table 21
Multi-Modal Alternative Capital Cost Opinion Summary
(In millions of 2001 dollars)

	Alt 1: No Action	Alt 2:[a] Safety and Preservation, I-90 HCT Conversion	Alt 2A:[b] Safety and Preservation, New I-90 HCT Bridge	Alt 3:[a] HOV and I-90 HCT Conversion	Alt 3A:[b] HOV and New I-90 HCT Bridge	Alt 4:[a] HOV+GP and I-90 HCT Conversion	Alt 4A:[b] HOV+GP and New I-90 HCT Bridge	Alt 5:[a] HOV and SR 520 HCT	Alt 6:[a] HOV+GP and SR 520 HCT	Alt 7:[a] HOV/BRT	Alt 8:[a] HOV/BRT+GP
Highway Capital Cost Opinion	$0	$1,480	$1,480	$2,590	$2,590	$4,100	$4,100	$2,550	$3,530	$2,760	$3,900
HOV Access/Flyerstop Transit Capital Cost Opinion	$0	$20	$20	$570	$570	$560	$560	$0	$590	$600	$680
P&R Upgrade Capital Cost Opinion	$0	$70	$70	$70	$70	$70	$70	$110	$110	$110	$110
HCT Transit Capital Cost Opinion	$0	$2,690	$3,350	$2,690	$3,350	$2,690	$3,350	$4,600	$4,600	$880	$770
Total Alternative Capital Cost Opinion	$0	$4,260	$4,920	$5,920	$6,580	$7,420	$8,080	$7,260	$8,830	$4,350	$5,460

[a] Project Team (July 11, 2001).
[b] Farquharson (February 13, 2002).

Capital Cost Opinion Breakdown
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Table 22

Multi-Modal Alternative Annual Cost Summary

Multi-Modal Alternative Annual O&M Cost Opinion

(incremental cost in millions of 2001 dollars)

		Alt 1: No Action	Alt 2:[a] Safety and Preservation, I-90 HCT Conversion	Alt 2A:[b] Safety and Preservation, New I-90 HCT Bridge	Alt 3:[a] HOV and I-90 HCT Conversion	Alt 3A:[b] HOV and New I-90 HCT Bridge	Alt 4:[a] HOV+GP and I-90 HCT Conversion	Alt 4A:[b] HOV+GP and New I-90 HCT Bridge	Alt 5:[a] HOV and SR 520 HCT	Alt 6:[a] HOV+GP and SR 520 HCT	Alt 7:[a] HOV/BRT	Alt 8:[a] HOV/BRT+GP
Highway O&M Annual Costs	Tunnel	$0	$0	$0	$0	$0	$1.06	$1.06	$0	$0	$0	$0.91
	Other	$0	$0.18	$0.18	$0.67	$0.67	$1.43	$1.43	$0.65	$1.37	$0.81	$1.23
Transit O&M Annual Costs	Tunnel	$0	$0	$0	$0.74	$0.74	$0.73	$0.73	$0	$1.28	$1.69	$2.12
	Rail	$0	$48.4	$48.6	$48.4	$48.6	$48.4	$48.6	$47.1	$47.1	$0	$0
	Bus	$0	$2.0	$2.0	$2.5	$2.5	$2.4	$2.4	-$2.9	-$3.1	$15.6	$15.6
Incremental Annual O&M Cost Opinion vs. Alternative[c]		$0	$50.58	$50.73	$52.31	$52.46	$54.02	$54.17	$44.85	$46.65	$18.10	$19.86

[a] Project Team (July 11, 2001).
[b] Farquharson (February 13, 2002).
[c] All O&M cost are incremental costs vs. the No Action alternative.

Multi-Modal Alternative Annual TDM Cost Opinion

(In millions of 2001 dollars)

	Alt 1: No Action	Alt 2:[a] Safety and Preservation, I-90 HCT Conversion	Alt 2A:[b] Safety and Preservation, New I-90 HCT Bridge	Alt 3:[a] HOV and I-90 HCT Conversion	Alt 3A:[b] HOV and New I-90 HCT Bridge	Alt 4:[a] HOV+GP and I-90 HCT Conversion	Alt 4A:[b] HOV+GP and New I-90 HCT Bridge	Alt 5:[a] HOV and SR 520 HCT	Alt 6:[a] HOV+GP and SR 520 HCT	Alt 7:[a] HOV/BRT	Alt 8:[a] HOV/BRT+GP
Annual TDM Cost[c]	$0	$6.75	$6.75	$7.70	$7.70	$8.34	$8.34	$7.64	$8.42	$7.79	$8.66

[a] Project Team (July 11, 2001).
[b] Farquharson (February 13, 2002).
[c] Annual TDM costs are developed from proposed TDM investments through 2020. The 2020 TDM costs were projected from PSRC Destination 2030 transportation plan.

Multi-Modal Alternative Annual Private Cost Opinion

(Incremental cost in millions of 2001 dollars)

	Alt 1: No Action	Alt 2:[a] Safety and Preservation, I-90 HCT Conversion	Alt 2A:[b] Safety and Preservation, New I-90 HCT Bridge	Alt 3:[a] HOV and I-90 HCT Conversion	Alt 3A:[b] HOV and New I-90 HCT Bridge	Alt 4:[a] HOV+GP and I-90 HCT Conversion	Alt 4A:[b] HOV+GP and New I-90 HCT Bridge	Alt 5:[a] HOV and SR 520 HCT	Alt 6:[a] HOV+GP and SR 520 HCT	Alt 7:[a] HOV/BRT	Alt 8:[a] HOV/BRT+GP
Annual Private Costs[c]	$0	$52	$52	-$5	-$5	$52	$52	$2	$51	$5	$52

[a] Project Team (July 11, 2001).
[b] Farquharson (February 13, 2002).
[c] Private costs are incremental cost vs. the No Action alternative. These costs are based on 2020 travel projections.

Multi-Modal Annual Cost Summary
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Table 23
Other Potential Costs
(In millions of 2001 dollars)

	Alternative 1 No Action	Alternative 2 Safety and Preservation, I-90 HCT Conversion	Alternative 2A Safety and Preservation, New I-90 HCT Bridge	Alternative 3 HOV and I-90 HCT Conversion	Alternative 3A HOV and New I-90 HCT Bridge	Alternative 4 HOV+GP and I-90 HCT Conversion	Alternative 4A HOV+GP and New I-90 HCT Bridge	Alternative 5 HOV and SR 520 HCT	Alternative 6 HOV+GP and SR 520 HCT	Alternative 7 HOV/BRT	Alternative 8 HOV/BRT+GP
Noise Walls[1]	$0	$30	$30	$60	$60	$60	$60	$60	$60	$60	$60
Storm Water Mitigation[2]	$0	$90	$90	$330	$330	$570	$570	$320	$560	$340	$570
Local Street Improvements[3]	$0	$50	$50	$190	$190	$930	$930	$150	$820	$250	$1,060
Environmental Mitigation[4]	$0	$50 to $430	$50 to $500	$60 to $600	$70 to $660	$80 to $750	$90 to $810	$80 to $730	$90 to $890	$50 to $440	$60 to $550
Lids[5]	$0	$130 to $3,480	$130 to $3,480	$130 to $3,570	$130 to $3,570	$130 to $3,740	$130 to $3,740	$130 to $3,780	$130 to $3,950	$130 to $3,620	$130 to $3,790

Note 1: Noise walls for Alt. 2-8 are assumed along 90% of the westside mainline, 90% of the corridor from Lake Washington to I-405, and for Alt. 3-8 along 60% of the corridor from I-405 to SR 202. These cost are included in the life cycle analysis.

Note 2: Storm water cost were modeled off the Sea-Tac Third runway storm water requirements. Any changes in storm water regulation from can cause these costs to vary. These cost are included in the life cycle analysis.

Note 3: Local street improvements are taken as a percentage of the highway construction costs. This percentage ranges from 3% for alternative 2, to 6% for the six-lane alternative and 20% for the eight-lane alternatives. These costs are included in the life cycle analysis.

Note 4: Environmental Mitigation includes wetland mitigation, habitat restoration, park mitigation, etc. It may range from 1-10% of the capital cost for each alternative. For purposes of the Life Cycle analysis the environmental mitigation cost was taken at 5%.

Note 5: Lid cost are not included in the life cycle analysis.

Multi-Modal Other Cost Summary
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Table 24
Multi-Modal Alternative Life Cycle Analysis
(Net Present Value of Costs over 30 years, in millions of 2001 dollars)

		Alternative 1 No Action	Alternative 2 Safety and Preservation, I-90 HCT Conversion	Alternative 2A Safety and Preservation, New I-90 HCT Bridge	Alternative 3 HOV and I-90 HCT Conversion	Alternative 3A HOV and New I-90 HCT Bridge	Alternative 4 HOV+GP and I-90 HCT Conversion	Alternative 4A HOV+GP and New I-90 HCT Bridge	Alternative 5 HOV and SR 520 HCT	Alternative 6 HOV+GP and SR 520 HCT	Alternative 7 HOV/BRT	Alternative 8 HOV/BRT+GP
Capital Costs[1]		$0	$2,257	$2,421	$2,899	$3,160	$4,016	$4,464	$3,703	$4,258	$2,399	$2,988
Private Costs[2]						$570						
	Auto	$0	$347	$328	-$23	-$21	$288	$268	$11	$239	$33	$246
	Truck	$0	$60	$57	-$4	-$4	$50	$47	$2	$42	$6	$46
TDM		$0	$47	$43	$37	$33	$44	$40	$48	$36	$50	$37
O&M Costs[3]												
	Roadway[4]	$0	$1	$1	$3	$3	$13	$12	$4	$6	$5	$9
	Transit[5]	$0	$353	$325	$249	$224	$271	$249	$284	$196	$111	$77
Total Costs		$0	$3,065	$3,175	$3,161	$3,395	$4,682	$5,079	$4,052	$4,777	$2,604	$3,403
Life Cycle Index, Low Cost = 100			118	122	121	130	180	195	156	183	100	131

Note 1: Includes estimated cost of noise walls, storm water mitigation, local street improvements. Environmental mitigation assumed to be 5% of capital cost. Does not include the cost of freeway lids
Note 2: Total private costs are shown for no build and build alternatives. Other costs shown are differences from the no build.
Note 3: O&M and private costs begin in year of implementation.
Note 4: "Roadway" includes O&M costs for fixed bridges, floating bridges, highway, and tunnel.
Note 5: "Transit" includes O&M costs for buses, rail cars, rail structures, and rail operations.

Multi-Modal Life Cycle Analysis
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4.3.4.2 Operation and Maintenance Costs

The operation and maintenance (O&M) cost opinions include the labor and material necessary to preserve the roadway, HCT guideway, structures, and bridges. O&M costs were calculated in 2001 dollars, and then entered into the life-cycle cost analysis. The O&M cost opinions were calculated separately for the highway, BRT, and HCT elements, and were merged to compute the total O&M cost for each alternative. The following describes the assumptions used for calculating the transit O&M costs.

O&M costs were estimated for each transit mode included in the Trans-Lake multi-modal alternatives. Except for Alternative 1, the alternatives included some type of HCT, either LRT or BRT. All alternatives include conventional bus service operated by King County Metro and Sound Transit. In addition, the costs for bus service changes are included in the overall transit O&M cost estimates. Cost for bus services have been included because implementation of HCT would require the adjustment of bus service patterns to complement the new service.

LRT. LRT was assumed to be the HCT technology within the I-90 corridor, as per Sound Transit's Long-Range Vision. For purposes of developing cost opinions, the fixed guideway component of Alternatives 5 and 6 was assumed to be light rail, similar to the Central Link line under development, and would also be operated by Sound Transit.

To estimate the light rail O&M costs, the model developed for the 1998 Central Link EIS was used (with an adjustment for inflation). The model is documented in detail in a report titled *Seattle Light Rail Transit—Operating and Maintenance Cost Model* (Manuel Padron & Associates, October 19, 1998). The model calculates O&M costs based on the quantity of service supplied and other system characteristics.

The model divides operating costs into four areas: vehicle operations (transportation administration and support, revenue vehicle operation, ticketing and fare collection, and security), vehicle maintenance for revenue and nonrevenue vehicles (administration, inspection and maintenance, servicing [cleaning, fueling], and repairs), facilities maintenance, and LRT administration and support (general management and administration). For each area the following types of individual costs were identified: labor, contract service, materials and supplies, utilities, insurance, taxes, fuel, and miscellaneous. The model assumes that the following services will be contracted out: repairing major revenue-vehicle components, cleaning revenue vehicles, sweeping parking lots, repairing and maintaining elevators and escalators, and collecting revenues. The model includes the following input data, which are drivers for the individual cost items in the model: peak cars (maximum number of vehicles in service at one time), annual revenue car-miles (total miles operated), annual revenue train hours (total hours of operation by vehicles), total stations, directional route miles (total miles of revenue track), and maintenance facilities.

BRT. The BRT alternatives (5 and 6) have buses operating on 3+ HOV lanes and on-line stations at several locations. The O&M costs for the HOV lanes were included as part of the highway O&M costs. The station costs were estimated using the same assumptions as the LRT station costs. The O&M costs for bus service were included in the overall estimate of bus system O&M costs (see Bus Transit section below). A marginal unit cost of $62.98 per hour (2001 dollars) was used for any increase in bus hours relative to Alternative 1 (No Action); this cost is for articulated buses.

Conventional Bus Transit. As mentioned previously, implementation of a new HCT system would require changes to regular bus transit services; therefore, costs for these changes were included in the cost opinions for Alternatives 2 through 8.

Operating costs for bus transit are based on estimates of annual bus hours. These hours have been estimated using a Puget Sound Regional Council (PSRC) ridership forecasting model. A marginal unit cost of $60.38 per hour (2001 dollars) is assumed for King County Metro bus service; this rate is a composite of separate rates for small, standard, and articulated buses. The marginal unit costs include all direct costs; in other words, costs that directly vary according to the amount of service. It was assumed that for the different levels of bus service for each alternative there would not be a significant change in overhead or administration.

Comparing HCT to BRT O&M Costs. No attempt should be made to compare the BRT and LRT O&M costs directly. The nature of the service provided for each mode is very different. The fixed guideway alternatives (2 through 6) have one route; the BRT alternatives (7 and 8) have multiple routes inside and outside of the SR 520 corridor.

The primary difference between O&M costs for the fixed guideway and BRT alternatives relates to their off-peak costs. Off-peak headway assumptions on BRT routes were based on forecasted demand, and typically ranged between 5 and 10 minutes. For the fixed guideway alternatives, the assumption was made that a maximum policy headway of 10 minutes would be maintained in 2020 on the east side during off-peak hours, regardless of actual demand. On low-volume fixed guideway branches (Kirkland and Redmond), a high level of service was assumed, resulting in very high O&M costs for these alternatives when compared with BRT.

The roadway maintenance costs for the BRT alternatives were assumed to be provided by WSDOT in the highway maintenance estimates. HCT alternatives assumed a significant cost for O&M of the fixed guideways. To provide fair comparisons, a proportional share of the highway O&M cost would need to be shown as related to BRT.

4.3.4.3 Private Costs

Private costs represent the cost of owning and operating vehicles including fuel, oil, maintenance, tires, depreciation, finance charges, tax and license, and insurance. (These costs apply to the highway portion of the multi-modal alternatives.)

Private costs are based on the total vehicle miles identified for each alternative. Of the nontransit vehicle miles, 95 percent are assumed to result from automobile travel and 5 percent are assumed to be from truck travel. The per mile private costs are assumed as:

- $0.39 per mile for automobiles (including fuel, oil, maintenance, tires, depreciation, finance charges, tax and license, and insurance)
- $1.29 per mile for trucks (including same costs as automobiles; driver labor not included)

4.3.4.4 Life-Cycle Costs

A life-cycle cost accounts for the cost of a project over its entire useful life.

If an investment has useful life remaining at the end of the evaluation period, a salvage value was included in the evaluation. The identified life-cycle costs are the net present value of costs over a 30-year timeframe. The life-cycle costs were estimated on the basis of the following assumptions:

- All costs are estimated in 2001 dollars.
- Costs opinions are calculated for the year of right-of-way expenditure, mid-point year of construction, year of implementation, and useful life.
- Capital costs and O&M costs are for structures and vehicles. (O&M costs are estimated as outlined above.)
- The analysis begins in 2001, project construction finishes and annual O&M costs begin in 2010, and the analysis ends in 2030.

4.3.5 Committee Discussions

Throughout June 2001, the Trans-Lake Washington Project committees met to consider the findings of the multi-modal evaluation. Overall, the evaluation indicated that person throughput for the BRT/HOV alternatives (Alternatives 7 and 8) would be similar to that of the HCT alternatives (Alternatives 2 through 4) over the next 20 years, but that beyond 2020 the BRT system would face severe capacity restraints. Either the SR 520 or the I-90 corridor would meet long-term transit needs, as indicated by the small differentiation in ridership at the lake crossing. A benefit of using the I-90 corridor would be that it takes advantage of existing infrastructure investments.

A number of questions remained about the feasibility of putting light rail on I-90, which made it problematic for the Project Team to make HCT/BRT recommendations. As such, Executive Committee members at their June 27, 2001, meeting agreed to postpone their decision on the EIS alternatives until the results of the additional analysis regarding I-90 HCT were available from the Trans-Lake Washington Project Team and other consultants.

The following sections summarize the conclusions of the multi-modal evaluation and the additional work conducted regarding the feasibility of LRT on the I-90 lake crossing.

4.3.5.1 Multi-Modal Evaluation: Conclusions

The multi-modal evaluation resulted in the following conclusions, which were documented in reports, presentations, and memoranda:

- In the short to medium term, the SR 520 HCT line could merge with the Central Link line on the west side of Lake Washington; however, in the long term, when the Central Link line extended beyond Northgate, capacity constraints on the line between the University District and Westlake Station would require construction of a second line to downtown from SR 520 at Montlake to Westlake Station. At Westlake Station, passengers from the second line could transfer to the Central Link line, where alighting passengers from north-south trains create capacity for SR 520 passengers travelling south of Westlake.

- The I-90 LRT alternatives would offer the best rail operations and interface with the Central Link line. Boardings at downtown Seattle stations would increase due to increased frequency of downtown trains (North Link trains combined with trains from the east side on the same downtown line). Daily transit demand would be balanced between ridership on the segment north of downtown Seattle and the combined ridership of the segment south of downtown Seattle and the I-90 corridor. This demand pattern would support optimal train operations and would not require an expensive, second fixed guideway line into downtown Seattle as required for the SR 520 HCT options.

- The eight-lane alternatives (4, 6, and 8) would have the highest daily and peak period person throughput across Lake Washington; however, the mode share for transit with the six- and eight-lane alternatives would be similar in 2020 (9 to 11 percent depending on the alternative).

- Total person throughput across the lake would not vary if the future HCT line is placed within either the I-90 or the SR 520 corridor; only the proportion of person trips that each route carries would change.

- An HCT extension from Central Link to the major eastside travel markets (Bellevue, Redmond, and Kirkland) would result in an overall increase in daily person trips across the lake of 1 to 26 percent in 2020, depending on the alternative, compared to the No Action alternative. Most of the alternatives increased transit use by more than 10 percent.

- Alternatives with LRT in the I-90 corridor would result in slightly higher daily cross-lake transit ridership than those with HCT in the SR 520 corridor. High-quality bus transit service in both corridors (bus transit in the I-90 corridor and BRT in the SR 520 corridor) would result in the highest daily cross-lake transit ridership by a slight margin.

- In the future, transit would represent a greater proportion of daily person trips in both the SR 520 and I-90 corridors than it does today, no matter which crossing is chosen for fixed guideway transit. Cross-lake transit mode share is expected to more than double by 2020 compared to today.

- Implementation of the LRT or HCT alternatives would provide peak period capacity that could handle future growth beyond 2020, but the BRT alternatives would be close to capacity in areas such as the University District, downtown Seattle, and possibly downtown Bellevue, where BRT vehicles would have to mix with general purpose traffic.

- HCT on SR 520 would offer slightly lower average PM peak travel times for transit users than LRT on I-90.

- LRT and HCT alternatives would offer better service reliability and safety for transit users than the BRT alternatives because HCT vehicles would use an exclusive right-of-way.

- HCT in the SR 520 corridor would cause more environmental impacts than LRT in the I-90 corridor. With LRT in the I-90 corridor, environmental impacts to Lake Washington are minimized because much of the alignment is located within the footprint of the existing highway facilities.

- The I-90 LRT alternatives, with capital costs of approximately $2.7 billion (2001 dollars), would be substantially less costly to construct than the SR 520 HCT alternatives, which have capital costs of approximately $4.7 billion (2001 dollars).

- BRT costs are difficult to separate from GP or HOV costs because BRT vehicles would use both GP and HOV facilities; however, estimated construction costs for BRT facilities in the SR 520 corridor would range from $770 million to $880 million (2001 dollars), which would be substantially less costly to construct than the SR 520 HCT ($4.7 billion in 2001 dollars).

4.3.5.2 Feasibility of LRT on I-90 Lake Crossing: Conclusions

On November 28, 2001, an all-committee workshop was held to report the results of the additional analyses, which are briefly summarized below and in more detail in Section 5 of this report. Summary conclusions relevant to cross-lake transit from those studies were:

- Light rail operations in the I-90 center roadway would require less space than the current reversible lanes and would slightly improve the geometric feasibility of adding HOV lanes to the outer roadway; thus, adding HOV lanes to the outer roadway would not be precluded.

- The loss of I-90 HOV capacity would increase the burden on SR 520, mostly at peak periods. It appears that added capacity on I-405 would reduce this effect on SR 520.

- A structural feasibility study of placing light rail on the I-90 floating bridge and its transition spans showed that the added weight from the light rail could be mitigated by replacing the existing concrete roadside barrier with a cable railing, removing existing ballast within the floating bridge pontoon cells, and/or replacing 1 inch of the existing concrete overlay in the center lanes with a 1/4-inch concrete polymer overlay. The costs of these mitigation actions would range from $23.2 to $38.8 million.

- If it was not possible to locate the LRT on the existing I-90 floating bridge and its approach spans, the worst case scenario for Alternatives 2 through 4 would be to place the light rail line on a separate floating bridge, parallel to the existing I-90 bridge. Construction costs would be more than $700 million higher than costs for placing LRT on the existing I-90 floating bridge; however, these costs would still be substantially lower than the costs for the SR 520 HCT alternatives (5 and 6). The environmental impacts of a separate I-90 floating bridge for LRT would be slightly higher than retrofitting the existing Homer Hadley floating bridge, particularly in shoreline areas, but overall environmental performance would be similar.

4.3.6 Executive Committee Recommendations

Committee discussions were held on the multi-modal alternatives during December and January to formulate recommendations on alternatives to move forward into the EIS process. On January 30, 2002, the Executive Committee endorsed the following actions:

- Carry forward the No Action alternative.
- Continue to analyze the four-lane safety and preservation alternative.
- Examine the six-lane SR 520 alternative with a combined HOV/BRT lane (with and without an additional Montlake Cut crossing).
- Carry forward the eight-lane SR 520 alternative that consists of three GP lanes and one HOV/BRT lane with a 4-foot buffer.
- Support the current Sound Transit Long-Range Vision that places fixed guideway transit in the I-90 corridor, and support inclusion of BRT for the SR 520 corridor in Sound Transit's Long-Range Vision.
- Consider whether the SR 520 alternatives include provisions to accommodate HCT within the SR 520 corridor in the distant future.

5. SUPPLEMENTAL TRANS-LAKE STUDIES

In addition to the modal and multi-modal evaluations, a number of supplemental studies have been conducted for the Trans-Lake Washington Project. These studies addressed specific technical issues associated with the Trans-Lake Washington Project alternatives, evaluated an I-90 separate bridge crossing, and considered the design implications of accommodating HCT on the SR 520 bridge in the future. The specific studies and issues included the following:

- *Trans-Lake Washington Project: High Capacity Transit Technology Options*—What technology would be best suited for HCT within the SR 520 and I-90 corridors?
- *The Homer Hadley (Interstate 90) Floating Bridge: Draft Structural Feasibility Study Light Rail Conversion*—What is the structural feasibility of converting the two existing HOV lanes of the Homer Hadley Floating Bridge to light rail?
- *The Homer Hadley (Interstate 90) Floating Bridge Approach Structure and Transition Span: Draft Structural Analysis Study for Light Rail Conversion*—What are the structural impacts of converting two lanes of the Homer Hadley Bridge approach structures and transition spans to light rail?
- *Interstate-90 Separate Bridge Crossing Evaluation Report*—What would the environmental impacts and costs for a separate I-90 HCT lake crossing be if it were not possible to convert the existing Homer Hadley HOV lanes to light rail?
- *Transportation Forecast Sensitivity Test Results*—What would the impact on the transportation performance of the I-90 and SR 520 corridors be if the HOV lanes on I-90 were displaced by LRT?
- *HCT Accommodation Report*—Being prepared.
- *2030 BRT System Definition and Analysis*—Being prepared.

The following section discusses the results of the analyses conducted to address these questions.

5.1 HCT TECHNOLOGY OPTIONS

A number of technology options were reviewed for HCT in the SR 520 and I-90 corridors in a report entitled *Trans-Lake Washington Project: High Capacity Transit Technology Options* (PB Farradyne, October 2001). The objective of the report was to suggest technologies that should be considered for further study rather than to recommend a specific technology.

The vehicle technologies considered in the report were bus (60-foot, articulated); people mover (Innovia and VAL); monorail (Bombardier M-VI), skytrain (Bombardier); light rail vehicle (St. Louis and Cityrunner); rapid transit, similar to light rail but typically with a third rail or sometimes a pantograph for overhead power collection (Boston #3 Red Line); commuter electric multiple unit (Montreal); and diesel multiple unit (Adtranz GTW). The vehicles not considered were commuter locomotive hauled, high-speed rail, and maglev. The latter two were not considered because the average spacing of stations within the Trans-Lake corridor would be 1.5 miles apart, which would not be suitable for these technologies; short distances between stations make the gains provided by the higher running speeds of high-speed rail and maglev of limited benefit. Detailed descriptions of the vehicle technologies are provided in the PB Farradyne report.

The report assumed the following route requirements:

- A peak 1-hour per direction ridership demand of 4,500 passengers (based on 2020 Trans-Lake forecasts for HCT).
- An average operating speed of 30 to 35 mph to provide in-vehicle travel times that are competitive with automobile travel. (A 60 to 70 mph maximum speed would be required to achieve the desired average speed, given the number and frequency of the proposed stations.)
- The route "guideway" would be compatible with the requirements of any vehicle technology, including the shore to bridge connection.
- Maximum platform length would be 400 feet.
- Spacing between stations would average about 1.5 miles.

The following route requirements or issues were not taken into consideration:

- Limitations, if any, for the power feed location, which might be located overhead, on a third rail, or on a guideway (with a people mover).
- The use of selected technology on other future routes.
- The environmental impact of rubber tire wear particles associated with a people mover system, which could put it at a disadvantage in comparison with the other HCT technologies evaluated in the report.

Two key parameters were used to identify a recommended vehicle design: passenger capacity and vehicle availability from more than one supplier. The key issues for evaluating vehicle design were:

- Can the vehicle provide the required passenger throughput in 2020? Can it provide for a significant growth in the passenger throughput requirements within the limitations of planned platform length?
- Can proven vehicles from more than one manufacturer be used on the same track or guideway structure?

5.1.1 Vehicle Passenger Capacity

The capacity requirement for a basic vehicle will be determined by the movement of the maximum passenger load at the busiest point on the HCT line during the AM and PM peak commute periods. Vehicle passenger capacity is affected by several factors: train seating arrangement/configuration, number of seats per vehicle, agency policy regarding maximum ratio of standing to seated passengers, number of vehicles per train (which can be limited by platform length), and train headways (number of minutes between trains).

The seating arrangement within a vehicle significantly affects passenger capacity. Typical vehicle seating arrangements were used in this study. Based on these typical seating arrangements, the number of seats per vehicle were identified (Table 25). If seating arrangements were revised to maximize seating, the passenger capacities of the unique vehicle designs (Innovia, VAL, Skytrain, monorails) would decrease significantly. Conversely, if seating was minimized, the passenger capacity of an LRV would increase significantly.

A selection of the required seats per train for all technologies can have a significant effect on the vehicle capacity. The optimum ratio of seated to standing passengers depends on the buyer's preference and type of service. The report did not identify a preference for Sound Transit.

A range of headways (2, 4, 10, and 20 minutes) was used to illustrate the impact on passenger capacity for each technology and headway (Table 25). Given the resulting capacities, 3- to 5-minute headways appear reasonable to serve the 2020 peak one-way ridership demand across Lake Washington. These headways were confirmed by related information provided in TCRP Report #13 (Transit Cooperative Research Program of Transportation Research Board).

5.1.2 Results

Using the passenger capacity table (Table 25), a 4-minute headway was used as a reasonable assumption for analysis of the project. This headway would require 15 trains per hour. A review of the technology capacities resulted in four categories:

- Those that cannot provide the 4,500 passengers per hour per direction capacity unless a significantly shorter headway is used: BRT
- Those that can provide the 4,500-passenger capacity but have minimum passenger growth capability beyond 2020: Innovia/VAL, U.S.-style monorail, and DMU.
- Those that can provide the 4,500-passenger capacity and have significant passenger growth capability beyond 2020: large Japanese monorails, Skytrain, and LRV. This is the most desirable category.
- Those that have excess capacity considering their typical applications: rapid transit and electric multiple unit commuter.

Table 25
HCT Passenger Capacities (Passengers Per Hour Per Direction)

Technology	Standees	Seats	Headway in Minutes (Trains Per Hour)			
			2 (3)	4 (15)	10 (6)	20 (3)
60-foot Articulated Bus	20	66	2,580	1,290	518	259
Innovia						
1 car	82	8	2,700	1,350	540	270
4 cars	328	32	10,800	5,400	2,160	1,080
VAL						
2 cars	110	50	4,800	2,400	960	480
4 cars	220	100	9,600	4,800	1,920	960
Monorail (Bombardier)						
3 cars	108	60	5,040	2,520	1,008	504
6 cars	216	120	10,080	5,040	2,016	1,008
Monorail (Tokyo Monorail)						
6 cars	388	212	18,000	9,000	3,600	1,800
Skytrain-Kennedy						
1 car	132	26	4,740	2,370	948	474
4 cars	528	104	18,960	9,480	3,792	1,896
Skytrain (Vancouver)						
1 car	86	42	3,840	1,920	768	384
4 cars	344	168	15,360	7,680	3,072	1,536
Light Rail Vehicle (St. Louis)						
1 car	118	72	5,700	2,850	1,140	570
4 cars	472	288	22,800	11,400	4,560	2,280
Light Rail Vehicle Extended						
7 sections	162	80	7,260	3,630	1,452	726
Diesel Multiple Unit (Articulated)						
GTW 2/6	100	100	6,000	3,000	1,200	600
GTW 4/8	134	184	9,540	4,770	1,908	954
HR MBTA #3 Red Line						
2 cars	220	100	9,600	4,880	1,920	960
6 cars	660	300	28,800	14,400	5,760	2,880
Commuter Electric Multiple Unit						
2 cars	180	176	10,680	5,340	2,136	1,068
4 cars	360	352	21,360	10,680	4,272	2,136

5.1.3 Conclusions

The report concluded that four additional issues be investigated prior to selecting a technology for the Trans-Lake corridor:

- Maximum Operating Speed—The proposed HCT station spacing varies significantly for planned Trans-Lake routes. A 60 to 70 mph maximum operating speed may be required to achieve a desired 30 to 35 mph average speed. This factor should be a key technology selection criterion, given the maximum operating speeds of the technologies in the preferred category: large Japanese monorail (Series 2000)—50 mph, Skytrain (New Vancouver and Kuala Lumpur)—50 mph, Skytrain (JFK Airport access)—62 mph, and LRV (Los Angeles and Houston)—66 mph.

- Unique System Design—The future impact of purchasing "one-of-a-kind" technology should be considered based on future route expansions, spare parts prices, compatibility with systems used on other routes, and the turnkey nature of the unique system design and installation, specifically people movers, monorail, and Skytrain.

- Acceptable Headway—While a 4-minute headway appears reasonable for this project, shorter or longer headways may be more appropriate in the future, depending on the time of day. When this is better defined, train operating scenarios with appropriate passenger capacities should be reviewed for each viable technology.

- Passenger Comfort—As noted previously, two factors should be considered that affect vehicle passenger capacity: seating arrangement and seat design. A separate issue may be the desired ratio of standing to seated passengers. The most comfortable seating arrangement is 2x2 seating because it maximizes the space used for comfortable seats, and provides an adequate aisle for passenger movement associated with short station spacing. The use of bench seats located along the interior sidewall will increase passenger capacity with a tradeoff in comfort.

Even though a firm vehicle technology recommendation was not made, the report indicates that the final choice may be between the low-cost BRT technology and the higher capacity, more expensive LRV technology. The possible operational problem of final destination crowding when using BRT with a short headway may be a key factor in the final evaluation. In addition, considering the population centers to be served, a fixed system may be desirable; especially one that has a large growth capability similar to LRV. Another option would be to mix BRT and LRV technology, possibly placing LRV on I-90 and BRT on SR 520. When these two technologies are combined, BRT passenger capacity will decrease and an operationally satisfactory headway may be obtained.

5.2 I-90 STRUCTURAL FEASIBILITY FOR LIGHT RAIL CONVERSION

The Homer Hadley (Interstate 90) Floating Bridge: Draft Structural Feasibility Study Light Rail Conversion (KPFF Consulting Engineers, September 13, 2001) report provided an evaluation of the structural feasibility of converting the two HOV lanes of the Homer Hadley Floating Bridge to light rail. The two existing HOV lanes are located on the 40-foot-wide southern section of the floating bridge. (The HOV lanes are often referred to as the center lanes because they are located between the GP lanes on the Homer Hadley Floating Bridge and the Lacey V. Murrow Memorial Bridge.) The 40-foot section is divided into a 12-foot-wide shoulder to the north, two 12-foot-wide HOV lanes, and a 4-foot shoulder to the south (see Figure 25). The section is bounded by a concrete median barrier to the north and a concrete side barrier to the south, both of which are integral to the floating bridge's construction.

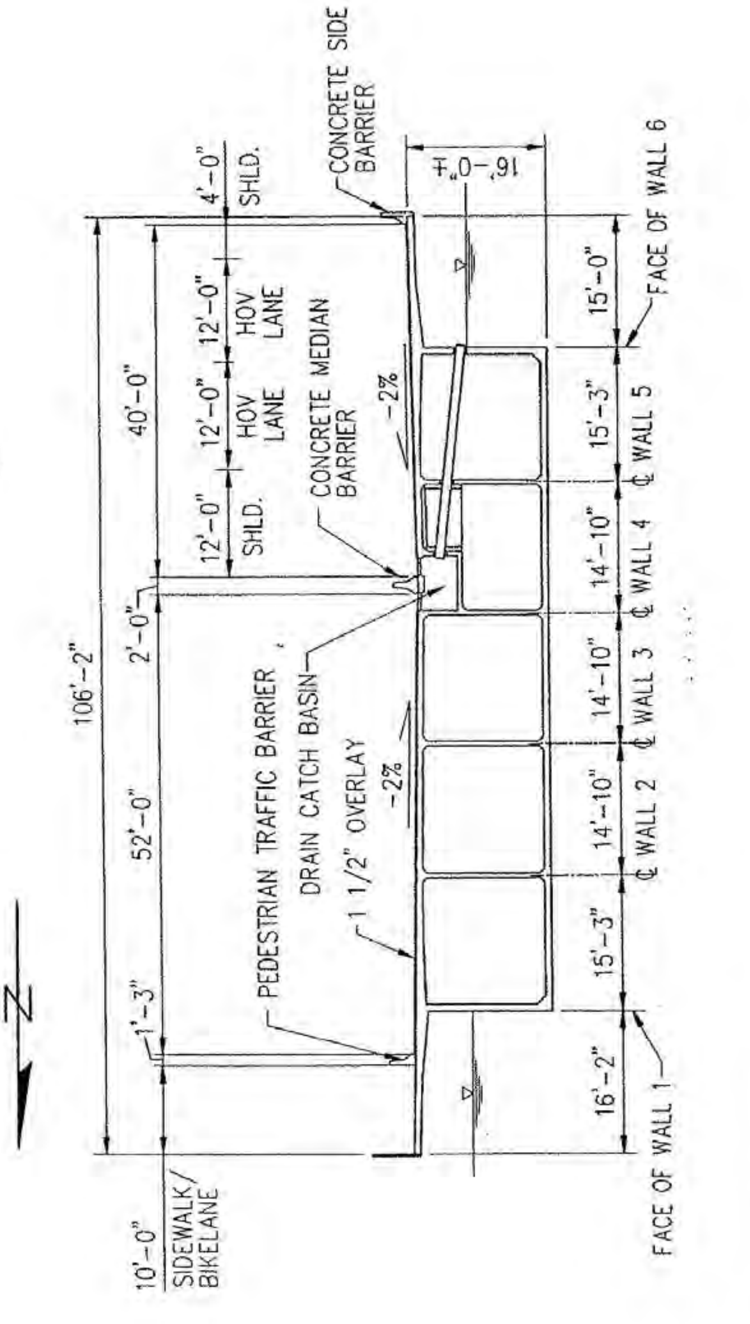
Floating bridges are unique bridge structures—they not only have to carry traditional vehicular traffic loads, but they must also remain watertight. Unique design solutions are used to enhance their watertightness, such as the use of pre-stressed concrete members, installation of watertight access hatches and doors, and rigorous adherence to regular inspection and maintenance procedures. Essentially, the I-90 floating bridge is a permanently moored marine structure. As such, the design alternatives studied within the structural feasibility report were evaluated for their structural and operational feasibility in light of sound marine engineering practice.

5.2.1 Study Alternatives and Analysis

Converting the existing HOV lanes to light rail requires evaluation of the rail system's dead load and location. The dead load of the rail system will reduce the bridge's freeboard (height above waterline). The farther the rail system is located from the center of the bridge's buoyancy, the more the rail system's dead load causes the bridge to lose additional freeboard and increases list. Because any bridge list must be leveled or trimmed with offsetting ballast, the added ballast necessary to trim the bridge further reduces the freeboard. Several rail systems, basic rail (BR), light rail (LR), and a modified version of light rail (LR [mod]), were evaluated to determine their effect on the bridge. The characteristics of these systems are described in Table 26.

Table 26
Evaluated Rail Systems

Rail System Designation	Rail System Description
BR	The "basic rail" system consists of the typical superimposed dead loading for the two-track Sound Transit LRT, with a loading per route foot of 1,470 pounds.
LR	The "light rail" system consists of a minimum superimposed dead loading for the two-track Sound Transit LRT, with a loading per route foot of 800 pounds. The system was weight optimized by reducing the concrete plinth weights and eliminating the restraining rails.
LR (mod)	As the project progressed, it became clear that it would be necessary to remove the existing south concrete side barrier in order to meet the project criteria. Therefore, the LR scenario was revised to include two restraining rails to preclude possibilities of derailment. These added safety features result in a new lower bound LRT superimposed dead load, LR (mod), with a loading per route foot of 920 pounds.



Trans-Lake Washington Project
Summary of HCT Screening Process

Figure 25
I-90 STRUCTURAL FEASIBILITY STUDY
Typical Section at Floating Pontoon

All rail systems are located off of the bridge's centerline; consequently, they will all result in loss of bridge freeboard due to placement of trim ballast. Four track locations/configurations were developed to capture a range of impacts on the bridge (Table 27).

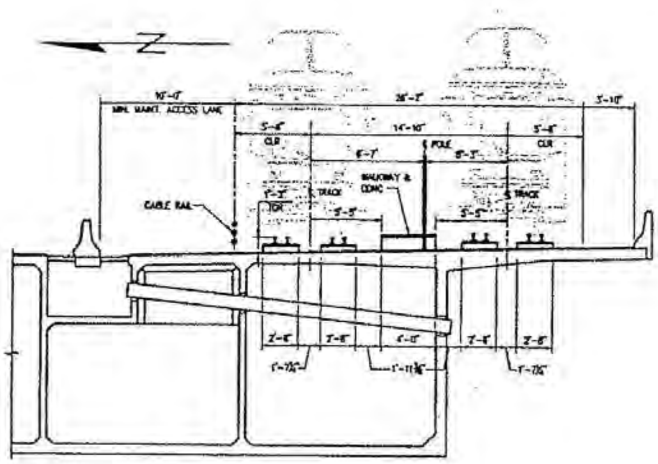
Table 27
Track Locations/Configurations

Location/ Configuration	Description
1	Location 1 positions the LRT tracks as close as possible to the concrete median barrier within the existing 40'-0" wide designated HOV lanes of the bridge, while still providing the minimum 10'-0" maintenance access lane.
2	Location 2 positions the LRT tracks as far as possible to the south within the existing designated HOV lanes of the bridge.
3	Location 3, which was included at a late stage of the study, is similar to Location 1 with respect to the position of the exterior outboard LRT track on the south cantilever; however, the remainder of the configuration was significantly revised to accommodate a 2'-0" median barrier movement to the south. The median barrier movement is associated with a preferred westbound lane addition configuration from the westbound lane addition study. Other modifications to the configuration include the relocation of the walkway and inboard LRT track, as well as modification of the OSC pole system.
4	Location 4, which was also included at a late stage in the study, is identical to Location 1, but with the median barrier relocated 8 feet to the south and the maintenance access road separated entirely from the LRT operational area.

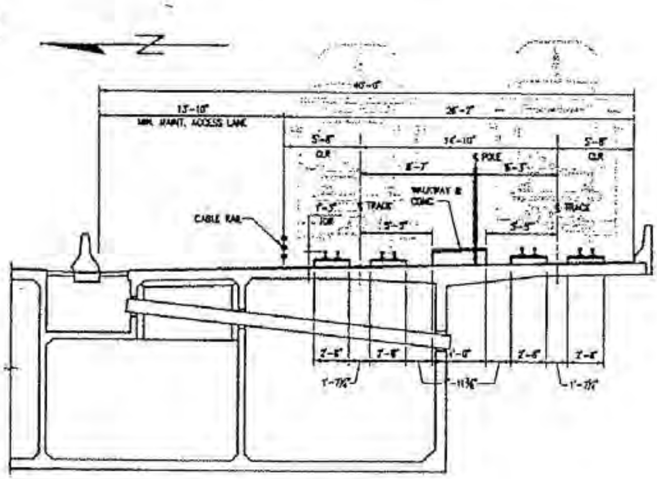
For the purposes of the structural feasibility investigation, eight separate combinations of rail types, locations, and configurations were considered. These combinations are shown in the Table 28. As the structural feasibility study progressed, the LR (mod) system showed significant advantages over the BR and LR systems; therefore, it was the only rail system that was combined with all of the locations and configurations.

Table 28
Alternative Combinations

Rail System	Location/ Configuration	Design Combination	Figure No.
BR	1	BR-1	26
BR	2	BR-2	26
LR	1	LR-1	27
LR	2	LR-2	27
LR (mod)	1	LR (mod) 1	27 (sim)
LR (mod)	2	LR (mod) 2	27 (sim)
LR (mod)	3	LR (mod) 3	28
LR (mod)	4	LR (mod) 4	28



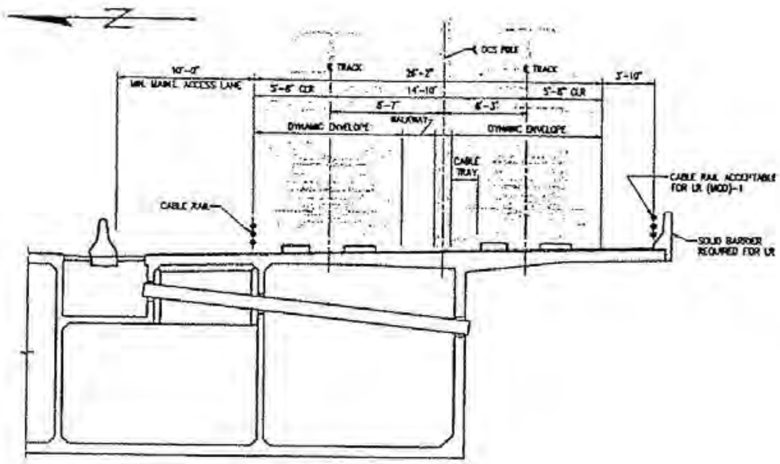
ALTERNATIVE BR-1



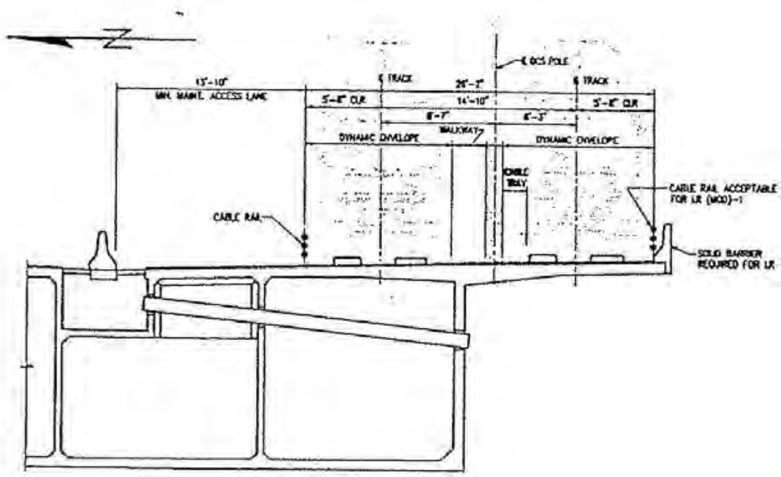
ALTERNATIVE BR-2

Trans-Lake Washington Project
Summary of HCT Screening Process
168395.AA.12.07_T042002001SEA - Fig. 26_BR Configurations - 12/10/02 - dk/LW

Figure 26
I-90 STRUCTURAL FEASIBILITY STUDY
BR Configurations
(Partial Section at Pontoon Deck)



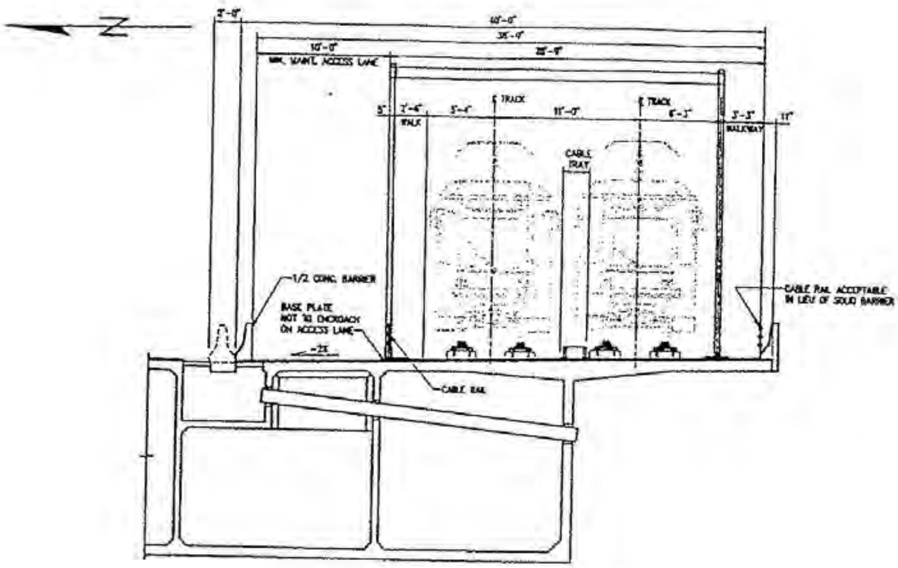
ALTERNATIVE LR-1 & LR (MOD)-1



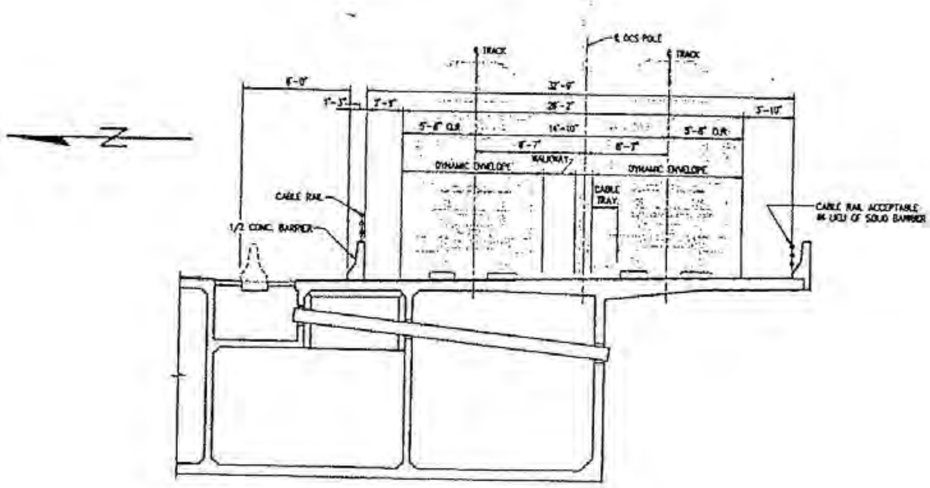
ALTERNATIVE LR-2 & LR (MOD)-2

Trans-Lake Washington Project
Summary of HCT Screening Process
168395.AA.12.07_T042002001SEA • Fig. 27_LR & LR (MOD) Configurations • 12/10/02 • dk/LW

Figure 27
I-90 STRUCTURAL FEASIBILITY STUDY
LR and LR (MOD) Configurations (Partial Section at Pontoon Deck)



ALTERNATIVE LR (MOD) - 3



ALTERNATIVE LR (MOD) - 4

Trans-Lake Washington Project
Summary of HCT Screening Process
168395.AA.12.07_T042002001SEA • Fig. 28_LR (MOD) Configurations • 12/10/02 • dk/LW

Figure 28
I-90 STRUCTURAL FEASIBILITY STUDY
LR (MOD) Configurations
(Partial Section at Pontoon Deck)

Hydrostatic analyses were performed on the floating bridge to determine the loss of bridge freeboard associated with the location of the different rail configurations. Freeboard loss was based on the new rail dead loads and the correspondingly ballast required to trim the bridge back to a level condition. Trim ballast was assumed to be gravel and to be placed in the center of the northernmost cells of the floating bridge.

A structural analysis was performed on the floating pontoons and elevated superstructure to determine if the existing floating bridge structure could support Sound Transit's current light rail loads, meet Sound Transit's structural performance criteria for light rail vehicles, and WSDOT's performance criteria for floating bridges.

5.2.2 Conclusions

- The hydrostatic analysis resulted in eliminating the BR system as a feasible LRT system because it lost the most freeboard (up to 8.76 inches) and required the greatest ballast depth (up to 1.3 feet).
- The hydrostatic analysis indicated that the added weight from both LR and LR (mod) systems could be mitigated using reasonable approaches.
- The hydrostatic analysis estimated the bridge responses during LRT loading at both mid-span and at the expansion joint locations. These bridge responses need to be verified by a more rigorous hydrodynamic analysis and Sound Transit should verify that the deflections are compatible with the LRT tolerances.[8]
- The structural analysis concluded that Location/Configuration Option 2 is not feasible. This is because this location placed LRT loads too far on the south end of the floating bridge cantilever and overstressed the floating pontoon top deck.
- The structural analysis showed that Location/Configuration Options 1, 3, and 4 can be used without overstressing the floating pontoon top deck; however, to accomplish this, the south concrete side barrier must be removed and replaced with a cable railing.
- When considering the above conclusions, it was clear that Alternatives LR (mod) 1, 3, and 4 were the only alternatives that could be considered further without strengthening the existing floating bridge pontoons. Because of this, all three of these options were identified as preferred alternatives.

[8] In a memorandum (October 4, 2001) from Art Borst (PSTC) to Don Billen (Sound Transit), it was concluded that there is no reason to believe that there is a "fatal flaw" with the rail joint associated with LRT operations on the I-90 Floating Bridge. This conclusion was based on previous work performed on joint movement (Attachment 1 to the October 4 memorandum) and two examples of modern rail bridges with joint movements similar to the I-90 Floating Bridge (Attachment 2 to the October 4 memorandum).

- Weight mitigation requirements for the preferred alternatives would involve three main elements:
  - Removal of the existing south concrete side barrier and replacement with a cable railing.
  - Removal of existing ballast within the floating bridge pontoons cells.
  - Removal of 1 inch of the existing concrete overlay on the south side of the concrete median barrier and replacement with 1/4 inch of polymer concrete overlay.

  In addition to the above alternatives, LR (mod) 4 would require that the relocated median barrier be constructed using lightweight concrete.

- The structural analysis of the elevated superstructure for all options identified very few problems; however, the steel box girders would not meet Sound Transit's design criteria for deflection. A steel cover plate retrofit for the box girder was proposed to mitigate the excessive deflections. The weight of the steel cover plates could be completely mitigated by removing additional existing gravel ballast from locations directly under the retrofitted box girders.

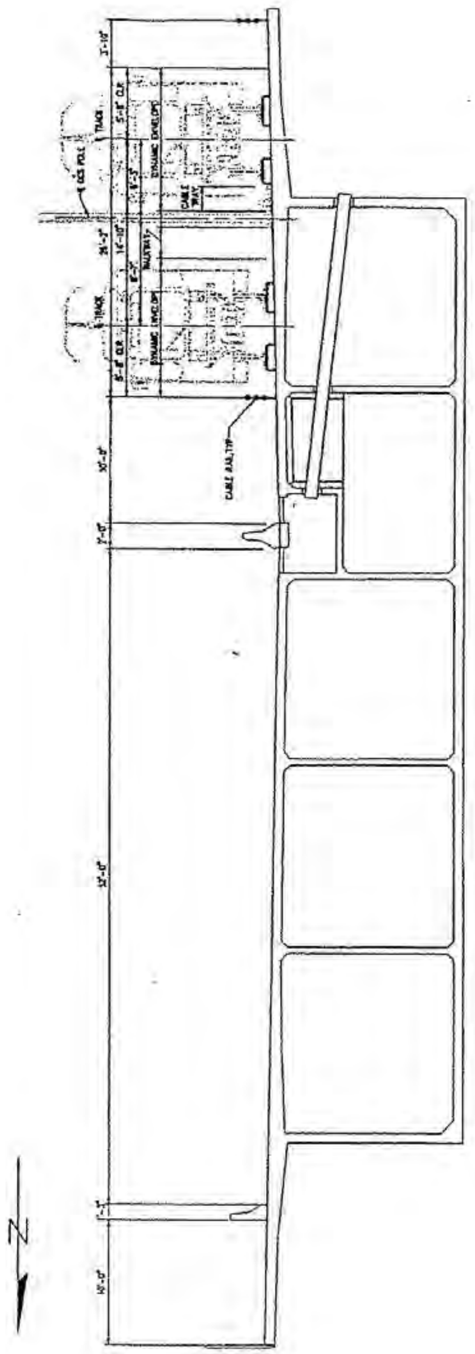
5.2.3 Preferred Alternatives and Costs

The preferred Alternatives LR (mod) 1, 3, and 4 are shown in Figures 29 through 32. LR (mod) 3 is shown in two versions (A and B) to identify two separate approaches to achieve the 10-foot maintenance lane and LRT walkway. All options are shown with the full width of the bridge to illustrate how they can integrate with potential modifications to the westbound lane configurations. Costs of the preferred alternatives are shown in Table 29.

Table 29
Costs of I-90 Floating Bridge Conversion Alternatives

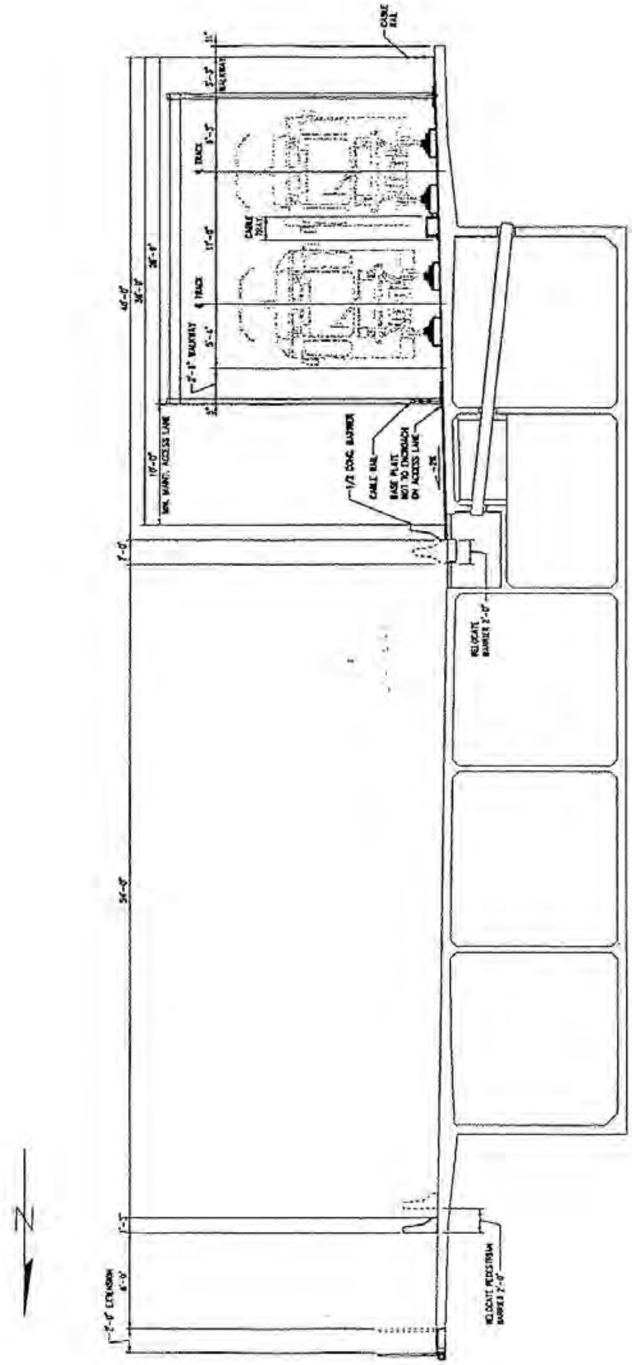
Preferred Alternative	LRT Conversion Cost	Added Westbound Lane Cost	Total Cost
LR (mod) 1	$12,296,000	$0	$12,296,000
LR (mod) 3A & 3B	$12,070,000	$15,826,000	$27,896,000
LR (mod) 4	$10,852,000	$12,001,000	$22,853,000

The above costs do not include sales tax, engineering or construction management, electrical modifications or temporary services, mitigation of traffic impacts due to the elimination of the existing HOV lanes, or LRT system installation costs. Since KPFF prepared these costs, the costs have been revised to reflect the costs of sales tax, engineering or construction management, electrical modifications or temporary services, and traffic mitigation (Ivo Gustetich, personal communication, October 25, 2001; Jane Farquharson, personal communication, February 13,



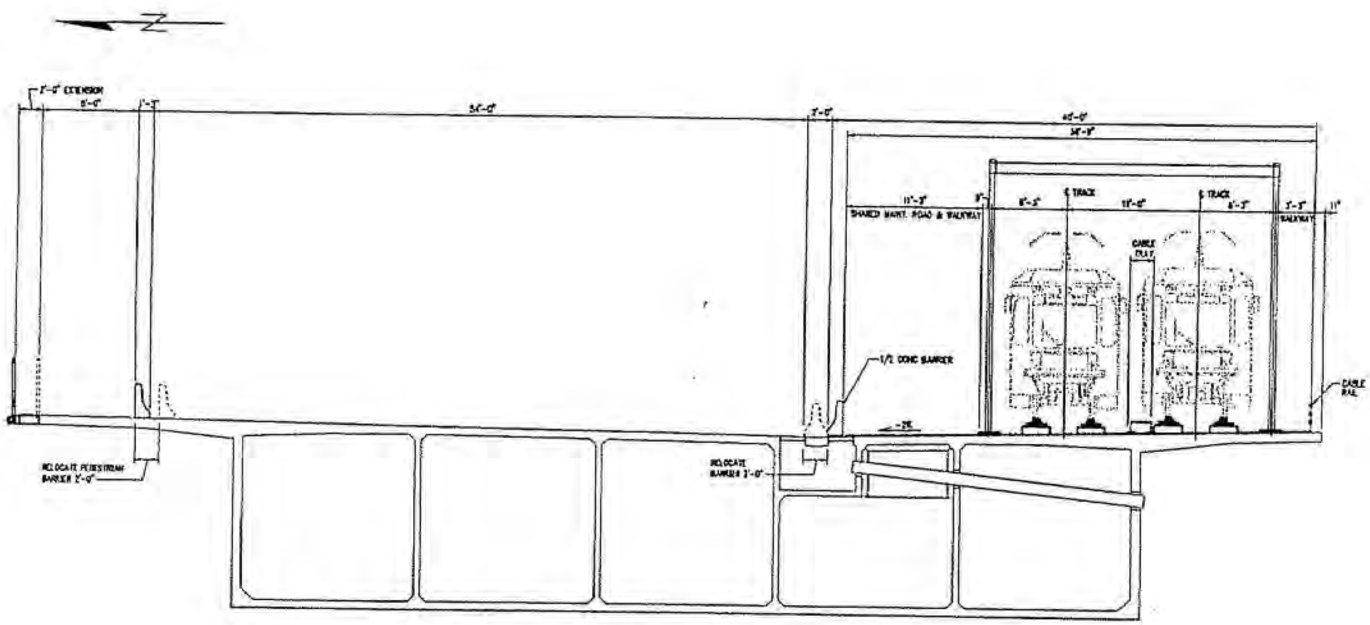
Trans-Lake Washington Project
Summary of HCT Screening Process

Figure 29
I-90 STRUCTURAL FEASIBILITY STUDY
LR (MOD)-1 Rail Alternative
(Typical Section at Floating Pontoon)



Trans-Lake Washington Project
Summary of HCT Screening Process
168395.AA.12.07_T042002201SEA • Fig. 30_LR (MOD)-3A Rail Alt. • 12/10/02 • dm/LW

Figure 30
I-90 STRUCTURAL FEASIBILITY STUDY
LR (MOD)-3A Rail Alternative
(Typical Section at Floating Pontoon)



Trans-Lake Washington Project
Summary of HCT Screening Process
188355.AA.12.07_T042002001SBA • Fig. 31_LR (MOD)-3B Rail Alt. • 12/16/02 • dk/LW

Figure 31
I-90 STRUCTURAL FEASIBILITY STUDY
LR (MOD)-3B Rail Alternative
(Typical Section at Floating Pontoon)

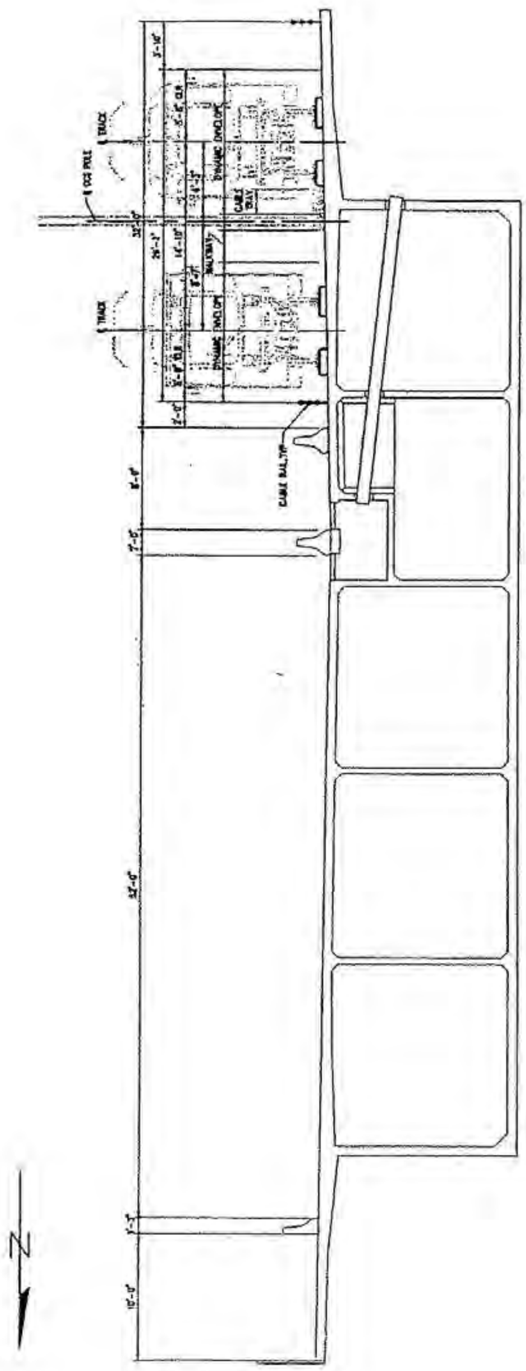


Figure 32
I-90 STRUCTURAL FEASIBILITY STUDY
LR (MOD)-4 Rail Alternative
(Typical Section at Floating Pontoon)

Trans-Lake Washington Project
Summary of HCT Screening Process

2002). These revised costs have been included in the multi-modal analysis cost tables presented in Section 4 of this report.

5.3 I-90 STRUCTURAL ANALYSIS STUDY FOR LIGHT RAIL CONVERSION

The Homer Hadley (I-90) Floating Bridge Approach Structure and Transition Span: Draft Structural Analysis Study for Light Rail Conversion (KPFF Consulting Engineers, August 31, 2001) provided an evaluation of the structural impacts of converting two lanes of the Homer Hadley Bridge approach structures and transition spans to light rail. The structural section considered in this study was the 40-foot-wide L^M line located on the southern portion of the alignment. The structure limits for this study are shown in Figure 33. The bridge approach structures and transition spans are shown in elevation in Figure 34.

The study included three analyses:

- Approach structure global analysis (demand-only approach)
- Approach structure local evaluation (demand/capacity approach)
- Transition span evaluation (demand/capacity approach)

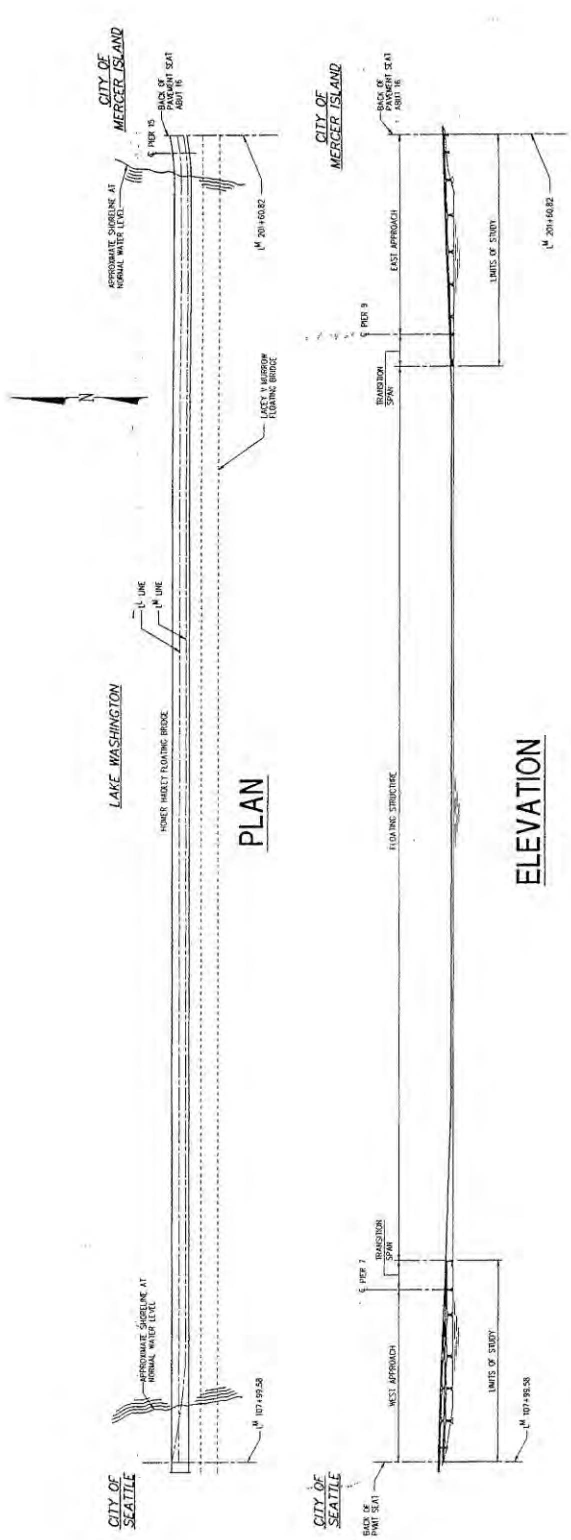
5.3.1 Study Criteria

The following criteria were used for this study:

- The demand/capacity ratios were based on both working stress and ultimate strength analysis using the allowable stresses and material strengths provided in the original design plans. A "zero tension" limit was placed on allowable concrete stresses in the deck for working stress analysis.
- Light rail loading criteria and structural performance criteria were taken from the Sound Transit's *Link Light Rail Design Criteria Manual* (Sound Transit, 1999). This loading is higher than the original LRT train loading for which the Homer Hadley Floating Bridge was designed. Refer to Figure 35 and Table 30 below for a comparison between the two.

Table 30
Comparison Between Original and Proposed LRT Train Loading

	Original LRT Train Loading (lbs/ft)	Proposed New LRT (mod) Train Loading (lbs/ft)	Percent Increase
Added LRT Dead Load Per Track	67	460	587.0
Uniform LRT Live Load Per Track	1,429	1,607	12.5



Trans-Lake Washington Project
Summary of HCT Screening Process

Figure 33
I-90 STRUCTURAL FEASIBILITY STUDY
Homer Hadley Floating Bridge

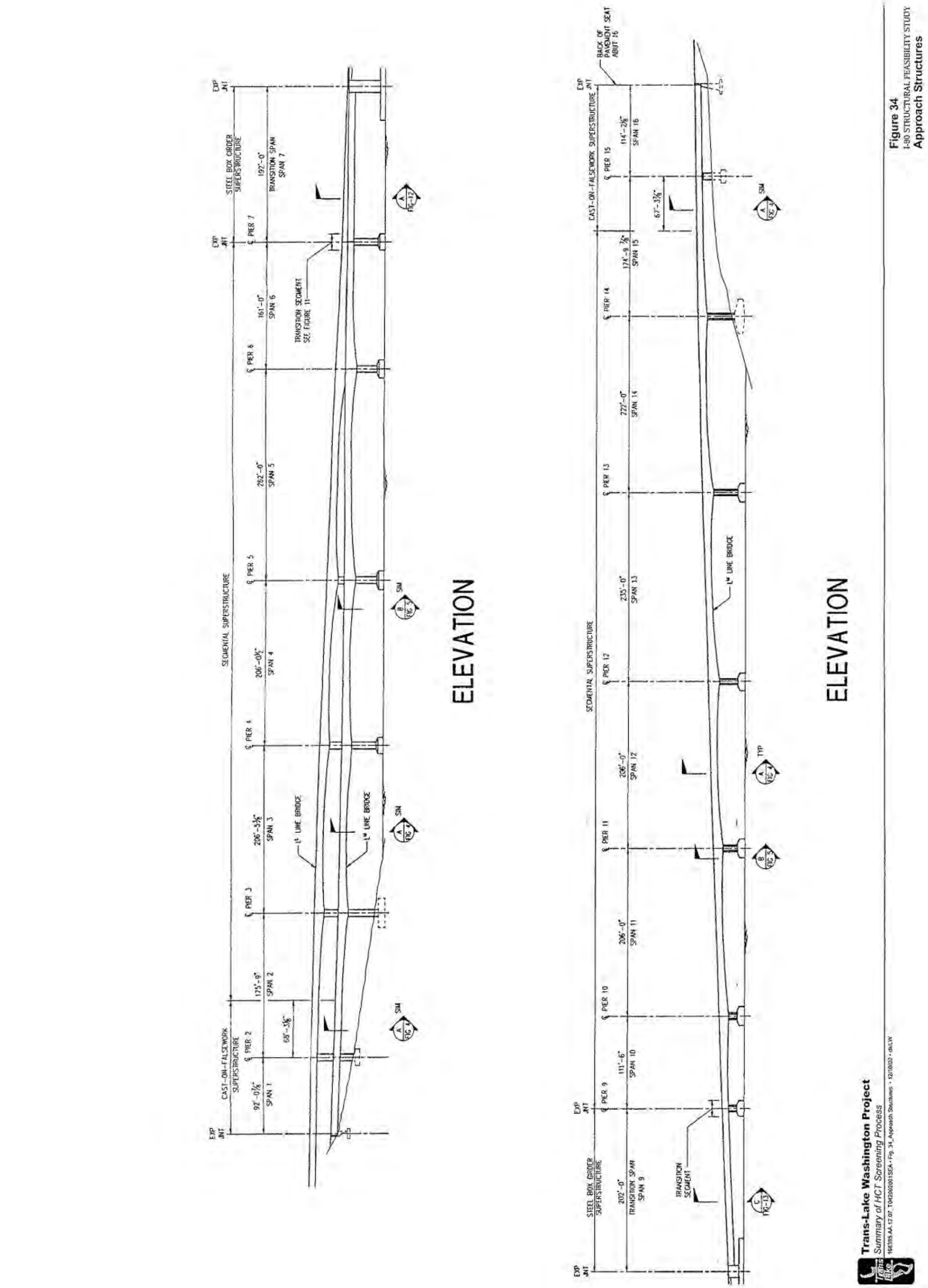
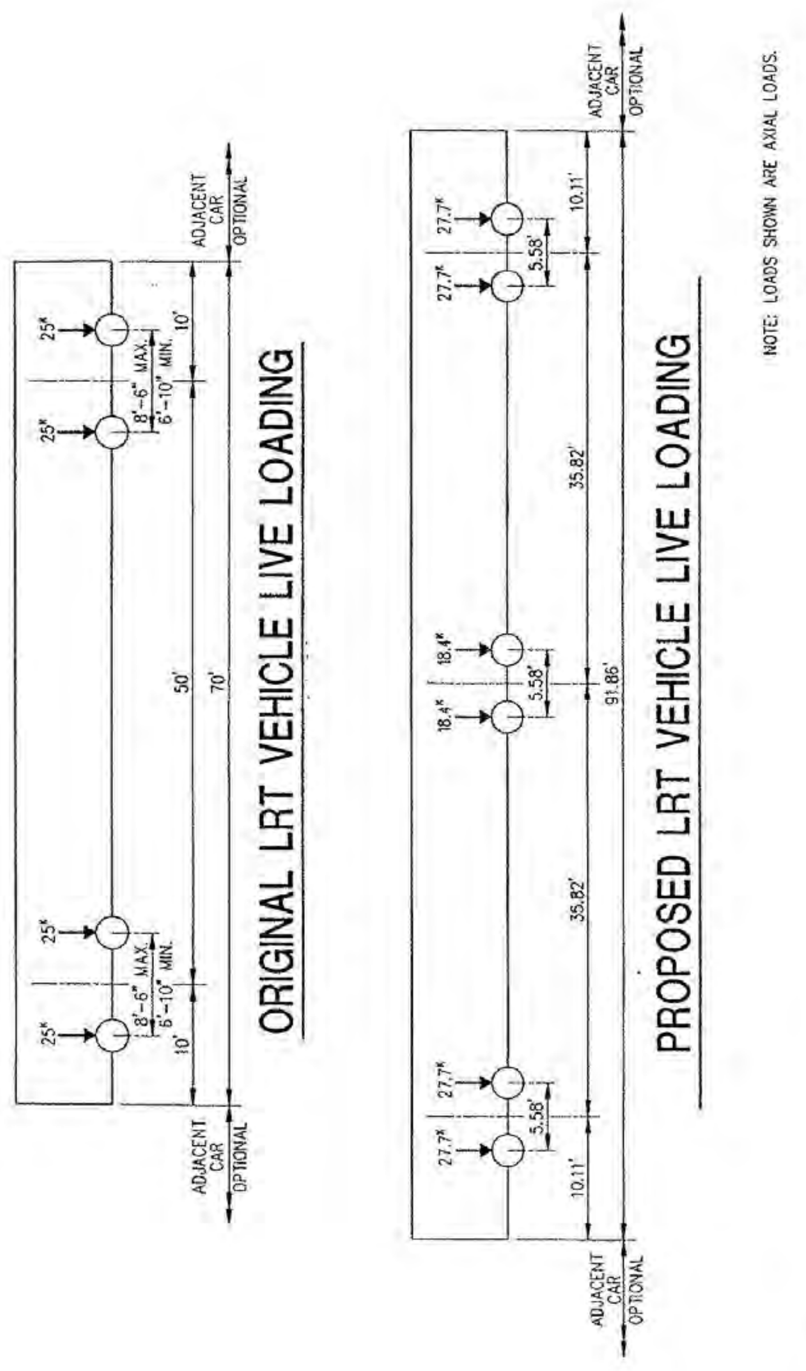


Figure 34
I-90 STRUCTURAL FEASIBILITY STUDY
Approach Structures



Trans-Lake Washington Project
Summary of HCT Screening Process

Figure 35
I-90 STRUCTURAL FEASIBILITY STUDY
Comparison of Original and Proposed LRT Vehicle Live Loading

- All analyses were performed for light rail loads with tracks in one location only. The location chosen was determined from Alternative LR (Mod)–3 from the study titled *Draft Structural Feasibility Study–Light Rail Conversion* (KPFF Consulting Engineers, June 1, 2001). The track location, with respect to the approach and transition structures, is shown in Figures 36 through 38.
- It was assumed that any penetrations in the top deck would be completed in a manner that would not damage the existing post-tensioning tendons. Replacement or repair of any damaged reinforcing steel would be required to mitigate loss of load-carrying capacity.

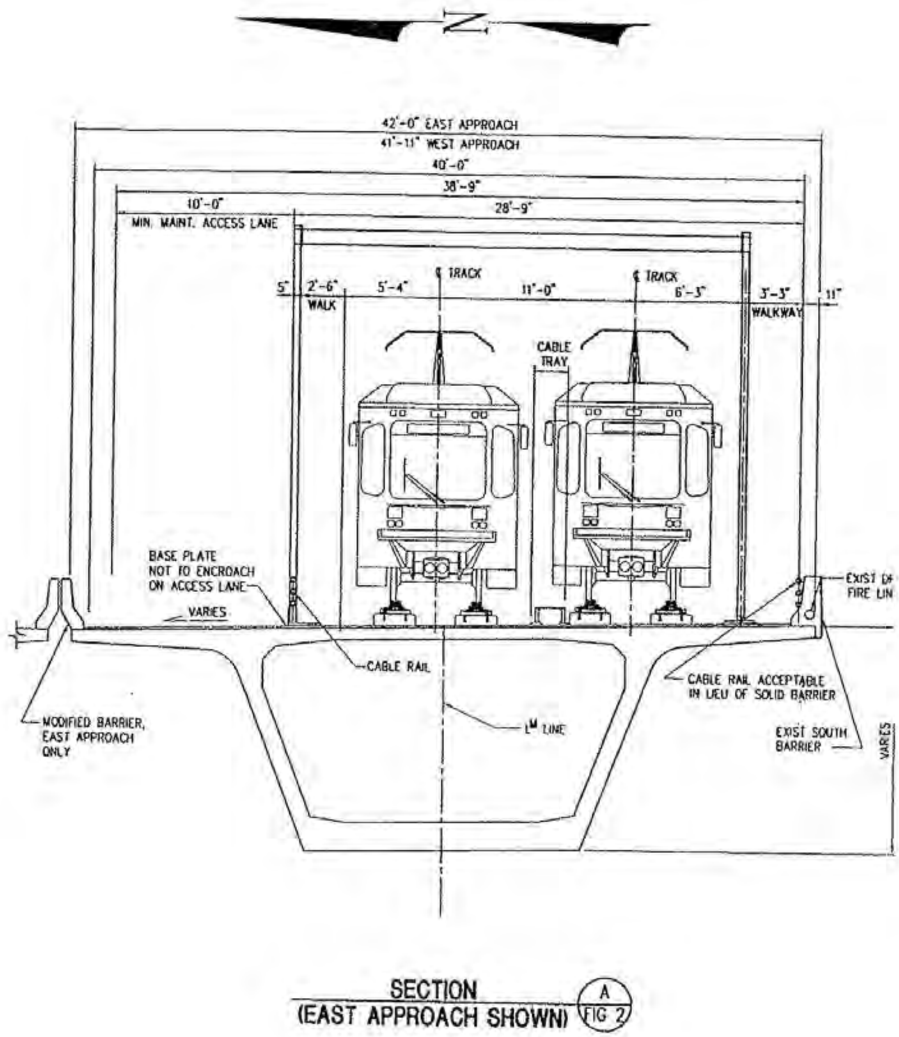
The study also provided a summary of material and loading properties used in the analysis.

5.3.2 Approach Structure Global Analysis

The two concrete approach structures are relatively complex post-tensioned concrete segmental bridges; therefore, traditional analysis of these structures is based on comparing capacities and demands throughout the entire length of each bridge from the foundations through the superstructures. Such an analysis requires a great deal of engineering effort. Because of this level of effort, a "demand-only" approach, which requires considerably less effort, was chosen for the structural analysis.

The demand-only approach involved creating a computer model of the as-built structure under two separate scenarios. The first scenario considered the as-built structure with track dead loads and LRT vehicle live loads in accordance with the original design plans. The second scenario considered the as-built structure with track dead loads and LRT vehicle live loads in accordance with Sound Transit's proposed loading criteria (see *Study Criteria* above). For each of these scenarios, a moving load analysis was performed that considered the combinations of one track operating alone or two tracks operating simultaneously, each carrying from one to eight LRT vehicles per track.

Under each scenario, bending, torsion, shear, and axial response quantities were calculated for different elements of the approach structures. The elements considered were the spans, piers, and foundations (including abutments). For each of these elements, live load, dead load, impact load, and centrifugal forceloads were combined in accordance with Sound Transit's *Link Light Rail Transit System Design Criteria Manual* (December 1999) and *AASHTO* (1996). The controlling load combination for each element formed that particular element's demand. Demand values for each scenario were tabulated and then compared by corresponding element. As expected, the demand values for the proposed LRT loads exceeded the demand values for the original design LRT loads. The percent increase in demand is shown in Table 31.



Trans-Lake Washington Project
Summary of HCT Screening Process
168395.AA.12.07_T042002001SEA - Fig. 36_Proposed LRT Location - 12/16/02 - dk&W

Figure 36
I-90 STRUCTURAL FEASIBILITY STUDY
Proposed LRT Location

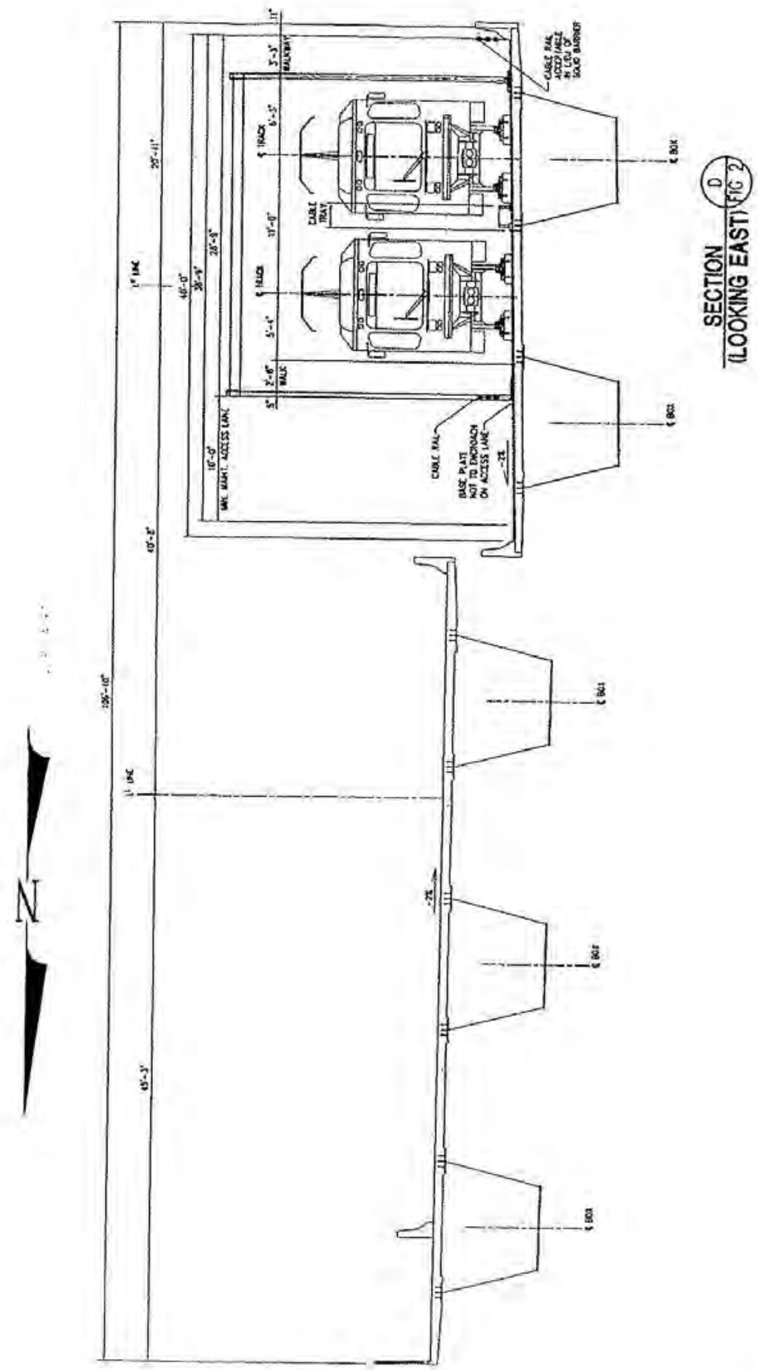


Figure 37
I-90 STRUCTURAL FEASIBILITY STUDY
Proposed LRT Location on West Transition Span

Trans-Lake Washington Project
Summary of HCT Screening Process
168395.AA.12.07_T0920020015EA • Fig. 37_Proposed LRT Location West • 12/10/02 • 00/LW

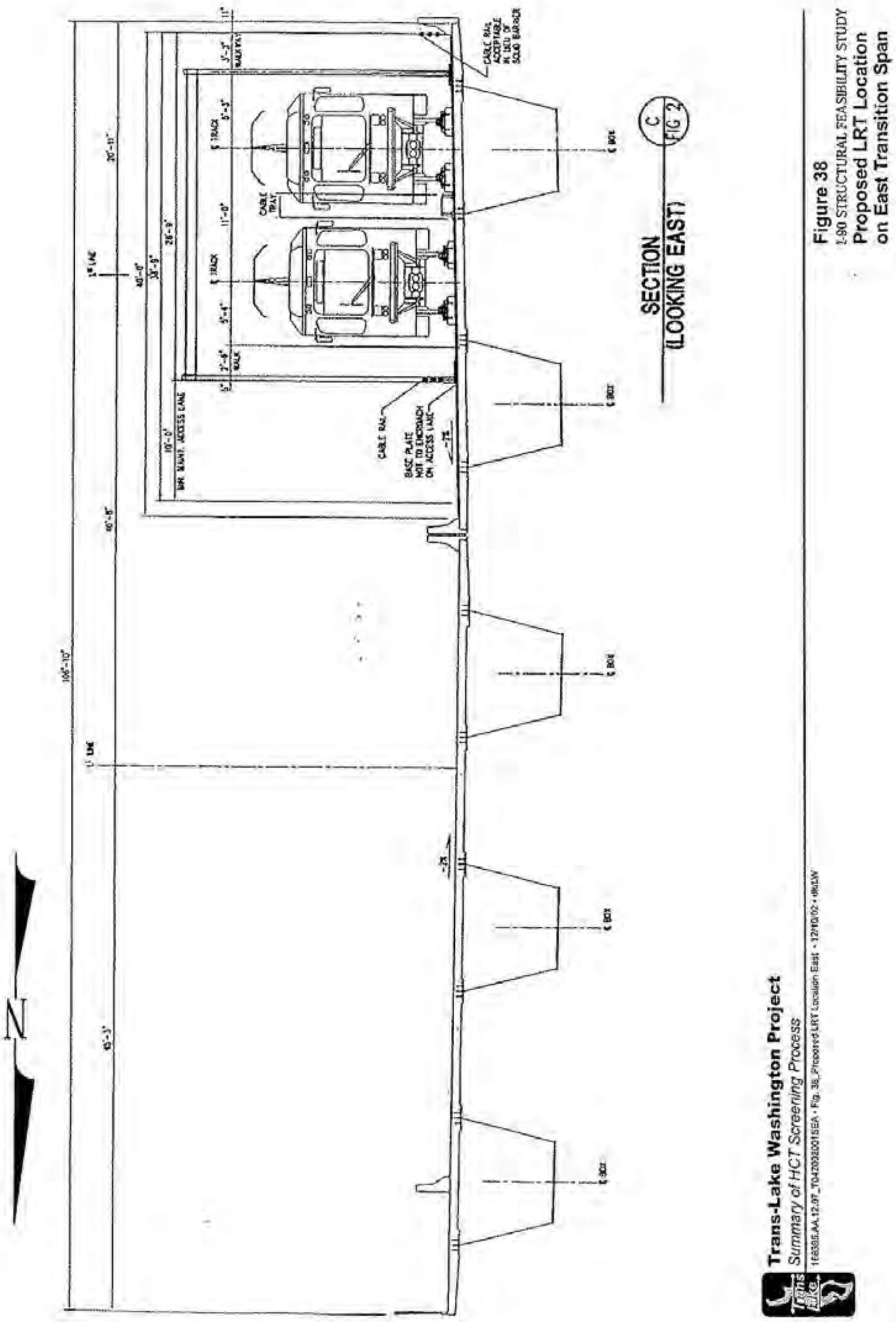

SECTION
(LOOKING EAST)
Figure 38
I-90 STRUCTURAL FEASIBILITY STUDY
Proposed LRT Location
on East Transition Span
Trans-Lake Washington Project
Summary of HCT Screening Process

Table 31
Approach Structures in As-Built Condition—Demand Increase

Element	Bending	Torsion	Shear	Axial
Spans	7–9 percent	26–38 percent	8–9 percent	N/A
Piers	0–40 percent	6–37 percent	0–51 percent	5–8 percent
Foundation	0–48 percent	4–41 percent	0–63 percent	5–8 percent

In an attempt to lower the demand increase, several weight mitigation measures were considered and subsequently analyzed. The measures considered most effective were (1) removing 1/2-inch of the existing overlay over a 23-foot section of the deck, and (2) replacing the existing concrete barrier rail on the south edge of deck with a lightweight cable barrier rail. The percent increases in demand with these weight mitigation measures are shown in Table 32.

Table 32
Approach Structures with Mitigation Measures—Demand Increase[a]

Element	Bending	Torsion	Shear	Axial
Spans	5–8 percent	0–7 percent	6–7 percent	N/A
Piers	0–9 percent	0–9 percent	0–12 percent	4–6 percent
Foundation	0–9 percent	0–5 percent	0–12 percent	4–6 percent

[a]Specific element-by-element demand comparisons are provided in Tables B1 through B5 in Appendix B of *Homer Hadley (Interstate 90) Floating Bridge Approach Structure and Transition Span: Draft Structural Analysis Study for Light Rail Conversion* (KPFF Consulting Engineers, August 31, 2001).

5.3.3 Approach Structure Local Evaluation

The approach structure local evaluation primarily involved analysis of the post-tensioned concrete box girder top deck. A series of 2-dimensional and 3-dimensional computer models was created to analyze the deck under dead loads, proposed LRT loads, and post-tensioning loads. The results of this evaluation showed that, overall, the deck would have sufficient capacity to meet the demand of the proposed LRT loads. There were isolated problem areas at the diaphragm locations over the piers. The shear demand in the deck near the pier and abutment diaphragms would exceed section capacity, but with strengthening measures at these locations, the structure could meet the proposed criteria.

5.3.4 Transition Span Evaluation

The transition span evaluation involved (1) checking the composite box girder sections for compliance with the study criteria for strength, deflection, and frequency under the proposed LRT loads; and (2) checking the concrete deck for strength compliance in bending and shear under the proposed LRT loads.

The initial results showed that the transition spans failed all the criteria for strength, deflection, and frequency. The analysis was conducted again with the addition of cover plates on the tension flange, which brought both the composite section and the concrete deck into compliance with the study criteria. In addition, this brought the deflection of the structures into compliance with the criteria and brought the frequency within 0.04 hertz of the minimum required.

Even after implementing the weight mitigation and strengthening measures, the transition spans would not meet the minimum frequency criteria imposed by Sound Transit. As a result, KPFF recommended that an analysis that takes into effect the dynamic interaction of the structure and the light rail cars be performed. In a memorandum (November 15, 2001), Dick Rudolph of PSTC concluded that the frequencies identified for the transitions should be considered an acceptable criteria deviation and that no special analysis should be required.

5.3.5 Structural Analysis Conclusions

The L^M line approach structures to the Homer Hadley Floating Bridge may be used to support the proposed Sound Transit light rail loading, provided the following conditions are met:

- The proposed light rail loading magnitude and location are consistent with the KPFF Consulting Engineers (August 31, 2001) report.
- The WSDOT Bridge and Structures Office accepts the identified increase in structural demand values.
- The following strengthening retrofits and weight reduction measures are implemented:
  - M1—reduce 1/2 inch of overlay
  - M2—replace south side concrete barrier with steel cable barrier
  - M3—relocate dry fire line
  - M4—provide method of attaching concrete plinths to deck
  - M5—provide method of attaching overhead catenary system to deck
  - M6—provide underdeck strengthening at pier and abutment diaphragms
  - M7—provide strengthening at transition segments

- M8—add cover plates to transition spans
- M9—remove ballast

- An analysis that takes into effect the dynamic interaction of the structure and the light rail cars must be performed.

5.3.6 Costs

- Approach Structure Global Measures—The estimate of probable construction costs for the strengthening and weight mitigation measures associated with the global analysis is $5,200,000.[9]

- Approach Structure Local Measures—The estimate of probable construction costs for the strengthening and weight mitigation measures associated with the local evaluation is $1,700,000.[9]

- Transition Span Measures—The estimate of probable construction costs for the strengthening and weight mitigation measures associated with the transition span is $4,000,000.[9]

- Total Costs of All Measures—The estimate of probable construction costs for all the strengthening and weight mitigation measures associated with the east and west approach structures and transition spans is $10,900,000.

The above estimates do not include the costs associated with installation of a pair of direct fixation tracks and associated LRT systems on an elevated structure, but are in addition to these costs. The above estimates also do not include costs associated with engineering, construction management, or Washington State sales tax, and do not include costs associated with electrical modifications and temporary electrical services. Because KPFF prepared these cost estimates, the costs have been revised to reflect costs for sales tax, engineering or construction management, electrical modifications or temporary services, and traffic mitigation (Ivo Gustetich, personal communication, October 25, 2001; Jane Farquharson, personal communication, February 13, 2002). These revised costs have been included in the multi-modal analysis cost tables presented in Section 4 of this report.

5.4 I-90 SEPARATE BRIDGE CROSSING

After the initial results of the multi-modal alternatives analysis in June 2001, Sound Transit requested the evaluation of an I-90 LRT alternative that did not require using the existing I-90 center roadway for HCT to cross Lake Washington. (A separate I-90 LRT lake crossing would be a worst case scenario for costs and environmental impacts.) As a result, the *Interstate-90*

[9] A breakdown of these costs is provided in Appendix A of *Homer Hadley (Interstate 90) Floating Bridge Approach Structure and Transition Span: Draft Structural Analysis Study for Light Rail Conversion* (KPFF Consulting Engineers, August 31, 2001).

Separate Bridge Crossing Evaluation Report (I-90 Separate Crossing Report; Project Team, January 24, 2002) was produced. The I-90 Separate Crossing Report described this new alternative, and documented its associated costs and environmental effects.

5.4.1 Definition of Alternative

The I-90 separate bridge crossing alternative would change the LRT alignment for Alternatives 2 through 4 between the downtown Seattle transit tunnel and Bellevue Way SE. Under the I-90 separate bridge crossing alternative, current Mercer Island SOV access and HOV operations would be unchanged. The I-90 separate bridge alignment would change HCT Segments A.1 and B.1. For this new alternative, new segment drawings of the alignment were developed and renumbered A.4 and B.4. The conceptual drawings for Segments A.4 and B.4 are provided in Appendix C.

For the I-90 separate bridge crossing, the fixed guideway would start at the International District Station and use the HOV D-2 roadway to Rainier Avenue South, where there would be an at-grade station. From there, the alignment would go below grade. The tunnel would daylight east of Lake Washington Boulevard and connect to the approach structure of the separate crossing. The separate crossing would parallel I-90 to the north of the existing lake crossing. Upon reaching Mercer Island, the alignment would descend to a tunnel configuration and continue east until the park-and-ride lot at 80th Avenue SE, where a cut-and-cover station would be located below the lot. From there, the alignment would ascend to an aerial configuration and transition to the I-90 center roadway. Just west of SE Shorewood Drive the alignment would descend to an at-grade configuration. From there the alignment would continue east, using the East Channel Bridge, to a match point with Segment C.1 near Bellevue Way SE.

5.4.2 Environmental Impacts

Environmental impacts for an I-90 parallel route would be slightly higher than the I-90 HCT route using the center roadway (Alternatives 2, 3, and 4), but overall there would be little difference in environmental performance. The difference in impacts would be in shoreline areas where new aerial structures would transition between the bridge and tunnel sections. These impacts would include increased stormwater runoff, reduced critical habitat for bald eagles, and erosion and sedimentation during construction (if proper mitigation is not implemented).

Up to five single-family residences could be displaced, and four parks could be directly impacted. In addition, the aerial HCT structures could result in noise impacts on residences and parks. Use of the parks would not be substantially impaired. Impacts on residences could be reduced or eliminated. Vibration impacts on residences directly adjacent to the aerial structures and at the tunnel portals in three parks could occur; mitigation could reduce or eliminate impacts. The aerial structure would result in additional medium to high impacts; however, the impacts would occur in areas that already experience high, transportation-related visual impacts.

5.4.3 Cost Opinions

The I-90 LRT capital costs for Alternatives 2 through 4 with HCT on an I-90 separate lake crossing would be approximately 25 percent greater than the capital costs for HCT in the center roadway. The LRT capital costs for Segments A.1 and B.1 in the July 2001 multi-modal cost opinion are $131.3 million. The conceptual-level capital cost estimates for the I-90 separate bridge crossing segments are $826.8 million. The difference is approximately $700 million. These costs are summarized in Table 33.

The capital costs for the I-90 separate lake crossing would be $1.3 billion less than the multi-modal alternatives with HCT on SR 520 (Alternatives 5 and 6). If the west side HCT alignment was modified to provide direct downtown service, the I-90 LRT alternatives would remain substantially less expensive than the SR 520 HCT alternatives.[10]

Table 33
I-90 LRT Capital Cost Opinion Summary, Full Route

Capital Cost Opinion (in Billions of 2001 Dollars)		
Alternatives 2-4 LRT in I-90 Center Roadway*	**Alternatives 2-4 LRT on Separate I-90 Crossing**	**Alternatives 5 and 6 LRT on SR 520**
$2.72	$3.42	$4.71

* The cost estimates for HCT in the I-90 center roadway do not include the KPFF cost estimates for structural improvements that would be needed to accommodate the load HCT would add to I-90. These additional costs are reflected in the multi-modal analysis cost tables in Section 4 of this report.

Table 34 includes total capital costs (costs for HCT, highway, and other improvements), annual costs, other corridor costs, and a life-cycle analysis for alternative comparison. The total costs for the I-90 separate lake crossing are not significantly different from those for alternatives with the I-90 center roadway conversion. The O&M costs for the HCT line and operation would be nearly the same for both options; the incremental cost to maintain a separate HCT floating bridge would be approximately $150,000 per year. The life-cycle costs reflect the change in capital costs and O&M costs.

5.4.4 Conclusions

The study found that an I-90 separate bridge crossing would be a reasonable optional alignment to the I-90 route defined for the Trans-Lake multi-modal Alternatives 2 through 4, and that it would avoid a potential loss of center roadway capacity for I-90. The costs for the parallel route would be up to $700 million higher than the HCT components of the original multi-modal Alternatives 2 through 4. This would be approximately $1.3 billion less than a comparable SR

[10] These cost estimates were also provided in a Technical Memorandum (October 17, 2001) by Craig Moore. The cost estimates for LRT in the I-90 center roadway do not include the KPFF cost estimates for structural improvements that would be needed to accommodate the load LRT would add to the Homer Hadley Floating Bridge. These additional costs are reflected in the multi-modal analysis cost tables.

520 HCT route. Environmental impacts for an I-90 parallel route would be slightly higher than HCT in I-90 center roadway, but overall there would be little difference in environmental performance. The transit ridership and reliability performance of the parallel route is assumed to be similar to the original I-90 route alternatives, although transit ridership would be influenced by the final configuration of the I-90 roadway.

Table 34
Costs for I-90 LRT Multi-Modal Alternatives (2-4)
Separate Lake Crossing Versus I-90 Center Roadway Conversion
(in millions of 2001 dollars)

Type of Cost	Alt 1	Alt 2		Alt 3		Alt 4	
	No Action	LRT Center Roadway[a]	LRT Separate Crossing[a]	LRT Center Roadway[a]	LRT Separate Crossing	LRT Center Roadway[a]	LRT Separate Crossing
Capital	0	$4,220	$4,920	$5,880	$6,580	$7,380	$8,080
Annual[b]	0	$109	$109	$55	$55	$114	$115
Other[c]	0	$350-4,080	$350-4,150	$770-4,740	$780-4,810	$1,770-6,040	$1,780-6,110
Life-Cycle[d]	0	$3,046	$3,175	$3,144	$3,404	$4,662	$5,091

[a] The cost estimates for LRT in the I-90 center roadway do not include the KPFF cost estimates for structural improvements that would be needed to accommodate the load LRT would add to I-90. These additional costs are reflected in the multi-modal analysis cost tables presented in Section 4 of this report.
[b] Annual costs include estimated TDM program costs, private costs (fuel and time lost), and O&M.
[c] This category reflects high and low costs for projected lidding and environmental mitigation.
[d] This category accounts for the costs of a project over its entire useful life. The costs shown are net present value.

A number of other issues could still affect a decision to place HCT on the I-90 center roadway or on a parallel route, but they would not substantially affect the choice of whether I-90 or SR 520 would be the preferred HCT lake crossing. The final decision on an I-90 HCT route would require an EIS project-level analysis. In the meantime, the I-90 route options could be further refined following decisions for Sound Transit's I-90 Two-Way Transit Operations Project. That project is exploring highway design alternatives that would allow additional lanes to be added to the outer roadways if the center roadway reversible HOV lanes are converted to two-way transit lanes. This project is discussed in Section 3 of this report.

5.5 TRANSPORTATION FORECAST SENSITIVITY RESULTS

When the initial results of the multi-modal alternatives were published by the Trans-Lake Washington Project Team in June 2001, the project committees requested more analysis based on assumptions other than those used in the initial modeling. The initial modeling assumed:

- The capacity of the I-405 corridor would remain unchanged.

- The displaced HOV lanes would be relocated to the outer roadways, if the I-90 center roadway was converted to rail, and HOV lane operations would be two way compared to the reversible operations assumed in the No Action Alternative, but the total number of lanes available for vehicle travel on I-90 would be unchanged.

In response, the Project Team ran two modeling sensitivity tests on Alternative 4, which originally involved eight highway lanes on SR 520 and LRT operations on I-90. (The results of the additional modeling were presented in the *Technical Memorandum: Transportation Forecast Sensitivity Test Results* [Wendle, October 17, 2001]). Alternative 4 was used because it had the potential to show the greatest changes in demand on SR 520 if other facilities were changed. The team ran the following two scenarios for Alternative 4:

- Scenario 1—The capacity of I-405 was assumed to increase by two general purpose lanes in each direction. On I-90, LRT would use the I-90 center roadway, thereby displacing the HOV lanes and reducing the total lanes available for vehicle travel on I-90 by two lanes.

- Scenario 2—The capacity of I-405 was assumed to be the same as it is presently. LRT would use the I-90 center roadway, thereby displacing the HOV lanes and reducing the total lanes available for vehicle travel on I-90 by two lanes.

The loss of I-90 HOV capacity would increase the vehicular demand on SR 520, mostly during peak periods. The added capacity on I-405 would reduce this effect on SR 520. Under Scenario 2, about half of the 10,000 daily vehicles and 6,500 of the PM peak period vehicles that would be lost from I-90 would migrate to SR 520 lanes. Under Scenario 1, there would be a higher drop on I-90 during the peak, but a lower diversion to SR 520 because travelers would find I-405 a more attractive option.

5.6 ACCOMMODATING HIGH-CAPACITY TRANSIT IN THE SR 520 CORRIDOR

Accommodating High-Capacity Transit in the SR 520 Corridor (Project Team, August 23, 2002) was prepared to inform policy-level discussions regarding what actions, if any, should be taken to preserve or accommodate future development of HCT facilities on the SR 520 corridor as part of the current Trans-Lake Washington Project effort. The report looked at various considerations for the assumed HCT technology, LRT, including potential alignments, scenarios for accommodating future construction of HCT in the corridor, costs and implications for the current roadway project, and foreseeable legal or procedural issues.

For the purpose of analyzing accommodation scenarios, LRT was selected as the future HCT technology within the SR 520 corridor given its superior flexibility in terms of right-of-way requirements and station spacing options, and its performance on steep grades.

The HCT alignment evaluated was based on the HCT alignment proposed during the multimodal screening phase of the Trans-lake project with some minor variations.

To understand the range of strategic, policy, environmental, design, ROW implications and costs, a set of scenarios were developed and studied. The following lists the scenarios and summarizes the results of the analysis:

- Scenario 1: No HCT Accommodation (Baseline Scenario)—No roadway, floating bridge, or high-rise structure design modifications, or additional ROW acquired, as part of the Trans-Lake Washington Project to accommodate or preserve an HCT envelope in the long term. The Trans-Lake Project EIS would not consider any future HCT alignments. An EIS would be prepared and right-of-way acquired at the time of the any future HCT. No costs would be incurred in the term but this scenario would have the highest future costs. It would be very difficult to implement HCT in the future because widening the bridge would be challenging. No near-term costs; highest future costs ($1,192 million).

- Scenario 2: HCT Accommodation on Floating Bridge—The floating bridge, approach structures, and the lid located at Evergreen Point Road. The Trans-Lake Project EIS would need to consider wider pontoons and potential increased park impact. An EIS would still need to be prepared in the future to consider other improvements. Some right-of-way would be acquired in the near term, with the rest acquired at a later date. Structures would need to be designed to support load of future HCT facilities. Implementation of future HCT would be moderately difficult because of widenings that would need to occur at locations of the Eastside. Near-term cost would be $116 million, and future cost would be $718 million.

- Scenario 3: HCT Accommodation on Entire Lake Crossing and at Key Structures—In addition to Scenario 2 accommodations, adjustments to key structures east of the Evergreen Point lid. The Trans-Lake Project EIS would need to consider more improvement than in the other scenarios. For this scenario, most of the right-of-way would be acquired in the future. Design would need to take into consideration the most future facilities. In the near term, the cost would be $190 million, with future costs totaling $567 million.

- Scenario 4: HCT Envelope Preservation for Full Corridor—The initial highway project would be constructed to allow a full HCT envelope between Montlake Boulevard in Seattle and the Redmond terminus. EIS complication in defining the project. This scenario would involve the most near-term right-of-way acquisition. The facilities would need to be designed as an integrated system, which would provide low-design flexibility in the future but easier implementation. This scenario would have the highest near-term costs $742 million. There would also be some undefined future costs associated with retaining walls and trackbed.

Because HCT would not be implemented in the SR 520 corridor within the next 20 years or even longer, the benefit/cost of project expenditures would be substantially lowered considering the time value of the investment. In addition, if the service life of the new Trans-Lake facility is 75 years and the benefit cannot be realized until half way through its service life, the effective benefit is reduced. Making an investment in the near term for benefits that will be realized in the future also must take future uncertainties, such as HCT technology may change and land use and commuting patterns may change, into account.

Foreseeable legal issues involve NEPA project definition and potential right-of-way acquisition and condemnation issues.

5.6.1 Recommendations

On September 5, 2002, the Executive Committee acted on the selection of a Preliminary Preferred Alternative. The Preliminary Preferred Alternative included a decision on an option for accommodating a future HCT line within the SR 520 corridor. The Executive Committee recommended a modified Scenario 2: the floating bridge and fixed approaches would be designed to allow a future widening of 30 feet to accommodate HCT only; the Evergreen Point lid was not included. For the highway corridor, the Executive Committee recommended the six-lane option, which would reconstruct the SR 520 corridor from I-5 to SR 202, providing a continuous corridor for two general purpose lanes and one HOV lane in each direction. Other highway improvements would occur within the corridor and to I-5 south of SR 520 to Stewart Street.

5.7 2030 TRANSIT SYSTEM DEFINITION

The Transit System Definition Technical Memorandum defines potential system characteristics and facilities for a BRT service operating within SR 520 HOV lanes and associated bus feeder network. The BRT service proposed for the Trans-Lake Washington Project would be rubber-tire-based HCT connection between key activity centers on the Eastside and the University District and downtown Seattle. Three types of bus service would operate in the SR 520 HOV lanes: BRT service, other all-day routes, and peak-period-only routes. The BRT service would include five routes:

- Woodinville to Downtown Seattle, via I-405, SR 520, and I-5
- Kingsgate/Totem Lake to the University District, via I-405 and SR 520
- Bear Creek/Downtown Redmond to Downtown Seattle, via SR 520 and I-5
- Bear Creek/Downtown Redmond to University District, via SR 520
- Downtown Bellevue to the University District, via I-405 and SR 520

Each route would operate all-day in both directions, with service at least every 10 and 15 minutes during the peak and off-peak periods, respectively. The BRT service would have limited stops on the freeway HOV system: Overlake, Bellevue Way, Montlake (for downtown Seattle routes), and Totem Lake (along I-405).

In addition to the three bus services utilizing the SR 520 HOV lanes, similar types of routes would operate within I-90 and I-405 HOV lanes. Overlaid on top of bus services using the freeway HOV lane system would be local bus routes providing connections between communities and neighborhoods on both sides of Lake Washington.

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Appendix D - Trans-Lake Washington Project: Accommodating High-Capacity Transit in the SR 520 Corridor report (2002) (forthcoming)

Trans-Lake Washington Project

Accommodating High-Capacity Transit in the SR 520 Corridor

Prepared for

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ACRONYMS

BRT	Bus Rapid Transit
BNSF	Burlington Northern Santa Fe Railroad
CEVP	Cost Estimate Validation Process
EIS	Environmental Impact Statement
EPR	Evergreen Point Road
HCT	High Capacity Transit
I-90	Interstate 90
I-405	Interstate 405
Link	Light Rail System being developed by Sound Transit, which includes Central Link and Tacoma Link
LRT	Light Rail Transit
PSRC	Puget Sound Regional Council
ROW	Right of Way
SR 520	State Route 520
ST	Sound Transit
WSDOT	Washington State Department of Transportation

1. BACKGROUND

Previous studies undertaken by the Puget Sound Regional Council (PSRC), King County Metro, and Sound Transit have led to the adoption of the Sound Move Long-Range Vision, Sound Transit's long-range transportation plan[TH1]. This plan includes a light rail line in the I-90 corridor with branches on the Eastside to serve portions of Eastgate, Bellevue, Issaquah, Kirkland, and Redmond, as shown in Figure 1-1.

According to travel forecasts developed during the multimodal phase of the Trans-Lake Washington Project, only one high-capacity transit (HCT) corridor across Lake Washington will be necessary to satisfy transit demands through the year 2020. The study further concluded that the total person throughput across the lake would not vary if the future HCT line was placed within either the I-90 or the SR 520 corridor.

The multimodal phase of this project also led to the following additional conclusions, as noted in *Summary of HCT Screening Process: Evaluations and Recommendations* (April 2002, draft document):

Overall Need for High-Capacity Transit

- Travel growth beyond the current forecast horizon of 2020 (in the cross-lake corridor) would have to be accommodated by increased transit capacity.
- An HCT extension from the Central Link line to the major Eastside travel markets (Bellevue, Redmond, and Kirkland) would result in an overall increase in daily person trips across the lake of 1 to 26 percent in 2020 and mode share of 10 percent compared to the No Action Alternative.

Advantages of the I-90 Corridor over SR 520

- An HCT line in the I-90 corridor would cost substantially less than an line in the SR 520 corridor.
- In the short to medium term, merging an SR 520 HCT line into Central Link would be feasible. However, in the longer term, when Central Link is extended to Northgate, the segment between the University of Washington and downtown Seattle will be capacity-constrained and another HCT line between the University and downtown will be required.
- Light rail transit (LRT) in the I-90 corridor would result in fewer environmental impacts than the HCT in the SR 520 corridor.

Based on the multimodal study work, the Translake executive committee choose to continue planning for HCT in the I-90 corridor with an investment in BRT in the SR 520 corridor.

2. PURPOSE OF THIS STUDY

At some point beyond the planning horizon of Sound Transit's Long-Range Vision, it is possible that travel demand by transit could grow to a level that would justify a second trans-lake HCT corridor in addition to the I-90 corridor. Since both development of a third corridor across Lake Washington or expansion of the I-90 corridor is unlikely, the SR 520 corridor is the most viable option for the second corridor. While the timing of this need is difficult to predict, it could occur within the 50 to 75-year service life [TH2]of the SR 520 improvements being contemplated as part of the current Trans-Lake Washington Project effort.

As a result, policy-level discussions need to occur regarding what actions should be taken now to preserve or accommodate future development of HCT facilities on the SR 520 corridor as part of the current Trans-Lake Washington Project effort. An informed decision requires that a number of issues need to be addressed. The issues include:

- What type of HCT technology should be planned for and what are the associated design requirements?
- What is the range of options available to preserve, accommodate, and even facilitate the possible future construction of HCT in the corridor?
- What are the most logical alignment locations and line configurations for a future SR 520 HCT line?
- What are the costs and implications of this range of options to the current roadway project? To what extent and how can these costs be born and the impacts be mitigated and/or justified within the context of the current project?
- What legal or procedural issues must be dealt with?

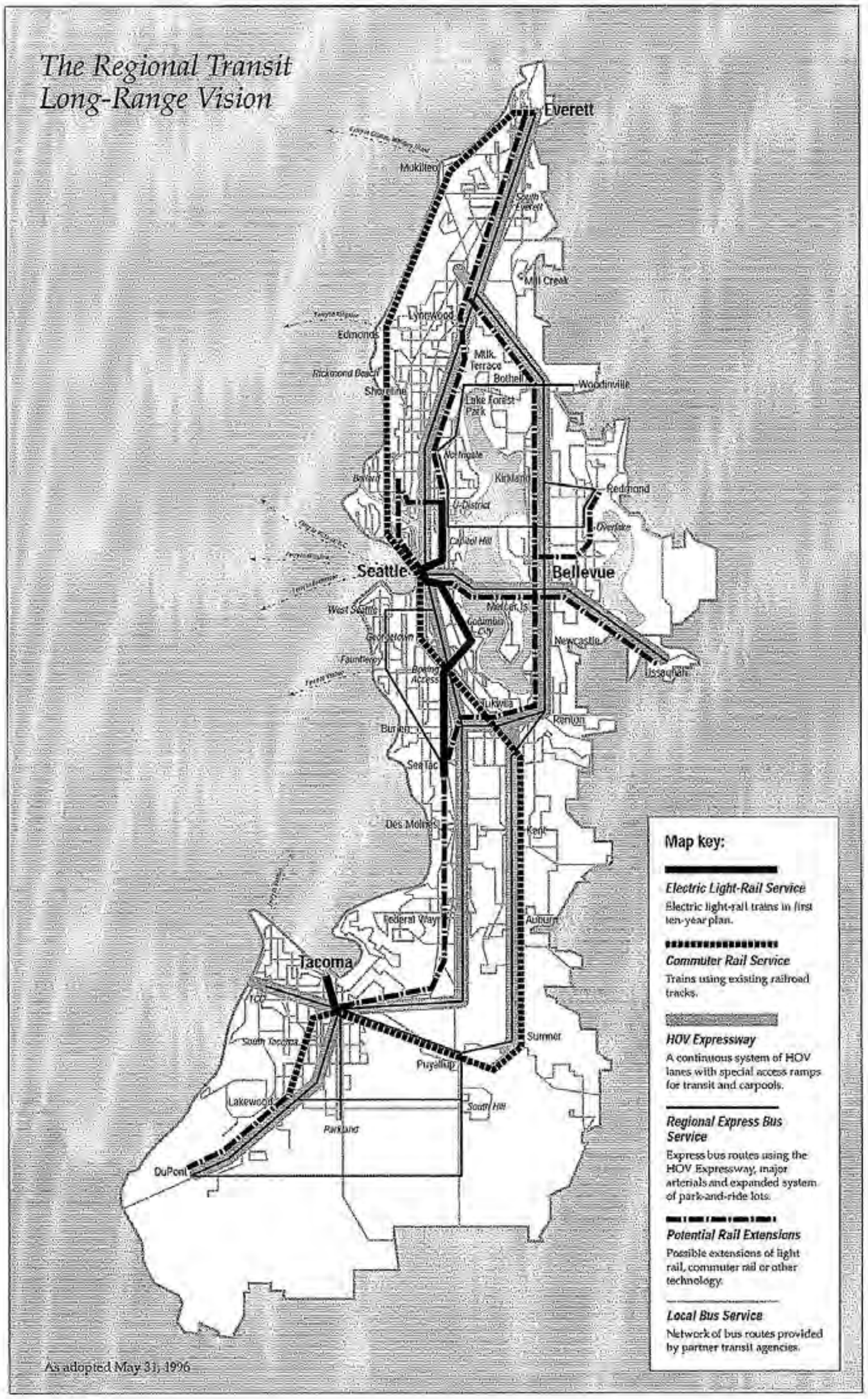

The Regional Transit Long-Range Vision
Everett
Mukilteo
Mill Creek
Lynnwood
Edmonds
Mtk. Terrace
Bothell
Woodinville
Shoreline
Lake Forest Park
Northgate
Kirkland
Redmond
U-District
Overlake
Capitol Hill
Seattle
Bellevue
West Seattle
Mercer Is.
Columbia City
Newcastle
Issaquah
Tukwila
Renton
Burien
SeaTac
Des Moines
Kent
Federal Way
Auburn
Tacoma
South Tacoma
Sumner
Puyallup
South Hill
Lakewood
Parkland
DuPont
Map key:
Electric Light-Rail Service
Electric light-rail trains in first ten-year plan.
Commuter Rail Service
Trains using existing railroad tracks.
HOV Expressway
A continuous system of HOV lanes with special access ramps for transit and carpools.
Regional Express Bus Service
Express bus routes using the HOV Expressway, major arterials and expanded system of park-and-ride lots.
Potential Rail Extensions
Possible extensions of light rail, commuter rail or other technology.
Local Bus Service
Network of bus routes provided by partner transit agencies.
As adopted May 31, 1996

Figure 1-1

3. TECHNOLOGY CHOICES

Analyzing the accommodation of HCT in the SR 520 corridor requires the selection of a basic fixed-guideway technology upon which the HCT envelope would be based.

Light rail and commuter rail are the only technologies now being deployed for fixed guideway HCT service in the region. Commuter rail is not a candidate technology for the SR 520 corridor. Commuter rail is generally appropriate only where existing rail lines or rights of way facilitate the use of traditional locomotive hauled rail passenger cars. It requires relatively flat grades and stations that are spaced over five miles apart. In the SR 520 corridor, the grades are steep and the spacing of the stations proposed would be close, precluding optimal use of commuter rail technology.

LRT is a form of rail transit that can operate both on exclusive right of way and mixed with other traffic and cross-traffic. Since it is such, it generally requires less costly infrastructure than systems that need exclusive right of way such as heavy rail or automated rubber tire systems.

Using the LRT-type envelope and design requirements would provide a good general basis for determining actions that might be needed now to accommodate future fixed guideway HCT development in the SR 520 corridor. While other technologies could be considered in the future, from the standpoint of the basic envelope and geometry, most other technologies could be accommodated within the requirements established by LRT standards.

In general, the design requirements of the HCT's fixed guideway envelope are a function of system capacity and speed of operation, not whether steel wheels, rubber tires, monorail beams, air cushion, or magnetic levitation are used. Systems with small radius curves and steep grades would be possible with any of these above technologies, but would result in speed limitations well below the desired 55 mph. Similarly, train vehicles with envelopes smaller than standard light rail cars would also be possible, but would severely limit the system's carrying capacity.

4. STUDY METHODOLOGY

In order to understand the range of strategic, policy, environmental, design, and right-of-way (ROW) implications, a set of scenarios were developed and studied. The scenarios range progressively from no accommodation to full preservation of the HCT corridor. The scenarios are:

- Scenario 1: No HCT Accommodation (Baseline Scenario)
- Scenario 2: HCT Accommodation on Floating Bridge
- Scenario 3: HCT Accommodation on Entire Lake Crossing and at Key Structures
- Scenario 4: HCT Envelope Preservation for Full Corridor

The study methodology consisted of sketching an approximate HCT alignment and cross-sections on roadway plans developed to date. A multidisciplinary team then identified the range of implications for each scenario, as well as the conceptual-level costs. The engineering and cost comparison work was done at a conceptual level and should only be used for general overall comparisons of the scenarios.

5. HCT ALIGNMENT

Although numerous alignment alternatives and variations could be analyzed to optimize cost, transit speed, and reliability, this report uses an HCT alignment based on the HCT alignment proposed during the multimodal screening phase of the Trans-lake project with some minor variations. This basic alignment serves the purpose of this study because it allows varying scenarios of accommodation and preservation to be applied, thus allowing the costs and implications to be summarized.

The alignment assumptions are listed as follows:

Montlake to 124th Avenue NE

- West of Montlake Boulevard, the HCT line would be in a subway and would turn either north to serve the University District or south to go to downtown Seattle.
- On the Lake Washington floating bridge, the HCT line would be located in the center of the bridge.
- On the east side of Lake Washington, the HCT line would travel in the center of the roadway under the structure/lid at Evergreen Point Road (EPR) and would transition out of the roadway between EPR Road and 84th Avenue NE, crossing over the westbound highway lanes. It would continue traveling on the north side of SR 520 passing underneath the structure at 84th Avenue NE.
- The HCT line would pass under the 84th Avenue NE westbound loop ramp with an HCT station be located just east of the loop ramp.
- The HCT alignment would continue along the north side of SR 520 toward Bellevue Way.
- Several alternative alignments could be considered for the HCT between Bellevue Way and 124th Avenue NE in the vicinity of the I-405 Interchange. These alternative alignments are shown in Figure 5-1 and are listed below. This analysis uses "Alternative A," which provides a good representation of the accommodation issues to be compared in the scenarios.
    - Alternative A - This alternative is based on the multimodal alignment, which follows the Burlington Northern-Santa Fe (BNSF) rail alignment from the vicinity of the South Kirkland park-and-ride lot through the I-405 interchange. An HCT station would be located at the easterly side of the I-405 interchange, from which the alignment would continue through a 1,200-foot cut-and-cover structure to reach the HCT alignment east of 124th Avenue NE.
    - Alternative B - This alignment would run parallel to Northup Way (on the north side), would have grade crossings at the termini of two of the interchange ramps, and would

Trans-Lake Washington Project
Alternative HCT Alignments in the Vicinity of the I-405 Interchange
Figure 5-1

avoid major cut-and-cover structures. Cut-and-cover structures at 120th Avenue NE and 124th Avenue NE might be desirable where this alignment continues to the east. An HCT station would be located at the easterly end of the I-405 interchange.

- Alternative C - This alignment would be located in the center of SR 520. The roadway alignment would need to be widened to provide for the HCT alignment and for the transit station.
- Alternative D - This alignment would follow the BNSF alignment down to the point where the HCT alignment from I-90 curves towards the east to head east along SR 520. The alignment would turn east at this location.

124th Avenue NE to Redmond

The HCT alignment between 124th Avenue NE and Redmond follows the alignment developed during the multimodal phase of the Trans-Lake Washington Project.

Due to the limited interaction of the highway and HCT alignments in this section of the SR 520 corridor, HCT accommodation and preservation are much more straightforward. There are only two critical locations—a potential cut-and-cover tunnel near the 51st Street NE interchange (just north of the Overlake Transit Center) and an elevated crossing near the intersection/interchange of SR 520 and NE Union Hill Road.

The HCT alignment analyzed is as described below:

- The HCT line would run parallel to the SR 520 highway lanes on the south side between 124th Avenue NE and NE 24th Street. At NE 24th Street, the HCT line would diverge from the SR 520 corridor and continue up NE 24th Street to serve a future HCT station located near NE 24th Street and 150th Avenue NE.
- The HCT line alignment would turn north on 156th Avenue NE and continue past the Microsoft campus to the Overlake Transit Center, where it would cross under SR 520 in the vicinity of the NE 51st Street interchange in a cut-and-cover tunnel to the west side of SR 520.
- The HCT line alignment would then parallel SR 520 to the west near the Sammamish River, where it would diverge from SR 520 to serve downtown Redmond.
- The HCT line alignment would again rejoin SR 520 at the Redmond Way/SR 202 interchange and cross over SR 520 at NE Union Hill Road to serve a future HCT station near the Bear Creek park-and-ride lot.

6. DEFINITION AND ANALYSIS OF SCENARIOS

Definition and analysis of the scenarios studied are presented below. The scenarios are presented in order with a qualitative comparison being made between the implications of dealing with the described scenario in the Trans-Lake Washington Project (immediate future) vs. dealing with the issues in the future with a separate HCT project.

The only quantitative evaluation that has been done is a comparison of cost implications to the Trans-Lake Washington Project vs. the implications to a future HCT project. Costs and cost elements are summarized in Chapter 7.

6.1 ROADWAY ASSUMPTIONS

For the purposes of this study, the following assumptions have been made regarding the roadway:

- The current roadway alignment being developed by the Trans-Lake Washington Project engineering team is the basis for the discussion in this report.
- A distinction has not been made between the 6-lane and 8-lane alternatives. For the purposes of simplifying the issues, the footprint and cross-sectional analysis was done with the 8-lane alternative. The results would not be significantly different with an analysis of the 6-lane alternative.
- The Trans-Lake Washington Project will construct lidded structures in the vicinity of Montlake Boulevard, Evergreen Point Road, 84th Avenue NE, and 92nd Avenue NE for the 6- and 8-lane alternatives.
- Bus Rapid Transit (BRT) stations will be located in the SR 520 corridor in the vicinity of Montlake Boulevard, Evergreen Point Road, 92nd Avenue NE, Bellevue Way NE, and at the current Overlake park-and-ride lot at NE 40th Street (an HOV direct access ramp is substituted for the NE 40th flyer stop in the 6-lane alternative).

6.2 SCENARIO 1: NO HCT ACCOMMODATION (BASELINE SCENARIO)

In Scenario 1, there would be no roadway, floating bridge, or high-rise structure design modifications, or additional ROW acquired, as part of the Trans-Lake Washington Project to accommodate or preserve an HCT envelope in the long term.

This scenario is the same as Multimodal Alternatives 7 and 8, which both include a BRT as the long-term regional transit choice in this portion of the SR 520 corridor. A summary of the implications of Scenario 1 is included in Table 6-1; a schematic of this scenario is shown in Appendix A.

Table 6-1. No HCT Accommodation (Baseline Scenario)

	Montlake to 124th	124th to Redmond
Environmental Documentation Implications	**Trans-Lake:** • Does not need to address HCT issues at this time	**Trans-Lake:** • Does not need to address HCT issues at this time
	Future HCT: • EIS will be needed to address HCT corridor program at a future time. An analysis of alternatives and impacts can be done at that time.	**Future HCT:** • EIS will be needed to address HCT corridor program at a future time. An analysis of alternatives and impacts can be done at that time.
ROW Implications	**Trans-Lake:** • Does not need to address ROW issues over and above the roadway requirements at this time	**Trans-Lake:** • Does not need to address ROW issues over and above the roadway requirements at this time
	Future HCT: • All ROW needed for HCT will need to be acquired at a future time	**Future HCT:** • All ROW needed for HCT will need to be acquired at a future time
Roadway Design Implications for Trans-Lake Washington Project	**Trans-Lake:** • No Roadway design implications for Trans-Lake	**Trans-Lake:** • No Roadway design implications for Trans-Lake
Design Flexibility for HCT	**Future HCT** • Structural constraints, including floating bridge and lids, would be in place. Any alignments affecting these locations will be complicated and costly.	**Future HCT** • Future design opportunities are very flexible
Ease of Implementation of Future HCT in SR 520 Corridor	**Future HCT** • Very difficult to implement HCT alignment in the future since widening the floating bridge will be difficult	**Future HCT** • Moderately difficult to implement HCT alignment in the future since future cut-and-cover tunnel construction in vicinity of NE 51st Street and other structures in vicinity of Union Hill Road will present significant disruptions to highway traffic
Cost Implications	**Trans-Lake:** • No additional cost for Trans-Lake at this time	**Trans-Lake:** • No additional cost for Trans-Lake at this time
	Future HCT • $1,019 million – see Chapter 7 for cost elements	**Future HCT** • $154 million - see Chapter 7 for cost elements

6.3 SCENARIO 2: HCT ACCOMMODATION ON FLOATING BRIDGE

The basic assumption in Scenario 2 is that the floating bridge, approach structures, and the lid located at EPR are most critical and that the HCT alignment beyond the floating bridge is less easily defined at this stage.

A summary of the implications of Scenario 2 is included in Table 6-2; a schematic of this scenario is shown in Appendix B.

Table 6-2. Scenario 2 - HCT Accommodation on the Floating Bridge

	Montlake to 124th	124th to Redmond
Environmental Documentation Implications	**Trans-Lake:** • Wider pontoons should not complicate EIS • EIS documentation in vicinity of EPR may be difficult for EPR lid Option B • EPR lid (Option B) will likely incur added 4F impacts	**Trans-Lake:** • Does not need to address HCT issues at this time.
	Future HCT: • The future EIS would need to cover all HCT planned improvements not provided for by the initial highway project	**Future HCT:** • Environmental document for HCT would have to cover entire corridor from 124th Ave NE to Redmond
ROW Implications	**Trans-Lake:** • Would have to acquire additional ROW in vicinity of EPR lid for Option B. This may be difficult due to NEPA requirements • No other ROW would be required	**Trans-Lake:** • No effect on this part of the project
	Future HCT: • Except for EPR lid vicinity, all ROW needed for HCT will need to be acquired at a future time	**Future HCT:** • All ROW needed for HCT will need to be acquired at a future time
Roadway Design Implications for Trans-Lake Washington Project	**Trans-Lake:** • Floating bridge pontoons and substructure will need to be designed to support roadway deck plus a deck for future HCT that could be built at a later time • Approach span foundations (east and west side of lake) will need to be designed to accommodate HCT loads, even though the approach structures will be widened at a future time • EPR lid Option A will take some preliminary design work to ensure no conflicts with adding HCT in the future • EPR lid Option B will require that the lid be designed wide enough for future HCT • Floating bridge superstructure and deck for HCT designed in future • Widening of transition spans for HCT done in future • All other HCT improvements done in future	**Trans-Lake:** • No roadway design implications for Trans-Lake
Design Flexibility for HCT	**Future HCT:** • High flexibility vs. Scenario 1 because only floating bridge pontoons are provided for	**Future HCT:** • Future design opportunities are very flexible
Ease of Implementation of Future HCT in SR 520 Corridor	**Future HCT:** Moderately difficult to implement due to following elements of work: • Floating bridge approach spans will need to be widened • 84th Avenue NE and 92nd Avenue NE lids will need to be widened • Roadway and possible retaining walls between EPR lid and 84th Avenue NE will have to be reconstructed • Points Community HCT station cut–and-cover tunnel under loop ramp will need to be constructed, resulting in traffic disruptions	**Future HCT:** • Moderately difficult to implement HCT alignment in the future because future cut-and-cover tunnel construction in vicinity of NE 51st Street and other structures near Union Hill Road will present significant disruptions to highway traffic
Cost Implications	**Trans-Lake:** • $113 million – see Chapter 7 for cost elements	**Trans-Lake:** • No additional cost – see Chapter 7 for cost elements
	Future HCT: • $569 million – see Chapter 7 for cost elements	**Future HCT:** • $154 million - see Chapter 7 for cost elements

6.3.1 Floating Bridge

In this "minimal" scenario for HCT accommodation, the floating bridge pontoons and bridge substructure would be modified to support a future HCT line across Lake Washington. The initial floating bridge deck lane configuration would be the same as for Scenario 1, but would be designed to allow future widening for HCT.

6.3.2 West Side Floating Bridge Approaches

On the west side of Lake Washington, it is assumed that the future HCT line would leave the highway median as quickly as possible after reaching the west side of the navigation channel (when traveling in a westerly direction). A transition length of approximately 1,800 feet on the west approach would be necessary to allow the HCT alignment to leave the highway median and cross over the highway lanes with a minimum 16.5-foot clearance.

The approach structure would have to be widened and strengthened/modified over this transition length when HCT is implemented in the future to allow for additional width/loads. As part of this scenario, the foundation of the approach span would be designed to accommodate HCT as part of the initial highway project because retrofitting foundations is extremely difficult.

Once the HCT alignment leaves the highway envelope, no additional highway design or ROW modifications would be required. The HCT line would touchdown in the Montlake area and change configuration to a bored tunnel. The HCT line could then turn north to the University District or south to downtown Seattle.

6.3.3 East Side Floating Bridge Approaches

On the east side of Lake Washington, the highway climbs up the east approach structure at a 3 percent grade and approaches EPR, which is located at the top of the grade. Assuming a maximum climbing grade of 6 percent for the HCT line, it would not be physically possible for the HCT line to shift out of the highway median west of Evergreen Point Road before encountering the proposed Evergreen Point Road structure/lid. Therefore, the east approach structure would have to be widened and modified over its entire length when HCT is implemented.

The foundations of the approach span need to be designed to accommodate HCT as part of the initial highway project because retrofit of structure foundations is extremely difficult.

6.3.4 Evergreen Point Road Lid

The HCT line has been assumed to travel under the EPR lid per the HCT definition discussed earlier in this report. There are two options to accommodate the HCT line under the lid as noted below.

6.3.4.1 Option A

This option assumes that the EPR BRT station could be displaced. In this option, the HCT envelope is assumed to fit within the footprint of the BRT station proposed under the Evergreen Point lid, so no additional ROW would be required and the lid would not have to be widened for HCT.

The lid will have to be designed carefully to ensure no conflicts between support walls/columns and the future HCT line. A construction staging area for the HCT line under the EPR lid would be very limited and could require some highway travel lane closures.

6.3.4.2 Option B

The second option for the EPR lid assumes that the BRT station cannot be displaced when the future HCT line is constructed. In this option, the HCT envelope must be provided in the middle of the BRT station (i.e., the footprint of the BRT station must be wider to allow the HCT line to pass between the two BRT platforms and bus bypass lanes).

Such a configuration would require initial construction of a wider (possibly 30 to 40 feet) EPR lid. A construction staging area for the HCT line under the Evergreen Point lid would be very limited and could require some BRT station and/or highway travel lane closures.

6.3.5 East of Evergreen Point Road Lid

For purposes of this discussion, the remainder of the HCT corridor is described; however, Scenario 2 would not include any changes to proposed highway structures east of EPR.

Just east of the EPR lid (and traveling east), it is assumed that the HCT line would transition as quickly as possible out of the highway ROW. The distance required for the HCT to transition out of the roadway to the north side of SR 520 is approximately 1,600 feet. This would require a full-width HCT footprint for about 1,000 feet, after which the footprint could narrow to accommodate columns and other support structures.

The additional width in the highway median for HCT would be developed at the time of construction and would require additional ROW acquisition on either side of SR 520. It would also require reconstruction of the highway mainline and possible reconstruction of retaining walls. It will be important to choose an initial highway alignment design that minimizes/balances the ultimate combined impacts of both the Trans-Lake Washington Project and the HCT line project between the EPR lid and 84th Avenue NE.

Once the HCT line has transitioned to the north side of SR 520, it would continue east along the edge of the highway and under the 84th Avenue NE lid through a cut-and-cover structure that goes under the westbound loop ramp. No accommodation for the HCT line would be made at the 84th Avenue NE lid. The cut-and-cover tunnel under the westbound loop ramp would not be part of the initial highway construction and would be deferred until construction of the HCT improvements.

The HCT line would continue to the proposed Points Community HCT station located in the northeast quadrant of the 84th Avenue NE interchange.

That portion of the HCT station footprint outside of the future highway ROW would not be acquired at the time of highway construction. If this scenario is chosen, further HCT planning and design work would be necessary to confirm the location of the Points Community HCT station and the size of the footprint before finalizing the ROW requirements and lid design at 84th Avenue.

East of 84th Avenue NE, the HCT line is expected to be outside of the SR 520 ROW, passing adjacent to the 92nd Avenue NE lid. East of 92nd Avenue NE (heading in an easterly direction), the HCT line will continue to follow the north side of SR 520, eventually turning north to serve the proposed South Kirkland park-and-ride HCT station. The additional ROW required for HCT would not be acquired under this scenario.

The proposed SR 520 bicycle/pedestrian path and the Points Loop Trail between EPR and 92nd Avenue NE may have to be reconstructed in several locations at the time of HCT construction.

6.3.6 Vicinity of I-405

The HCT alignment would follow the BNSF rail alignment from the vicinity of the South Kirkland park-and-ride lot through the I-405 interchange. A transit transfer station would be located on the east side of the I-405 interchange. The HCT alignment would continue through a 1,200-foot cut-and-cover structure to reach the HCT alignment east of 124th, where it would join the future I-90 light rail alignment between Bellevue and Redmond on the south side of SR 520.

In Scenario 2, the cut-and-cover tunnel would not be constructed as part of the initial highway project. The undercrossing could cause major traffic disruptions during construction of the HCT line.

6.4 SCENARIO 3: HCT ACCOMMODATION ON ENTIRE LAKE CROSSING AND AT KEY STRUCTURES

Scenario 3 is similar to Scenario 2; however, it includes making additional accommodation adjustments to key structures east of the Evergreen Point lid. The accommodation of HCT is integral to the roadway design in this scenario of the Trans-Lake Washington Project. A summary of the implications of Scenario 3 are included in Table 6-3; a schematic of this scenario is shown in Appendix C.

Table 6-3. Scenario 3 - HCT Accommodation on Entire Lake Crossing and at Key Structures

	Montlake to 124th	124th to Redmond
Environmental Documentation Implications	**Trans-Lake:** • Wider pontoons and structural improvements to the approaches should not complicate EIS • EIS documentation in vicinity of EPR may be difficult for EPR lid Option B • EPR lid (Option B) will likely incur added 4F impacts • Cut-and-cover tunnel under westbound loop ramp at 84th Avenue NE will require stormwater treatment facility in current conceptual design to be vaulted within the roadway prism or to be constructed in an alternate location • Other structural modifications such as cut-and-cover structure east of I-405 will not complicate the EIS	**Trans-Lake:** • Minimal implications to Trans-Lake EIS
	Future HCT: • The future EIS will need to cover all HCT planned improvements not provided for by the initial highway project	**Future HCT:** • The future EIS will need to cover all HCT planned improvements not provided for by the initial highway project
ROW Implications	**Trans-Lake:** • Will have to acquire additional ROW in vicinity of EPR lid for Option B. This may be difficult due to NEPA requirements • Additional ROW is likely required if stormwater treatment facility is relocated	**Trans-Lake:** • No effect on this part of the project
	Future HCT: • Except for EPR lid vicinity and possibly stormwater treatment facility, all ROW needed for HCT will be acquired at a future time	**Future HCT:** • All ROW needed for HCT will need to be acquired at a future time
Roadway Design Implications for Trans-Lake Washington Project	**Trans-Lake:** • Floating bridge pontoons and substructure will be designed to support roadway deck plus a deck for future HCT that could be built at a later time • Approach span structures will be designed to facilitate building HCT superstructure without major rebuilding of structures • EPR lid Option A will take some preliminary design work to ensure that there are no conflicts with adding HCT in the future • EPR lid Option B will require that the lid be designed wide enough for future HCT • Cut-and-cover tunnel in vicinity of 84th Avenue NE westbound on-ramp will need to be designed and constructed • 84th Ave NE lid will need to be designed so it can be widened in the future by adding another span to the north • 92nd Ave NE lid will need to be designed so it can be widened in the future by adding another span to the north • I-405 interchange will be designed to allow room for HCT transfer station • Cut-and-cover tunnel east of I-405 will need to be designed and constructed • Floating bridge superstructure and deck for HCT designed in future • Widening of transition spans for HCT done in future • All other HCT improvements done in future	**Trans-Lake:** • If the 8-lane alternative is chosen as the preferred alternative, investigation should be done to see if overall savings can be realized by constructing the cut-and-cover tunnel north of the Overlake transit center during the construction of the braided ramps at NE 51st Street • Conceptual design of the HCT alignment should be done in the vicinity of Union Hill road to ensure roadway design does not preclude HCT

	Montlake to 124th	124th to Redmond
Design Flexibility for HCT	**Future HCT:** • Moderate flexibility because the floating bridge, approach structures, EPR lid, and cut-and-cover tunnel at 84th Avenue NE are fixed. Cut-and-cover tunnel east of I-405 also has fixed location • Some risk of throw-away costs with these investments if different alignments are chosen in the future	**Future HCT:** • High flexibility for future HCT
Ease of Implementation of Future HCT in SR 520 Corridor	**Future HCT:** Moderately difficult to implement due to following elements of work: • Superstructure and deck for HCT will be added to the floating bridge • Columns, superstructure, and decking will need to be added to the approach structures for HCT • 84th Avenue NE and 92nd Avenue NE lids will need to be widened by adding spans to the north • Roadway and possible retaining walls between EPL and 84th Avenue NE will have to be reconstructed	**Future HCT:** • Selection of future HCT alignment in this area remains flexible • Potential cost throw-away of cut-and-cover undercrossing just east of I-405 interchange
Cost Implications	**Trans-Lake:** • $203 million – see Chapter 7 for cost elements	**Trans-Lake:** • No added cost
	Future HCT: • $411 million – see Chapter 7 for cost elements	**Future HCT:** • $147 million – see Chapter 7 for cost elements

6.4.1 Floating Bridge

As in Scenario 2, the design and construction of the floating bridge pontoons and substructure would be modified at the time of the initial highway construction to support a future HCT line across the lake. The initial floating bridge deck lane configuration would be the same as for Scenario 2.

6.4.2 West Side Floating Bridge Approaches

On the west side of the lake, the HCT envelope would be as described for Scenario 2. However, the difference between this scenario and Scenario 2 is that the approaches would be constructed in their ultimate "spread" location and the structural elements would be designed so the HCT superstructure could be added at a later time without requiring reconstruction of the roadway or approach support structures.

6.4.3 East Side Floating Bridge Approaches

As with Scenario 2, the east approach structure for the roadway would be constructed in the "spread" position, and would be modified over its entire length to eventually accommodate HCT in the center. The difference between this scenario and Scenario 2 is the design modifications for the east approach structure would be implemented as part of the initial highway project. The structural elements would be designed so the HCT superstructure could be added at a later time and no future reconstruction of the roadway or support structures would be required.

6.4.4 Evergreen Point Road Lid

On the east side of the lake, the HCT line is assumed to remain in the highway median and pass under the EPR lid. As with Scenario 2, there are two options to accommodate HCT under the EPR lid.

The first option assumes that displacing the BRT station is feasible (this option does not require a wider lid, but would require careful lid design to ensure no future conflicts with HCT would arise). The second option would place the HCT line in the middle of the BRT station (which would require a wider lid design and ROW acquisition of approximately 30 to 40 feet). With the second option, the initial highway construction would take the wider lid into account.

6.4.5 East of Evergreen Point Road Lid

East of the EPR lid, it is assumed that the HCT envelope would transition out of the highway median and ROW and continue as described in the definition of the HCT alignment.

As noted for Scenario 2, there are significant space requirements for the HCT to transition from the center to the outside of the highway. The acquisition of additional ROW and reconstruction of the highway mainline to achieve an adequate transition length would occur at the time of HCT implementation.

Once the HCT line has transitioned to the north side of SR 520, it would continue east along the edge of the highway and under the 84th Avenue NE lid. The lid at 84th Avenue NE would be built under the Trans-Lake Washington Project without the extra width; however, the lid would be designed and constructed such that adding another span farther north could be accommodated. The cut-and-cover tunnel under the northbound-to-westbound loop ramp would be part of the initial highway construction.

The Points Community HCT station is assumed to be outside the 84th Avenue NE lid in the northeast quadrant of the interchange. That portion of the HCT station footprint outside of the future highway ROW would not be acquired at the time of the highway construction. If this scenario is chosen, further HCT planning and design work should be pursued to confirm the location of the Points Community HCT station and the size of the footprint before finalizing the ROW requirements and the lid design at 84th Avenue.

Under Scenario 3, a stormwater treatment facility planned (conceptually) in the northeast quadrant of the interchange for the initial highway project would need to be constructed in the roadway prism as a vault system or as treatment ponds in another location that would require additional ROW elsewhere.

Continuing east from the 84th Avenue station, it is assumed that the HCT envelope would continue on the north side of SR 520 and pass under the 92nd Avenue NE lid on the north side of the travel lanes. This location is preferred over the highway median location because it avoids displacing the BRT station at 92nd Avenue NE. This location also avoids future highway mainline reconstruction for the transition of the HCT back to the north side of SR 520.

The 92nd Avenue NE lid structure would not initially be built with an HCT envelope, but the lid would be designed and constructed such that adding another span farther north could be accommodated.

East of 92nd Avenue NE, it is assumed the HCT alignment would be on the north side of SR 520 and, at some point, the alignment would diverge from the highway corridor to access the South Kirkland park-and-ride. Therefore, east of the 92nd Avenue NE lid, no design modifications or ROW changes would be necessary to accommodate HCT in this scenario.

HCT construction staging space under the EPR and the 92nd Avenue NE lids would probably be very limited and could require some highway travel lane closures. Also, the proposed SR 520 bicycle/pedestrian path and the Points Loop Trail between EPR and 124th Avenue NE may have to be reconstructed in several locations at the time of HCT construction.

6.4.6 Vicinity of I-405

The HCT alignment in the vicinity of I-405 is the same as described for Scenario 2.

The interchange itself would have to be carefully designed and constructed to ensure no future conflicts would arise between the HCT station and the HCT line that passes through the interchange.

The shallow 1,200-foot-long cut-and-cover tunnel undercrossing of SR 520 would be constructed as part of the initial highway project to avoid major traffic disruption during construction of the HCT line.

6.4.7 NE 124th to Redmond

Although the definition of Scenario 3 includes accommodation of HCT in the design and construction of major structures, it is not clear what the implications are for the cut-and-cover tunnel in the vicinity of NE 51st Street.

The 6-lane alternative will not be constructing roadway improvements in this area so the construction of the tunnel becomes more of a "build it now" or "build it later" question.

Further investigation of the possible construction of the cut-and-cover tunnel would be necessary if the 8-lane alternative were chosen because that alternative includes rebuilding portions of the NE 40th Street and NE 51st Street interchanges. Investigating the staging of the cut-and-cover HCT tunnel at the same time as the ramps in the vicinity of NE 51st should be considered.

Another accommodation issue would include preliminary conceptual design work for the HCT crossing at the intersection at SR 520/NE Union Hill Road. Roadway design would ensure the HCT line crossing SR 520 would not be precluded.

6.5 SCENARIO 4: HCT ENVELOPE PRESERVATION ON FULL CORRIDOR

Scenario 4 would go the furthest to provide for future HCT development. In this scenario, the initial highway project would be constructed to allow a full HCT envelope between Montlake Boulevard in Seattle and the Redmond terminus, where it is within the SR 520 corridor as described the HCT alignment definition.

The intent of Scenario 4 is to provide for highway travel lanes that would be constructed in their ultimate location so the floating bridge, the approach spans, the lids, and the SR 520 roadway would not need to be reconstructed when HCT is implemented in the future.

All ROW for the future HCT line, when it is located within or adjacent to SR 520, would be acquired at the time of the highway project, including the ROW for the Points Community HCT station.

Scenario 4 requires that the highway design and HCT envelope design are closely coordinated to optimize both alignments concurrently and to minimize overall impacts for the combined projects. This scenario requires significantly more planning and design work to better define the HCT alignment and station locations.

A summary of the implications of Scenario 4 are included in Table 6-4; a schematic of this scenario is shown in Appendix D.

6.5.1 Floating Bridge

The floating bridge would be constructed as part of the Trans Lake Washington Project with pontoons, substructure, and deck ready to support a future HCT line with no further structural improvements. No future widening or reconstruction of any portion of the floating bridge would be required at the time of HCT implementation.

6.5.2 West Side Floating Bridge Approaches

6.5.2.1 Option A

On the west side of the lake, it is assumed that the HCT envelope would remain in the highway median west of the floating bridge. This would require design modifications to the west approach structure, the ramps to Lake Washington Boulevard, and possibly the mainline highway footprint as part of the initial highway project. Just east of the proposed Montlake lid, the HCT line would descend into a tunnel configuration within the highway median. This tunnel would either turn northward to serve the University District or southward to downtown Seattle. In this option, the Montlake BRT station under the Montlake lid would be displaced.

Table 6-4. HCT Envelope Preservation on Full Corridor

	Montlake to 124th	124th to Redmond
Environmental Documentation Implications	**Trans-Lake:** • Trans-Lake EIS will address roadway and HCT alignment in one document. This may present complications, so FHWA, FTA staff, and legal council should be consulted regarding restrictions and nuances of the NEPA process • Environmental document would likely need to address HCT alignment alternatives and cumulative impacts of both projects	**Trans-Lake:** • Trans-Lake EIS will address roadway and HCT alignment in one document. This may present complications, so FHWA, FTA staff, and legal council should be consulted regarding restrictions and nuances of the NEPA process • Environmental document would likely need to address HCT alignment alternatives and cumulative impacts of both projects
	Future HCT • Will need to deal with environmental documentation for trackage and operations issues only	**Future HCT** • Will need to deal with environmental documentation for trackage and operations issues only
ROW Implications	**Trans-Lake:** • Trans-Lake project will acquire all corridor ROW; this may include 4F ROW	**Trans-Lake:** • Trans-Lake project will acquire all corridor ROW
	• **Future HCT** • SR 520 ROW will have been acquired • All ROW needed for HCT outside the SR 520 corridor will need to be acquired at a future time	• **Future HCT** • SR 520 ROW will have been acquired • All ROW needed for HCT outside the SR 520 corridor will need to be acquired at a future time
Roadway Design Implications for Trans-Lake Washington Project/	**Trans-Lake:** • Entire roadway and HCT corridor will need to be designed as an integrated system	**Trans-Lake:** • Entire roadway and HCT corridor will need to be designed as an integrated system
Design Flexibility for Future HCT	**Future HCT** • Low Flexibility • This scenario will not allow flexibility since there will have been a signification investment in the SR 520 corridor that would become throwaway	**Future HCT** • Low Flexibility • This scenario will not allow flexibility since there will have been a signification investment in the SR 520 corridor that would become throwaway
Ease of Implementation of Future HCT in SR 520 Corridor	**Future HCT** • This scenario is optimal for future HCT	**Future HCT** • This scenario is optimal for future HCT
Cost Implications	**Trans-Lake:** • $601 million – see Chapter 7	**Trans-Lake:** • $147 million – see Chapter 7
	Future HCT • No added cost related to moving the roadway, buying ROW, or major structural modifications • Future HCT will still have costs associated with some retaining wall trackbed and other HCT systems.	**Future HCT** • No added cost related to moving the roadway, buying ROW, or major structural modifications • Future HCT will still have costs associated with some retaining wall trackbed and other HCT systems.

6.5.2.2 Option B

To avoid displacement of the Montlake BRT station, transition from cut-and-cover to a bored tunnel configuration would have to occur east of Montlake Boulevard to allow the HCT alignment to descend below the BRT station with adequate clearance. Option B is only feasible if there is no highway tunnel connection from SR 520 to the Pacific/Montlake intersection.

6.5.2.3 Option C

If avoiding displacement of the Montlake BRT station as described under Option B above were not feasible, the footprint of the highway ROW and lid through Montlake would have to be significantly widened to accommodate both a BRT station and a tunnel portal under Montlake Boulevard.

6.5.3 East Side Floating Bridge Approaches

The difference between this scenario and Scenario 3 is the design modifications for the east approach structure would be implemented as part of the initial highway project, such that no future reconstruction would be required.

6.5.4 Evergreen Point Road Lid

On the east side of the lake, the HCT alignment is assumed to be located under EPR lid. As with Scenarios 2 and 3, there are two options for placement of the HCT envelope; the choice of option will depend on whether displacement of the Evergreen Point BRT station is feasible. An option will need to be chosen and implemented as a part of the initial construction of the highway.

6.5.5 East of Evergreen Point Road Lid

East of the EPR lid between EPR and 84th Avenue, the HCT alignment would be the same as that described for Scenario 3. The difference between this scenario and Scenario 3 is initial highway design, construction, and acquisition would take into account later HCT construction so that future highway reconstruction or acquisition would not be necessary. This would require that the lid at 84th Avenue NE be built to full width to accommodate HCT. It would also require construction of the cut-and-cover structure at the westbound loop ramp and the retaining walls for the Points Community HCT station.

Another key difference between this scenario and Scenario 3 is that all ROW required to accommodate a future HCT line (whether parallel to or in the SR 520 envelope) would be acquired at the same time as the highway ROW acquisition. This would require 30 to 40 feet more ROW than Scenario 1.

To achieve this scenario, the location and footprint of the Points Community HCT station at 84th Avenue NE would have to be well defined at the time of highway design and construction.

Similar to Scenario 3, the stormwater treatment facility proposed in the northeast quadrant of the interchange would be located in vaults within the roadway prism or constructed elsewhere as treatment ponds that require additional ROW.

The 92nd Avenue NE lid would be designed to provide a full, clear HCT envelope under the lid. This could be accommodated in one of three ways:

1. The future HCT line could displace the BRT station (this would not require a wider lid and ROW at 92nd Avenue NE, but would require a wider highway median to transition in/out of the lid for considerable lengths both east and west of 92nd Avenue NE); or
2. The future HCT line could be located in the middle of the BRT station (this would require a wider lid and a wider highway median for a considerable distance to transition in/out of the lid); or
3. The future HCT line could be located directly adjacent to the westbound highway travel lanes. In this option, the BRT station could remain (which would require a wider lid but not a wider highway median), or the BRT station could be displaced by the westbound highway lanes shifting southward under the lid to accommodate HCT without widening the lid.

Because of its reduced impact on the initial highway design, the third option is the most feasible. For costing purposes, this option (without displacement of the BRT station) has been assumed for Scenario 4.

East of the 92nd Avenue NE lid, the HCT line would continue eastward on the north side of SR 520 parallel to the highway lanes. The HCT alignment would continue in this location to a point just west of Lake Washington Boulevard, where the HCT alignment would diverge to serve the South Kirkland park-and-ride. ROW for this length of the HCT envelope would be acquired at the same time as the highway ROW acquisition. The initial highway design and acquisition should minimize overall impacts of the combined project. This would require a significant HCT design effort as part of the highway design work.

The proposed SR 520 bicycle/pedestrian path and the Points Loop Trail between EPR and 124th Avenue NE would be reconstructed in its final location for significant portions of its length.

6.5.6 Vicinity of I-405

The HCT alignment in the vicinity of I-405 is the same as described in Scenario 2.

In Scenario 4, the interchange and the HCT envelope (including the cut and cover tunnel) will be designed and constructed as an integrated package.

East of the undercrossing, all ROW necessary to construct the HCT line on the south side of SR 520 between I-405 and 124th Avenue NE would be acquired as part of the initial highway acquisition.

6.5.7 NE 124th to Redmond

The alignment and design/construction modifications at the two crossing locations (as described above for Scenario 3) would be part of Scenario 4. Property acquisition for the HCT alignment where it parallels the highway ROW would be part of the initial highway project.

7. COST EVALUATION AND IMPLICATIONS

There are several methods that can be used to compare alternative costs. The methods include:

- Present Value Analysis – This allows a simple comparison of alternative expenditures without the concern for interest rate, revenue, or time in which expenditures, revenues, and benefits occur.
- Year of Expenditure Analysis – This method is often used when evaluating revenues and expenditures to assure project cash flow is adequate and to cause less confusion to legislative bodies and the press about the total expenditures for public projects.

Because this paper is attempting to address the overall question of the level of investment—near future vs. distant future—the present value approach provides a simple analysis tool. There has been no effort to quantify benefits of an investment or to quantify benefit/cost for the scenarios.

7.1 ELEMENTS CONSIDERED IN COST ESTIMATE

Table 7-1 outlines the elements considered in developing costs for initial highway construction that provide the level of accommodation as provided in the scenario definition.

Table 7-2 outlines the elements considered in developing future HCT costs.

Table 7-1. General Assumption for Developing Cost for HCT During Initial Highway Construction

Scenario 1: No HCT Accommodation (Baseline Scenario)	Scenario 2: HCT Accommodation on Floating Bridge	Scenario 3: HCT Accommodation on Entire Lake Crossing and at Key Structures	Scenario 4: HCT Envelope for Full Corridor
HCT Corridor • No Accommodations	Floating Bridge • Install floating bridge substructure	Floating Bridge • Install floating bridge substructure	Floating Bridge • Install substructure and superstructure
	Approach Structures • Assume future widening • Design the UB-1b & UB-2 stormwater facilities to accommodate future HCT	Approach Structures • Leave gap in approaches for future structure • Design the UB-1b & UB-2 stormwater facilities to accommodate future HCT	Approach Structures • Build HCT approach structures • Design the UB-1b & UB-2 stormwater facilities to accommodate future HCT
	Evergreen Point Road • Option A (Design Issue No Cost) • Option B - widening lid structure for future HCT	Evergreen Point Road • Option A (Design Issue No Cost) • Option B - widening lid structure for future HCT	Evergreen Point Road • Option A (Design Issue No Cost) • Option B - widening lid structure for future HCT
	84th Avenue • No design accommodation	84th Avenue • Design lid to accommodate expansion • Build cut-and-cover structure at ramp • Build stormwater detention for FB-1 in vaults outside of expansion area • Assume that stormwater vault CC-1 will be designed to accommodate HCT	84th Avenue • Build lid expansion • Build cut-and-cover structure at ramp • Build stormwater detention for FB-1 in vaults outside of expansion area • Assume that stormwater vault CC-1 will be designed to accommodate HCT • Buy ROW for transition from south to north side from Evergreen Point to 84th
	92nd Avenue • No design accommodation	92nd Avenue • Design lid to accommodate expansion	92nd Avenue • Build lid expansion

Scenario 1: No HCT Accommodation (Baseline Scenario)	Scenario 2: HCT Accommodation on Floating Bridge	Scenario 3: HCT Accommodation on Entire Lake Crossing and at Key Structures	Scenario 4: HCT Envelope for Full Corridor
	I-405 • No accommodation	I-405 • Build 1,200-foot cut-and-cover under SR 520 • Assume that stormwater vault GC-1 will be designed to accommodate HCT	I-405 • Build 1200-foot cut-and-cover under SR 520 • Assume that stormwater vault GC-1 will be designed to accommodate HCT
	51st • No accommodation	51st • For 6 lanes no accommodation • For 8 lanes build cut-and-cover under SR 520	51st • Build cut-and-cover under SR 520
	Redmond • No accommodation	Redmond • Design for future HCT	Redmond • Design for future HCT
	ROW • Purchase ROW only where necessary for accommodations listed above	ROW • Purchase ROW only where necessary for accommodations listed above	ROW • Buy all ROW in SR 520 corridor for HCT route

Table 7-2. General Assumptions for Developing Future HCT Costs

Scenario 1: No HCT Accommodation (Baseline Scenario)	Scenario 2: HCT Accommodation on Floating Bridge	Scenario 3: HCT Accommodation on Entire Lake Crossing and at Key Structures	Scenario 4: HCT Envelope for Full Corridor
Floating Bridge • Assume floating bridge is expandable • Assume that the stormwater vault GC-1 does not have to be adjusted for the HCT corridor	Floating Bridge • Build superstructure for floating bridge	Floating Bridge • Build superstructure for floating bridge	HCT Corridor • No work
Approach Structures • Assume approach structures can be widened • The south highway alignment will be held for all options so UB-1b & UB-2 stormwater facility does not need to be adjusted	Approach Structures • Widen approach structures	Approach Structures • Build approach structure	
Evergreen Point Lid • Option B - widen nonaccommodated lid structure	Evergreen Point Lid • Option B - widen nonaccommodated lid structure	Evergreen Point Lid • No work	
84th Avenue • Widen nonaccommodated lid structure • Build cut-and-cover structure at ramp • Build new stormwater detention for FB-1 in vaults outside of expansion area • Assume that the CC-1 stormwater vaults do not have to be adjusted for the HCT corridor	84th Avenue • Widen nonaccommodated lid structure • Build cut-and-cover structure at ramp • Build new stormwater detention for FB-1 in vaults outside of expansion area • Assume that the CC-1 stormwater vaults do not have to be adjusted for the HCT corridor	84th Avenue • Widen lid structure • Buy ROW for transition from south to north side from Evergreen Point to 84th	
92nd Avenue • Widen nonaccommodated lid structure	92nd Avenue • Widen nonaccommodated lid structure	92nd Avenue • Widen lid structure	

Scenario 1: No HCT Accommodation (Baseline Scenario)	Scenario 2: HCT Accommodation on Floating Bridge	Scenario 3: HCT Accommodation on Entire Lake Crossing and at Key Structures	Scenario 4: HCT Envelope for Full Corridor
I-405 • Build 1200-foot cut-and-cover under SR 520	I-405 • Build 1,200-foot cut-and-cover under SR 520 • Assume that the GC-1 stormwater vault does not have to be adjusted for the HCT corridor	I-405 • No work	
51st • Build cut-and-cover under SR 520	51st • Build cut-and-cover under SR 520	51st • Build cut and cover under 6-lane alternative • No work for 8-lane alternative	
Redmond • Assume HCT can fit in Redmond interchange design	Redmond • No work	Redmond • No work	
Right of Way • Buy all ROW in SR 520 corridor for HCT route	Right of Way • Buy all ROW in SR 520 corridor for HCT route not previously purchased	Right of Way • Buy all ROW in SR 520 corridor for HCT route not previously purchased	

7.2 COST DEVELOPMENT METHODOLOGY

Construction costs include the costs incurred to accommodate HCT in the SR 520 corridor as part of the initial highway construction. These costs include bridge modifications, tunnels, lids, reconstruction of the highway when necessary, traffic control, staging, and construction administration. These costs are calculated using the cost methodology submitted and approved by the CEVP team in April 2002.

The cost opinion does not include the future implementation cost of the HCT system including such items as the guideway, power/electrical system, vehicles, stations, or maintenance bases. It also excludes Sound Transit agency costs.

Preliminary design costs are calculated as a percentage of the construction costs. If a structure needs to be modified during initial construction to allow for future HCT, the preliminary engineering is brought forward to reflect a complete design.

The environmental documentation costs are taken at 30 percent of the construction costs for the EIS.

ROW costs are calculated on a square footage basis. At this level of analysis, individual parcels and their values have not been identified.

Because of the preliminary nature of this estimate, final project costs will vary from those shown. Final costs will depend on actual costs for labor, construction equipment, disposal, and materials, as well as surface and subsurface conditions, regulatory constraints and approach to corridor mitigation, labor productivity, competitive market conditions, final project scope, schedule, and other factors. The cost opinions developed are not sufficiently accurate to support the development of program budgets.

7.3 COST IMPLICATIONS

Table 7-3 presents a cost summary; Appendix E provides backup spreadsheet information. As the levels of accommodation increase, overall costs decrease. The largest decrease in overall costs occurs by moving from Scenario 1 to Scenario 2, which is mainly attributable to minimized structural throwaway costs.

Table 7-3. Cost Summary
($2002)

Scenario Description		Env Doc/Design Costs		ROW Costs		Construction		Subtotal		Subotals
		Montlake to 124th	124th to Redmond	Montlake to 124th	124th to Redmond	Montlake to 124th	124th to Redmond	Montlake to 124th	124th to Redmond	
Scenario 1: No HCT Accomodation	Translake	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Future HCT	$355	$36	$60	$48	$630	$53	$1,045	$147	$1,192
Scenario 2: Accomodation on Floating Bridge	Translake	$30	$0	$2	$0	$84	$0	$116	$0	$116
	Future HCT	$215	$36	$58	$48	$298	$63	$571	$147	$718
Scenario 3: HCT Accomodation on Entire Lake Crossing and at Key Structures	Translake	$52	$0	$2	$0	$136	$0	$190	$0	$190
	Future HCT	$162	$35	$58	$48	$206	$58	$426	$141	$567
Scenario 4: HCT Envelope Preservation	Translake	$210	$35	$60	$48	$332	$58	$602	$141	$743
	Future HCT	$0	$0	$0	$0	$0	$0	$0	$0	$0

Note: Costs are in million dollars.

8. INVESTMENT TIMEFRAME IMPLICATIONS

Although cost benefits and the time value of project expenditures have not been quantified, policy makers must deal with the issue of benefits with respect to time and uncertainty as they relate to HCT in the SR 520 corridor.

Implementation of HCT in the entire SR 520 corridor is not anticipated within the next 20 years or even longer. This has a major implication because the benefit/cost of project expenditures would be lowered substantially considering the time value of the investment. Decision makers will need to compare the transportation benefits of this investment with other investments (expenditures) that could be made.

Another implication is making an investment in a facility that may be halfway through its service life when the benefits are finally realized. For instance, if the service life of the new Trans-Lake facility is 75 years and the benefit cannot be realized until half way through its service life, the effective benefit is reduced (because the benefit can only be realized over a limited time frame) and would need to be compared to making another investment.

Making an investment in the near term for benefits that will be realized in the future also must take future uncertainties into consideration. HCT technology may change and land use and commuting patterns may change. These uncertainties create a risk that the accommodation investments will not be compatible with future HCT implementation and that the expected value of the investment options is reduced. This risk factor must be included in the decision-making process.

9. LEGAL/PROCEDURAL ISSUES

Decision makers must have a clear understanding of several related issues before making decisions on the accommodation/preservation issue.

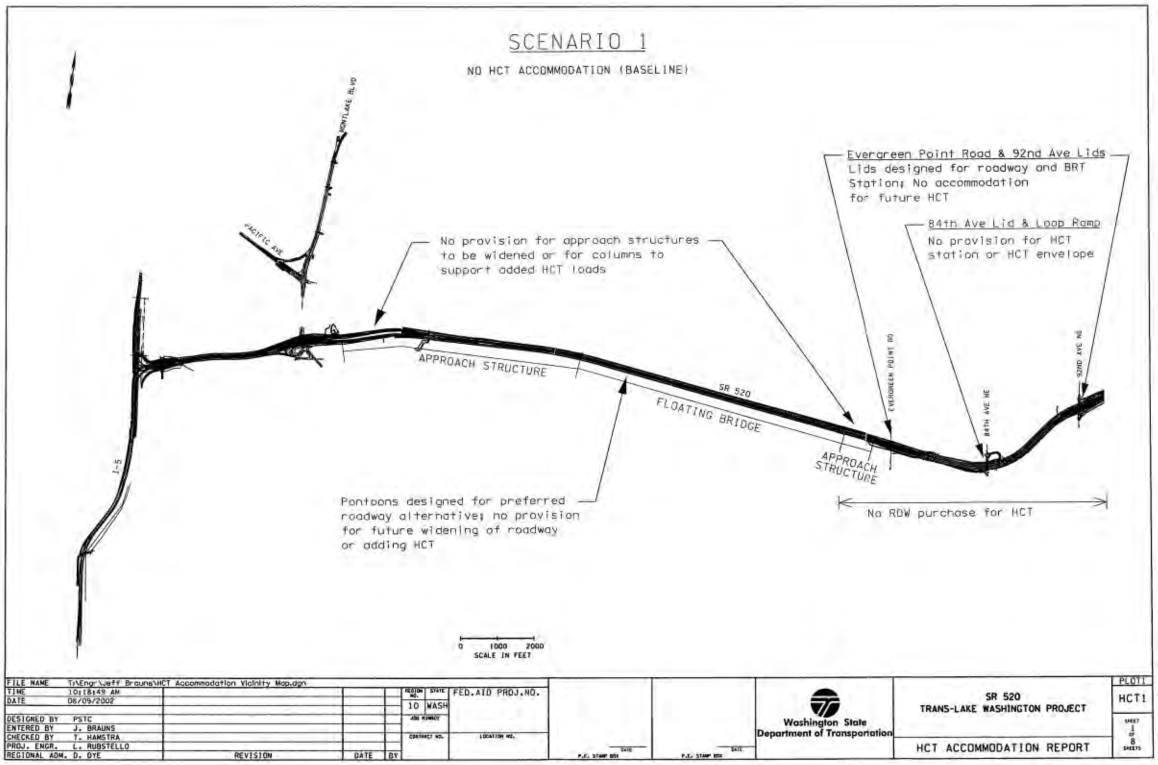
9.1 NATIONAL ENVIRONMENTAL POLICY ACT

Decision makers must understand the limits and nuances of what must and must not be included in a National Environmental Policy Act (NEPA) EIS because specific legal requirements must be met. An issue like this comes within the decision-making jurisdiction of FHWA and FTA, so both of these agencies should be consulted.

9.2 RIGHT OF WAY ACQUISITION

ROW acquisition through the use of eminent domain proceedings usually relies on a project being identified in a transportation plan or having a record of decision as the basis for demonstrating the public use and necessity requirement. This is the first step in condemnation proceedings. Decision makers must understand the limits and exceptions to this process. Legal counsel needs to be sought on whether ROW can be acquired for a speculative project for which no planning or environmental documentation has been done.

Appendix A – Schematic of Scenario 1


SCENARIO 1
NO HCT ACCOMMODATION (BASELINE)
MONTLAKE BLVD
PACIFIC AVE
No provision for approach structures to be widened or for columns to support added HCT loads
Evergreen Point Road & 92nd Ave Lids
Lids designed for roadway and BRT Station; No accommodation for future HCT
84th Ave Lid & Loop Ramp
No provision for HCT station or HCT envelope
APPROACH STRUCTURE
SR 520
FLOATING BRIDGE
APPROACH STRUCTURE
EVERGREEN POINT RD
84TH AVE NE
92ND AVE NE
I-5
Pontoons designed for preferred roadway alternative; no provision for future widening of roadway or adding HCT
No ROW purchase for HCT
0 1000 2000
SCALE IN FEET
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TIME 10:18:49 AM
DATE 08/09/2002
DESIGNED BY PSTC
ENTERED BY J. BRAUNS
CHECKED BY T. HAMSTRA
PROJ. ENGR. L. RUBSTELLO
REGIONAL ADM. D. DYE
REVISION
DATE
BY
10 WASH
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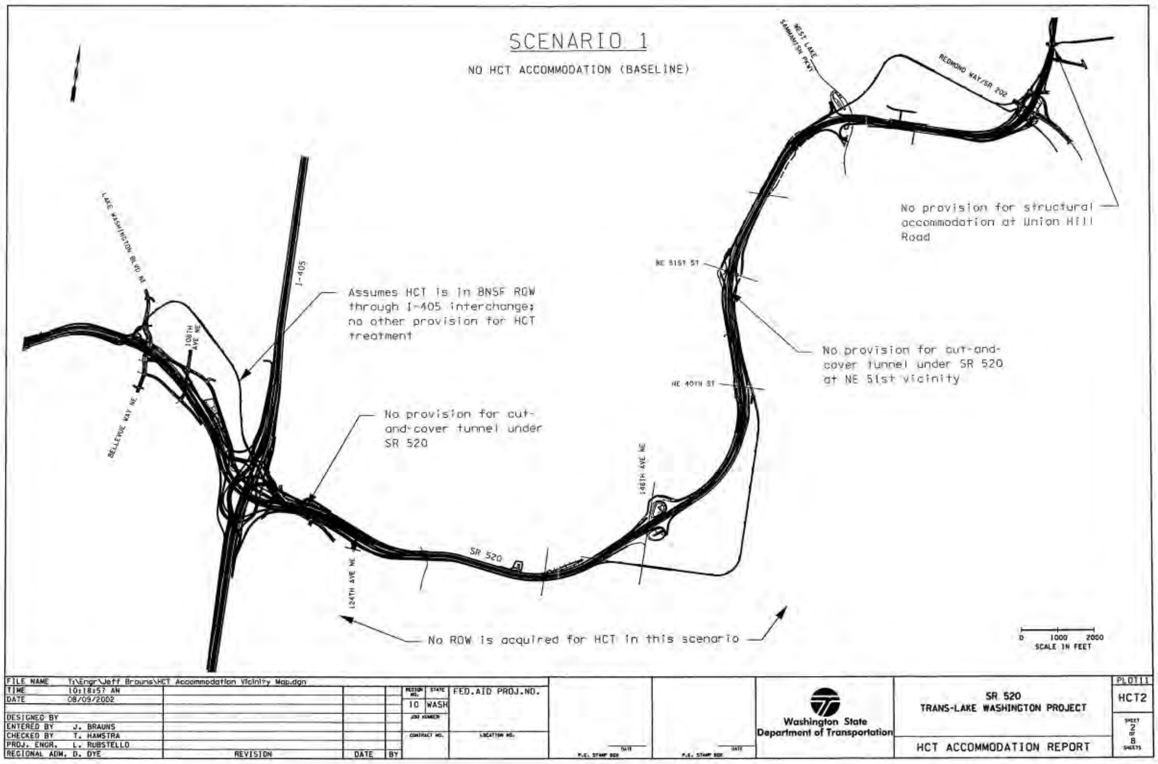
Washington State Department of Transportation
SR 520
TRANS-LAKE WASHINGTON PROJECT
HCT ACCOMMODATION REPORT
PLOT1
HCT1
SHEET 1 OF 8 SHEETS


SCENARIO 1
NO HCT ACCOMMODATION (BASELINE)
Assumes HCT is in BNSF ROW through I-405 interchange; no other provision for HCT treatment
No provision for cut-and-cover tunnel under SR 520
No provision for cut-and-cover tunnel under SR 520 at NE 51st vicinity
No provision for structural accommodation at Union Hill Road
No ROW is acquired for HCT in this scenario
I-405
SR 520
124TH AVE NE
148TH AVE NE
NE 40TH ST
NE 51ST ST
BELLEVUE WAY NE
LAKE WASHINGTON BLVD NE
108TH AVE NE
WEST LAKE SAMMAMISH PKWY
REDMOND WAY/SR 202
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DATE 08/09/2002
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PROJ. ENGR. L. RUBSTELLO
REGIONAL ADM. D. DYE
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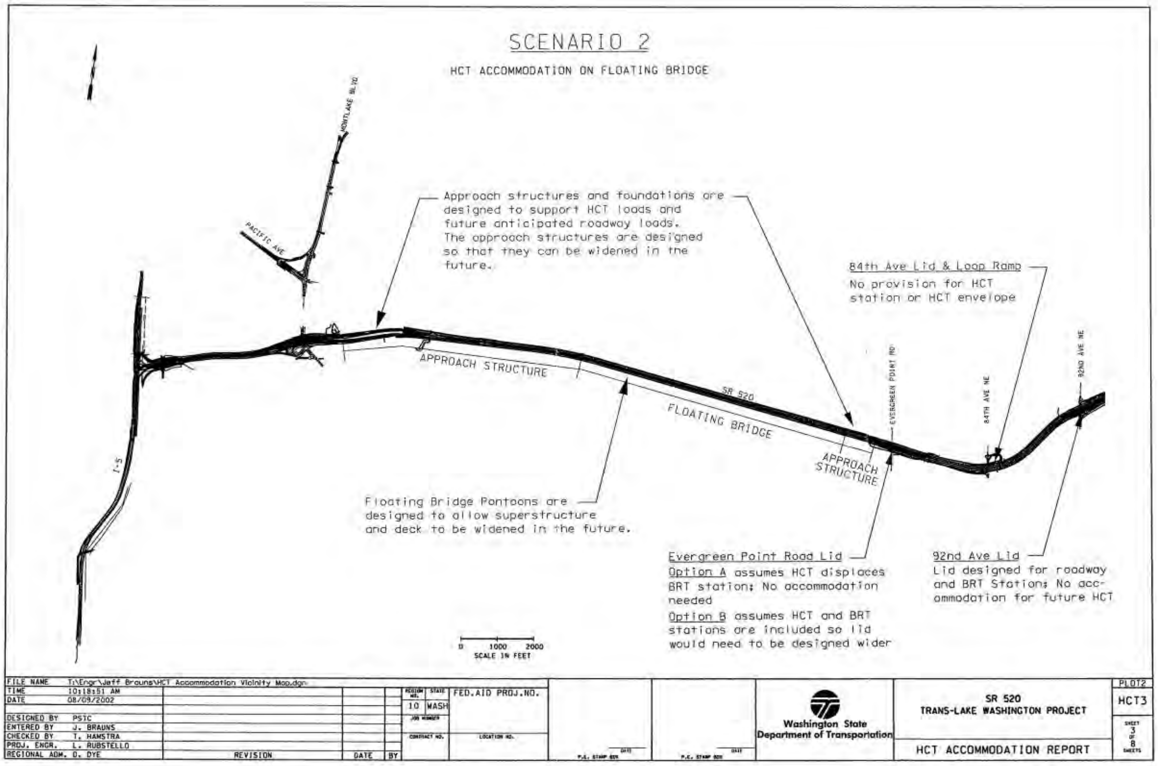
HCT ACCOMMODATION REPORT
PLOT11
HCT2
SHEET 2 OF 8 SHEETS

Appendix B – Schematic of Scenario 2


SCENARIO 2
HCT ACCOMMODATION ON FLOATING BRIDGE
MONTLAKE BLVD
PACIFIC AVE
Approach structures and foundations are designed to support HCT loads and future anticipated roadway loads. The approach structures are designed so that they can be widened in the future.
84th Ave Lid & Loop Ramp
No provision for HCT station or HCT envelope
APPROACH STRUCTURE
SR 520
FLOATING BRIDGE
APPROACH STRUCTURE
EVERGREEN POINT RD
84TH AVE NE
92ND AVE NE
I-5
Floating Bridge Pontoons are designed to allow superstructure and deck to be widened in the future.
Evergreen Point Road Lid
Option A assumes HCT displaces BRT station; No accommodation needed
Option B assumes HCT and BRT stations are included so lid would need to be designed wider
92nd Ave Lid
Lid designed for roadway and BRT Station; No accommodation for future HCT
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DATE 08/09/2002
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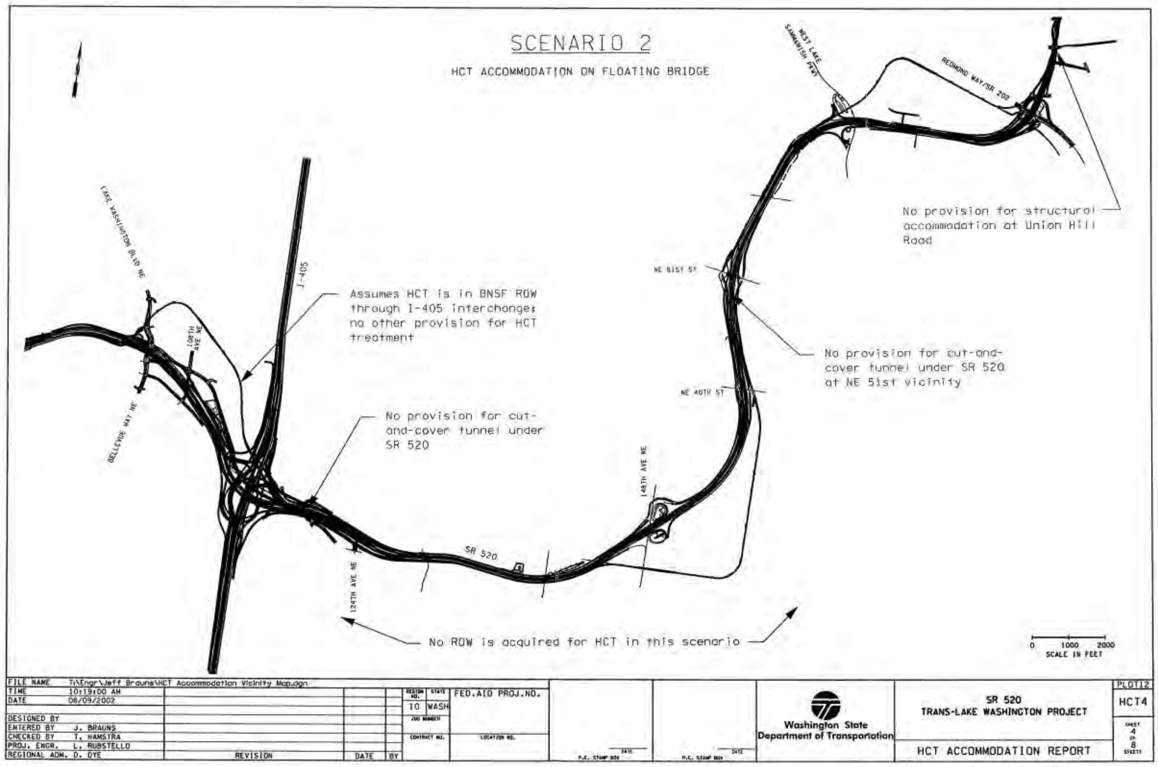
HCT ACCOMMODATION REPORT
PLOT2
HCT3
SHEET 3 OF 8 SHEETS


SCENARIO 2
HCT ACCOMMODATION ON FLOATING BRIDGE
I-405
SR 520
NE 51ST ST
NE 40TH ST
148TH AVE NE
124TH AVE NE
BELLEVUE WAY NE
108TH AVE NE
LAKE WASHINGTON BLVD NE
WEST LAKE SAMMAMISH PKWY
REDMOND WAY/SR 202
Assumes HCT is in BNSF ROW through I-405 interchange; no other provision for HCT treatment
No provision for cut-and-cover tunnel under SR 520
No provision for cut-and-cover tunnel under SR 520 at NE 51st vicinity
No provision for structural accommodation at Union Hill Road
No ROW is acquired for HCT in this scenario
0 1000 2000
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DATE 08/09/2002
DESIGNED BY
ENTERED BY J. BRAUNS
CHECKED BY T. HAMSTRA
PROJ. ENGR. L. RUBSTELLO
REGIONAL ADM. D. DYE
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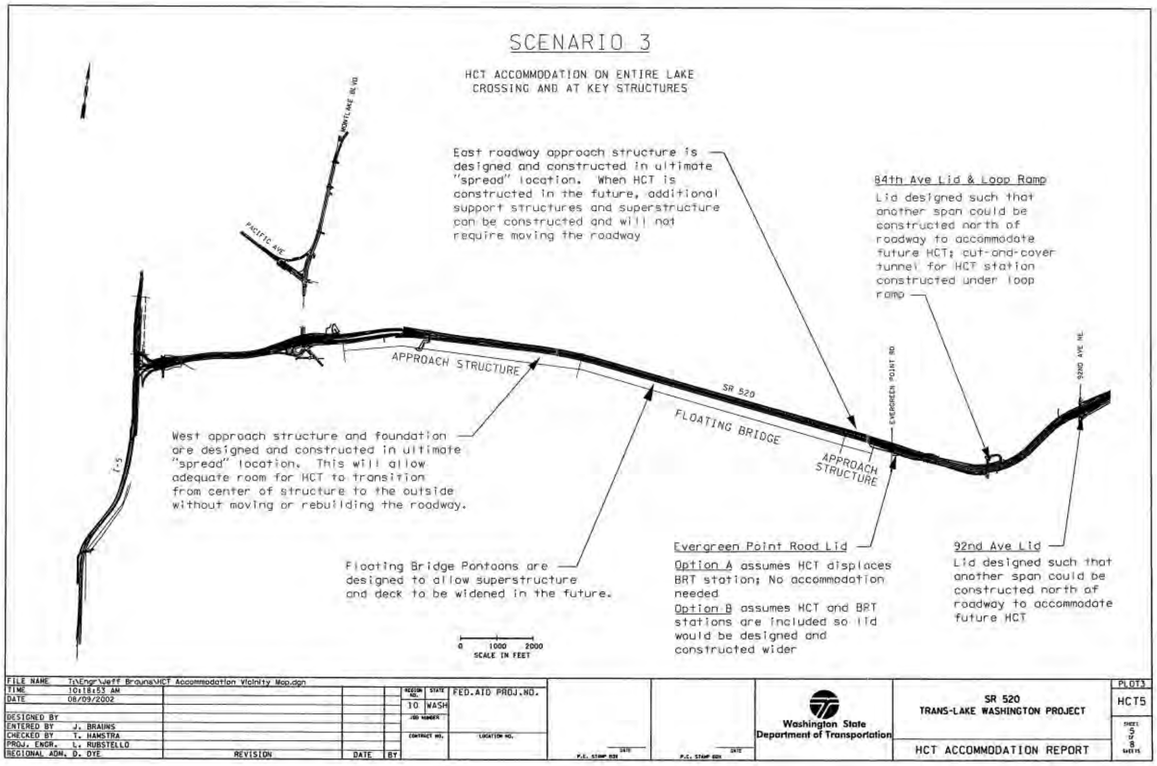
HCT ACCOMMODATION REPORT
PLOT12
HCT4
4
8

Appendix C – Schematic of Scenario 3


SCENARIO 3
HCT ACCOMMODATION ON ENTIRE LAKE CROSSING AND AT KEY STRUCTURES
East roadway approach structure is designed and constructed in ultimate "spread" location. When HCT is constructed in the future, additional support structures and superstructure can be constructed and will not require moving the roadway
84th Ave Lid & Loop Ramp
Lid designed such that another span could be constructed north of roadway to accommodate future HCT; cut-and-cover tunnel for HCT station constructed under loop ramp
MONTLAKE BLVD
PACIFIC AVE
APPROACH STRUCTURE
SR 520
FLOATING BRIDGE
APPROACH STRUCTURE
EVERGREEN POINT RD
92ND AVE NE
I-5
West approach structure and foundation are designed and constructed in ultimate "spread" location. This will allow adequate room for HCT to transition from center of structure to the outside without moving or rebuilding the roadway.
Floating Bridge Pontoons are designed to allow superstructure and deck to be widened in the future.
Evergreen Point Road Lid
Option A assumes HCT displaces BRT station; No accommodation needed
Option B assumes HCT and BRT stations are included so lid would be designed and constructed wider
92nd Ave Lid
Lid designed such that another span could be constructed north of roadway to accommodate future HCT
0 1000 2000
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DATE 08/09/2002
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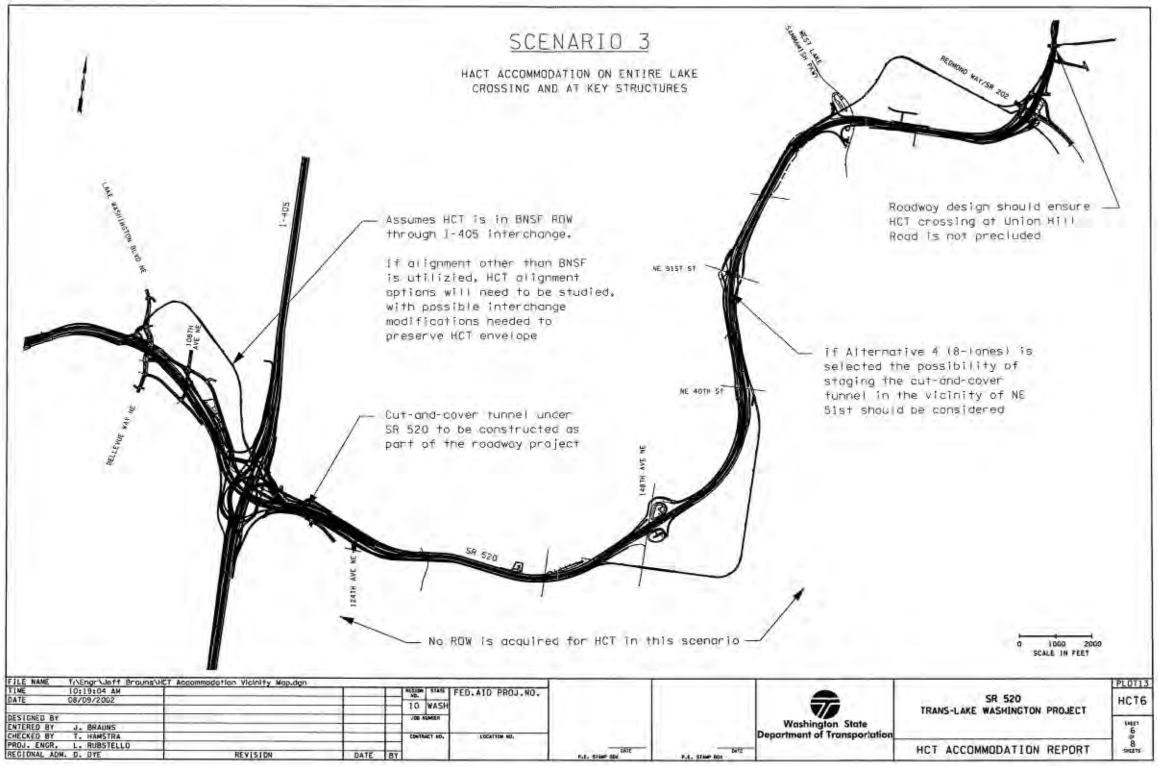
TRANS-LAKE WASHINGTON PROJECT
HCT ACCOMMODATION REPORT
PLOT3
HCT5


SCENARIO 3
HACT ACCOMMODATION ON ENTIRE LAKE CROSSING AND AT KEY STRUCTURES
Assumes HCT is in BNSF ROW through I-405 interchange.
If alignment other than BNSF is utilized, HCT alignment options will need to be studied, with possible interchange modifications needed to preserve HCT envelope
Cut-and-cover tunnel under SR 520 to be constructed as part of the roadway project
Roadway design should ensure HCT crossing at Union Hill Road is not precluded
If Alternative 4 (8-lanes) is selected the possibility of staging the cut-and-cover tunnel in the vicinity of NE 51st should be considered
No ROW is acquired for HCT in this scenario
I-405
SR 520
124TH AVE NE
148TH AVE NE
NE 51ST ST
NE 40TH ST
BELLEVUE WAY NE
REDMOND WAY/SR 202
0 1000 2000
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PROJ. ENGR. L. RUBSTELLO
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Washington State Department of Transportation
SR 520
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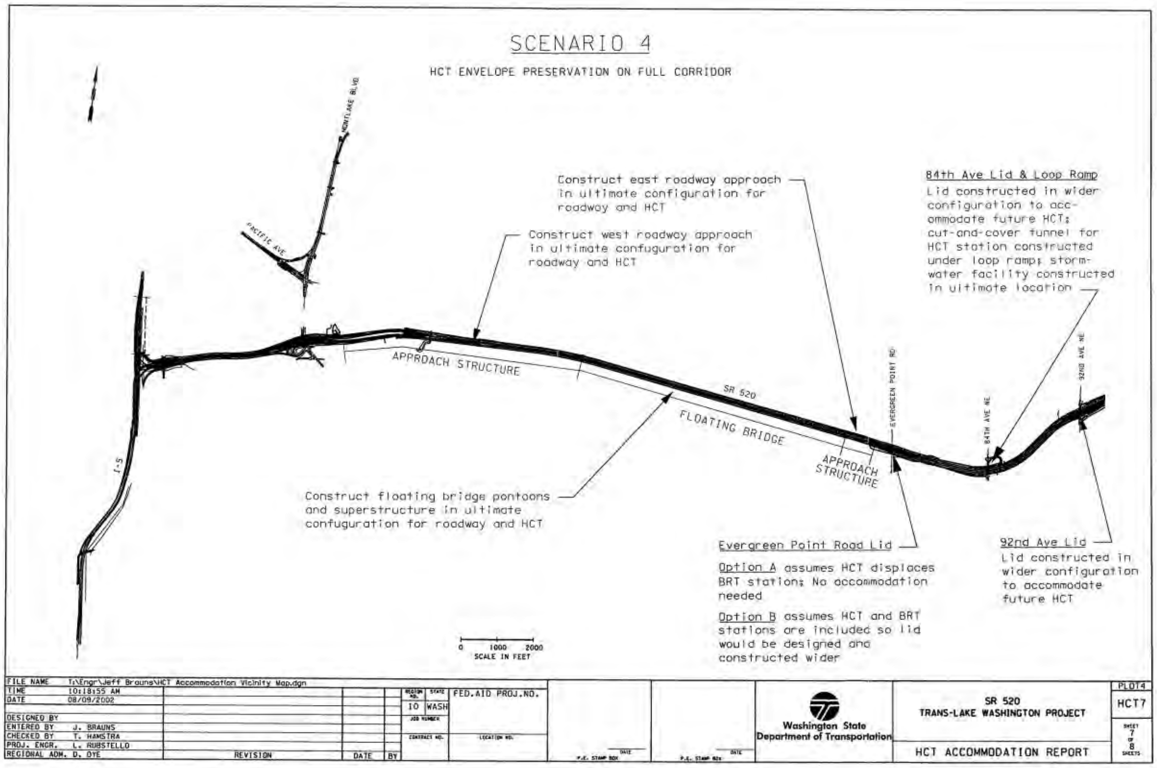
HCT ACCOMMODATION REPORT
PLOT13
HCT6

Appendix D – Schematic of Scenario 4



SCENARIO 4
HCT ENVELOPE PRESERVATION ON FULL CORRIDOR
MONTLAKE BLVD
PACIFIC AVE
I-5
Construct east roadway approach in ultimate configuration for roadway and HCT
Construct west roadway approach in ultimate confuguration for roadway and HCT
84th Ave Lid & Loop Ramp
Lid constructed in wider configuration to accommodate future HCT; cut-and-cover tunnel for HCT station constructed under loop ramp; stormwater facility constructed in ultimate location
APPROACH STRUCTURE
SR 520
FLOATING BRIDGE
APPROACH STRUCTURE
EVERGREEN POINT RD
84TH AVE NE
92ND AVE NE
Construct floating bridge pontoons and superstructure in ultimate confuguration for roadway and HCT
Evergreen Point Road Lid
Option A assumes HCT displaces BRT station; No accommodation needed
Option B assumes HCT and BRT stations are included so lid would be designed and constructed wider
92nd Ave Lid
Lid constructed in wider configuration to accommodate future HCT
0 1000 2000
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DATE 08/09/2002
DESIGNED BY
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CHECKED BY T. HAMSTRA
PROJ. ENGR. L. RUBSTELLO
REGIONAL ADM. D. DYE
REVISION
DATE
BY
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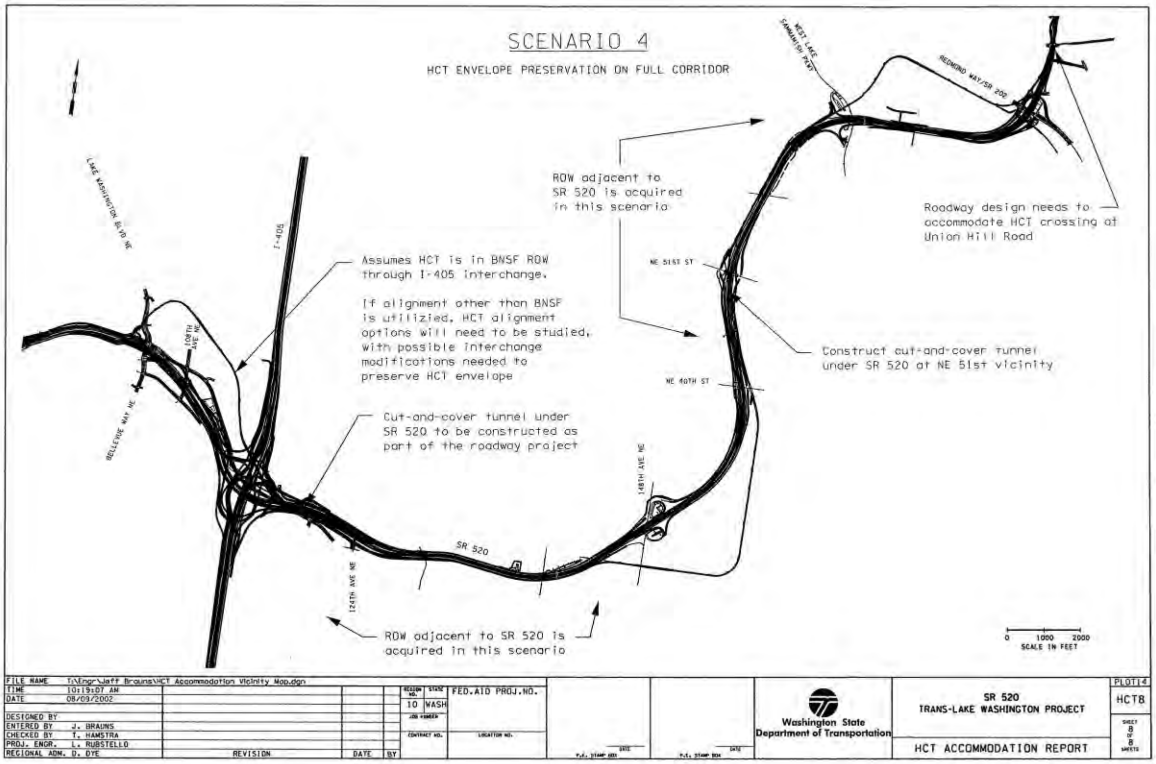
Washington State Department of Transportation
SR 520
TRANS-LAKE WASHINGTON PROJECT
HCT ACCOMMODATION REPORT
PLOT4
HCT7
7 OF 8 SHEETS


SCENARIO 4
HCT ENVELOPE PRESERVATION ON FULL CORRIDOR
ROW adjacent to SR 520 is acquired in this scenario
Roadway design needs to accommodate HCT crossing at Union Hill Road
Assumes HCT is in BNSF ROW through I-405 interchange.
If alignment other than BNSF is utilized, HCT alignment options will need to be studied, with possible interchange modifications needed to preserve HCT envelope
Construct cut-and-cover tunnel under SR 520 at NE 51st vicinity
Cut-and-cover tunnel under SR 520 to be constructed as part of the roadway project
ROW adjacent to SR 520 is acquired in this scenario
I-405
SR 520
NE 51ST ST
NE 40TH ST
148TH AVE NE
124TH AVE NE
BELLEVUE WAY NE
LAKE WASHINGTON BLVD NE
REDMOND WAY/SR 202
0 1000 2000
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DATE 08/09/2002
DESIGNED BY
ENTERED BY J. BRAUNS
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PROJ. ENGR. L. RUBSTELLO
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HCT ACCOMMODATION REPORT
PLOT14
HCT8

Appendix E – Cost Information

		Env Doc/Design Cost		ROW Costs		Construction		Subtotal		
		Montlake to 124th	124th to Redmond	Montlake to 124th	124th to Redmond	Montlake to 124th	124th to Redmond	Montlake to 124th	124th to Redmond	**Total**
Scenario 1	Translake	$0	$0	$0	$0	$0	$0	$0	$0	**$0**
	Future HCT	$355	$36	$60	$48	$630	$63	$1,044	$148	**$1,192**
Scenario 2	Translake	$30	$0	$2	$0	$84	$0	$116	$0	**$116**
	Future HCT	$215	$36	$58	$48	$298	$63	$571	$148	**$718**
Scenario 3	Translake	$52	$0	$2	$0	$136	$0	$190	$0	**$190**
	Future HCT	$162	$35	$58	$48	$206	$58	$426	$141	**$567**
Scenario 4	Translake	$210	$35	$60	$48	$332	$58	$602	$141	**$743**
	Future HCT	$0	$0	$0	$0	$0	$0	$0	$0	**$0**

Notes:

1 The cost opinion is presented for alternative analysis. It's intent is to capture the additional cost incurred to accommodate the HCT in the corridor. It does not capture HCT costs such as guideway, electrical, vehicles or other costs necessary to develop the HCT line.

2 All cost were calculated using the approved highway cost estimating methodology for the Trans-Lake project.

3 Costs are given for the six lane highway alternative.

4 All costs in presented in 2002 dollars so that furture & current cost can be directly compared.

This planning-level cost estimate is intended only for the comparison of different alternatives based on information available at the time of preparation. Because of the preliminary nature of this estimate, final project costs will vary from those shown and will depend on actual costs for labor, construction equipment, disposal, and materials as well as surface and subsurface conditions, regulatory constraints and approach to corridor mitigation, labor productivity, competitive market conditions, final project scope, schedule, and other factors. Cost opinions developed here do not contain sufficient accuracy to support the development of program budgets.

Alternative Analysis Cost Opinion for HCT Accommodation in the SR 520 Corridor

Description	Env Doc/Design Costs		ROW Costs		Construction Costs	
	Current Costs In Millions (2001 Dollars)	Future Cost In Millions (2001 Dollars)	Current Costs In Millions (2001 Dollars)	Future Cost In Millions (2001 Dollars)	Current Costs In Millions (2001 Dollars)	Future Cost In Millions (2001 Dollars)
Scenario 1: No HCT Preservation/Accommodation						
Floating Bridge		$31		$0		$362
West Side: Option A		$9		$0		$136
West Side: Option B (Not usable with 8 lane tunnel)		$9		$0		$136
West Side: Option C		$10		$4		$142
East Side: Evergreen Point Bridge Option A		$3		$0		$27
East Side: Evergreen Point Bridge Option B		$4		$2		$34
East Side: East of Evergreen Point Lid		$9		$52		$74
EIS (Montlake to 124th)		*$291*				
124th to WLSP		$3		$42		$61
WLSP to NE Union		$0		$5		$0
EIS (124th to Redmond)		*$32*				
Scenario 2: HCT Accommodation on Floating Bridge						
Floating Bridge	$3	$2	$0	$0	$76	$57
West Side: Option A		$8		$0		$120
West Side: Option B (Not usable with 8 lane tunnel)		$8		$0		$120
West Side: Option C		$8		$4		$126
East Side: Evergreen Point Bridge Option A		$4		$0		$33
East Side: Evergreen Point Bridge Option B	$1	$4	$2	$0	$8	$33
East Side: East of Evergreen Point Lid		$9		$52		$74
EIS (Montlake to 124th)	*$25*	*$166*				
124th to WLSP		$3		$42		$61
Redmond Way to NE Union		$0		$5		$0
EIS (124th to Redmond)		*$32*				
Scenario 3: HCT Accommodation on Entire Lake Crossing and at Key Structures						
Floating Bridge	$3	$2	$0	$0	$76	$57
West Side: Option A		$7		$0		$101
West Side: Option B (Not usable with 8 lane tunnel)		$7		$0		$101
West Side: Option C		$7		$4		$106
East Side: Evergreen Point Bridge Option A		$3		$0		$21
East Side: Evergreen Point Bridge Option B	$1	$3	$2	$0	$6	$21
East Side: East of Evergreen Point Lid	$6	$2	$0	$52	$50	$16
EIS (Montlake to 124th)	*$40*	*$144*				
124th to WLSP (Six Lanes)		$3		$42		$56
124th to WLSP (Eight Lanes)	$3		$0	$42	$56	
Redmond Way to NE Union		$0		$5		$0
EIS (124th to Redmond) (Six Lanes)	*$0*	*$31*				
EIS (124th to Redmond) (Eight Lanes)	*$17*	*$14*				
Scenario 4: HCT Envelope Preservation on Full Corridor						
Floating Bridge	$8		$0		$133	
West Side: Option A	$7		$0		$101	
West Side: Option B (Not usable with 8 lane tunnel)	$7		$0		$101	
West Side: Option C	$7		$4		$106	
East Side: Evergreen Point Bridge Option A	$3		$0		$21	
East Side: Evergreen Point Bridge Option B	$3		$2		$27	
East Side: East of Evergreen Point Lid	$7		$52		$57	
EIS (Montlake to 124th)	*$181*					
124th to WLSP	$3		$42		$56	
Redmond Way to NE Union	$0		$5		$0	
EIS (124th to Redmond)	*$31*					

HCT Accommodation 1 of 1 8/9/02 12:56 PM

Cost in 2001 dollars

		Env Doc/Design Cost		ROW Costs		Construction		Subtotal		Total
		Montlake to 124th	124th to Redmond	Montlake to 124th	124th to Redmond	Montlake to 124th	124th to Redmond	Montlake to 124th	124th to Redmond	
Scenario 1	Translake	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Future HCT	$345	$35	$58	$47	$612	$61	$1,015	$143	$1,158
Scenario 2	Translake	$29	$0	$2	$0	$82	$0	$113	$0	$113
	Future HCT	$209	$35	$56	$47	$290	$61	$555	$143	$698
Scenario 3	Translake	$50	$0	$2	$0	$132	$0	$184	$0	$184
	Future HCT	$158	$34	$56	$47	$200	$56	$414	$137	$551
Scenario 4	Translake	$204	$34	$58	$47	$323	$56	$585	$137	$722
	Future HCT	$0	$0	$0	$0	$0	$0	$0	$0	$0

Cost escalated to 2002 dollars

		Env Doc/Design Cost		ROW Costs		Construction		Subtotal		Total
		Montlake to 124th	124th to Redmond	Montlake to 124th	124th to Redmond	Montlake to 124th	124th to Redmond	Montlake to 124th	124th to Redmond	
Scenario 1	Translake	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Future HCT	$355	$36	$60	$48	$630	$63	$1,044	$148	$1,192
Scenario 2	Translake	$30	$0	$2	$0	$84	$0	$116	$0	$116
	Future HCT	$215	$36	$58	$48	$298	$63	$571	$148	$718
Scenario 3	Translake	$52	$0	$2	$0	$136	$0	$190	$0	$190
	Future HCT	$162	$35	$58	$48	$206	$58	$426	$141	$567
Scenario 4	Translake	$210	$35	$60	$48	$332	$58	$602	$141	$743
	Future HCT	$0	$0	$0	$0	$0	$0	$0	$0	$0

Notes:

1. The cost opinion is presented for alternative analysis. It's intent is to capture the additional cost incurred to accommodate the HCT in the corridor. It does not capture HCT costs such as track, guideway, or other cost necessary to develop the HCT line.
2. All cost were developed using the approved highway cost estimating methodology for the Trans-Lake project.
3. Scenario costs are given for the six lane highway alternative.
4. Potential EIS costs were determined by using 30% of the ROW and construction costs.

This planning-level cost estimate is intended only for the comparison of different alternatives based on information available at the time of preparation. Because of the preliminary nature of this estimate, final project costs will vary from those shown and will depend on actual costs for labor, construction equipment, disposal, and materials as well as surface and subsurface conditions, regulatory constraints and approach to corridor mitigation, labor productivity, competitive market conditions, final project scope, schedule, and other factors. Cost opinions developed here do not contain sufficient accuracy to support the development of program budgets.

HCT Accommodation 1 of 1 8/9/02 12:57 PM

Scenario 1: No HCT Preservation/Accommodation

HCT Cost During Initial Highway Construction

No Accommodations

Future HCT Costs

Floating Bridge

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Reconstruct Floating Bridge for HCT	Floating Bridge	288,000	SF	$ 700	$ 201,600,000	
			Subtotal			$ 201,600,000	A
		Traffic Control on "A"	0.5%			$ 1,008,000	B
		Construction Staging on "A"	0%			$ -	C
		Removals on "A"	2%			$ 4,032,000	D
			Subtotal			$ 206,640,000	E
		Mobilization on "E"	8%			$ 16,531,200	F
		Misc Construction Allowance on "E"	15%			$ 30,996,000	G
		Construction Cost	Subtotal			$ 254,167,200	H
		Sales Tax on "H"	8.8%			$ 22,366,714	I
		Construction Administration on "H"	10%			$ 25,416,720	J
			Subtotal			$ 301,950,634	K
		Scope Contingency on "K"	20%			$ 60,390,127	L
			Construction Total (Rounded)			$ 362,000,000	M
		Preliminary Engineering on "H"	10%			$ 25,416,720	N
		Scope Contingency on "N"	20%			$ 5,083,344	O
			Preliminary Engineering (Rounded)			$ 31,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

Notes:
1. Assume that the floating bridge is expandable. Standard bridge cost is $350/sf for widening onto floating bridge use $700/sf for comparision purposes only.

West Side: Option A

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Widen and strenghten/modify west approach structure for 1,800 ft	Widen bridge	72,000	SF	$ 300	$ 21,600,000	
		Upgrade existing bridge for HCT	1,800	RF	$ 810	$ 1,458,000	
	Install HCT Bridge Structure for remaining length	New Approach Structures to Lake Washington Crossing	4,800	RF	$ 8,130	$ 39,024,000	
			Subtotal			$ 62,082,000	A
		Traffic Control on "A"	10%			$ 6,208,200	B
		Construction Staging on "A"	10%			$ 6,208,200	C
		Removals on "A"	5%			$ 3,104,100	D
			Subtotal			$ 77,602,500	E
		Mobilization on "E"	8%			$ 6,208,200	F
		Misc Construction Allowance on "E"	15%			$ 11,640,375	G
		Construction Cost	Subtotal			$ 95,451,075	H
		Sales Tax on "H"	8.8%			$ 8,399,695	I
		Construction Administration on "H"	10%			$ 9,545,108	J
			Subtotal			$ 113,395,877	K
		Scope Contingency on "K"	20%			$ 22,679,175	L
			Construction Total (Rounded)			$ 136,000,000	M
		Preliminary Engineering on "H"	8%			$ 7,636,086	N
		Scope Contingency on "N"	20%			$ 1,527,217	O
			Preliminary Engineering (Rounded)			$ 9,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

Notes:
1. Assume that approach structures can be widened.
2. For HCT approach structure costs use unit cost item 4150 - New Approach Structure to Lake Washington Crossing without rail and systems cost.
3. Widen existing bridge structure to move highway lanes to outside for HCT to transition from inside to outside.
4. Use unit cost item 3170 - Upgrade for Existing Bridge Structure

West Side: Option B (Not usable with 8 lane tunnel)

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Widen and strenghten/modify west approach structure	Widen bridge	72,000	SF	$ 300	$ 21,600,000	
		Upgrade existing bridge for HCT	1,800	RF	$ 810	$ 1,458,000	
	Install HCT Bridge Structure	New Approach Structures to Lake Washington Crossing	4,800	RF	$ 8,130	$ 39,024,000	
			Subtotal			$ 62,082,000	A
		Traffic Control on "A"	10%			$ 6,208,200	B
		Construction Staging on "A"	10%			$ 6,208,200	C
		Removals on "A"	5%			$ 3,104,100	D
			Subtotal			$ 77,602,500	E
		Mobilization on "E"	8%			$ 6,208,200	F
		Misc Construction Allowance on "E"	15%			$ 11,640,375	G
		Construction Cost	Subtotal			$ 95,451,075	H
		Sales Tax on "H"	8.8%			$ 8,399,695	I
		Construction Administration on "H"	10%			$ 9,545,108	J
			Subtotal			$ 113,395,877	K
		Scope Contingency on "K"	20%			$ 22,679,175	L
			Construction Total (Rounded)			$ 136,000,000	M
		Preliminary Engineering on "H"	8%			$ 7,636,086	N
		Scope Contingency on "N"	20%			$ 1,527,217	O
			Preliminary Engineering (Rounded)			$ 9,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

Notes:
1. Assume that approach structures can be widened.
2. For HCT approach structure costs use unit cost item 4150 - New Approach Structure to Lake Washington Crossing without rail and systems cost.
3. Widen existing bridge structure to move highway lanes to outside for HCT to transition from inside to outside.
4. Use unit cost item 3170 - Upgrade for Existing Bridge Structure

West Side: Option C

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Widen non-accommodated Lid structure	Widen non-accommodated Non Ventilated Li	17,500	SF	$ 145	$ 2,537,500	
	Widen and strenghten/modify west approach structure	Widen bridge	72,000	SF	$ 300	$ 21,600,000	
		Upgrade existing bridge for HCT	1,800	RF	$ 810	$ 1,458,000	
	Install HCT Bridge Structure	New Approach Structures to Lake Washington Crossing	4,800	RF	$ 8,130	$ 39,024,000	
			Subtotal			$ 64,619,500	A
		Traffic Control on "A"	10%			$ 6,461,950	B
		Construction Staging on "A"	10%			$ 6,461,950	C
		Removals on "A"	5%			$ 3,230,975	D
			Subtotal			$ 80,774,375	E
		Mobilization on "E"	8%			$ 6,461,950	F
		Misc Construction Allowance on "E"	15%			$ 12,116,156	G
		Construction Cost	Subtotal			$ 99,352,481	H
		Sales Tax on "H"	8.8%			$ 8,743,018	I
		Construction Administration on "H"	10%			$ 9,935,248	J
			Subtotal			$ 118,030,748	K
		Scope Contingency on "K"	20%			$ 23,606,150	L
			Construction Total (Rounded)			$ 142,000,000	M
		Preliminary Engineering on "H"	8%			$ 7,948,199	N
		Scope Contingency on "N"	20%			$ 1,589,640	O
			Preliminary Engineering (Rounded)			$ 10,000,000	P
		Additional ROW for Widened Lid	20,000	SF	$ 175	$ 3,500,000	Q
		Scope Contingency on "Q"	20%			$ 700,000	R
			Right of Way (Rounded)			$ 4,000,000	S

Notes:
1. Assume that approach structures can be widened.
2. For HCT approach structure costs use unit cost item 4150 - New Approach Structure to Lake Washington Crossing without rail and systems cost.
3. Widen existing bridge structure to move highway lanes to outside for HCT to transition from inside to outside.
4. Use unit cost item 3170 - Upgrade for Existing Bridge Structure

East Side: Evergreen Point Bridge Option A

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Redesign non-accommodated BRT for HCT displacement		1	LS	$ 1,000,000	$ 1,000,000	
	Widen and strenghten/modify east approach structure	Widen bridge	40,000	SF	$ 200	$ 8,000,000	
		Upgrade existing bridge for HCT	1,800	RF	$ 810	$ 1,458,000	
			Subtotal			$ 10,458,000	A
		Traffic Control on "A"	15%			$ 1,568,700	B
		Construction Staging on "A"	20%			$ 2,091,600	C
		Removals on "A"	10%			$ 1,045,800	D
			Subtotal			$ 15,164,100	E
		Mobilization on "E"	8%			$ 1,213,128	F
		Misc Construction Allowance on "E"	15%			$ 2,274,615	G
		Construction Cost	Subtotal			$ 18,651,843	H
		Sales Tax on "H"	8.8%			$ 1,641,362	I
		Construction Administration on "H"	10%			$ 1,865,184	J
			Subtotal			$ 22,158,389	K
		Scope Contingency on "K"	20%			$ 4,431,678	L
			Construction Total (Rounded)			$ 27,000,000	M
		Preliminary Engineering on "H"	15%			$ 2,797,776	N
		Scope Contingency on "N"	20%			$ 559,555	O
			Preliminary Engineering (Rounded)			$ 3,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

Notes:
1. Assume that approach structures can be widened.
2. Widen existing bridge structure to move highway lanes to outside for HCT to transition from inside to outside.
3. Use unit cost item 3170 - Upgrade for Existing Bridge Structure

East Side: Evergreen Point Bridge Option B

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Widen non-accommodated Lid structure	Widen non-accommodated Non Ventilated Li	17,500	SF	$ 218	$ 3,806,250	
	Reconstruct approach structure to EP	Widen bridge	40,000	SF	$ 200	$ 8,000,000	
		Upgrade existing bridge for HCT	1,800	RF	$ 810	$ 1,458,000	
			Subtotal			$ 13,264,250	A
Notes:		Traffic Control on "A"	15%			$ 1,989,638	B
1. Assume that approach structures can be widened.		Construction Staging on "A"	20%			$ 2,652,850	C
2. Widen existing bridge structure to move highway lanes to outside for HCT to transition from inside to outside.		Removals on "A"	10%			$ 1,326,425	D
			Subtotal			$ 19,233,163	E
3. Use unit cost item 3170 - Upgrade for Existing Bridge Structure.		Mobilization on "E"	8%			$ 1,538,653	F
4. Assume that the lid can be widened for HCT.		Misc Construction Allowance on "E"	15%			$ 2,884,974	G
		Construction Cost	Subtotal			$ 23,656,790	H
		Sales Tax on "H"	8.8%			$ 2,081,798	I
		Construction Administration on "H"	10%			$ 2,365,679	J
			Subtotal			$ 28,104,268	K
		Scope Contingency on "K"	20%			$ 5,620,853	L
			Construction Total (Rounded)			$ 34,000,000	M
		Preliminary Engineering on "H"	15%			$ 3,548,518	N
		Scope Contingency on "N"	20%			$ 709,704	O
			Preliminary Engineering (Rounded)			$ 4,000,000	P
		Additional ROW for Widened Lid	20,000	SF	$ 70	$ 1,400,000	Q
		Scope Contingency on "Q"	20%			$ 280,000	R
			Right of Way (Rounded)			$ 2,000,000	S

East Side: East of Evergreen Point Lid to I-405

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
Widen Median Past EP Lid							
	Widen highway median to HCT transition by moving two inside lane to outside	Pavment	4,000	Lane FT	$ 67	$ 268,000	
		Earthwork	4,000	Lane FT	$ 80	$ 320,000	
		New enclosed drainage system	2,000	LF	$ 70	$ 140,000	
		Replace Retaining Walls	5,000	SF	$ 80	$ 300,000	
		Replace Noise Wall	1,800	LF	$ 275	$ 495,000	
84th Avenue							
	Widen non-accommodated Lid structure	Widen non-accommodated Non Ventilated Li	17,500	SF	$ 218	$ 3,806,250	
	Cut and Cover Structure at 84th ramp	HCT Cut & Cover	50	RF	$ 14,640	$ 732,000	
	Rebuild 84th ramp	Pavement	400	Lane FT	$ 67	$ 26,800	
	Demo and reconnect existing Stormwater pipes		1	LS	$ 120,000	$ 120,000	
	Convert FB-1 Stormwater pond to vault system under roadway	Detention vault equal to pond stroage	91,875	CF	$ 12	$ 1,102,500	
92nd Avenue							
	Widen non-accommodated Lid structure	Widen non-accommodated Non Ventilated Li	17,500	SF	$ 218	$ 3,806,250	
East of I-405							
	Cut and Cover Structure under SR 520	HCT Cut & Cover	1,200	RF	$ 14,640	$ 17,568,000	
	Rebuild 6 lanes across SR 520 for 500' each side	Pavement	6,000	Lane FT	$ 67	$ 402,000	
			Subtotal			$ 29,086,800	A
Notes:		Traffic Control on "A"	15%			$ 4,363,020	B
1. Use HCT unit cost item 1160 - Cut and Cover Dual Track Tunnel Suburban minu minus track and systems cost.		Construction Staging on "A"	20%			$ 5,817,360	C
		Removals on "A"	10%			$ 2,908,680	D
2. Assume that the lid can be widened for HCT.			Subtotal			$ 42,175,860	E
		Mobilization on "E"	8%			$ 3,374,069	F
		Misc Construction Allowance on "E"	15%			$ 6,326,379	G
		Construction Cost	Subtotal			$ 51,876,308	H
		Sales Tax on "H"	8.8%			$ 4,565,115	I
		Construction Administration on "H"	10%			$ 5,187,631	J
			Subtotal			$ 61,629,054	K
		Scope Contingency on "K"	20%			$ 12,325,811	L
			Construction Total (Rounded)			$ 74,000,000	M
		Preliminary Engineering on "H"	15%			$ 7,781,446	N
		Scope Contingency on "N"	20%			$ 1,556,289	O
			Preliminary Engineering (Rounded)			$ 9,000,000	P
	Right of Way for widened median area		80,000	SF	$ 70	$ 5,600,000	M
	Right of Way along SR 520 to L Washington Blvd		260,000	SF	$ 70	$ 18,200,000	M
	Right of Way from I-405 to 124th		112,000	SF	$ 175	$ 19,600,000	M
		Scope Contingency on "Q"	20%			$ 8,680,000	R
			Right of Way (Rounded)			$ 52,000,000	S

124th to WLSP

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
NE 51st							
	Cut and Cover Structure under SR 520 at NE 51st	HCT Cut & Cover	1,900	RF	$ 14,640	$ 27,816,000	
	Rebuild 6 lanes across SR 520 for 500' both sides	Pavement	6,000	Lane FT	$ 67	$ 402,000	
			Subtotal			$ 28,218,000	A
Notes:		Traffic Control on "A"	8%			$ 2,257,440	B
1. Use HCT unit cost item 1160 - Cut and Cover Dual Track Tunnel Suburban minu minus track and systems cost		Construction Staging on "A"	10%			$ 2,821,800	C
		Removals on "A"	5%			$ 1,410,900	D
			Subtotal			$ 34,708,140	E
		Mobilization on "E"	8%			$ 2,776,651	F
		Misc Construction Allowance on "E"	15%			$ 5,206,221	G
		Construction Cost	Subtotal			$ 42,691,012	H
		Sales Tax on "H"	8.8%			$ 3,756,809	I
		Construction Administration on "H"	10%			$ 4,269,101	J
			Subtotal			$ 50,716,922	K
		Scope Contingency on "K"	20%			$ 10,143,384	L
			Construction Total (Rounded)			$ 61,000,000	M
		Preliminary Engineering on "H"	6%			$ 2,561,461	N
		Scope Contingency on "N"	20%			$ 512,292	O
			Preliminary Engineering (Rounded)			$ 3,000,000	P
		Right of Way along SR 520	562,400	SF	$ 62	$ 34,868,800	Q
		Scope Contingency on "Q"	20%			$ 6,973,760	R
			Right of Way (Rounded)			$ 42,000,000	S

Redmond Way to NE Union

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
						$ -	
			Subtotal			$ -	A
Notes:		Traffic Control on "A"	10%			$ -	B
1. Assume HCT can fit into the Redmond I/C		Construction Staging on "A"	10%			$ -	C
		Removals on "A"	5%			$ -	D
			Subtotal			$ -	E
		Mobilization on "E"	8%			$ -	F
		Misc Construction Allowance on "E"	15%			$ -	G
		Construction Cost	Subtotal			$ -	H
		Sales Tax on "H"	8.8%			$ -	I
		Construction Administration on "H"	10%			$ -	J
			Subtotal			$ -	K
		Scope Contingency on "K"	20%			$ -	L
			Construction Total (Rounded)			$ -	M
		Preliminary Engineering on "H"	10%			-	N
		Scope Contingency on "N"	20%			$ -	O
			Preliminary Engineering (Rounded)			$ -	P
		Right of Way along SR 520	68,000	SF	$ 62	$ 4,216,000	Q
		Scope Contingency on "Q"	20%			$ 843,200	R
			Right of Way (Rounded)			$ 5,000,000	S

HCT Accommodation　　4.6.4　　9/9/02 12:57 PM

Scenario 2: HCT Accommodation on Floating Bridge

HCT Cost During Initial Highway Construction

Floating Bridge

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Additional floating bridge pontoon width	Pontoon Substructure	216,000	SF	$ 200	$ 43,200,000	
			Subtotal			$ 43,200,000	A
Notes:		Traffic Control on "A"	0.5%			$ 216,000	B
		Construction Staging on "A"	0%			$ -	C
		Removals on "A"	0%			$ -	D
			Subtotal			$ 43,416,000	E
		Mobilization on "E"	8%			$ 3,473,280	F
		Construction Contingency on "E"	15%			$ 6,512,400	G
		Construction Cost	Subtotal			$ 53,401,680	H
		Sales Tax on "H"	8.8%			$ 4,699,348	I
		Construction Administration on "H"	10%			$ 5,340,168	J
			Subtotal			$ 63,441,196	K
		Scope Contingency on "K"	20%			$ 12,688,239	L
			Construction Total (Rounded)			$ 76,000,000	M
		Preliminary Engineering on "H"	5%			$ 2,670,084	N
		Scope Contingency on "N"	20%			$ 534,017	O
			Preliminary Engineering (Rounded)			$ 3,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

West Side
Foundations of the approach span are designed to Accommodate future HCT. Design issue cost already included.

East Side: Evergreen Point Bridge Option A
Design for Future use of BRT Station (No Cost)

East Side: Evergreen Point Bridge Option B

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Additional 35' of width to Evergreen Point Lid	Non Ventilated Lid	17,500	SF	$ 145	$ 2,537,500	
			Subtotal			$ 2,537,500	A
Notes:		Traffic Control on "A"	15%			$ 380,625	B
		Construction Staging on "A"	20%			$ 507,500	C
		Removals on "A"	10%			$ 253,750	D
			Subtotal			$ 3,679,375	E
		Mobilization on "E"	8%			$ 294,350	F
		Construction Contingency on "E"	15%			$ 551,906	G
		Construction Cost	Subtotal			$ 4,525,631	H
		Sales Tax on "H"	8.8%			$ 398,256	I
		Construction Administration on "H"	10%			$ 452,563	J
			Subtotal			$ 5,376,450	K
		Scope Contingency on "K"	20%			$ 1,075,290	L
			Construction Total (Rounded)			$ 6,000,000	M
		Preliminary Engineering on "H"	15%			$ 678,845	N
		Scope Contingency on "N"	20%			$ 135,769	O
			Preliminary Engineering (Rounded)			$ 1,000,000	P
		Additional ROW for Widened Lid	20,000	SF	$ 70	$ 1,400,000	Q
		Scope Contingency on "Q"	20%			$ 280,000	R
			Right of Way (Rounded)			$ 2,000,000	S

East Side: East of Evergreen Point Lid
No Accommodations

124th to WLSP
No Accommodations

Redmond Way to NE Union
No Accommodations

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Future HCT Costs

Floating Bridge

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Place superstructure on existing pontoons	Floating Bridge: Superstructure	216,000	SF	$ 150	$ 32,400,000	
			Subtotal			$ 32,400,000	A
Notes:		Traffic Control on "A"	0.5%			$ 162,000	B
		Construction Staging on "A"	0%			$ -	C
		Removals on "A"	0%			$ -	D
			Subtotal			$ 32,562,000	E
		Mobilization on "E"	8%			$ 2,604,960	F
		Construction Contingency on "E"	15%			$ 4,884,300	G
		Construction Cost	Subtotal			$ 40,051,260	H
		Sales Tax on "H"	8.8%			$ 3,524,511	I
		Construction Administration on "H"	10%			$ 4,005,126	J
			Subtotal			$ 47,580,897	K
		Scope Contingency on "K"	20%			$ 9,516,179	L
			Construction Total (Rounded)			$ 57,000,000	M
		Preliminary Engineering on "H"	5%			2,002,563	N
		Scope Contingency on "N"	20%			$ 400,513	O
			Preliminary Engineering (Rounded)			$ 2,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

West Side: Option A

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Widen and strenghten/modify west approach structure for 1,800 ft	Widen bridge	72,000	SF	$ 200	$ 14,400,000	
		Upgrade existing bridge for HCT	1,800	RF	$ 810	$ 1,458,000	
	Install HCT Bridge Structure for remaining length	New Approach Structures to Lake Washington Crossing	4,800	RF	$ 8,130	$ 39,024,000	
			Subtotal			$ 54,882,000	A
Notes:		Traffic Control on "A"	10%			$ 5,488,200	B
		Construction Staging on "A"	10%			$ 5,488,200	C
		Removals on "A"	5%			$ 2,744,100	D
			Subtotal			$ 68,602,500	E
		Mobilization on "E"	8%			$ 5,488,200	F
		Misc Construction Allowance on "E"	15%			$ 10,290,375	G
		Construction Cost	Subtotal			$ 84,381,075	H
		Sales Tax on "H"	8.8%			$ 7,425,535	I
		Construction Administration on "H"	10%			$ 8,438,108	J
			Subtotal			$ 100,244,717	K
		Scope Contingency on "K"	20%			$ 20,048,943	L
			Construction Total (Rounded)			$ 120,000,000	M
		Preliminary Engineering on "H"	8%			$ 6,750,486	N
		Scope Contingency on "N"	20%			$ 1,350,097	O
			Preliminary Engineering (Rounded)			$ 8,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

Notes:
1. Assume that approach structures foundations are design to be widened for HCT.
2. For HCT approach structure costs use unit cost item 4150 - New Approach Structure to Lake Washington Crossing without rail and systems cost.
3. Widen existing bridge structure to move highway lanes to outside for HCT to transition from inside to outside.
4. Use unit cost item 3170 - Upgrade for Existing Bridge Structure

West Side: Option B (Not usable with 8 lane tunnel)

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Widen and strenghten/modify west approach structure	Widen bridge	72,000	SF	$ 200	$ 14,400,000	
		Upgrade existing bridge for HCT	1,800	RF	$ 810	$ 1,458,000	
	Install HCT Bridge Structure	New Approach Structures to Lake Washington Crossing	4,800	RF	$ 8,130	$ 39,024,000	
			Subtotal			$ 54,882,000	A
Notes:		Traffic Control on "A"	10%			$ 5,488,200	B
		Construction Staging on "A"	10%			$ 5,488,200	C
		Removals on "A"	5%			$ 2,744,100	D
			Subtotal			$ 68,602,500	E
		Mobilization on "E"	8%			$ 5,488,200	F
		Misc Construction Allowance on "E"	15%			$ 10,290,375	G
		Construction Cost	Subtotal			$ 84,381,075	H
		Sales Tax on "H"	8.8%			$ 7,425,535	I
		Construction Administration on "H"	10%			$ 8,438,108	J
			Subtotal			$ 100,244,717	K
		Scope Contingency on "K"	20%			$ 20,048,943	L
			Construction Total (Rounded)			$ 120,000,000	M
		Preliminary Engineering on "H"	8%			$ 6,750,486	N
		Scope Contingency on "N"	20%			$ 1,350,097	O
			Preliminary Engineering (Rounded)			$ 8,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

Notes:
1. Assume that approach structures foundations are design to be widened for HCT.
2. For HCT approach structure costs use unit cost item 4150 - New Approach Structure to Lake Washington Crossing without rail and systems cost.
3. Widen existing bridge structure to move highway lanes to outside for HCT to transition from inside to outside.
4. Use unit cost item 3170 - Upgrade for Existing Bridge Structure

West Side: Option C

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Widen non-accommodated Lid structure	Widen non-accommodated Non Ventilated Li	17,500	SF	$ 145	$ 2,537,500	
	Widen and strenghten/modify west approach structure	Widen bridge	72,000	SF	$ 200	$ 14,400,000	
		Upgrade existing bridge for HCT	1,800	RF	$ 810	$ 1,458,000	
	Install HCT Bridge Structure	New Approach Structures to Lake Washington Crossing	4,800	RF	$ 8,130	$ 39,024,000	
			Subtotal			$ 57,419,500	A
		Traffic Control on "A"	10%			$ 5,741,950	B
		Construction Staging on "A"	10%			$ 5,741,950	C
		Removals on "A"	5%			$ 2,870,975	D
			Subtotal			$ 71,774,375	E
		Mobilization on "E"	8%			$ 5,741,950	F
		Misc Construction Allowance on "E"	15%			$ 10,766,156	G
		Construction Cost	Subtotal			$ 88,282,481	H
		Sales Tax on "H"	8.8%			$ 7,768,858	I
		Construction Administration on "H"	10%			$ 8,828,248	J
			Subtotal			$ 104,879,588	K
		Scope Contingency on "K"	20%			$ 20,975,918	L
			Construction Total (Rounded)			$ 126,000,000	M
		Preliminary Engineering on "H"	8%			$ 7,062,599	N
		Scope Contingency on "N"	20%			$ 1,412,520	O
			Preliminary Engineering (Rounded)			$ 8,000,000	P
		Additional ROW for Widened Lid	20,000	SF	$ 175	$ 3,500,000	Q
		Scope Contingency on "Q"	20%			$ 700,000	R
			Right of Way (Rounded)			$ 4,000,000	S

Notes:
1. Assume that approach structures foundations are design to be widened for HCT
2. For HCT approach structure costs use unit cost item 4150 - New Approach Structure to Lake Washington Crossing without rail and systems cost
3. Widen existing bridge structure to move highway lanes to outside for HCT to transition from inside to outside.
4. Use unit cost item 3170 - Upgrade for Existing Bridge Structure

East Side: Evergreen Point Bridge Option A

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	BRT replacement by HCT has been accommodated for.						
	Reconstruct approach structure to EP	Widen bridge	40,000	SF	$ 200	$ 8,000,000	
		Strengthen for HCT	40,000	SF	$ 120	$ 4,800,000	
			Subtotal			$ 12,800,000	A
		Traffic Control on "A"	15%			$ 1,920,000	B
		Construction Staging on "A"	20%			$ 2,560,000	C
		Removals on "A"	10%			$ 1,280,000	D
			Subtotal			$ 18,560,000	E
		Mobilization on "E"	8%			$ 1,484,800	F
		Construction Contingency on "E"	15%			$ 2,784,000	G
		Construction Cost	Subtotal			$ 22,828,800	H
		Sales Tax on "H"	8.8%			$ 2,008,934	I
		Construction Administration on "H"	10%			$ 2,282,880	J
			Subtotal			$ 27,120,614	K
		Scope Contingency on "K"	20%			$ 5,424,123	L
			Construction Total (Rounded)			$ 33,000,000	M
		Preliminary Engineering on "H"	15%			3,424,320	N
		Scope Contingency on "N"	20%			$ 684,864	O
			Preliminary Engineering (Rounded)			$ 4,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

Notes:
1. Assume that approach structures can be widened.
2. Cost to strengthen bridge is difference between $271/sf for HCT approach structure and the $150/sf for standard highway approach span.

East Side: Evergreen Point Bridge Option B

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Place HCT in provided lid space						
	Reconstruct approach structure to EP	Widen bridge	40,000	SF	$ 200	$ 8,000,000	
		Strengthen for HCT	40,000	SF	$ 120	$ 4,800,000	
			Subtotal			$ 12,800,000	A
		Traffic Control on "A"	15%			$ 1,920,000	B
		Construction Staging on "A"	20%			$ 2,560,000	C
		Removals on "A"	10%			$ 1,280,000	D
			Subtotal			$ 18,560,000	E
		Mobilization on "E"	8%			$ 1,484,800	F
		Construction Contingency on "E"	15%			$ 2,784,000	G
		Construction Cost	Subtotal			$ 22,828,800	H
		Sales Tax on "H"	8.8%			$ 2,008,934	I
		Construction Administration on "H"	10%			$ 2,282,880	J
			Subtotal			$ 27,120,614	K
		Scope Contingency on "K"	20%			$ 5,424,123	L
			Construction Total (Rounded)			$ 33,000,000	M
		Preliminary Engineering on "H"	15%			3,424,320	N
		Scope Contingency on "N"	20%			$ 684,864	O
			Preliminary Engineering (Rounded)			$ 4,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

Notes:
1. Assume that approach structures can be widened.
2. Cost to strengthen bridge is difference between $271/sf for HCT approach structure and the $150/sf for standard highway approach span.

East Side: East of Evergreen Point Lid

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
Widen Median Past EP Lid							
	Replace two lanes to outside	Payment	4,000	Lane FT	$ 67	$ 268,000	
		Earthwork	4,000	Lane FT	$ 80	$ 320,000	
		Enclosed drainage system	2,000	LF	$ 70	$ 140,000	
		Replace Retaining Walls	5,000	SF	$ 60	$ 300,000	
		Replace Noise Wall	1,800	LF	$ 275	$ 495,000	
84th Avenue							
	Widen non-accommodated Lid structure	Widen non-accommodated Non Ventilated Li	17,500	SF	$ 218	$ 3,806,250	
	Cut and Cover Structure at 84th ramp	HCT Cut & Cover	50	RF	$ 14,640	$ 732,000	
	Rebuild 84th ramp	Pavement	400	Lane FT	$ 67	$ 26,800	
	Demo and reconnect existing Stormwater pipes		1	LS	$ 120,000	$ 120,000	
	Convert FB-1 Stormwater pond to vault system under roadway	Detention vault equal to pond storage	91,875	CF	$ 12	$ 1,102,500	
92nd Avenue							
	Widen non-accommodated Lid structure	Widen non-accommodated Non Ventilated Li	17,500	SF	$ 218	$ 3,806,250	
East of I-405							
	Cut and Cover Structure under SR 520	HCT Cut & Cover	1,200	RF	$ 14,640	$ 17,568,000	
	Rebuild 6 lanes across SR 520 for 500' each side	Pavement	6,000	Lane FT	$ 67	$ 402,000	
			Subtotal			$ 29,086,800	A
Notes:		Traffic Control on "A"	15%			$ 4,363,020	B
1. Use HCT unit cost item 1160 - Cut and Cover Dual Track Tunnel Suburban minu minus track and systems cost.		Construction Staging on "A"	20%			$ 5,817,360	C
		Removals on "A"	10%			$ 2,908,680	D
2. Assume that the lid can be widened for HCT.			Subtotal			$ 42,175,860	E
		Mobilization on "E"	8%			$ 3,374,069	F
		Construction Contingency on "E"	15%			$ 6,326,379	G
		Construction Cost	Subtotal			$ 51,876,308	H
		Sales Tax on "H"	8.8%			$ 4,565,115	I
		Construction Administration on "H"	10%			$ 5,187,631	J
			Subtotal			$ 61,629,054	K
		Scope Contingency on "K"	20%			$ 12,325,811	L
			Construction Total (Rounded)			$ 74,000,000	M
		Preliminary Engineering on "H"	15%			7,781,446	N
		Scope Contingency on "N"	20%			$ 1,556,289	O
			Preliminary Engineering (Rounded)			$ 9,000,000	P
	Right of Way for widened median area		80,000	SF	$ 70	$ 5,600,000	M
	Right of Way along SR 520 to L Washington Blvd		260,000	SF	$ 70	$ 18,200,000	M
	Right of Way from I-405 to 124th		112,000	SF	$ 175	$ 19,600,000	M
		Scope Contingency on "Q"	20%			$ 8,680,000	R
			Right of Way (Rounded)			$ 52,000,000	S

124th to WLSP

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
51st Ave							
	Cut and Cover Structure under SR 520 at 51	HCT Cut & Cover	1,900	RF	$ 14,640	$ 27,816,000	
	Rebuild 6 lanes across SR 520 for 500' both sides	Pavement	6,000	Lane FT	$ 67	$ 402,000	
			Subtotal			$ 28,218,000	A
Notes:		Traffic Control on "A"	8%			$ 2,257,440	B
1. Use HCT unit cost item 1160 - Cut and Cover Dual Track Tunnel Suburban minu minus track and systems cost.		Construction Staging on "A"	10%			$ 2,821,800	C
		Removals on "A"	5%			$ 1,410,900	D
			Subtotal			$ 34,708,140	E
		Mobilization on "E"	8%			$ 2,776,651	F
		Construction Contingency on "E"	15%			$ 5,206,221	G
		Construction Cost	Subtotal			$ 42,691,012	H
		Sales Tax on "H"	8.8%			$ 3,756,809	I
		Construction Administration on "H"	10%			$ 4,269,101	J
			Subtotal			$ 50,716,922	K
		Scope Contingency on "K"	20%			$ 10,143,384	L
			Construction Total (Rounded)			$ 61,000,000	M
		Preliminary Engineering on "H"	6%			$ 2,561,461	N
		Scope Contingency on "N"	20%			$ 512,292	O
			Preliminary Engineering (Rounded)			$ 3,000,000	P
		Right of Way along SR 520	562,400	SF	$ 62	$ 34,868,800	Q
		Scope Contingency on "Q"	20%			$ 6,973,760	R
			Right of Way (Rounded)			$ 42,000,000	S

Redmond Way to NE Union

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	I/C was designed to accommodate HCT					$ -	
			Subtotal			$ -	A
Notes:		Traffic Control on "A"	10%			$ -	B
		Construction Staging on "A"	10%			$ -	C
		Removals on "A"	5%			$ -	D
			Subtotal			$ -	E
		Mobilization on "E"	8%			$ -	F
		Construction Contingency on "E"	15%			$ -	G
		Construction Cost	Subtotal			$ -	H
		Sales Tax on "H"	8.8%			$ -	I
		Construction Administration on "H"	10%			$ -	J
			Subtotal			$ -	K
		Scope Contingency on "K"	20%			$ -	L
			Construction Total (Rounded)			$ -	M
		Preliminary Engineering on "H"	10%			$ -	N
		Scope Contingency on "N"	20%			$ -	O
			Preliminary Engineering (Rounded)			$ -	P
		Right of Way along SR 520	68,000	SF	$ 62	$ 4,216,000	Q
		Scope Contingency on "Q"	20%			$ 843,200	R
			Right of Way (Rounded)			$ 5,000,000	S

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Scenario 3: HCT Accommodation on Entire Lake Crossing and at Key Structures

HCT Cost During Initial Highway Construction

Floating Bridge

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Additional floating bridge pontoon width	Pontoon Substructure	216,000	SF	$ 200	$ 43,200,000	
			Subtotal			$ 43,200,000	A
Notes:		Traffic Control on "A"	0.5%			$ 216,000	B
		Construction Staging on "A"	0%			$ -	C
		Removals on "A"	0%			$ -	D
			Subtotal			$ 43,416,000	E
		Mobilization on "E"	8%			$ 3,473,280	F
		Construction Contingency on "E"	15%			$ 6,512,400	G
		Construction Cost	Subtotal			$ 53,401,680	H
		Sales Tax on "H"	8.8%			$ 4,699,348	I
		Construction Administration on "H"	10%			$ 5,340,168	J
			Subtotal			$ 63,441,196	K
		Scope Contingency on "K"	20%			$ 12,688,239	L
			Construction Total (Rounded)			$ 76,000,000	M
		Preliminary Engineering on "H"	5%			$ 2,670,084	N
		Scope Contingency on "N"	20%			$ 534,017	O
			Preliminary Engineering (Rounded)			$ 3,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

West Side

Construct the Approach Structure with a gap between the eastbound and westbound lanes long enough to accommodate for the transition from the inside.
For Option C where the Montlake Lid needs to be widened design lid to accommodate widening. These are design issues and don't add to the overall cost.

East Side: Evergreen Point Bridge Option A

Design for Future use of BRT Station (No Cost)

East Side: Evergreen Point Bridge Option B

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Additional 35' of width to Evergreen Point Lid Leave gap between approach structures	Non Ventilated Lid	17,500	SF	$ 145	$ 2,537,500	
			Subtotal			$ 2,537,500	A
Notes:		Traffic Control on "A"	15%			$ 380,625	B
		Construction Staging on "A"	20%			$ 507,500	C
		Removals on "A"	10%			$ 253,750	D
			Subtotal			$ 3,679,375	E
		Mobilization on "E"	8%			$ 294,350	F
		Construction Contingency on "E"	15%			$ 551,906	G
		Construction Cost	Subtotal			$ 4,525,631	H
		Sales Tax on "H"	8.8%			$ 398,256	I
		Construction Administration on "H"	10%			$ 452,563	J
			Subtotal			$ 5,376,450	K
		Scope Contingency on "K"	20%			$ 1,075,290	L
			Construction Total (Rounded)			$ 6,000,000	M
		Preliminary Engineering on "H"	15%			$ 678,845	N
		Scope Contingency on "N"	20%			$ 135,769	O
			Preliminary Engineering (Rounded)			$ 1,000,000	P
		Additional ROW for Widened Lid	20,000	SF	$ 70	$ 1,400,000	Q
		Scope Contingency on "Q"	20%			$ 280,000	R
			Right of Way (Rounded)			$ 2,000,000	S

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East Side: East of Evergreen Point Lid

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
SR 520 Lanes East of Evergreen Point							
	Widened median transition area is constructed for future HCT. No cost except in ROW purchase.						
84th Avenue							
	Design Lid to accommodate future expansion.						
	Cut and Cover Structure at 84th ramp	HCT Cut & Cover	50	RF	$ 14,640	$ 732,000	
	Rebuild 84th ramp	Pavement	400	Lane FT	$ 67	$ 26,800	
	Construct FB-1 Stormwater pond to vault system under roadway	Detention vault equal to pond streage	91,875	CF	$ 12	$ 1,102,500	
92nd Avenue							
	Design 92nd Lid to be expandable in future					$ -	
East of I-405							
	Cut and Cover Structure under SR 520	HCT Cut & Cover	1,200	RF	$ 14,640	$ 17,568,000	
	Rebuild 6 lanes across SR 520	Pavement	6,000	Lane FT	$ 67	$ 402,000	
			Subtotal			$ 19,831,300	A
Notes:		Traffic Control on "A"	15%			$ 2,974,695	B
1. Use HCT unit cost item 1160 - Cut and Cover Dual Track Tunnel Suburban minu		Construction Staging on "A"	20%			$ 3,966,260	C
minus track and systems cost.		Removals on "A"	10%			$ 1,983,130	D
			Subtotal			$ 28,755,385	E
		Mobilization on "E"	8%			$ 2,300,431	F
		Construction Contingency on "E"	15%			$ 4,313,308	G
		Construction Cost	Subtotal			$ 35,369,124	H
		Sales Tax on "H"	8.8%			$ 3,112,483	I
		Construction Administration on "H"	10%			$ 3,536,912	J
			Subtotal			$ 42,018,519	K
		Scope Contingency on "K"	20%			$ 8,403,704	L
			Construction Total (Rounded)			$ 50,000,000	M
		Preliminary Engineering on "H"	15%			5,305,369	N
		Scope Contingency on "N"	20%			$ 1,061,074	O
			Preliminary Engineering (Rounded)			$ 6,000,000	P
		Right of Way		SF		$ -	M
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

124th to WLSP

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
51st Ave (8 lanes only)							
	Cut and Cover Structure under SR 520 at 51	HCT Cut & Cover	1,900	RF	$ 14,640	$ 27,816,000	
	Rebuild 6 lanes across SR 520 for 500' both sides	Pavement	6,000	Lane FT	$ 67	$ 402,000	
			Subtotal			$ 28,218,000	A
Notes:		Traffic Control on "A"	4%			$ 1,128,720	B
1. Use HCT unit cost item 1160 - Cut and Cover Dual Track Tunnel Suburban minu		Construction Staging on "A"	5%			$ 1,410,900	C
minus track and systems cost.		Removals on "A"	5%			$ 1,410,900	D
2. The 51st cut and cover crossing will only be constructed for the eight lane scenario			Subtotal			$ 32,168,520	E
since under the six lane scenario no work work occur in this section of the		Mobilization on "E"	8%			$ 2,573,482	F
corridor during the highway construction.		Construction Contingency on "E"	15%			$ 4,825,278	G
		Construction Cost	Subtotal			$ 39,567,280	H
		Sales Tax on "H"	8.8%			$ 3,481,921	I
		Construction Administration on "H"	10%			$ 3,956,728	J
			Subtotal			$ 47,005,928	K
		Scope Contingency on "K"	20%			$ 9,401,186	L
			Construction Total (Rounded)			$ 56,000,000	M
		Preliminary Engineering on "H"	6%			2,374,037	N
		Scope Contingency on "N"	20%			$ 474,807	O
			Preliminary Engineering (Rounded)			$ 3,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

Redmond Way to NE Union

Design interchange for future HCT. (No cost)

Future HCT Costs

Floating Bridge

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Place superstructure on existing pontoons	Floating Bridge: Superstructure	216,000	SF	$ 150	$ 32,400,000	
			Subtotal			$ 32,400,000	A
Notes:		Traffic Control on "A"	0.5%			$ 162,000	B
		Construction Staging on "A"	0%			$ -	C
		Removals on "A"	0%			$ -	D
			Subtotal			$ 32,562,000	E
		Mobilization on "E"	8%			$ 2,604,960	F
		Construction Contingency on "E"	15%			$ 4,884,300	G
		Construction Cost	Subtotal			$ 40,051,260	H
		Sales Tax on "H"	8.8%			$ 3,524,511	I
		Construction Administration on "H"	10%			$ 4,005,126	J
			Subtotal			$ 47,580,897	K
		Scope Contingency on "K"	20%			$ 9,516,179	L
			Construction Total (Rounded)			$ 57,000,000	M
		Preliminary Engineering on "H"	5%			2,002,563	N
		Scope Contingency on "N"	20%			$ 400,513	O
			Preliminary Engineering (Rounded)			$ 2,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

West Side: Option A

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Install HCT Bridge Structure in gap and to Montlake	New Approach Structures to Lake Washington Crossing	6,600	RF	$ 8,130	$ 53,658,000	
			Subtotal			$ 53,658,000	A
Notes: 1. For HCT approach structure costs use unit cost item 4150 - New Approach Structure to Lake Washington Crossing without rail and systems cost		Traffic Control on "A"	3.5%			$ 1,878,030	B
		Construction Staging on "A"	4%			$ 2,146,320	C
		Removals on "A"	0%			$ -	D
			Subtotal			$ 57,682,350	E
		Mobilization on "E"	8%			$ 4,614,588	F
		Construction Contingency on "E"	15%			$ 8,652,353	G
		Construction Cost	Subtotal			$ 70,949,291	H
		Sales Tax on "H"	8.8%			$ 6,243,538	I
		Construction Administration on "H"	10%			$ 7,094,929	J
			Subtotal			$ 84,287,757	K
		Scope Contingency on "K"	20%			$ 16,857,551	L
			Construction Total (Rounded)			$ 101,000,000	M
		Preliminary Engineering on "H"	8%			5,675,943	N
		Scope Contingency on "N"	20%			$ 1,135,189	O
			Preliminary Engineering (Rounded)			$ 7,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

West Side: Option B (Not usable with 8 lane tunnel)

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Install HCT Bridge Structure in gap and to Montlake	New Approach Structures to Lake Washington Crossing	6,600	RF	$ 8,130	$ 53,658,000	
			Subtotal			$ 53,658,000	A
Notes: 1. For HCT approach structure costs use unit cost item 4150 - New Approach Structure to Lake Washington Crossing without rail and systems cost		Traffic Control on "A"	3.5%			$ 1,878,030	B
		Construction Staging on "A"	4%			$ 2,146,320	C
		Removals on "A"	0%			$ -	D
			Subtotal			$ 57,682,350	E
		Mobilization on "E"	8%			$ 4,614,588	F
		Construction Contingency on "E"	15%			$ 8,652,353	G
		Construction Cost	Subtotal			$ 70,949,291	H
		Sales Tax on "H"	8.8%			$ 6,243,538	I
		Construction Administration on "H"	10%			$ 7,094,929	J
			Subtotal			$ 84,287,757	K
		Scope Contingency on "K"	20%			$ 16,857,551	L
			Construction Total (Rounded)			$ 101,000,000	M
		Preliminary Engineering on "H"	8%			5,675,943	N
		Scope Contingency on "N"	20%			$ 1,135,189	O
			Preliminary Engineering (Rounded)			$ 7,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

West Side: Option C

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Reconstruct Montlake Lid for HCT Tunnel Enterance which has been designed for expansion.	Non Ventilated Lid	17,500	SF	$ 145	$ 2,537,500	
	Install HCT Bridge Structure in gap and to Montlake	New Approach Structures to Lake Washington Crossing	6,600	RF	$ 8,130	$ 53,658,000	
			Subtotal			$ 56,195,500	A
Notes:		Traffic Control on "A"	3.5%			$ 1,966,843	B
1. For HCT approach structure costs use unit cost item 4150 - New Approach Structure to Lake Washington Crossing without rail and systems cost.		Construction Staging on "A"	4%			$ 2,247,820	C
		Removals on "A"	0%			$ -	D
			Subtotal			$ 60,410,163	E
		Mobilization on "E"	8%			$ 4,832,813	F
		Construction Contingency on "E"	15%			$ 9,061,524	G
		Construction Cost	Subtotal			$ 74,304,500	H
		Sales Tax on "H"	8.8%			$ 6,538,796	I
		Construction Administration on "H"	10%			$ 7,430,450	J
			Subtotal			$ 88,273,746	K
		Scope Contingency on "K"	20%			$ 17,654,749	L
			Construction Total (Rounded)			$ 106,000,000	M
		Preliminary Engineering on "H"	8%			5,944,360	N
		Scope Contingency on "N"	20%			$ 1,188,872	O
			Preliminary Engineering (Rounded)			$ 7,000,000	P
		Additional ROW for Widened Lid	20,000	SF	$ 175	$ 3,500,000	Q
		Scope Contingency on "Q"	20%			$ 700,000	R
			Right of Way (Rounded)			$ 4,000,000	S

East Side: Evergreen Point Bridge Option A

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	BRT replacement by HCT has been accomodated for.						
	Install HCT Bridge Structure in gap.	New Approach Structures to Lake Washington Crossing	1,000	RF	$ 8,130	$ 8,130,000	
			Subtotal			$ 8,130,000	A
Notes:		Traffic Control on "A"	15%			$ 1,219,500	B
1. For HCT approach structure costs use unit cost item 4150 - New Approach Structure to Lake Washington Crossing without rail and systems cost.		Construction Staging on "A"	20%			$ 1,626,000	C
		Removals on "A"	10%			$ 813,000	D
			Subtotal			$ 11,788,500	E
		Mobilization on "E"	8%			$ 943,080	F
		Construction Contingency on "E"	15%			$ 1,768,275	G
		Construction Cost	Subtotal			$ 14,499,855	H
		Sales Tax on "H"	8.8%			$ 1,275,987	I
		Construction Administration on "H"	10%			$ 1,449,986	J
			Subtotal			$ 17,225,828	K
		Scope Contingency on "K"	20%			$ 3,445,166	L
			Construction Total (Rounded)			$ 21,000,000	M
		Preliminary Engineering on "H"	15%			2,174,978	N
		Scope Contingency on "N"	20%			$ 434,996	O
			Preliminary Engineering (Rounded)			$ 3,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

East Side: Evergreen Point Bridge Option B

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Place HCT in provided lid space						
	Install HCT Bridge Structure in gap..	New Approach Structures to Lake Washington Crossing	1,000	RF	$ 8,130	$ 8,130,000	
			Subtotal			$ 8,130,000	A
Notes:		Traffic Control on "A"	15%			$ 1,219,500	B
1. For HCT approach structure costs use unit cost item 4150 - New Approach Structure to Lake Washington Crossing without rail and systems cost.		Construction Staging on "A"	20%			$ 1,626,000	C
		Removals on "A"	10%			$ 813,000	D
			Subtotal			$ 11,788,500	E
		Mobilization on "E"	8%			$ 943,080	F
		Construction Contingency on "E"	15%			$ 1,768,275	G
		Construction Cost	Subtotal			$ 14,499,855	H
		Sales Tax on "H"	8.8%			$ 1,275,987	I
		Construction Administration on "H"	10%			$ 1,449,986	J
			Subtotal			$ 17,225,828	K
		Scope Contingency on "K"	20%			$ 3,445,166	L
			Construction Total (Rounded)			$ 21,000,000	M
		Preliminary Engineering on "H"	15%			2,174,978	N
		Scope Contingency on "N"	20%			$ 434,996	O
			Preliminary Engineering (Rounded)			$ 3,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

East Side: East of Evergreen Point Lid

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
Widen Median Past EP Lid							
	Replace two lanes to outside	Pavment	4,000	Lane FT	$ 67	$ 268,000	
		Earthwork	4,000	Lane FT	$ 80	$ 320,000	
		Enclosed drainage system	2,000	LF	$ 70	$ 140,000	
		Replace Retaining Walls	5,000	SF	$ 60	$ 300,000	
		Replace Noise Wall	1,800	LF	$ 275	$ 495,000	
84th Avenue							
	Widen accommodated Lid structure	Non Ventilated Lid	17,500	SF	$ 145	$ 2,537,500	
	Existing Cut and Cover Structure at 84th ramp					$ -	
92nd Avenue							
	Widen accommodated Lid structure	Non Ventilated Lid	15,000	SF	$ 145	$ 2,175,000	
East of I-405							
	Existing Cut and Cover Structure under SR 520	HCT Cut & Cover				$ -	
			Subtotal			$ 6,235,500	A
Notes:		Traffic Control on "A"	15%			$ 935,325	B
		Construction Staging on "A"	20%			$ 1,247,100	C
		Removals on "A"	10%			$ 623,550	D
			Subtotal			$ 9,041,475	E
		Mobilization on "E"	8%			$ 723,318	F
		Construction Contingency on "E"	15%			$ 1,356,221	G
		Construction Cost	Subtotal			$ 11,121,014	H
		Sales Tax on "H"	8.8%			$ 978,849	I
		Construction Administration on "H"	10%			$ 1,112,101	J
			Subtotal			$ 13,211,765	K
		Scope Contingency on "K"	20%			$ 2,642,353	L
			Construction Total (Rounded)			$ 16,000,000	M
		Preliminary Engineering on "H"	15%			1,668,152	N
		Scope Contingency on "N"	20%			$ 333,630	O
			Preliminary Engineering (Rounded)			$ 2,000,000	P
	Right of Way for widened median area		80,000	SF	$ 70	$ 5,600,000	
	Right of Way along SR 520 to L Washington Blvd		260,000	SF	$ 70	$ 18,200,000	M
	Right of Way from I-405 to 124th		112,000	SF	$ 175	$ 19,600,000	M
		Scope Contingency on "Q"	20%			$ 8,680,000	R
			Right of Way (Rounded)			$ 52,000,000	S

124th to WLSP

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
51st Ave (8 lanes)							
	No Work, Existing Cut and Cover Structure under SR 520 at 51						
51st Ave (6 lanes)							
	Cut and Cover Structure under SR 520 at 51	HCT Cut & Cover	1,900	RF	$ 14,640	$ 27,816,000	
	Rebuild 6 lanes across SR 520 for 500' both sides	Pavement	6,000	Lane FT	$ 67	$ 402,000	
			Subtotal			$ 28,218,000	A
Notes:		Traffic Control on "A"	4%			$ 1,128,720	B
1. The 51st cut and cover crossing was only constructed for the eight lane scenario since under the six lane scenario no work work occur in this section. Therefore th 51st cut and cover structure would occur as a future cost in the six lane alternative.		Construction Staging on "A"	5%			$ 1,410,900	C
		Removals on "A"	5%			$ 1,410,900	D
			Subtotal			$ 32,168,520	E
		Mobilization on "E"	8%			$ 2,573,482	F
		Construction Contingency on "E"	15%			$ 4,825,278	G
		Construction Cost	Subtotal			$ 39,567,280	H
		Sales Tax on "H"	8.8%			$ 3,481,921	I
		Construction Administration on "H"	10%			$ 3,956,728	J
			Subtotal			$ 47,005,928	K
		Scope Contingency on "K"	20%			$ 9,401,186	L
			Construction Total (Rounded)			$ 56,000,000	M
		Preliminary Engineering on "H"	6%			2,374,037	N
		Scope Contingency on "N"	20%			$ 474,807	O
			Preliminary Engineering (Rounded)			$ 3,000,000	P
		Right of Way along SR 520	562,400	SF	$ 62	$ 34,868,800	Q
		Scope Contingency on "Q"	20%			$ 6,973,760	R
			Right of Way (Rounded)			$ 42,000,000	S

HCT Accommodation 12:57 PM

Redmond Way to NE Union

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	I/C was designed to accommodate HCT						
			Subtotal			$ -	A
Notes:		Traffic Control on "A"	10%			$ -	B
		Construction Staging on "A"	10%			$ -	C
		Removals on "A"	5%			$ -	D
			Subtotal			$ -	E
		Mobilization on "E"	8%			$ -	F
		Construction Contingency on "E"	15%			$ -	G
		Construction Cost	Subtotal			$ -	H
		Sales Tax on "H"	8.8%			$ -	I
		Construction Administration on "H"	10%			$ -	J
			Subtotal			$ -	K
		Scope Contingency on "K"	20%			$ -	L
			Construction Total (Rounded)			$ -	M
		Preliminary Engineering on "H"	10%			-	N
		Scope Contingency on "N"	20%			$ -	O
			Preliminary Engineering (Rounded)			$ -	P
		Right of Way along SR 520	68,000	SF	$ 62	$ 4,216,000	Q
		Scope Contingency on "Q"	20%			$ 843,200	R
			Right of Way (Rounded)			$ 5,000,000	S

HCT Accommodation 9 of 9 8/9/02 12:57 PM

Scenario 4: HCT Envelope Preservation on Full Corridor

HCT Cost During Initial Highway Construction

Floating Bridge

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Additional floating bridge structure	Floating Bridge	215,000	SF	$ 350	$ 75,600,000	
			Subtotal			$ 75,600,000	A
Notes:		Traffic Control on "A"	0.5%			$ 378,000	B
		Construction Staging on "A"	0%			$ -	C
		Removals on "A"	0%			$ -	D
			Subtotal			$ 75,978,000	E
		Mobilization on "E"	8%			$ 6,078,240	F
		Construction Contingency on "E"	15%			$ 11,396,700	G
		Construction Cost	Subtotal			$ 93,452,940	H
		Sales Tax on "H"	8.8%			$ 8,223,859	I
		Construction Administration on "H"	10%			$ 9,345,294	J
			Subtotal			$ 111,022,093	K
		Scope Contingency on "K"	20%			$ 22,204,419	L
			Construction Total (Rounded)			$ 133,000,000	M
		Preliminary Engineering on "H"	5%			4,672,647	N
		Scope Contingency on "N"	20%			$ 934,529	O
			Preliminary Engineering (Rounded)			$ 6,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

West Side: Option A

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Lake Bridge to Montlake	New Approach Structures to Lake Washington Crossing	6,600	RF	$ 8,130	$ 53,658,000	
			Subtotal			$ 53,658,000	A
Notes:		Traffic Control on "A"	3.5%			$ 1,878,030	B
1. For HCT approach structure costs use unit cost item 4150 - New Approach Structure to Lake Washington Crossing without rail and systems cost.		Construction Staging on "A"	4%			$ 2,146,320	C
		Removals on "A"	0%			$ -	D
			Subtotal			$ 57,682,350	E
		Mobilization on "E"	8%			$ 4,614,588	F
		Construction Contingency on "E"	15%			$ 8,652,353	G
		Construction Cost	Subtotal			$ 70,949,291	H
		Sales Tax on "H"	8.8%			$ 6,243,538	I
		Construction Administration on "H"	10%			$ 7,094,929	J
			Subtotal			$ 84,287,757	K
		Scope Contingency on "K"	20%			$ 16,857,551	L
			Construction Total (Rounded)			$ 101,000,000	M
		Preliminary Engineering on "H"	8%			5,675,943	N
		Scope Contingency on "N"	20%			$ 1,135,189	O
			Preliminary Engineering (Rounded)			$ 7,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

West Side: Option B (Not usable with 8 lane tunnel)

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Lake Bridge to Montlake	New Approach Structures to Lake Washington Crossing	6,600	RF	$ 8,130	$ 53,658,000	
			Subtotal			$ 53,658,000	A
Notes:		Traffic Control on "A"	3.5%			$ 1,878,030	B
1. For HCT approach structure costs use unit cost item 4150 - New Approach Structure to Lake Washington Crossing without rail and systems cost.		Construction Staging on "A"	4%			$ 2,146,320	C
		Removals on "A"	0%			$ -	D
			Subtotal			$ 57,682,350	E
		Mobilization on "E"	8%			$ 4,614,588	F
		Construction Contingency on "E"	15%			$ 8,652,353	G
		Construction Cost	Subtotal			$ 70,949,291	H
		Sales Tax on "H"	8.8%			$ 6,243,538	I
		Construction Administration on "H"	10%			$ 7,094,929	J
			Subtotal			$ 84,287,757	K
		Scope Contingency on "K"	20%			$ 16,857,551	L
			Construction Total (Rounded)			$ 101,000,000	M
		Preliminary Engineering on "H"	8%			5,675,943	N
		Scope Contingency on "N"	20%			$ 1,135,189	O
			Preliminary Engineering (Rounded)			$ 7,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

West Side: Option C

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Widen Montlake Lid for HCT Tunnel Entrance	Non Ventilated Lid	17,500	SF	$ 145	$ 2,537,500	
	Approach Bridge to Montlake	New Approach Structures to Lake Washington Crossing	6,600	RF	$ 8,130	$ 53,658,000	
			Subtotal			$ 56,195,500	A
		Traffic Control on "A"	3.5%			$ 1,966,843	B
		Construction Staging on "A"	4%			$ 2,247,820	C
		Removals on "A"	0%			$ -	D
			Subtotal			$ 60,410,163	E
		Mobilization on "E"	8%			$ 4,832,813	F
		Construction Contingency on "E"	15%			$ 9,061,524	G
		Construction Cost	Subtotal			$ 74,304,500	H
		Sales Tax on "H"	8.8%			$ 6,538,796	I
		Construction Administration on "H"	10%			$ 7,430,450	J
			Subtotal			$ 88,273,746	K
		Scope Contingency on "K"	20%			$ 17,654,749	L
			Construction Total (Rounded)			$ 106,000,000	M
		Preliminary Engineering on "H"	8%			5,944,360	N
		Scope Contingency on "N"	20%			$ 1,188,872	O
			Preliminary Engineering (Rounded)			$ 7,000,000	P
		Additional ROW for Widened Lid	20,000	SF	$ 175	$ 3,500,000	Q
		Scope Contingency on "Q"	20%			$ 700,000	R
			Right of Way (Rounded)			$ 4,000,000	S

Notes:
1. For HCT approach structure costs use unit cost item 4150 - New Approach Structure to Lake Washington Crossing without rail and systems cost.

East Side: Evergreen Point Bridge Option A

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Redesign BRT for future HCT displacement						
	Approach Bridge to Evergreen Point	New Approach Structures to Lake Washington Crossing	1,000	RF	$ 8,130	$ 8,130,000	
			Subtotal			$ 8,130,000	A
		Traffic Control on "A"	15%			$ 1,219,500	B
		Construction Staging on "A"	20%			$ 1,626,000	C
		Removals on "A"	10%			$ 813,000	D
			Subtotal			$ 11,788,500	E
		Mobilization on "E"	8%			$ 943,080	F
		Construction Contingency on "E"	15%			$ 1,768,275	G
		Construction Cost	Subtotal			$ 14,499,855	H
		Sales Tax on "H"	8.8%			$ 1,275,987	I
		Construction Administration on "H"	10%			$ 1,449,986	J
			Subtotal			$ 17,225,828	K
		Scope Contingency on "K"	20%			$ 3,445,166	L
			Construction Total (Rounded)			$ 21,000,000	M
		Preliminary Engineering on "H"	15%			2,174,978	N
		Scope Contingency on "N"	20%			$ 434,996	O
			Preliminary Engineering (Rounded)			$ 3,000,000	P
		Right of Way		SF		$ -	Q
		Scope Contingency on "Q"	20%			$ -	R
			Right of Way (Rounded)			$ -	S

Notes:
1. For HCT approach structure costs use unit cost item 4150 - New Approach Structure to Lake Washington Crossing without rail and systems cost.

East Side: Evergreen Point Bridge Option B

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Additional 35' of width to Evergreen Point Lid	Non Ventilated Lid	17,500	SF	$ 145	$ 2,537,500	
	Approach Bridge to Evergreen Point	New Approach Structures to Lake Washington Crossing	1,000	RF	$ 8,130	$ 8,130,000	
			Subtotal			$ 10,667,500	A
		Traffic Control on "A"	15%			$ 1,600,125	B
		Construction Staging on "A"	20%			$ 2,133,500	C
		Removals on "A"	10%			$ 1,066,750	D
			Subtotal			$ 15,467,875	E
		Mobilization on "E"	8%			$ 1,237,430	F
		Construction Contingency on "E"	15%			$ 2,320,181	G
		Construction Cost	Subtotal			$ 19,025,486	H
		Sales Tax on "H"	8.8%			$ 1,674,243	I
		Construction Administration on "H"	10%			$ 1,902,549	J
			Subtotal			$ 22,602,278	K
		Scope Contingency on "K"	20%			$ 4,520,456	L
			Construction Total (Rounded)			$ 27,000,000	M
		Preliminary Engineering on "H"	15%			2,853,823	N
		Scope Contingency on "N"	20%			$ 570,765	O
			Preliminary Engineering (Rounded)			$ 3,000,000	P
		Additional ROW for Widened Lid	20,000	SF	$ 70	$ 1,400,000	Q
		Scope Contingency on "Q"	20%			$ 280,000	R
			Right of Way (Rounded)			$ 2,000,000	S

Notes:
1. For HCT approach structure costs use unit cost item 4150 - New Approach Structure to Lake Washington Crossing without rail and systems cost.

East Side: East of Evergreen Point Lid

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
84th Avenue							
	Additional 35' of width to 84th Lid	Non Ventilated Lid	17,500	SF	$ 145	$ 2,537,500	
	Cut and Cover Structure at 84th ramp	HCT Cut & Cover	50	RF	$ 14,640	$ 732,000	
	Rebuild 84th ramp	Pavement	400	Lane FT	$ 67	$ 26,800	
	Convert FB-1 Stormwater pond to vault system under roadway	Detention vault equal to pond storage	91,875	CF	$ 12	$ 1,102,500	
92nd Avenue							
	Additional 35' of width to 92nd lid	Non Ventilated Lid	17,500	SF	$ 145	$ 2,537,500	
East of I-405							
	Cut and Cover Structure under SR 520	HCT Cut & Cover	1,200	RF	$ 14,640	$ 17,568,000	
	Rebuild 6 lanes across SR 520	Pavement	6,000	Lane FT	$ 67	$ 402,000	
			Subtotal			$ 22,368,800	A
Notes:		Traffic Control on "A"	15%			$ 3,355,320	B
1. Use HCT unit cost item 1160 - Cut and Cover Dual Track Tunnel Suburban minus minus track and systems cost.		Construction Staging on "A"	20%			$ 4,473,760	C
		Removals on "A"	10%			$ 2,236,880	D
			Subtotal			$ 32,434,760	E
		Mobilization on "E"	8%			$ 2,594,781	F
		Construction Contingency on "E"	15%			$ 4,865,214	G
		Construction Cost	Subtotal			$ 39,894,755	H
		Sales Tax on "H"	8.8%			$ 3,510,738	I
		Construction Administration on "H"	10%			$ 3,989,475	J
			Subtotal			$ 47,394,969	K
		Scope Contingency on "K"	20%			$ 9,478,994	L
		Construction Total (Rounded)				$ 57,000,000	M
		Preliminary Engineering on "H"	15%			5,984,213	N
		Scope Contingency on "N"	20%			$ 1,196,843	O
		Preliminary Engineering (Rounded)				$ 7,000,000	P
	Right of Way for widened median area		80,000	SF	$ 70	$ 5,600,000	M
	Right of Way along SR 520 to L Washington Blvd		260,000	SF	$ 70	$ 18,200,000	M
	Right of Way from I-405 to 124th		112,000	SF	$ 175	$ 19,600,000	M
		Scope Contingency on "Q"	20%			$ 8,680,000	R
		Right of Way (Rounded)				$ 52,000,000	S

124th to WLSP

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
51st Ave							
	Cut and Cover Structure under SR 520 at 51	HCT Cut & Cover	1,900	RF	$ 14,640	$ 27,816,000	
	Rebuild 6 lanes across SR 520	Pavement	6,000	Lane FT	$ 67	$ 402,000	
			Subtotal			$ 28,218,000	A
Notes:		Traffic Control on "A"	4%			$ 1,128,720	B
1. Use HCT unit cost item 1160 - Cut and Cover Dual Track Tunnel Suburban minus minus track and systems cost.		Construction Staging on "A"	5%			$ 1,410,900	C
		Removals on "A"	5%			$ 1,410,900	D
			Subtotal			$ 32,168,520	E
		Mobilization on "E"	8%			$ 2,573,482	F
		Construction Contingency on "E"	15%			$ 4,825,278	G
		Construction Cost	Subtotal			$ 39,567,280	H
		Sales Tax on "H"	8.8%			$ 3,481,921	I
		Construction Administration on "H"	10%			$ 3,956,728	J
			Subtotal			$ 47,005,928	K
		Scope Contingency on "K"	20%			$ 9,401,186	L
		Construction Total (Rounded)				$ 56,000,000	M
		Preliminary Engineering on "H"	6%			$ 2,374,037	N
		Scope Contingency on "N"	20%			$ 474,807	O
		Preliminary Engineering (Rounded)				$ 3,000,000	P
		Right of Way along SR 520	562,400	SF	$ 62	$ 34,868,800	Q
		Scope Contingency on "Q"	20%			$ 6,973,760	R
		Right of Way (Rounded)				$ 42,000,000	S

Redmond Way to NE Union

Location	Description	Type	Quantity	Unit	Unit Cost	Cost	
	Design to Accommodate HCT crossing	Pavement	0	Lane FT	$ 67	$ -	
			Subtotal			$ -	A
Notes:		Traffic Control on "A"	10%			$ -	B
		Construction Staging on "A"	10%			$ -	C
		Removals on "A"	5%			$ -	D
			Subtotal			$ -	E
		Mobilization on "E"	8%			$ -	F
		Construction Contingency on "E"	15%			$ -	G
		Construction Cost	Subtotal			$ -	H
		Sales Tax on "H"	8.8%			$ -	I
		Construction Administration on "H"	10%			$ -	J
			Subtotal			$ -	K
		Scope Contingency on "K"	20%			$ -	L
		Construction Total (Rounded)				$ -	M
		Preliminary Engineering on "H"	10%			$ -	N
		Scope Contingency on "N"	20%			$ -	O
		Preliminary Engineering (Rounded)				$ -	P
		Right of Way along SR 520	68,000	SF	$ 62	$ 4,216,000	Q
		Scope Contingency on "Q"	20%			$ 843,200	R
		Right of Way (Rounded)				$ 5,000,000	S

Future HCT Costs

No Work

Appendix E – Sound Transit Staff Report: Motions related to I-90 LRT (December 14, 2006)

SOUND TRANSIT
STAFF REPORT

MOTION NO. M2006-87

Identify East Link Light Rail Route Alternatives to be Studied in a Draft EIS

Meeting:	Date:	Type of Action:	Staff Contact:	Phone:
Board Meeting	12/14/06	Discussion/Possible Action	Ahmad Fazel, Link Director Mike Williams, Project Development Manager **Don Billen, East Link Project Manager**	(206) 398-5389 (206) 398-5145 (206) 398-5052

Contract/Agreement Type:	✓	Requested Action:	✓
Competitive Procurement		Execute New Contract/Agreement	
Sole Source		Amend Existing Contract/Agreement	
Agreement with Other Jurisdiction(s)		Budget Amendment	
Real Estate		Property Acquisition	

PROJECT NAME

East Corridor Phase 2 Planning

PROPOSED ACTION

Identify the light rail routes, stations, and maintenance facility alternatives to be studied in detail in the East Link draft Environmental Impact Statement

KEY FEATURES of PROPOSED ACTION

- This action seeks Board identification of the light rail routes, stations, and maintenance facility alternatives to study in detail in the draft Environmental Impact Statement (draft EIS). At the November 9, 2006 Board meeting, staff briefed the Board on the evaluation of route alternatives and maintenance facility locations for the East Link project. Staff also briefed the Board on the results of the public and agency scoping process.

- Alternatives identified for further study will generally be developed to a conceptual engineering level of design, 5% to10% and analyzed in the draft EIS. During conceptual engineering, alignment, station, and maintenance facility locations will be refined within the general routes and station areas identified in the November 2006 East Link Project Sound Transit Board Briefing Book: Light Rail Alternatives.

- During the design and environmental review of the routes advanced, route and station development workshops will be held to engage affected communities in the project development process and get feedback on alignment and station location design issues. Sound Transit will also seek to avoid, minimize, or mitigate potential impacts of the project as design progresses.

- The routes, stations and maintenance facility alternatives for consideration are:

Segment A

There is one route alternative between downtown Seattle and Bellevue. The route begins in the existing Downtown Seattle Transit Tunnel and connects to the Central Link light rail system at the Chinatown/International District Station. It enters I-90 via the existing D2 roadway, a high occupancy vehicle (HOV) ramp between downtown Seattle and Rainier Avenue. The route is in the center reversible lanes of I-90 across Lake Washington and Mercer Island.

Segment B: I-90 to Downtown Bellevue:

Options to identify for detailed study in the draft EIS & conceptual engineering:

- Alternative B1: Bellevue Way
- Alternative B2-A: Bellevue Way SE/112th Avenue SE At-grade
- Alternative B2-E: Bellevue Way SE/112th Avenue SE Elevated
- Alternative B3: Bellevue Way/I-405
- Alternative B4: 118th/112th
- Alternative B5: 118th/I-405
- Alternative B6: BNSF/112th
- Alternative B7: BNSF/I-405

Segment C: Downtown Bellevue to Overlake Hospital

Options to identify for detailed study in the draft EIS & conceptual engineering:

- Alternative C1-T: Bellevue Way/NE 6th Street Tunnel
- Alternative C2-T: 106th Avenue NE Tunnel
- Alternative C3-T: Bellevue 108th Avenue NE Tunnel
- Alternative C4-A: 108th and 110th Avenues NE At-Grade Couplet
- Alternative C7-E: 112th Avenue NE Elevated
- Alternative C8-E: 110th Avenue NE Elevated

The following alternatives were studied but precluded during early project development by construction starting on a 400,000 square foot residential tower in the path of the route and are not recommended for further study:

- Alternative C5-E: 110th Avenue NE/NE 7th Street Elevated
- Alternative C6-A: 110th Avenue NE At-Grade/NE 7th Street Elevated

Segment D: Downtown Bellevue to Overlake Transit Center

Options to identify for detailed study in the draft EIS & conceptual engineering:

- Alternative D1: NE Bellevue-Redmond Road
- Alternative D2-A: NE 16th Street/SR 520 to Overlake At-Grade*
- Alternative D2-E: NE 16th Street/SR 520 to Overlake Elevated*

- Alternative D3: NE 16th Street/NE 20th Street to Overlake*
- Alternative D4: NE 16th Street/Bel-Red Road to Overlake*
- Alternative D5: BNSF/SR 520 to Overlake

* A potential station at NE 16th/122nd is recommended for study with Alternatives D2, D3, and D4.

Segment E: Overlake Transit Center to Downtown Redmond

Options to identify for detailed study in the draft EIS & conceptual engineering:

- Alternative E1: Redmond Way
- Alternative E2: Marymoor Park*
- Alternative E3: Bear Creek
- Alternative E4: Leary Way

*An option to terminate at the Redmond Town Center Station, rather than continuing to the Redmond Park-and-Ride, is recommended for study with Alternative E2 in order to increase cost-effectiveness and reduce impacts.

Maintenance Facility

Options to identify for detailed study in the draft EIS & conceptual engineering:

- MF-1: 116th Avenue NE
- MF-2: BNSF
- MF-3: SR 520
- MF-4: NE 136th Place
- MF-5: Redmond

BUDGET IMPACT SUMMARY

Identification of the light rail alternatives does not create an immediate budget impact. However, beginning preparation of the draft EIS for East Link is dependent upon approval of the 2007 Budget with a new Transit Vision project titled East Corridor Phase 2 Planning; within the East King County subarea. Assuming approval of the East Corridor Phase 2 Planning budget, staff will return to the Board in January 2007 to seek authority for consultant support required for conceptual engineering and preparation of the draft EIS. The amount of contract authority requested will be affected by the number of alternatives identified for further study in this action.

M/W/DBE – SMALL BUSINESS PARTICIPATION

Not applicable to this action.

PROJECT DESCRIPTION and BACKGROUND for PROPOSED ACTION

The East Link project is a potential ST2 project to provide light rail transit between Seattle, Bellevue, and Redmond via I-90 and Mercer Island. Within ST2, the eastern limits of the project may be in Bellevue or Redmond. The project also includes a light rail operations and maintenance facility.

On June 1, 2005, Sound Transit released a Supplemental Environmental Impact Statement (Supplemental EIS) to update its plan-level environmental analysis and to inform regional transit project decisions. Like the 1993 EIS which it supplements, the 2005 Supplemental EIS provides plan-level environmental review to be followed, as appropriate, by more detailed project-level environmental review for specific project elements.

In July 2005 following the completion of appropriate planning studies, the Sound Transit Board designated Seattle to Redmond via I-90 and Bellevue as a light rail or rail convertible bus rapid transit corridor in the Regional Transit Long Range Vision. In September 2005, Sound Transit and the Washington State Department of Transportation (WSDOT) conducted a load test on the I-90 Bridge over three days. This full-scale test was launched to provide additional information to complement and affirm modeling work and structural analyses prepared by WSDOT consulting engineers in 2001 which showed that the bridge is capable of carrying Sound Transit's light rail system. Results of this load test confirmed previous findings.

In addition to the load test, several other studies were prepared, including a planning level analysis on the feasibility of the "rail joint" necessary for the construction and operation of light rail on the I-90 floating bridge, a WSDOT report detailing future congestion on I-90 and the projected traffic effects on I-90 resulting from converting the center roadway to exclusive transit use, and a high-level historical review of the more than 40 years of planning studies and agreements relevant to the I-90 corridor between the Eastside and Seattle.

In May 2006, the Finance Committee authorized the chief executive officer to execute a contract with CH2M Hill to provide engineering, environmental, and public outreach services for the Phase II East Corridor High Capacity Transit planning. Subsequently, staff initiated NEPA/SEPA project-level environmental review, route, station, and maintenance facility screening, and project-level public involvement in the corridor.

In July 2006 following the review of the planning and other studies described above, the Board identified light rail as the preferred mode in the Seattle to Redmond via I-90 corridor. Light rail provides the highest level of ridership and the shortest travel time of all the modes evaluated in the corridor and provides a higher level of system integration, because East Link light rail will be interlined with northbound Central Link light rail in downtown Seattle.

Evaluation of the alternative project routes, stations, and maintenance facility locations identified by the Board will be conducted in cooperation with the Federal Transit Administration (FTA). Before committing federal funds to the East Link project, the FTA is required to undertake environmental review in compliance with the National Environmental Policy Act (NEPA). As the public agency proposing the East Link project, Sound Transit is required to comply with the State Environmental Policy Act (SEPA). The FTA, as the federal lead agency under NEPA, and Sound Transit, as the state lead agency under SEPA, have determined that alternative routes and stations in the project may have probable significant adverse environmental impacts. The Washington State Department of Transportation (WSDOT) is also expected to be a SEPA co-lead agency. To satisfy both NEPA and SEPA requirements, the agencies are preparing a combined NEPA/SEPA EIS for the project.

For this project-level EIS, a scoping process took place to receive comments on the project's proposed purpose and need, range of alternatives and impacts to be discussed in the draft EIS. The scoping comment period for the East Link project ended October 2, 2006. The process involved a 30-day comment period, four scoping open houses, and an agency scoping meeting, where the public had the opportunity to review possible route alternatives and provide comments. Those comments were considered in further defining the route alternatives being brought before the Board for consideration.

At the November 9, 2006 Board meeting, staff briefed the Board on the evaluation of route alternatives and maintenance facility locations for the East Link project. Staff has also provided the Board with information on cost factors, environmental impacts, and transportation service of the various route and maintenance facility alternatives. This action seeks Board identification of the light rail routes, stations, and maintenance facility alternatives to study in detail in the draft EIS.

Prior Board/Committee Actions on this Project and Relevant Board Policies

Motion or Resolution Number	Summary of Action	Date of Action
R2006-15	Identifying light rail as the preferred high capacity transit mode in the Seattle to Bellevue to Redmond via I-90 corridor	7/13/06
M2006-39	Authorizing the Chief Executive Officer to execute a contract to provide the first portion of engineering, environmental, and public outreach services of a multi-part project with CH2M Hill for the Phase II East Corridor High Capacity Transit project	5/4/06
M2005-86	Task Order with Washington Department of Transportation for light rail simulation on the I-90 Floating Bridge	7/28/05
R2005-18	Amending the Adopted 2005 Budget for High Capacity Transit Phase 2 Planning for payment to the Washington State Department of Transportation for light rail simulation on the I-90 Floating Bridge	7/28/05
R2005-14	Adoption of the Regional Transit Long-Range Plan designating Seattle to Redmond via I-90 and Bellevue as light rail or rail convertible bus rapid transit	7/7/05
M2005-19	Executed Agreement GCA 3536 Task Order #12 with the Washington State Department of Transportation for design services for Stage 1 of the I-90 Two-Way Transit and HOV Operations project.	5/18/05
M2004-63	Authorized the Chief Executive Officer to enter into an amendment to the I-90 Memorandum Agreement.	8/12/04
R2004-09	Amended Sound Move to provide for Two-Way Transit and HOV Operations in the outer roadways of I-90 and to select Alternative R-8A as the project to be built.	8/12/04
M2003-120	Directed staff to negotiate an amendment to the Memorandum Agreement for I-90 to define the guiding principles for the ultimate configuration of the I-90 roadway with HCT in the center roadway.	11/13/03
M2003-99	Identified Alternative R-8A as the preferred alternative for the I-90 Two-Way Transit and HOV Operations Project.	11/13/03
Resolution 73	Adoption of the Regional Transit Long-Range Vision identifying the I-90/East Corridor as a potential rail extension	5/31/96

CONSEQUENCES of DELAY

A delay would lead staff to defer the start of detailed study of light rail routes, stations and maintenance facility alternatives until the Board identifies which alternatives to study.

PUBLIC INVOLVEMENT

The scoping comment period for the East Link project EIS ended on October 2, 2006. The process involved a comment period, four scoping open houses, and an agency scoping meeting where the public had the opportunity to review possible route alternatives and provide comments. Two of the scoping meetings were held in conjunction with ST2 open houses in Seattle and Bellevue. Sound Transit also held a public meeting at Bellevue City Hall on September 27, 2006 to further inform Bellevue neighborhoods about the South Bellevue routes and solicit public comments.

A summary report of all scoping comments has been provided to the Board. Those comments were considered in further defining the route alternatives being brought before the Board for consideration and will also be used to refine designs during conceptual engineering. In some cases, routes were suggested that after review did not meet project objectives or Sound Transit tunneling criteria. While considered, these routes were generally not developed to the same level of design as the routes presented in the November 2006 East Link Project Sound Transit Board Briefing Book: Light Rail Alternatives.

Since briefing the Board on November 9, 2006, on the evaluation of route alternatives and maintenance facility locations for the East Link project, staff has also offered briefings to local jurisdiction staff, elected officials, neighborhood groups, and other project stakeholders.

When conceptual engineering begins on the alternatives identified for further study, route and station development workshops will be held to engage affected communities in the project development process and get feedback on alignment and station location design issues.

ENVIRONMENTAL COMPLIANCE

JI, 12/12/06

LEGAL REVIEW

JW, 12/12/06

No Build Toll Sensitivity Analysis

Washington State Department of Transportation

SR 520 Bridge Replacement and HOV Program

Toll Sensitivity Analysis for the SR 520 No Build Alternative Technical Memorandum

Prepared by

Washington State Department of Transportation

February 2011

Table of Contents

List of Exhibits

Acronyms and Abbreviations

EA	environmental assessment
ESSB	Engrossed Substitute Senate Bill
Final EIS	final environmental impact statement
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
GP	general-purpose (lane)
HOV	high-occupancy vehicle
I-5	Interstate 5
SR	State Route
WSDOT	Washington State Department of Transportation

Purpose of the SR 520 No Build Alternative Tolling Sensitivity Analysis

Introduction

This technical memorandum was written to address comments received on the SDEIS for the SR 520, I-5 to Medina: Bridge Replacement and HOV Project. It evaluates how the No Build Alternative would operate if a toll were assumed to be in place on State Route (SR) 520 in the design year of 2030. (The analysis through the Draft, Supplemental Draft, and Final Draft EIS has consistently assumed that the No Build Alternative would not be tolled.) It also describes how the Preferred Alternative would compare to a tolled No Build alternative in terms of travel demand.

The SR 520, I-5 to Medina project encompasses the area from the eastern landing of the Evergreen Point Bridge in Medina to the I-5/SR 520 interchange in Seattle. The project would include continuous high-occupancy vehicle (HOV) , which would connect with HOV lanes currently being constructed as part of the Eastside Transit and HOV Project. The primary tool used for the assessment is the Puget Sound Regional Council travel demand model as applied for the Final Environmental Impact Statement (Final EIS) for the SR 520, I-5 to Medina project. The analysis used the No Build Alternative's network with the same toll rates that are anticipated in the year 2030 for the project's Preferred Alternative.

Background on SR 520 Tolling

All-electronic tolling is planned to start on the floating portion of the Evergreen Point Bridge in the summer of 2011 under the SR 520 Variable Tolling Project, which is part of the Lake Washington Congestion Management Program. The purpose of this tolling is to manage congestion on SR 520 by tolling the existing four-lane facility. The Washington State Department of Transportation (WSDOT), with the Federal Highway Administration (FHWA), published an Environmental Assessment (EA) for the Variable Tolling Project on April 9, 2009. The EA disclosed the results of WSDOT's analysis of the effects of implementing tolling on the corridor prior to and during construction of the SR 520, I-5 to Medina Project (2010 through 2016). The FHWA issued a Finding of No Significant Impact (FONSI) for the variable tolling project on June 5, 2009. The SR 520, I-5 to Medina EIS evaluates the effects of tolling that is assumed to occur to fund construction of corridor improvements.

The Washington State Legislature, in Engrossed Substitute Senate Bill (ESSB) 6392, allowed revenue generated from the SR 520 Variable Tolling Project to be used to fund portions of the SR 520 corridor program that have already completed their environmental review and are proceeding toward construction. These include the SR 520, Medina to SR 202: Eastside Transit and HOV Project, as well as the construction of pontoons necessary for replacement of the Evergreen Point Bridge in the event of a catastrophic failure. The Legislature has also allocated funding from the tolls for the floating portion of the bridge and its landings, pending the completion of environmental review under the SR 520, I-5 to Medina project.

From its inception, the SR 520, I-5 to Medina project has been envisioned and publicly discussed as a toll project, and tolls on the facility were assumed for each of the build alternatives evaluated in the Draft, Supplemental Draft, and Final EIS. The purpose of these tolls would be to fund full construction of the new corridor. Therefore, in a true "no build" alternative for the SR 520, I-5 to Medina project, neither the floating bridge nor the Seattle portion of the project would be constructed, and funding for this purpose would not be required. However, revenue from the Variable Tolling Project would still be used to pay for the Eastside project and the construction of replacement pontoons. Bonds for these projects could be retired prior to 2030; hence, the EIS analysis has assumed that tolls would no longer be needed in the corridor after retirement of those bonds. Although regional tolling efforts are envisioned in the *Vision 2040* regional transportation plan, they are not currently planned or programmed for implementation.

The Tolled No Build Alternative

The No Build Alternative in the Final EIS assumes that there would be no improvements to the existing facility between I-5 and Medina. The study area and its transportation functions are assumed to remain as they are today, providing a four-lane highway crossing the lake, with no pedestrian or bicycle facilities, no shoulders, and no dedicated HOV or transit facilities. Although the existing bridges crossing Lake Washington and its bays are vulnerable and may not remain intact through the project’s design year of 2030, for purposes of analysis the facility and its functions are assumed to remain available for use.

For a sensitivity test of a toll on SR 520 for the No Build Alternative, the key assumptions are:

- Variable toll rates (the same rates as applied for the Preferred Alternative) would be imposed at the Evergreen Point Bridge mid-span. The rates used are those assumed for the Final EIS model.
- Transit and 3+ HOVs would be toll-exempt.
- Over a 24-hour weekday, tolls would change eleven times, representing seven different price levels.
- Over a 24-hour weekend day, tolls would change four times, representing three different price levels.

Potential Effects of Tolling on No Build Transportation Conditions

If the No Build alternative were tolled in the year 2030, the cost would provide some incentive for more people to utilize transit and carpools, choose different routes, or reduce travel altogether. However, congestion would still be present on the highway, and because continuous HOV lanes would not exist, bus and carpool travel would offer no benefits over general-purpose travel in terms of time savings or reliability.

Exhibits 1, 2, and 3 summarize the results of model forecasts for the No Build Alternative with and without a toll, examining the morning and evening peak periods and all-day conditions in 2030. Exhibits 1 to 3 and the conclusions below focus on the primary differences in transportation conditions in 2030 that would be expected with a toll on an unimproved SR 520.

Exhibit 1. AM Peak Period Cross-Lake Vehicle and Person Trip Volumes for 2030 No Build alternative with and without Tolling

2030 No Build Alternative (No Toll)								
	AM Peak Period Vehicle Volumes			AM Peak Period Person Trip Volumes				
Roadway Facility	Total Non-HOV[1]	HOV (3+)	Total	Non-HOV	HOV (3+)	Commercial	Transit	Total
SR 522 (West of 61st Avenue NE)	10,270	270	10,540	10,990	970	750	630	13,340
SR 520 (Evergreen Point Bridge) – General-Purpose (GP) Lanes	23,730	660	24,390	23,590	2,400	3,020	1,130	30,140
I-90 (West Bridge) - GP Lanes	30,940	200	31,140	30,630	720	4,730	-	36,080
I-90 (West Bridge) - HOV Lanes	-	2,310	2,310	-	8,290	-	990	9,280
I-90 Rail	-	-	-	-	-	-	13,940	13,940
I-90 Total	30,940	2,510	33,450	30,630	9,010	4,730	14,930	59,300
Total Cross-Lake	64,940	3,440	68,380	65,210	12,380	8,500	16,690	102,780

Exhibit 1. AM Peak Period Cross-Lake Vehicle and Person Trip Volumes for 2030 No Build alternative with and without Tolling

2030 No Build Tolled								
	AM Peak Period Vehicle Volumes			AM Peak Period Person Trip Volumes				
Roadway Facility	**Total Non-HOV[1]**	**HOV (3+)**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Transit**	**Total**
SR 522 (West of 61st Avenue NE)	10,460	250	10,710	11,220	870	670	550	13,310
Percent Change from No Build	*2*	*-7*	*2*	*2*	*-10*	*-11*	*-13*	*0*
Plus or Minus from No-Build'	*190*	*-20*	*170*	*230*	*-100*	*-80*	*-80*	*-30*
SR 520 (Evergreen Point Bridge) - GP Lanes	20,540	1,010	21,550	20,680	3,680	2,720	1,480	28,560
Percent Change from No Build	*-13*	*53*	*-12*	*-12*	*53*	*-10*	*31*	*-5*
Plus or Minus from No Build'	*-3,190*	*350*	*-2,840*	*-2,910*	*1,280*	*-300*	*350*	*-1,580*
I-90 (West Bridge) - GP Lanes	32,090	160	32,250	31,930	590	4,580	-	37,100
I-90 (West Bridge) - HOV Lanes	-	2,100	2,100	-	7,530	-	1,050	8,580
I-90 Rail	-	-	-	-	-	-	13,780	13,780
I-90 Total	32,090	2,260	34,350	31,930	8,120	4,580	14,830	59,460
Percent Change from No Build	*4*	*-10*	*3*	*4*	*-10*	*-3*	*-1*	*0*
Plus or Minus from No Build'	*1,150*	*-250*	*900*	*1,300*	*-890*	*-150*	*-100*	*160*
Total Cross-Lake	63,090	3,520	66,610	63,830	12,670	7,970	16,860	101,330
Percent Change from No Build	*-3*	*2*	*-3*	*-2*	*2*	*-6*	*1*	*-1*
Plus or Minus from No Build'	*-1,850*	*80*	*-1,770*	*-1,380*	*290*	*-530*	*170*	*-1,450*

AM Peak Period Conditions

- While a tolled No Build Alternative would have fewer SR 520 vehicle trips than the untolled No Build Alternative, it would still have about the same volumes as the corridor today, with heavily congested conditions for all travelers, regardless of mode.
- Total cross-lake vehicle trips (all corridors including SR 522, SR 520, and I-90) would decrease by 3 percent, but person trips would decrease by only 1 percent, indicating that about half the change in AM peak vehicle trips would be absorbed by travelers switching to either HOV or transit.
- SR 520 total vehicle trips would decrease by 13 percent during the peak, due to SR 520 general-purpose (GP) trips shifting to the I-90 corridor (about one-third of the trips), or remaining in the SR 520 corridor but switching to HOV or transit. The remaining vehicle trips may switch to another time period, or travelers would change their trips to avoid crossing the lake.
- HOV trips on SR 520 in the AM peak period would increase by nearly 53 percent, but travelers would still need to use the GP lanes across the lake. Drivers traveling to or from the Eastside would experience some travel time advantages compared to GP travelers because of the HOV lanes that would be in place east of Medina.
- SR 520 person trips would decrease by 5 percent during the AM peak, less than half the 12 percent decrease seen in vehicle trips. This is the result of travelers switching to HOV and transit, and indicates that most trips would remain in the SR 520 corridor even if it is tolled.
- SR 522 would be largely unaffected, with about a 2 percent change in trips during the 3-hour peak period.
- A 3 percent increase in I-90 GP lane vehicle volumes during the AM peak period, compared to the No Build Alternative, could further aggravate congested conditions predicted in that corridor for the year 2030.

Exhibit 2. PM Peak Period Cross-Lake Vehicle and Person Trip Volumes for 2030 No Build alternative with and without Tolling

2030 No Build Alternative (no toll)								
	PM Peak Period Vehicle Volumes			PM Peak Period Person Trip Volumes				
Roadway Facility	Total Non-HOV[1]	HOV (3+)	Total	Non-HOV	HOV (3+)	Commercial	Transit	Total
SR 522 (West of 61st Avenue NE)	11,500	290	11,790	12,340	1,020	810	630	14,800
SR 520 (Evergreen Point Bridge) - GP Lanes	25,950	620	26,570	26,270	2,220	3,260	1,130	32,880
I-90 (West Bridge) - GP Lanes	36,230	230	36,460	36,030	830	5,440	-	42,300
I-90 (West Bridge) - HOV Lanes	-	2,900	2,900	-	10,370	-	990	11,360
I-90 Rail	-	-	-	-	-	-	13,940	13,940
I-90 Total	36,230	3,130	39,360	36,030	11,200	5,440	14,930	67,600
Total Cross-Lake	73,680	4,040	77,720	74,640	14,440	9,510	16,690	115,280

Exhibit 2. PM Peak Period Cross-Lake Vehicle and Person Trip Volumes for 2030 No Build alternative with and without Tolling

2030 No Build Tolled								
	PM Peak Period Vehicle Volumes			PM Peak Period Person Trip Volumes				
Roadway Facility	**Total Non-HOV[1]**	**HOV (3+)**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Transit**	**Total**
SR 522 (West of 61st Avenue NE)	11,750	260	12,010	12,730	910	690	550	14,880
Percent Change from No Build	2	-10	2	3	-11	-15	-13	1
Plus or Minus from No-Build'	250	-30	220	390	-110	-120	-80	80
SR 520 (Evergreen Point Bridge) - GP Lanes	23,100	1,180	24,280	23,060	4,230	3,480	1,480	32,250
Percent Change from No Build	*-11*	*90*	*-9*	*-12*	*91*	*7*	*31*	*-2*
Plus or Minus from No-Build'	*-2,850*	*560*	*-2,290*	*-3,210*	*2,010*	*220*	*350*	*-630*
I-90 (West Bridge) - GP Lanes	37,100	130	37,230	37,660	460	4,780	-	42,900
I-90 (West Bridge) - HOV Lanes	-	2,580	2,580	-	9,190	-	1,050	10,240
I-90 Rail	-	-	-	-	-	-	13,780	13,780
I-90 Total	37,100	2,710	39,810	37,660	9,650	4,780	14,830	66,920
Percent Change from No Build	*2*	*-13*	*1*	*5*	*-14*	*-12*	*-1*	*-1*
Plus or Minus from No-Build'	*870*	*-420*	*450*	*1,630*	*-1,550*	*-660*	*-100*	*-680*
Total Cross-Lake	71,950	4,150	76,100	73,450	14,790	8,950	16,860	114,050
Percent Change from No Build	*-2*	*3*	*-2*	*-2*	*2*	*-6*	*1*	*-1*
Plus or Minus from No-Build'	*-1,730*	*110*	*-1,620*	*-1,190*	*350*	*-560*	*170*	*-1,230*

PM Peak Period Conditions

Tolling the existing corridor in 2030 would have similar effects during the PM peak period as the AM peak period, although the shifts in traffic volumes compared to the untolled No Build Alternative are slightly less marked than predicted for the AM.

- Again, while tolling would reduce SR 520 vehicle trips compared to the No Build Alternative, it would still have about the same volumes as the corridor today, and congestion problems would remain.
- The PM total cross-lake vehicle trips (all corridors including SR 522, SR 520, and I-90) would decrease by 2 percent, with person trips decreasing by only 1 percent.
- SR 520 total vehicle trips would decrease by 9 percent during the peak; however, compared to the 13 percent decrease at the AM peak period, fewer GP trips in the PM peak appear to be affected by the toll. This indicates that during the evening peak, travelers appear less likely to migrate to other corridors such as I-90.
- SR 520 person trips would decrease by only 2 percent, which is a lower shift than the 6 percent decrease in the AM peak period, with more PM peak trips being accommodated by HOV use (48 percent higher than No Build untolled) and transit use (24 percent higher than No Build untolled).
- SR 522 again would remain largely unaffected, with about a 2 percent change in trips during the 3-hour peak period.I-90 would also be less affected than in the AM peak period, with about a 2 percent increase in GP trips, but this increase could still aggravate the congestion expected in that corridor.

Exhibit 3. Daily Cross-Lake Vehicle and Person Trip Volumes for 2030 No Build alternative Untolled and Tolled

2030 No Build Alternative								
	Daily Vehicle Volumes			Daily Person Trip Volumes				
Roadway Facility	Total Non-HOV[1]	HOV (3+)	Total	Non-HOV	HOV (3+)	Commercial	Transit	Total
SR 522 (West of 61st Avenue NE)	52,550	1,760	54,310	56,490	6,200	3,290	1,840	67,820
SR 520 (Evergreen Point Bridge) - GP Lanes	123,040	4,530	127,570	123,750	16,020	15,340	3,670	158,780
I-90 (West Bridge) - GP Lanes	164,750	2,090	166,840	164,780	7,360	23,070	-	195,210
I-90 (West Bridge) - HOV Lanes	-	9,320	9,320	-	33,030	-	1,990	35,020
I-90 Rail	-	-	-	-	-	-	41,390	41,390
I-90 Total	164,750	11,410	176,160	164,780	40,390	23,070	43,380	271,620
Total Cross-Lake	340,340	17,700	358,040	345,020	62,610	41,700	48,890	498,220

Exhibit 3. Daily Cross-Lake Vehicle and Person Trip Volumes for 2030 No Build alternative Untolled and Tolled

	2030 No Build Tolled[3]							
	Daily Vehicle Volumes			Daily Person Trip Volumes				
Roadway Facility	Total Non-HOV[1]	HOV (3+)	Total	Non-HOV	HOV (3+)	Commercial	Transit	Total
SR 522 (West of 61st Avenue NE)	54,190	1,600	55,790	58,590	5,620	2,950	1,630	68,790
Percent Change from No Build	3	-9	3	4	-9	-10	-11	1
Plus or Minus from No Build'	1,640	-160	1,480	2,100	-580	-340	-210	970
SR 520 (Evergreen Point Bridge) - GP Lanes	106,390	6,200	112,590	106,820	21,950	14,430	4,750	147,950
Percent Change from No Build	-14	37	-12	-14	37	-6	29	-7
Plus or Minus from No Build'	-16,650	1,670	-14,980	-16,930	5,930	-910	1,080	-10,830
I-90 (West Bridge) - GP Lanes	171,470	1,790	173,260	173,710	6,290	21,740	-	201,740
I-90 (West Bridge) - HOV Lanes	-	8,410	8,410	-	29,780	-	2,110	31,890
I-90 Rail	-	-	-	-	-	-	40,850	40,850
I-90 Total	171,470	10,200	181,670	173,710	36,070	21,740	42,960	274,480
Percent Change from No Build	4	-11	3	5	-11	-6	-1	1
Plus or Minus from No Build'	6,720	-1,210	5,510	8,930	-4,320	-1,330	-420	2,860
Total Cross-Lake	332,050	18,000	350,050	339,120	63,640	39,120	49,340	491,220
Percent Change from No Build	-2	2	-2	-2	2	-6	1	-1
Plus or Minus from No Build'	-8,290	300	-7,990	-5,900	1,030	-2,580	450	-7,000

Daily Travel Demand Conditions

The daily travel demand changes due to a toll would maintain the trends seen at the peak periods.

- Tolling would reduce daily SR 520 vehicle trips compared to the untolled No Build Alternative, and would result in fewer vehicle trips than under existing (2006) conditions. However, most of the reduction in trips would be during off-peak hours, with congested conditions remaining during the peak periods for all modes.
- Total cross-lake vehicle trips (all corridors including SR 522, SR 520, and I-90) would decrease by 2 percent, but person trips would decrease by only 1 percent, reflecting that about half the travelers who had been driving alone would switch to either HOV or transit.
- SR 520 total vehicle trips would decrease by 12 percent, while person trips would decrease by about 7 percent, indicating that even with the toll, 93 percent of the trips would remain in the corridor rather than switching to other corridors or eliminating the trips.
- Daily HOV trips on SR 520 would increase by nearly 37 percent compared to the No Build Alternative with no toll, and transit trips would increase by 29 percent.
- HOV and transit trips on I-90 would decrease slightly as the toll on SR 520 reduced total vehicle volumes on SR 520, because travelers making HOV trips would be attracted by the comparatively lower levels of congestion on SR 520 during non-peak periods.
- SR 522 would be more affected on a daily basis than at either of the peaks, reflecting a somewhat higher potential for drivers to divert due to the toll, with about a 3 percent change in daily vehicle trips.
- A 4 percent increase in daily I-90 GP vehicle volumes, compared to the No Build Alternative, would further aggravate congested conditions.

Preferred Alternative Compared with Tolled No Build

Compared to a tolled No Build, the Preferred Alternative would complete the HOV lanes and provide a substantial travel time savings for transit and HOV. The HOV lanes would also provide schedule reliability for transit. This would offer more incentive for people to use transit and carpools than would exist in a No Build Alternative with a toll. Travel demand analysis indicates that over half of the increase in demand for transit and HOV under the Preferred Alternative would be associated with the corridor improvements, as opposed to toll avoidance alone.

Under the untolled No Build, the toll alone would reduce both vehicle and person trips on the SR 520 corridor due to the lack of travel time incentives for using transit and HOV. Therefore the Preferred Alternative would result in an even more substantial increase in person trips compared to a tolled No Build alternative than it would compared to the untolled No Build. The Preferred Alternative would also likely result in a small increase in general purpose demand due to more efficient operations associated with improved highway features like shoulders, ramps, and road geometry. Exhibits 4 and 5 show the results of peak period and daily travel modeling for the tolled and untolled No Build in comparison to the Preferred Alternative.

Travel demand on SR 522 and I-90 would not be substantially different between the Preferred Alternative and a tolled No Build. Some HOV and transit travel would shift from SR 522 to SR 520 due to travel time improvements under the Preferred Alternative. I-90 would also see a reduction in HOV travel and a small reduction in transit travel for the same reason. The change in total vehicle volumes on I-90 between the tolled No Build and the Preferred Alternative would only be about 2 to 3 percent, and the change in person trips would be 4 to 7 percent, depending on the time of day. The detailed tabulation of results for all corridors is included in Appendix A.

Summary of Findings

A tolled No Build Alternative would encourage some mode shift to transit and carpools by drivers wishing to avoid a toll. However, both GP and transit/HOV users would still experience significant congestion and delay during peak commute periods. The Preferred Alternative would encourage a substantial additional mode shift to transit and carpools because of the travel time and reliability benefits it would provide to HOV lane users. Following are some key comparisons between the Preferred Alternative and a tolled NO Build:

- HOV 3+ vehicle trips on SR 520 would increase by about 80 percent in the AM peak and 100 percent in the PM peak with the Preferred Alternative, due to the addition of HOV lanes. This would be nearly half of the increase in total vehicle trips during the peak periods.
- HOV 3+ person trips on SR 520 would also increase by about 80 percent in the AM peak and 100 percent in the PM peak.
- The Preferred Alternative would increase SR 520 total person trips more substantially when compared to a tolled No Build Alternative than it would compared to the untolled No Build modeled for the Final EIS.

With the Preferred Alternative, total vehicle trips on SR 520 would increase by about 10 percent compared to the tolled No Build due to roadway design improvements and the addition of HOV lanes. About half of this increase would be in transit and HOV trips. Tolling the No Build Alternative would reduce vehicle trips on SR 520 by more than 10 percent, so the Preferred Alternative would allow some of the diverted trips to continue using the corridor. Total cross-lake vehicle trips, including SR 522 and I-90, would remain similar to No Build conditions or increase slightly.

The sensitivity analysis demonstrates that, whether compared to a tolled or an untolled No Build, the Preferred Alternative would result in significant mobility improvements in the SR 520 corridor through the addition of HOV lanes that provide travel time and reliability benefits for buses and carpools. Under the Preferred Alternative, the combination of tolling and the HOV lanes results in greater person-mobility than either No Build scenario, while minimizing diversion to other cross-lake corridors.

Exhibit 4. SR 520 Peak Period Travel Demand with Preferred Alternative

AM Peak Period								
	AM Peak Period Vehicle Volumes			AM Peak Period Person Trip Volumes				
Roadway Facility	**Total Non-HOV[1]**	**HOV (3+)**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Transit**	**Total**
No Build (un tolled)	23,730	660	24,390	23,590	2,400	3,020	1,130	30,140
Tolled No Build	20,540	1,010	21,550	20,680	3,680	2,720	1,480	28,560
Percent Change from No Build (un tolled)	*-13%*	*53%*	*-12%*	*-12%*	*53%*	*-10%*	*31%*	*-5%*
Preferred Alternative	21,560	1850	23,410	21,650	6770	2,890	2350	33,660
Percent Change from No Build (un tolled)	*-9%*	*180%*	*-4%*	*-8%*	*182%*	*-4%*	*108%*	*12%*
Percent Change from Tolled No Build	*5%*	*83%*	*9%*	*5%*	*84%*	*6%*	*59%*	*18%*

PM Peak Period								
	PM Peak Period Vehicle Volumes			PM Peak Period Person Trip Volumes				
Roadway Facility	**Total Non-HOV[1]**	**HOV (3+)**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Transit**	**Total**
No Build (un tolled)	25,950	620	26,570	26,270	2,220	3,260	1,130	32,880
Tolled No Build	23,100	1,180	24,280	23,060	4,230	3,480	1,480	32,250
Percent Change from No Build (un tolled)	*-11%*	*90%*	*-9%*	*-12%*	*91%*	*7%*	*31%*	*-2%*
Preferred Alternative	24,150	2400	26,550	23,950	8650	3,760	2350	38,710
Percent Change from No Build (un tolled)	*-7%*	*287%*	*0%*	*-9%*	*290%*	*15%*	*108%*	*18%*
Percent Change from Tolled No Build	*5%*	*103%*	*9%*	*4%*	*104%*	*8%*	*59%*	*20%*

Exhibit 5. SR 520 Daily Travel Demand with Preferred Alternative

Average Weekday								
	PM Peak Period Vehicle Volumes			PM Peak Period Person Trip Volumes				
Roadway Facility	Total Non-HOV[1]	HOV (3+)	Total	Non-HOV	HOV (3+)	Commercial	Transit	Total
No Build (un tolled)	123,040	4,530	127,570	123,750	16,020	15,340	3,670	158,780
Tolled No Build	106,390	6,200	112,590	106,820	21,950	14,430	4,750	147,950
Percent Change from No Build (un tolled)	-14%	37%	-12%	-14%	37%	-6%	29%	-7%
Preferred Alternative	111,640	9470	121,110	111,690	33690	15,450	7050	167,880
Percent Change from No Build (un tolled)	*-9%*	*109%*	*-5%*	*-10%*	*110%*	*1%*	*92%*	*6%*
Percent Change from Tolled No Build	*5%*	*53%*	*8%*	*5%*	*53%*	*7%*	*48%*	*13%*

Appendix A: Detailed Travel Demand Model Results

AM Peak Period Cross Lake Travel Demand for 2030 tolled and un-tolled No Build with Preferred Alternative

2030 No Build Alternative (No Toll)

	AM Peak Period Vehicle Volumes			AM Peak Period Person Trip Volumes				
Roadway Facility	**Total Non-HOV[1]**	**HOV (3+)**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Transit**	**Total**
SR 522 (West of 61st Avenue NE)	10,270	270	10,540	10,990	970	750	630	13,340
SR 520 (Evergreen Point Bridge)	23,730	660	24,390	23,590	2,400	3,020	1,130	30,140
I-90 (West Bridge) - GP Lanes	30,940	200	31,140	30,630	720	4,730	-	36,080
I-90 (West Bridge) - HOV Lanes	-	2,310	2,310	-	8,290	-	990	9,280
I-90 Rail	-	-	-	-	-	-	13,940	13,940
I-90 Total	30,940	2,510	33,450	30,630	9,010	4,730	14,930	59,300
Total Cross-Lake	64,940	3,440	68,380	65,210	12,380	8,500	16,690	102,780

2030 No Build Tolled

	AM Peak Period Vehicle Volumes			AM Peak Period Person Trip Volumes				
Roadway Facility	**Total Non-HOV[1]**	**HOV (3+)**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Transit**	**Total**
SR 522 (West of 61st Avenue NE)	10,460	250	10,710	11,220	870	670	550	13,310
Percent Change from No Build	*2%*	*-7%*	*2%*	*2%*	*-10%*	*-11%*	*-13%*	*0%*
SR 520 (Evergreen Point Bridge)	20,540	1,010	21,550	20,680	3,680	2,720	1,480	28,560
Percent Change from No Build	*-13%*	*53%*	*-12%*	*-12%*	*53%*	*-10%*	*31%*	*-5%*
I-90 (West Bridge) - GP Lanes	32,090	160	32,250	31,930	590	4,580	-	37,100
I-90 (West Bridge) - HOV Lanes	-	2,100	2,100	-	7,530	-	1,050	8,580
I-90 Rail	-	-	-	-	-	-	13,780	13,780
I-90 Total	32,090	2,260	34,350	31,930	8,120	4,580	14,830	59,460
Percent Change from No Build	*4%*	*-10%*	*3%*	*4%*	*-10%*	*-3%*	*-1%*	*0%*
Total Cross-Lake	63,090	3,520	66,610	63,830	12,670	7,970	16,860	101,330
Percent Change from No Build	*-3%*	*2%*	*-3%*	*-2%*	*2%*	*-6%*	*1%*	*-1%*

2030 Preferred Alternative

Roadway Facility	AM Peak Period Vehicle Volumes			AM Peak Period Person Trip Volumes				
	Total Non-HOV[1]	HOV (3+)	Total	Non-HOV	HOV (3+)	Commercial	Transit	Total
SR 522 (West of 61st Ave.NE)	10,460	230	10,690	11,230	820	670	530	13,250
Percent Change from No Build	*2%*	*-15%*	*1%*	*2%*	*-15%*	*-11%*	*-16%*	*-1%*
Percent Change from Tolled No Build	*0%*	*-8%*	*0%*	*0%*	*-6%*	*0%*	*-4%*	*0%*
SR 520 (Lake Wash. Bridge)	21,560	1850	23,410	21,650	6770	2,890	2350	33,660
Percent Change from No Build	*-9%*	*180%*	*-4%*	*-8%*	*182%*	*-4%*	*108%*	*12%*
Percent Change from Tolled No Build	*5%*	*83%*	*9%*	*5%*	*84%*	*6%*	*59%*	*18%*
I-90 (West Bridge) - GP Lanes	31,960	150	32,110	31,770	570	4,570	-	36,910
I-90 (West Bridge) - HOV Lanes	-	1,590	1,590	-	5,650	-	990	6,640
I-90 Rail	-	-	-	-	-	-	12,770	12,770
I-90 Total	31,960	1,740	33,700	31,770	6,220	4,570	13,760	56,320
Percent Change from No Build	*3%*	*-31%*	*1%*	*4%*	*-31%*	*-3%*	*-8%*	*-5%*
Percent Change from Tolled No Build	*0%*	*-23%*	*-2%*	*-1%*	*-23%*	*0%*	*-7%*	*-5%*
Total Cross-Lake	63,980	3,820	67,800	64,650	13,810	8,130	16,640	103,230
Percent Change from No Build	*-1%*	*11%*	*-1%*	*-1%*	*12%*	*-4%*	*0%*	*0%*
Percent Change from Tolled No Build	*1%*	*9%*	*2%*	*1%*	*9%*	*2%*	*-1%*	*2%*

PM Peak Period Cross Lake Travel Demand for 2030 tolled and un-tolled No Build with Preferred Alternative

2030 No Build Alternative (no toll)

	PM Peak Period Vehicle Volumes			PM Peak Period Person Trip Volumes				
Roadway Facility	**Total Non-HOV[1]**	**HOV (3+)**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Transit**	**Total**
SR 522 (West of 61st Avenue NE)	11,500	290	11,790	12,340	1,020	810	630	14,800
SR 520 (Evergreen Point Bridge)	25,950	620	26,570	26,270	2,220	3,260	1,130	32,880
I-90 (West Bridge) - GP Lanes	36,230	230	36,460	36,030	830	5,440	-	42,300
I-90 (West Bridge) - HOV Lanes	-	2,900	2,900	-	10,370	-	990	11,360
I-90 Rail	-	-	-	-	-	-	13,940	13,940
I-90 Total	36,230	3,130	39,360	36,030	11,200	5,440	14,930	67,600
Total Cross-Lake	73,680	4,040	77,720	74,640	14,440	9,510	16,690	115,280

2030 No Build Tolled

	PM Peak Period Vehicle Volumes			PM Peak Period Person Trip Volumes				
Roadway Facility	**Total Non-HOV[1]**	**HOV (3+)**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Transit**	**Total**
SR 522 (West of 61st Avenue NE)	11,750	260	12,010	12,730	910	690	550	14,880
Percent Change from No Build	2%	-10%	2%	3%	-11%	-15%	-13%	1%
SR 520 (Evergreen Point Bridge)	23,100	1,180	24,280	23,060	4,230	3,480	1,480	32,250
Percent Change from No Build	*-11%*	*90%*	*-9%*	*-12%*	*91%*	*7%*	*31%*	*-2%*
I-90 (West Bridge) - GP Lanes	37,100	130	37,230	37,660	460	4,780	-	42,900
I-90 (West Bridge) - HOV Lanes	-	2,580	2,580	-	9,190	-	1,050	10,240
I-90 Rail	-	-	-	-	-	-	13,780	13,780
I-90 Total	37,100	2,710	39,810	37,660	9,650	4,780	14,830	66,920
Percent Change from No Build	*2%*	*-13%*	*1%*	*5%*	*-14%*	*-12%*	*-1%*	*-1%*
Total Cross-Lake	71,950	4,150	76,100	73,450	14,790	8,950	16,860	114,050
Percent Change from No Build	*-2%*	*3%*	*-2%*	*-2%*	*2%*	*-6%*	*1%*	*-1%*

2030 Preferred Alternative

Roadway Facility	PM Peak Period Vehicle Volumes			PM Peak Period Person Trip Volumes				
	Total Non-HOV[1]	HOV (3+)	Total	Non-HOV	HOV (3+)	Commercial	Transit	Total
SR 522 (West of 61st Ave.NE)	11,700	240	11,940	12,690	830	680	530	14,730
Percent Change from No Build	*2%*	*-17%*	*1%*	*3%*	*-19%*	*-16%*	*-16%*	*0%*
Percent Change from Tolled No Build	*0%*	*-8%*	*-1%*	*0%*	*-9%*	*-1%*	*-4%*	*-1%*
SR 520 (Lake Wash. Bridge)	24,150	2400	26,550	23,950	8650	3,760	2350	38,710
Percent Change from No Build	*-7%*	*287%*	*0%*	*-9%*	*290%*	*15%*	*108%*	*18%*
Percent Change from Tolled No Build	*5%*	*103%*	*9%*	*4%*	*104%*	*8%*	*59%*	*20%*
I-90 (West Bridge) - GP Lanes	36,870	160	37,030	37,470	570	4,710	-	42,750
I-90 (West Bridge) - HOV Lanes	-	1,710	1,710	-	6,050	-	990	7,040
I-90 Rail	-	-	-	-	-	-	12,770	12,770
I-90 Total	36,870	1,870	38,740	37,470	6,620	4,710	13,760	62,560
Percent Change from No Build	*2%*	*-40%*	*-2%*	*4%*	*-41%*	*-13%*	*-8%*	*-7%*
Percent Change from Tolled No Build	*-1%*	*-31%*	*-3%*	*-1%*	*-31%*	*-1%*	*-7%*	*-7%*
Total Cross-Lake	72,720	4,510	77,230	74,110	16,100	9,150	16,640	116,000
Percent Change from No Build	*-1%*	*12%*	*-1%*	*-1%*	*11%*	*-4%*	*0%*	*1%*
Percent Change from Tolled No Build	*1%*	*9%*	*1%*	*1%*	*9%*	*2%*	*-1%*	*2%*

Daily Cross Lake Travel Demand for 2030 tolled and un-tolled No Build with Preferred Alternative

2030 No Build Alternative

	Daily Vehicle Volumes			Daily Person Trip Volumes				
Roadway Facility	**Total Non-HOV[1]**	**HOV (3+)**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Transit**	**Total**
SR 522 (West of 61st Avenue NE)	52,550	1,760	54,310	56,490	6,200	3,290	1,840	67,820
SR 520 (Evergreen Point Bridge)	123,040	4,530	127,570	123,750	16,020	15,340	3,670	158,780
I-90 (West Bridge) - GP Lanes	164,750	2,090	166,840	164,780	7,360	23,070	-	195,210
I-90 (West Bridge) - HOV Lanes	-	9,320	9,320	-	33,030	-	1,990	35,020
I-90 Rail	-	-	-	-	-	-	41,390	41,390
I-90 Total	164,750	11,410	176,160	164,780	40,390	23,070	43,380	271,620
Total Cross-Lake	340,340	17,700	358,040	345,020	62,610	41,700	48,890	498,220

2030 No Build Tolled[3]

	Daily Vehicle Volumes			Daily Person Trip Volumes				
Roadway Facility	**Total Non-HOV[1]**	**HOV (3+)**	**Total**	**Non-HOV**	**HOV (3+)**	**Commercial**	**Transit**	**Total**
SR 522 (West of 61st Avenue NE)	54,190	1,600	55,790	58,590	5,620	2,950	1,630	68,790
Percent Change from No Build	3%	-9%	3%	4%	-9%	-10%	-11%	1%
SR 520 (Evergreen Point Bridge)	106,390	6,200	112,590	106,820	21,950	14,430	4,750	147,950
Percent Change from No Build	-14%	37%	-12%	-14%	37%	-6%	29%	-7%
I-90 (West Bridge) - GP Lanes	171,470	1,790	173,260	173,710	6,290	21,740	-	201,740
I-90 (West Bridge) - HOV Lanes	-	8,410	8,410	-	29,780	-	2,110	31,890
I-90 Rail	-	-	-	-	-	-	40,850	40,850
I-90 Total	171,470	10,200	181,670	173,710	36,070	21,740	42,960	274,480
Percent Change from No Build	4%	-11%	3%	5%	-11%	-6%	-1%	1%
Total Cross-Lake	332,050	18,000	350,050	339,120	63,640	39,120	49,340	491,220
Percent Change from No Build	-2%	2%	-2%	-2%	2%	-6%	1%	-1%

2030 Preferred Alternative								
	Daily Vehicle Volumes			Daily Person Trip Volumes				
Roadway Facility	Total Non-HOV[1]	HOV (3+)	Total	Non-HOV	HOV (3+)	Commercial	Transit	Total
SR 522 (West of 61st Ave.NE)	53,970	1,520	55,490	58,410	5,340	2,910	1,590	68,250
Percent Change from No Build	*3%*	*-14%*	*2%*	*3%*	*-14%*	*-12%*	*-14%*	*1%*
Percent Change from Tolled No Build	*0%*	*-5%*	*-1%*	*0%*	*-5%*	*-1%*	*-2%*	*-1%*
SR 520 (Lake Wash. Bridge)	111,640	9470	121,110	111,690	33690	15,450	7050	167,880
Percent Change from No Build	*-9%*	*109%*	*-5%*	*-10%*	*110%*	*1%*	*92%*	*6%*
Percent Change from Tolled No Build	*5%*	*53%*	*8%*	*5%*	*53%*	*7%*	*48%*	*13%*
I-90 (West Bridge) - GP Lanes	170,150	1,760	171,910	172,300	6,190	21,570	-	200,060
I-90 (West Bridge) - HOV Lanes	-	6,320	6,320	-	22,270	-	1,990	24,260
I-90 Rail	-	-	-	-	-	-	38,360	38,360
I-90 Total	170,150	8,080	178,230	172,300	28,460	21,570	40,350	262,680
Percent Change from No Build	*3%*	*-29%*	*1%*	*5%*	*-30%*	*-7%*	*-7%*	*-3%*
Percent Change from Tolled No Build	*-1%*	*-21%*	*-2%*	*-1%*	*-21%*	*-1%*	*-6%*	*-4%*
Total Cross-Lake	335,760	19,070	354,830	342,400	67,490	39,930	48,990	498,810
Percent Change from No Build	*-1%*	*8%*	*-1%*	*-1%*	*8%*	*-4%*	*0%*	*0%*
Percent Change from Tolled No Build	*1%*	*6%*	*1%*	*1%*	*6%*	*2%*	*-1%*	*2%*

Light Rail Transit Ridership Analysis

Washington State Department of Transportation

SR 520 Bridge Replacement and HOV Program

SR 520 with Light Rail Transit (LRT)
Technical Memorandum

Prepared for

Washington State Department of Transportation

Prepared by

WSDOT Office of Urban Mobility
WSDOT SR 520 Bridge Replacement and HOV Program
King County Metro
Sound Transit
Seattle Department of Transportation

November 2010

Table of Contents

Appendices

List of Exhibits

Acronyms and Abbreviations

BRT	bus rapid transit
FEIS	final environmental impact statement
GP	general-purpose
HCT	high-capacity transit
HOV	high-occupancy vehicle
LRT	light rail transit
O-D	origin-destination
PSRC	Puget Sound Regional Council
ST2	Sound Transit 2
WSDOT	Washington State Department of Transportation

Purpose of Evaluation

The purpose of this work was to confirm previous regional decisions regarding the operation of light rail transit (LRT) on SR 520 in the year 2030. This evaluation also provided a high-level determination of the effects of implementing LRT in place of the HOV/transit lane that is currently identified in the Preferred Alternative. Many changes have taken place throughout the region since the Trans-Lake Washington Project's (2000-2002) Executive Committee determined "…only one high-capacity (HCT) corridor across Lake Washington will be necessary to satisfy transit demands through the year 2020" (see Appendix A for additional background information). Significant regional changes include:

- The passage of the Sound Transit 2 (ST2) plan, which includes East Link;
- On-going implementation and financing of I-405 corridor projects;
- Significant updates to the Puget Sound Regional Council's (PSRC) population, employment, and land use forecasts, along with its regional travel demand model; and
- Imminent tolling of the SR 520 Bridge in 2011 associated with the Urban Partnership program.

For these reasons, the SR 520 Project's legal review team recommended that the SR 520 Bridge Replacement and HOV Program revisit the potential for implementing LRT on SR 520 *in place* of the planned high-occupancy vehicle (HOV)/transit lane between the Montlake interchange and the Eastside. This review is intended as a preliminary evaluation of LRT ridership demand on SR 520 and is not intended to offset any planning work that will be completed by Sound Transit as part of their long-range planning efforts.

This evaluation was a collaborative effort among the staffs of the Washington State Department of Transportation (WSDOT) SR 520 Program, Sound Transit, King County Metro, and the Seattle Department of Transportation. Together, we identified the representative LRT alignment and potential station locations, performed the modeling, evaluated the results, and reached conclusions regarding the implications the evaluation results had for the SR 520 Program as it moved into the preparation of the Final Environmental Impact Statement (FEIS).

This evaluation was completed by:

- Determining a "representative light rail alignment" and associated stations to serve the SR 520 corridor;
- Modifying the Preferred Alternative transit network in the SR 520 FEIS travel demand model to serve the representative light rail alignment and associated stations;
- Evaluating model results to determine effects on SR 520 and I-90 transit ridership and vehicle volumes (general-purpose [GP] and 3+HOV); and
- Identifying conclusions.

Each of these evaluation steps is explained in more detail in the following sections.

Determining a Representative Alignment for SR 520 with LRT

A “representative light rail alignment” is an alignment option that has not been through the environmental process; therefore, there has been neither a formal review of the environmental (built and natural) impacts, nor a formal decision regarding alignment or station locations. The purpose of a representative alignment is to provide enough detail needed to perform a high-level evaluation to gain insight into the opportunities and challenges associated with implementing LRT service on SR 520 in the year 2030. The representative light rail alignment and stations for the SR 520 corridor selected for this evaluation were collaboratively developed by project staff from Sound Transit, King County Metro, the Seattle Department of Transportation, and WSDOT’s Office of Urban Mobility. WSDOT SR 520 Program staff facilitated the meetings, performed the travel demand modeling, and prepared documentation.

Building upon year 2030 transit systems and markets

The team developed the representative alignment and station locations for an SR 520 bridge crossing by building on the region’s transit markets and light rail and bus service assumed to be in place by the year 2030. Exhibit 1 shows Sound Transit’s Central and East Link alignments and stations assumed to be in place for this evaluation.

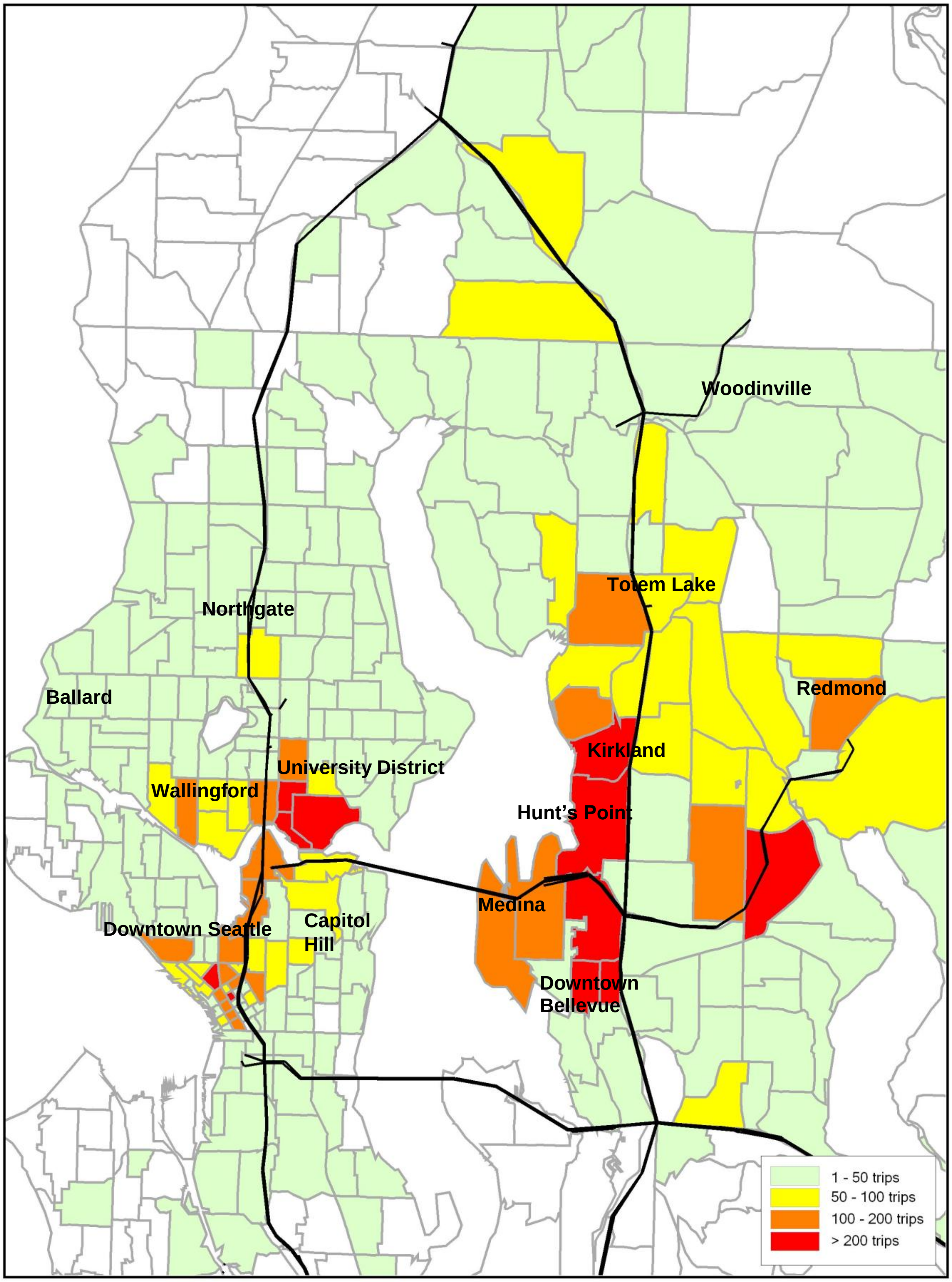
EXHIBIT 1. SOUND TRANSIT LIGHT RAIL ALIGNMENTS

Source: Sound Transit

The team also used origin-destination (O-D) data from the SR 520 High Capacity Transit (HCT) Plan (December 2008) to estimate how future year 2030 SR 520 transit markets would be affected by East Link LRT (see Exhibit 2).

The number of daily transit trips between O-Ds shown in Exhibit 2 assumed a high level of bus rapid transit (BRT) on the SR 520 corridor, which would provide a level of service very similar to LRT. Therefore, it was assumed that transit trips between these O-Ds would be similar with LRT operating on SR 520; the representative alignment and stations were developed to serve this demand.

EXHIBIT 2. 2030 HCT – DAILY ORIGINS AND DESTINATIONS OF SR 520 TRANSIT TRIPS WITH EAST LINK



Source: SR 520 Bridge Replacement and HOV Program, High Capacity Transit Plan – 2030 HCT with East Link Sensitivity Test Transit Ridership Forecasting Analysis Results Technical Memorandum (January 2009).

Representative Alignment and Stations

With the implementation of East Link across I-90, the major transit markets of Redmond's Overlake area, Downtown Bellevue, Downtown Seattle, University District, and Capitol Hill would be primarily served with North Link and East Link. The Ballard, Fremont, and Wallingford neighborhoods on the west side of Lake Washington and the cities of Kirkland, Totem Lake, Medina, and Hunt's Point would primarily use local and regional bus service. Adding rail between Totem Lake and Ballard would serve the mobility needs between these markets and provide key transfer opportunities to other rail or regional bus service. The representative alignment and stations identified to serve these markets are shown in Exhibit 3.

EXHIBIT 3. YEAR 2030 SR 520 REPRESENTATIVE LIGHT RAIL ALIGNMENT

Representative Alignment Details

The following information summarizes team discussions regarding the development of the representative alignment and associated stations.

- The representative alignment for SR 520 connected Ballard to Totem-Lake/Totem Lake-Bellevue.
- The Totem Lake-Bellevue alignment was included in this evaluation to provide a connection between SR 520 LRT and East Link.

- Headways were assumed to be the same as East Link, with headways of 7.5-minutes during the a.m. and p.m. peak periods, and 10 minutes during the off-peak period. This means that 4-minute (approximate) peak and 5-minute off-peak headways would be provided between the Totem Lake Transit Center and the S. Kirkland Park-and-Ride.
- SR 520 would be four GP lanes + LRT between the Montlake interchange and Bellevue Way/108th Interchange (no HOV lanes). This configuration was assumed because there is limited right of way in this section of the corridor, and the location of the lids/stations/transit stops further decreases the available space.
- It was assumed that SR 520 LRT would be a combination of at-grade (street running) and elevated (grade-separated). Station-to-station travel times were provided by Sound Transit (see Appendix B).
- SR 520 was tolled at the rate assumed for the SR 520 Preferred Alternative, with 3+ HOV free. HOV traffic would be required to travel in the GP lanes. This decision was based on the assumption that SR 520 buses would be replaced with light rail service between I-5 and the Bellevue Way/108th Avenue NE interchange. With no buses crossing the bridge, a higher toll rate would not be needed to manage traffic flow for transit.

Ballard was selected as the west terminus because:

- There is an established and high demand market between the University District and Ballard (KCM Route 44).
- Although an SR 99 corridor alignment had been suggested in recent regional conversations, North Link is planned as the primary north-south service; the team did not want to duplicate that service with an SR 99 representative alignment.

Dual termini on the eastside – Totem Lake and Bellevue (Overlake Hospital) – were selected because:

- Review of the HCT Plan showed the strongest markets are between Downtown Seattle and the Eastside, which would already be served by East Link.
- They connected all three primary Eastside transit markets – Kirkland, Redmond, and Bellevue – to the University of Washington and Seattle neighborhoods west of I-5.
- Totem Lake is identified as one of twelve “Regional Growth Centers” in the PSRC’s Regional Growth Strategy and is a logical transfer point for bus service originating from the north and east (Woodinville, Canyon Park, Snohomish, etc).
- The smaller markets of Seattle neighborhoods west of I-5 and north of the Ship Canal can still get to Bellevue and Redmond with rail transfers – much less onerous than bus transfers due to high frequency and trip reliability.
- Issaquah-to-Bellevue and points north are likely markets to serve with future rail and this configuration aligns with this future service.

Representative Alignment Station Details

The following representative stations were assumed to be in the vicinity of:

1. Ballard: 17th Avenue NW/NW Market
2. North Fremont: N 45th Street/Greenwood Avenue N
3. Aurora: SR 99/N 45th Street
4. Wallingford: Wallingford /N 45th Street

5. Brooklyn: Brooklyn Avenue NE/NE 45th Street (assumed to be different station platforms than North Link)
6. Montlake: Husky Stadium (assumed to be different station platforms than for U-Link)
7. Evergreen Point
8. South Kirkland Park-and-Ride
9. Kirkland Transit Center: 3rd Street/NE 85th Street
10. Totem Lake Transit Center: NE 128th Street/ 120th Avenue NE
11. Bellevue/Overlake Hospital: NE 8th Street/116th Avenue NE(assumed to be shared station platforms with East Link)

Developing a bus network to support SR 520 Representative Alignment

Once the team had identified a representative light rail alignment and associated stations, King County Metro and Sound Transit service planners identified bus network modifications to optimize the overall transit system (LRT and bus transit). Modifications included truncating and eliminating routes as well as improving frequencies to serve ridership demand between the primary transit markets on the west and east sides of Lake Washington.

Cross-Lake and Eastside Changes

The modeled transit network assumed that bus services across Lake Washington and on the Eastside would be restructured to integrate with the representative alignment and stations for SR 520 LRT service. The most notable assumption was that all bus service across the SR 520 Bridge would be replaced by LRT service. Additionally, Westside and Eastside bus routes would be truncated at the various LRT stations and some routes would be modified or restructured to serve the station, feeding more people into the light rail system to make connections to both Downtown Seattle and to the University District. It was also assumed that some routes would have improved frequencies during peak and off-peak periods. The most recent East Link transit integration plan, dated November 5, 2009, was assumed to be in place in the year 2030.

Please see Appendix C for a summary of the changes that were assumed for the 2030 peak transit routes and headways, as well as service modifications to several routes for the proposed light rail on SR 520.

Model Results

The effect of SR 520 LRT on *region-wide* transit (bus+light rail) trips are shown in Exhibit 4 and summarized below and are in comparison to the SR 520 Preferred Alternative:

- SR 520 LRT would increase system-wide transit person trips by approximately 5,000 trips per day (less than 1 percent).
- SR 520 LRT would increase the system-wide transfer rate from 1.49 to 1.53 (about 2.7 percent) meaning that some people would have more transfers with SR 520 LRT than without.
- SR 520 LRT would increase transit ridership by approximately 1,760 riders per day (4 percent) on SR 522, SR 520, and I-90 *combined.*
- Total cross-lake (SR 522, SR 520, I-90) person trips would remain fairly constant compared to those without SR 520 LRT.
    - Total cross-lake person trips of 486,600 would decrease by 1,690 person trips (less than 0.3 percent) (486,600 is the total person trips for all modes – GP, 3+HOV, transit – on all three roadways).

The effect of SR 520 LRT on transit ridership *across the SR 520 and I-90 bridges* are shown in Exhibits 5, 6, and 7 and can be summarized as follows:

- I-90 daily rail ridership would decrease by 5,000 people (13 percent) from 37,070 to 32,360 (see Exhibit 4).
- HOV 3+ person trips on SR 520 and I-90 would decrease by about 2,300 per day (see Exhibit 4).

- Rail on SR 520 increases *overall* transit ridership across the SR 520 and I-90 bridges by approximately 2,210 trips (5 percent, or from 46,330 to 48,540) (see Exhibit 5).
- SR 520 daily transit person trips across the bridge would increase by approximately 7,200 (or double) from 7,320 to 14,510 (see Exhibit 5).
  - Although daily transit person trips across SR 520 would double, it would be about the same as *today* (2010).
  - SR 520 rail ridership would be 1/3 of the I-90 ridership.
- 38 percent of Ballard-to-Totem Lake boarding's would cross SR 520 per day (i.e., 38,000 riders board Ballard-to-Totem Lake, but only 14,500 riders cross the SR 520 Bridge. See Exhibit 6).
- There would be a total of 52,000 daily boardings on the Ballard-to-Totem Lake and Totem Lake-to-Bellevue LRT lines combined. (For comparison, total East Link daily boardings are estimated to be up to 48,000 in 2030.)
  - Ballard-to-Totem Lake ridership would be approximately 38,400.
  - Totem Lake-to-Bellevue would be approximately 14,000.
- Evergreen Point Station daily boardings are 200, which represents the lowest boardings along the SR 520 LRT alignment.

EXHIBIT 4. COMPARISON OF AVERAGE WEEKDAY CROSS-LAKE VEHICLE AND PERSON TRIP VOLUMES

2030 Preferred Alternative[1]

	Average Weekday Vehicle Volumes			Average Weekday Person Trip Volumes					
						Transit			
Roadway Facility	GP	HOV (3+)	Total	GP	HOV (3+)	Bus	Rail	All Transit	Total
SR 522 (West of 61st Ave.NE)	55,010	1,640	56,650	62,270	5,770	1,920		1,920	69,960
SR 520 (Lake Wash. Bridge)	110,190	8,530	118,720	124,660	30,350	7,340		7,340	162,350
I-90 (West Bridge)	167,050	7,250	174,300	189,730	25,590	1,940	37,040	38,980	254,300
Total Cross-Lake	332,250	17,420	349,670	376,660	61,710	11,200	37,040	48,240	486,610

2030 Preferred Alternative with Rail on SR 520 Sensitivity Test[1]

	Average Weekday Vehicle Volumes			Average Weekday Person Trip Volumes					
						Transit			
Roadway Facility	GP	HOV (3+)	Total	GP	HOV (3+)	Bus	Rail	All Transit	Total
SR 522 (West of 61st Ave.NE)	55,150	1,690	56,840	62,430	5,920	1,460		1,460	69,810
SR 520 (Lake Wash. Bridge)	108,150	6,420	114,570	122,470	22,790		14,510	14,510	159,770
I-90 (West Bridge)	167,870	8,670	176,540	190,620	30,690	1,670	32,360	34,030	255,340
Total Cross-Lake	331,170	16,780	347,950	375,520	59,400	3,130	46,870	50,000	484,920

Rail on SR 520 minus Preferred Alternative

	Average Weekday Vehicle Volumes			Average Weekday Person Trip Volumes					
						Transit			
Roadway Facility	GP	HOV (3+)	Total	GP	HOV (3+)	Bus	Rail	All Transit	Total
SR 522 (West of 61st Ave.NE)	140	50	190	160	150	(460)		(460)	(150)
SR 520 (Lake Wash. Bridge)	(2,040)	(2,110)	(4,150)	(2,190)	(7,560)	(7,340)	14,510	7,170	(2,580)
I-90 (West Bridge)	820	1,420	2,240	890	5,100	(270)	(4,680)	(4,950)	1,040
Total Cross-Lake	(1,080)	(640)	(1,720)	(1,140)	(2,310)	(8,070)	9,830	1,760	(1,690)

[1]Toll model run was executed for mode choice and route diversion effects using trip distribution results from 2030 Preferred Alternative model run.

EXHIBIT 5. YEAR 2030 AVERAGE WEEKDAY DAILY TRANSIT BOARDINGS ON I-90 AND SR 520 WITH SR 520 LRT

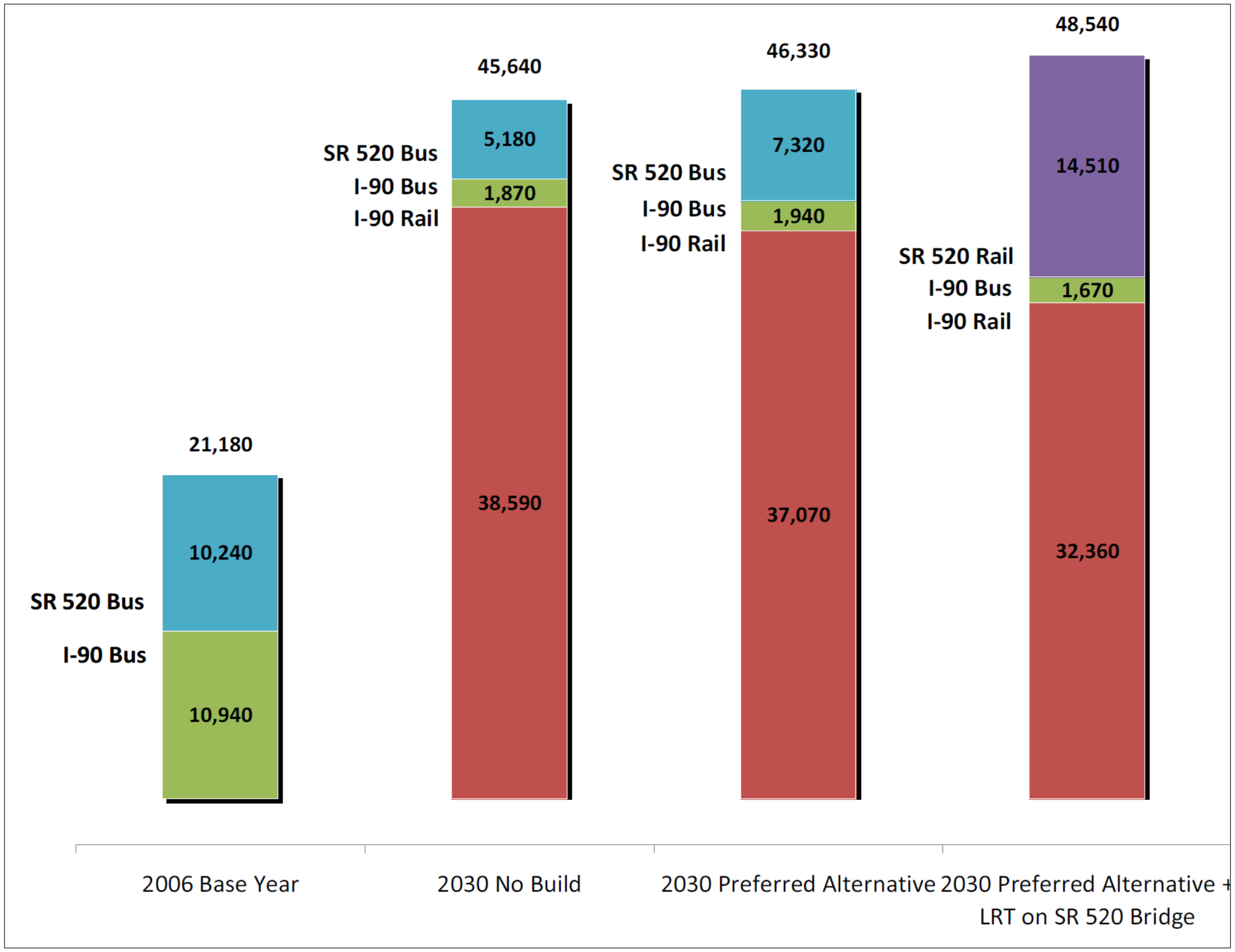
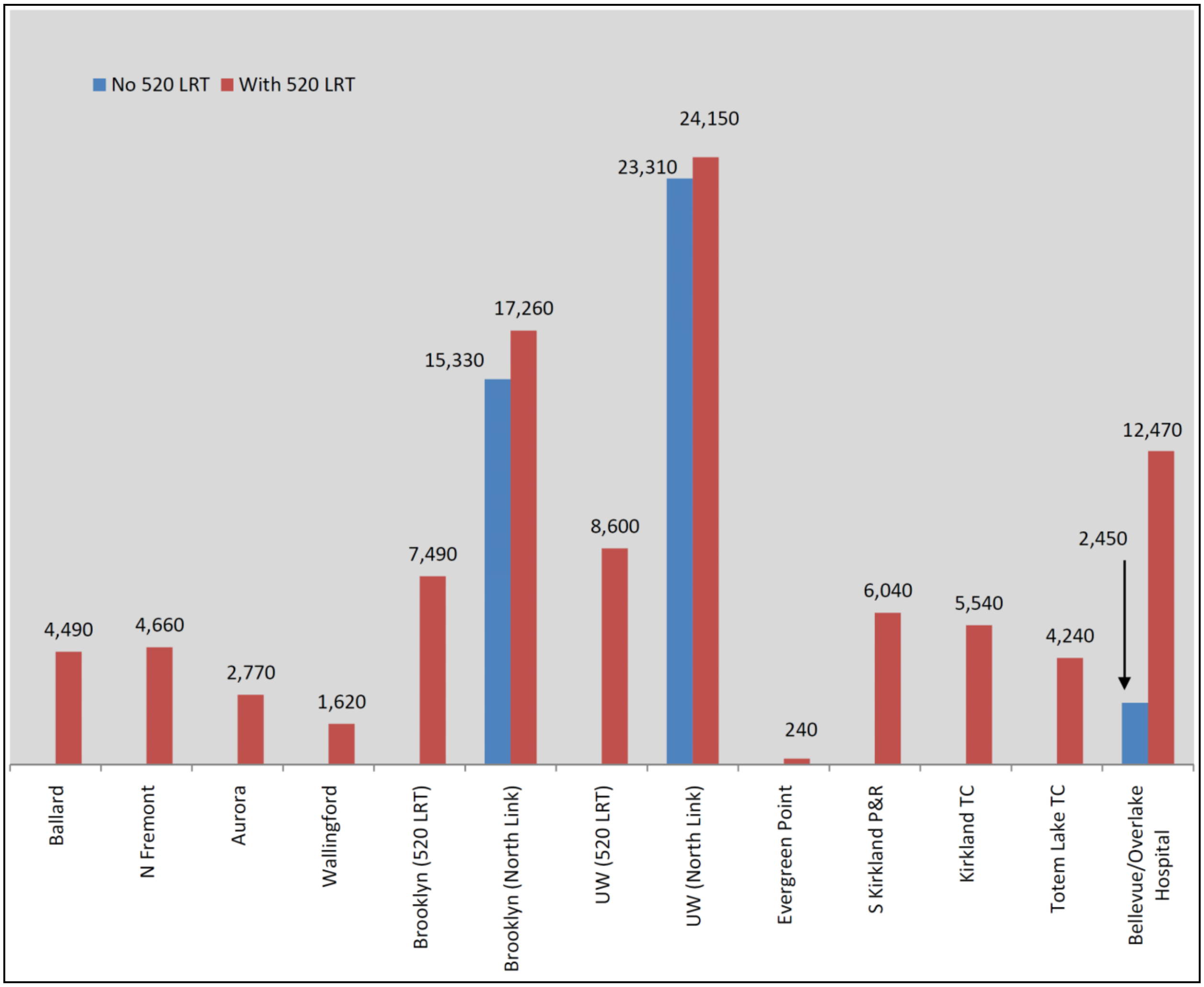


EXHIBIT 6. YEAR 2030 TOTAL DAILY WEEKDAY SEGMENT PASSENGER VOLUMES AND BOARDINGS ON SR 520 LRT

EXHIBIT 7. YEAR 2030 WEEKDAY STATION BOARDINGS WITHOUT AND WITH SR 520 LRT



Note: UW and Brooklyn stations are assumed to be on different platforms. Transfers between lines were assumed in the model.

Conclusions

The findings from the work performed and presented in this memorandum reinforce the conclusions drawn from past similar work and the resulting decisions made – i.e., that the long-range cross-lake transit market can be adequately served by a combination of bus/BRT service along the SR 520 corridor and a light rail system on I-90. Transit demand along the SR 520 corridor may eventually warrant significant alteration to the system currently being planned to serve cross-lake needs – indeed, the Regional Transit Long-range Plan envisions an HCT system for this corridor, and the new bridge design and HOV/transit improvements within the SR 520 project anticipate and support future HCT. Periodic monitoring of the corridor's transit system performance should provide an indication for when it is appropriate to conduct another assessment of the next generation of transit improvements for cross-lake travel.

The findings further demonstrate that replacing the proposed HOV improvements on SR 520 (and much of the bus service that would use these improvements) with a light rail system could result in more transit trips using cross-lake facilities. However, it would not induce an increase in ridership to a degree that would warrant the significant investment and impacts accompanying such an undertaking. Cross-lake transit trips are forecasted to increase by only four percent when the SR 520 corridor is served exclusively by light rail instead of a BRT system using HOV lanes and other dedicated bus facilities. The effect on a region-wide basis is even less significant, with total transit trips increasing by less than one percent with light rail on SR 520. By 2030, transit ridership across SR 520 is forecasted to be approximately the same as it is today.

Appendix A – Overview of Decisions Supporting I-90 as Priority Corridor for Light Rail

Background

As of 1963, the central Puget Sound region had built two floating bridges across Lake Washington connecting Seattle with communities in East King County, one on State Route 520 (SR 520), and one on Interstate 90 (I-90). In the early 1970s, the region debated at length whether to expand and modernize the I-90 floating bridge. Key controversial issues included how many GP lanes to provide, the degree to which transit would enjoy exclusive or semi-exclusive rights-of-way on the bridge, and what provisions could be made for Mercer Island traffic. An historic decision was reached in 1976, culminating in an I-90 Memorandum of Agreement (MOA) signed by the cities of Seattle, Mercer Island, and Bellevue, King County Metro Transit, and the Washington State Transportation department, supporting the alternative known as “3-2T-3”. This alternative included three GP lanes in the eastbound and westbound directions, and two center lanes for transit, HOVs, and Mercer Island SOVs. Consistent with this agreement, the new I-90 structure was designed to be built for the ultimate conversion to fixed guideway at some point in the future. Over the past 40 years, a wealth of studies have examined many ways to provide HCT service between Seattle and the Eastside and re-affirmed the identification of I-90 as the initial cross-lake corridor for HCT. Repeatedly, LRT on the I-90 corridor has proven to result in similar or higher ridership than LRT on SR 520 and to have substantially lower costs (environmentally and financially). An overview of regional transit planning as it relates to evaluating HCT across Lake Washington is provided in Exhibit A-1.

Sound Transit Long-Range Plan (1996)

As the Regional Transit Authority[1], Sound Transit is responsible for regional HCT planning. The Sound Transit Regional Transit Long-Range Plan (LRP) is the long-term vision for the development of regional HCT service in the Central Puget Sound Region. Sound Transit[2] adopted its first Regional Transit Long-Range Vision in May 1996 and it was used as a basis for much of the multimodal transportation planning conducted for the SR 520 corridor to date. That plan identified express bus service on a “Regional HOV Expressway” in the SR 520 corridor, and potential rail extensions in the I-90 corridor from Seattle to Redmond, Kirkland, Bellevue, and Issaquah.

Trans-Lake Washington Study and Project

After the approval of Sound Transit Long-Range Vision and System Plan in May 1996, WSDOT’s Trans-Lake Washington Study began in 1998. One of the primary objectives of this study was to determine which corridor – SR 520 or I-90 – should be used for an extension of HCT across Lake Washington to the Eastside. The evaluation process leading up to this decision took place over four years, between 1998 and 2002, and is outlined in Exhibit A-2.

A 47-person committee composed of local governments and neighborhood, business and advocacy interests evaluated a range of solutions to improve mobility across and/or around Lake Washington. Each solution considered a range of cross-lake capacity improvements within an area bounded by I-90 to the south, SR 522 to the north, I-5 to the west, and the terminus of SR 520 to the east. The Trans-Lake Study noted that “at some point beyond the planning horizon of Sound Transit’s Long Range Vision, it is possible that travel demand by transit could grow to a level that would justify a second trans-lake HCT

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[1] Under Revised Code of Washington {RCW} Chapters 81.104 and 81.112.

[2] Then known as the Central Puget Sound Regional Transit Authority.

corridor in addition to the I-90 corridor. Since both development of a third corridor across Lake Washington or expansion of the I-90 corridor is unlikely, the SR 520 corridor is the most viable option for the second corridor." Therefore, SR 520 with HCT [light rail] was one of the solutions carried forward into the Trans-Lake Washington Project.

The Trans-Lake Washington Project further evaluated and refined the Trans-Lake Washington Study solutions in preparation for an EIS. These evaluations gave the region a chance to test the previous assumption of first implementing LRT on I-90 within the current regional context and to use updated regional information, such as population, employment, and land use forecasts.

The evaluation results showed that:

- Light rail in the I-90 corridor resulted in slightly higher daily cross-lake transit ridership compared to those that had HCT in the SR 520 corridor. Total person throughput across the lake was similar regardless of which corridor (SR 520 or I-90) LRT was placed.
- Building light rail in the I-90 corridor also had fewer environmental impacts and lower construction costs compared to building in the SR 520 corridor ($2.7 billion on I-90 compared with $4.7 billion on SR 520[3]).
- If LRT was in the SR 520 corridor only, there would be line capacity problems into Downtown Seattle once North Link opened, requiring two tunnels between the University of Washington and Downtown Seattle. Therefore, given that ridership was nearly the same for each corridor, I-90 was re-confirmed as the best corridor.
- Finally, BRT (an HCT technology) was sufficient to meet SR 520 transit demand until at least 2030, if not beyond.

Given these results, the Trans-Lake Project team determined that the evaluation confirmed the region's previous decision that light rail would first be implemented on I-90 with express bus service on SR 520. Since this decision, regional transit planning has proceeded based on the assumption that I-90 would be the first corridor to receive an extension of light rail across Lake Washington.

Sound Transit Long-Range Plan Update (2005)

- In 2005, Sound Transit adopted an update to their 1996 long-range plan. The original 1996 plan was reviewed and updated to reflect extensive analysis of the region's growth in the coming decades, and how a regional transit system might best accommodate that growth. Sound Transit staff held a series of public meetings throughout the region to solicit comments. After reviewing public and agency comments on the draft, the Board unanimously adopted the updated Long-Range Plan in July 2005.
- The Plan included the following changes to the cross-lake corridors:
- University District to Redmond and Northgate to Bothell were each designated as HCT corridors.
- Downtown Seattle to Redmond, via I-90 to Downtown Bellevue was identified as an LRT or Rail Convertible BRT corridor. Light rail was identified as the preferred mode for the Downtown Seattle-Bellevue CBD-Overlake-Redmond corridor in 2006 based on extensive analysis and public comment.

The 2005 plan informed the identification of the Sound Transit 2 (ST2) Plan and provided the foundation for expanding the regional transit system. ST2, approved by voters in November 2008, added regional

[3] 2001 dollars from *Summary of HCT Screening Process: Evaluation and Recommendations, Trans-lake Washington Project, December 2002*.

express bus, commuter rail, and LRT service, including East Link across I-90. ST2 also includes new routes in the SR 520 corridor to further develop BRT connecting Redmond, Bellevue, the University of Washington, and Downtown Seattle, taking advantage of transit speed and reliability improvements programmed as part of the WSDOT SR 520 Bridge Replacement and HOV Project.[4]

The Future of Light Rail on SR 520

Since the Trans-Lake Project and the adoption of the ST's updated Long Range Plan, LRT planning efforts have been focused on completing Central/North Link and East Link. With I-90 identified as the corridor to receive LRT, SR 520 has been identified as the corridor to receive BRT. The same agencies that collaborated in the SR 520 with LRT evaluation also collaborated in 2007-2008, along with the University of Washington, to identify potential BRT service structures in the SR 520 corridor that could meet transit demand in the year 2030 and beyond. This work is documented in the Draft and Final High Capacity Transit Plans (WSDOT, 2008).

ST2 also includes funding for planning studies, including HCT from Redmond to the University District via Kirkland in the SR 520 corridor, continuing on to Ballard and Downtown Seattle. Meanwhile, the SR 520 corridor is being designed and built to accommodate LRT in the future.

4 Sound Transit 2, A Mass Transit Guide, The Regional Transit System Plan for Central Puget Sound, pg 9.

EXHIBIT A-1. REGIONAL HIGH CAPACITY AND LIGHT RAIL PLANNING

1967-9
- *Comprehensive Public Transportation Plan for the Seattle Metropolitan Area - 1985 Horizon* identifies rail corridor from Seattle-Mercer Island-Bellevue-Redmond
- Included in *Forward Thrust* bond measure in 1968 - had simple majority but failed because it didnt' have 60% supermajority needed for financing

1970's
- Region debates at length whether to expand and modernize I-90, including whether transit should have semi- or totally exclusive ROW

1976
- I-90 Memorandum Agreement - specifies dedicated transit facility to be included on new I-90 bridge
- Signed by cities of Seattle, Mercer Island, Bellevue and King County Metro Transit and WSDOT
- This agreement comes well prior to any similar process for SR 520 (which wasn't until 1998)

1986
- Puget Sound Council of Governments (PSCOG)-Metro performs The Multi-Corridor Analysis
- LRT on SR 520 elminated as alternative in Phase II analysis due to low ridership, lower feeder bus potential, higher cost, and lower cost-effectiveness compared with I-90.

1990's
- Joint Regional Policy Committee (JRPC) begins planning regional high capacity transit - looking at 520?
- JRPC, which includes King, Pierce and Snohomish counties and WSDOT Secretary, is pre-cursor to RTA

1993
- JRPC completes EIS on Regional Transit System - light rail on I-90 identified as preferred mode
- Following adoption of JRPC's Regional Transit Plan, Central Puget Sound Regional Transit Authority (RTA) forms

1994-5
- RTA conducts public outreach on JRPC's Regional Transit Plan & identifies set of HCT investments for vote
- RTA adopts plan in 1994 -includes I-90 LRT btwn Seattle, Bellevue, Redmond - presents to voters in 1995 (fails)
- RTA develops new investment plan - Sound Move - express bus service in HOV lanes substituted for LRT

1996-8
- Sound Transit adopts first long-range plan - plan highlights I-90 corridor as HOV expressway & potential LRT
- SR 520 identified for "local bus service" (later identified as regional express bus service)
- I-90 Two-Way Transit and HOV Project EIS started

1999
- Trans-Lake Study - ST (a co-lead) wants to confirm I-90 as preferred cross-lake corridor or define a better crossing location
- Recommends HCT element (doesn't specify what kind) be carried forward into development of EIS alternatives

2000
- Trans-Lake Washington Project - series of studies (see next page) confirms I-90 rather than SR 520 as the preferred corridor for light rail due to higher ridership and lower cost (environmental & financial)

2004
- Amendment to I-90 Memorandum Agreement -identified R8A from I-90 Two Way Transit and HOV Project as first step to having transit operating in dedicated ROW as the first step towards the ultimate configuration of I-90 between Seattle and Bellevue with high capacity transit in the center roadway.
- PSRC prepares Central Puget Sound Region High Capacity Transit Corridor Assessment Report - findings about 520 HCT/LRT

2005
- ST updates and adopts long-range plan (based on SEIS and extensive public outreach)
- I-90 remains the priority corridor and HOV/BRT system added to SR 520 corridor

2006
- Sound Transit Board passes Resolution No. R2006-15
- Identifies light rail as the preferred mode for HCT in the Seattle to Bellevue and Redmond via I-90

2010
- SR 520 Bridge Replacement and HOV Program revisits SR 520 with LRT

EXHIBIT A-2. TRANS-LAKE WASHINGTON STUDY AND PROJECT SR 520 AND I-90 HCT EVALUATIONS PROCESS

1996 ST Long Range Plan
****I-90 identified as HCT corridor***

ST I-90 Two-Way Transit & HOV
****don't have to widen = less cost & impacts***

ST Central Link
****LRT capacity north of DT Seattle***

I-405 Corridor Program
****accounted for in 520 traffic forecasts***

*indicates affect on SR 520 that was considered/accounted for in Trans-Lake Washington Project alternatives development and analysis

Stage/Study/Project + Purpose	Analysis & Documentation	Outcomes
1998-1999 Trans-Lake Washington *Study*		
Purpose is to identify a set of reasonable & feasible solutions to improve mobility across and/or around Lake Washington. Solution sets: * No Action * MTP 98 * MTP Flipped *Roadway/Rail * New Crossing *Roadway/Bus * Maximize Alternatives	• Trans-Lake Study Overview & Recommendation Pamphlet (10/99) ***ST wants to confirm I-90 as preferred cross-lake corridor or define a better crossing location & SR 520 planned for regional express bus service***	EIS should evaluate the following on SR 520: • Study passenger ferry options *(ST performed)* • One HOV in each direction • One HOV in each direction + HCT • One HOV + One GP in each direction • One HOV + One GP + HCT • Minimum footprint i.e. 4 Lane + bike/ped • Continue to study ST I-90 Two-Way Transit • ***SR 520 qualified as potential 2nd cross-lake HCT route*** • Preference of HCT in SR 520 Corridor
2000-2002 Trans-Lake Washington *Project*		
First level screening evaluation = 2 stages ***Stage 1:*** ID of potential alignment corridors:	• Preliminary Definition of Alternatives for First Level Screening (9/28/00) • First Level Screening Evaluation Results-Technical Steering Committee Review Draft with Comments (10/12/00)	Recommendations • EIS should evaluate the following: o Alt C1: HCT in 520 corridor o Alt C2: HCT in I-90 corridor o Alt C3: HCT in new mid-lake corridor • Do not analyze further due high costs: o Alt C4.2 – mid-lake crossing Sand point to Kirkland o Alt. C4.1 – mid-lake crossing Madison to Kirkland
First level screening evaluation Stage 2: Evaluate modes (i.e. highway and transit) separately for corridors selected in Stage 1 (Alts C1, C2 & C3) to determine which HCT alts (BRT & LRT) performed the best and which should be analyzed further in the multi-modal evaluation	• HCT Modal Evaluation Initial Findings (3/9/01) • HCT Modal Evaluation: Transportation, Environmental, Cost Findings (4/10/01) • Definition of HCT Alternatives for Modal Evaluation (4/11/01)	Recommendations • Exclude the following HCT alternatives: o Bus only lanes o Mid-lake crossing o Pure BRT alternatives • HCT modal alts combined with GP/HOV alts into these multi-modal alternatives: o Alt 2: 4 Lane with I-90 LRT o Alt 3: 520 HOV with I-90 LRT o Alt 4: 520 HOV+GP+I-90 LRT o Alt 5: 520 HOV+520 HCT o Alt 6: 520 HOV+GP+ 520 HCT o Alt 7: 520 HOV with BRT connections o Alt 8: 520 HOV+GP+BRT connections
Second level screening: Multi-Modal Evaluation Purpose of this screening was to analyze in more detail the multi-modal alternatives (Alt 2-8) developed in First level screening: Stage 2 (Alt 1 was No Action)	• Preliminary Definition of Multi-Modal Alternatives for Second Level Screening (5/14/01) • Multi-Modal Alternatives Evaluation Report (6/6/01) • Multi-Modal Alternatives Evaluation – Environmental Findings (6/7/01) • Final Multi-Modal Cost Methodology and Multi-Modal Cost Opinions for Alternatives Analysis (7/11/01) • Update to Multi-Modal Alternatives Evaluation Report to include all elements of analysis (4/12/02)	Recommendations for DEIS: • Carry forward No Action • Analyze 4-Lane • Analyze 6-Lane w/ combined HOV/BRT (with & without additional Montlake Cut crossing) • Analyze 8-Lane (+1 GP+1HOV/BRT) • ***Support ST Long-range plan for LRT on I-90 and BRT on SR 520 (see next page)*** • Consider whether 520 alts should include provisions to accommodate HCT in distant future (beyond 2020?) ***See ST memo dated Nov 15, 2001 confirming I-90 as the corridor for potential LRT extension across Lake Washington + revision to Long-Range plan to include BRT/HOV system on the SR 520 corridor (was adopted)***
Accommodating HCT in the SR 520 Corridor Purpose was to examine options /how to accommodate HCT (likely LRT in 520)	• Accommodating HCT in the SR 520 Corridor (9/29/02)	Evaluated 4 scenarios: • No HCT accommodation • HCT accommodation on floating bridge, approach structures, and EP lid • HCT accommodation on entire lake crossing plus adj. to lids east of EP • HCT envelope preservation between Montlake Blvd and Redmond Recommendations: • Selection of HCT accommodation scenario = reconstruct corridor I-5 to Redmond with + 30 ft to accommodate future HCT (likely LRT)
Summary of HCT Screening Process: Evaluations and Recommendations (December 2002) Purpose of this report was to summarize the analyses that have been conducted as part of the Trans-Lake Project regarding HCT and BRT on the SR 520 and I-90 corridors.		

This exhibit developed using the Summary of HCT Screening Process: Evaluations and Recommendations (Trans-Lake Washington Project, Dec 2002) report

Appendix B – Station-to-Station Travel Times Provided by Sound Transit

EXHIBIT B-1. SR 520 TRAVEL TIME ANALYSIS

SR 520 LRT Travel Time Analysis

Ballard to Totem Lake Line

Trave Time (T_S) = $[(3.6*S)/V_{max}]+[(V_{max}/7.2)*((1/a)+(1/b))]+t_s$

Segment Start	Segment Stop	Alignment/ROW	Station Spacing (ft)	Station Spacing (mi)	Station Spacing (m)	Maximum Speed / Off-peak Speed (mi/h)	Maximum Speed (km/h)	Accel. Rate (m/s^2)	Braking Rate (m/s^2)	Dwell Time (sec)	Station to Station Travel Time (sec)	Avg. Speed (mph)
Ballard (17th Ave. NW & NW Market St.)	Fremont (NW 45th St. & Greenwood Ave. N)	At-grade street running	7,399.81	1.40	2,255.46	25.00	40.23	1.340	1.340	60.0	270.15	18.7
Fremont (NW 45th St. & Greenwood Ave. N)	Aurora Ave. (N 45th St. & SR 99/Aurora Ave. N)	At-grade street running	1,899.00	0.36	578.82	25.00	40.23	1.340	1.340	30.0	90.13	14.4
Aurora Ave. (N 45th St. & SR 99/Aurora Ave. N)	Wellingford (N 45th St. & Wellingford Ave. N)	At-grade street running	2,723.00	0.52	829.97	25.00	40.23	1.340	1.340	30.0	112.60	16.5
Wellingford (N 45th St. & Wellingford Ave. N)	Brooklyn (N 45th St. & Brooklyn Ave. NE)	At-grade street running	5,657.73	1.07	1,724.47	25.00	40.23	1.340	1.340	60.0	222.64	17.3
Brooklyn (N 45th St. & Brooklyn Ave. NE)	UW Station (via University Wy. NE & NE Pacific St.)	At-grade street running	5,705.83	1.08	1,739.13	20.00	32.19	1.340	1.340	60.0	261.19	14.9
UW Station	Evergreen Point Station	Aerial/grade-seperated	17,151.45	3.25	5,227.75	45.00	72.42	1.340	1.340	30.0	304.88	38.4
Evergreen Point Station	South Kirkland park-n-ride	Aerial/grade-seperated	12,090.99	2.29	3,685.33	45.00	72.42	1.340	1.340	30.0	228.21	36.1
South Kirkland park-n-ride	Kirkland Transit Center (3rd & Park Ln. via BNSF ERC & State St. S)	At-grade street running	13,195.30	2.50	4,021.92	30.00	48.28	1.340	1.340	30.0	339.90	26.5
Kirkland Transit Center (3rd & Park Ln.)	Totem Lake TC (via Central Wy/NE 85th St & BNSF ERC)	At-grade street running	19,660.08	3.72	5,992.38	30.00	48.28	1.340	1.340	60.0	516.83	25.9
Return Trip												
Totem Lake TC (120th Ave. NE & NE 128th St.)	Kirkland Transit Center (3rd & Park Ln. via BNSF ERC & State St. S)	At-grade street running	19,660.08	3.72	5,992.38	30.00	48.28	1.340	1.340	60.00	516.83	25.9
Kirkland Transit Center (3rd & Park Ln.)	South Kirkland park-n-ride (via State St. S & BNSF ERC)	At-grade street running	13,195.30	2.50	4,021.92	30.00	48.28	1.340	1.340	30.00	339.90	26.5
South Kirkland park-n-ride	Evergreen Point Station	Aerial/grade-seperated	12,090.99	2.29	3,685.33	45.00	72.42	1.340	1.340	30.00	228.21	36.1
Evergreen Point Station	UW Station	Aerial/grade-seperated	17,151.45	3.25	5,227.75	45.00	72.42	1.340	1.340	30.00	304.88	38.4
UW Station	Brooklyn (N 45th St. & Brooklyn Ave. NE via NE Pacific St. & Univ. Wy. NE)	At-grade street running	5,705.83	1.08	1,739.13	20.00	32.19	1.340	1.340	60.00	261.19	14.9
Brooklyn (N 45th St. & Brooklyn Ave. NE)	Wellingford (N 45th St. & Wellingford Ave. N)	At-grade street running	5,657.73	1.07	1,724.47	25.00	40.23	1.340	1.340	60.00	222.64	17.3
Wellingford (N 45th St. & Wellingford Ave. N)	Aurora Ave. (N 45th St. & SR 99/Aurora Ave. N)	At-grade street running	2,723.00	0.52	829.97	25.00	40.23	1.340	1.340	30.00	112.60	16.5
Aurora Ave. (N 45th St. & SR 99/Aurora Ave. N)	Fremont (NW 45th St. & Greenwood Ave. N)	At-grade street running	1,899.00	0.36	578.82	25.00	40.23	1.340	1.340	30.00	90.13	14.4
Fremont (NW 45th St. & Greenwood Ave. N)	Ballard (17th Ave. NW & NW Market St.)	At-grade street running	7,399.81	1.40	2,255.46	25.00	40.23	1.340	1.340	60.00	270.15	18.7
Round Trip Total			**170,966.40**	**32.38**	**52,110.46**						**4,693.08**	**24.84**

Trave Time (T_S) = $[(3.6*S)/V_{max}]+[(V_{max}/7.2)*((1/a)+(1/b))]+t_s$

Where:

V_{max} = maximum speed reached (kilometers/hour)

S = distance traveled (meters)

a = acceleration rate (meters/second^2)

b = braking rate (meters/second^2)

t_s = dwell time (seconds)

Route Mileage

Sation	Cum. mi.	Spacing
Ballard	0.00000	0.00000
Fremont	1.40148	1.40148
Aurora Ave.	1.76114	0.35966
Wellington	2.27686	0.51572
Brooklyn	3.34840	1.07154
UW	4.42905	1.08065
Evergreen Point	7.67743	3.24838
S. Kirkland	9.96739	2.28996
Kirkland TC	12.46650	2.49911

Vehicle Requirements	
Pk Headway (min)	10
Rd Trip Total Running Time (sec)	4,693.08
Round Trip Total Running Time (min)	78.22
Cycle Time (min)	89.95
Peak Trainsets	9
Terminal Time (min)	11.73

SR 520 LRT Travel Time Analysis

Trave Time (T_S) = $[(3.6*S)/V_{max}]+[(V_{max}/7.2)*((1/a)+(1/b))]+t_s$

Totem Lake to Ballard Line

Segment Start	Segment Stop	Alignment/ROW	Station Spacing (ft)	Station Spacing (mi)	Station Spacing (m)	Maximum Speed / Off-peak Speed (mi/h)	Maximum Speed (km/h)	Accel. Rate (m/s^2)	Braking Rate (m/s^2)	Dwell Time (sec)	Station to Station Travel Time (sec)	Avg. Speed (mph)
Totem Lake TC (120th Ave. NE & NE 128th St.)	Kirkland Transit Center (3rd & Park Ln.)	At-grade street running	19,660.08	3.72	5,992.38	30.00	48.28	1.340	1.340	60.0	516.83	25.9
Kirkland Transit Center (3rd & Park Ln.)	South Kirkland park-n-ride	At-grade street running	13,195.30	2.50	4,021.92	30.00	48.28	1.340	1.340	30.0	339.90	26.5
South Kirkland park-n-ride	Bellevue (Hospital Station)	At-grade street running	8,711.05	1.65	2,655.12	30.00	48.28	1.340	1.340	60.0	267.99	22.2
Return Trip												
Bellevue (Hospital Station)	South Kirkland park-n-ride	At-grade street running	8,711.05	1.65	2,655.12	30.00	48.28	1.340	1.340	60.00	267.99	22.2
South Kirkland park-n-ride	Kirkland Transit Center (3rd & Park Ln.)	At-grade street running	13,195.30	2.50	4,021.92	30.00	48.28	1.340	1.340	30.00	339.90	26.5
Kirkland Transit Center (3rd & Park Ln.)	Totem Lake TC (120th Ave. NE & NE 128th St.)	Aerial/grade-seperated	19,660.08	3.72	5,992.38	30.00	48.28	1.340	1.340	60.00	516.83	25.9
Round Trip Total			**83,132.86**	**15.74**	**25,338.85**						**2,249.43**	**25.20**

Trave Time (T_S) = $[(3.6*S)/V_{max}]+[(V_{max}/7.2)*((1/a)+(1/b))]+t_s$

Where:

- V_{max} = maximum speed reached (kilometers/hour)
- S = distance traveled (meters)
- a = acceleration rate ($meters/second^2$)
- b = braking rate ($meters/second^2$)
- t_s = dwell time (seconds)

Route Mileage

Sation	Cum. mi.	Spacing
Totem Lake TC	0.00000	0.00000
Kirkland TC	3.72350	3.72350
S. Kirkland	6.22261	2.49911
Bellevue (Hsopital Station	7.87243	1.64982

Vehicle Requirements	
Pk Headway (min)	10
Rd Trip Total Running Time (sec)	2,249.43
Round Trip Total Running Time (min)	37.49
Cycle Time (min)	43.11
Peak Trainsets	5
Terminal Time (min)	5.62

Appendix C - Year 2030 Bus Network Changes Assumed in SR 520 with LRT Evaluation (provided by King County Metro)

EXHIBIT C-1. PROPOSED PEAK AND NON-PEAK TRANSIT ROUTES AND HEADWAYS FOR THE 2030 FEIS NO-BUILD TRANSIT NETWORK

	2030 Headways		SR-520 Light Rail 2030 Headways			SR-520 Light Rail		SR-520 Light Rail			Link Stations (East Link)												Link Stations (SR-520 Link)										
Route	Peak 3	Midday	Peak	Midday	Route Description	Route Description Change	Path Changes	Path Changes	Comments	Comments	Rainier	Mercer Is	S. Bellevue	East Main	BTC	Ashwood/Hospital	122nd	130th	Overlake Village	OTC	SE Redmond	Downtown Redmond	Ballard	Fremont	Aurora	Wallingford	Brooklyn	Husky Stadium	Evergreen Point	South Kirkland	Kirkland TC	Totem Lake TC	Overlake Hospital
1	15	30			Kinnear-Beacon Hill 1					Fiscal Crisis reduction																							
2	30	30			W Qu. Anne-Madrona 2																												
2	30	30			Sea Center-Madrona 2																												
2	15				Queen Anne Exp 2E																			x									
3	**20**	**30**	**20**	**20**	**Queen Anne-Madrona 3**	**Woodland Pk - Madrona**		**Extend route to Woodland Park via Fremont**																**x**									
3	**30**	**30**	**30**	**30**	**Queen Anne-1st Hill 3**	**Woodland Pk - 1st Hill**		**Extend route to Woodland Park via Fremont**																									
4	20	30			Qu Anne-Judkins Pk 4																												
5X	**30**		**15**	**XX**	**Greenwood-Sea CBD 5X**																			**x**	**x**								
5	-	-			Ngate-Grnwd-SeaCBD 5		Eliminate variant to Northgate																	x	x								
5	**15**	**15**	**15**	**15**	**Sh CC-Grnwd-SeaCBD 5**	**Sh CC-Grnwd-Fremont-SeaCBD**		**Operate through Fremont and along Dexter Ave**		**Improve frequency**														**x**	**x**								
7	10	10			Rainier Bch-Seattle CBD		No Change			Stop consolidation on Rainier, Fiscal Crisis reductions.	x																						
7X	30	-			Rainier Bch-Seattle CBD		No Change			Added per service change implemented Sept 2009. Fiscal Crisis reductions	x																						
7	12				CBD-Rainr 7R					Fiscal Crisis reduction																							
8	15	15			Sea-Cap HI-Rain BC 8																												
9	20	30			Rainr Bch-Brdwy-UW 9						x																						
9X	15	60			Rainr Bch-Capital Hill		In September 2009, Route 9X will terminate at Rainier Beach Link Station			Extended to Henderson Station	x																						
10	15	15			Cap Hill-Sea CBD 10					Fiscal Crisis/Link reductions																							
11	15	20			Madison Prk-Ferry 11																												
12	15	15			Cap Hill-Sea CBD 12																												
12	-	NA			Sea CBD-First Hill 12		All trips extend to Interlaken Park (midday)																										
13	**15**	**30**	**15**	**15**	**SPU-Seattle CBD 13**	**Woodland Pk - Seattle CBD**		**Extend route to Woodland Park via Fremont**	**Improved frequency**															**x**									
14	15	30			Summit-Mt. Baker 14																												
15	-	-			Ballard-Sea CBD 15					Route deleted due to Ballard BRT (dependent on RapidRide travel time)																							
16	20	20			Ngate-Wlngfrd-Sea 16																					x							
17X	**30**	**-**	**20**	**XX**	**Sunset Hill-CBD 17X**				**Improve frequency**																								
17	**30**	**30**	**20**	**30**	**Sunset Hill-CBD 17**	**Broadview-CBD**		**Revise route to serve 8th NW, north of Market Street.**															**x**										

			SR-520 Light Rail			SR-520 Light Rail		SR-520 Light Rail																									
	2030 Headways		2030 Headways								Link Stations (East Link)											Link Stations (SR-520 Link)											
Route	Peak 3	Midday	Peak	Midday	Route Description	Route Description Change	Path Changes	Path Changes	Comments	Comments	Rainier	Mercer Is	S. Bellevue	East Main	BTC	Ashwood/Hospital	122nd	130th	Overlake Village	OTC	SE Redmond	Downtown Redmond	Ballard	Fremont	Aurora	Wallingford	Brooklyn	Husky Stadium	Evergreen Point	South Kirkland	Kirkland TC	Totem Lake TC	Overlake Hospital
18	30	30	XX	XX	Loyal Hts SeaCBD 18	DELETE		DELETE	DELETE	Deleted-Revised with Ballard RapidRide																							
18E	15	-	12	XX	Loyal Hts SeaCBD 18E				Improve frequency	Deleted-Revised with Ballard RapidRide																							
19	30	-			W Magnolia-Galer 19																												
21E	15	-			Arbor Hts-Sea 21E																												
21	30	30			Arbor Hts-Sea CBD 21																												
22	30	30			White Ctr-Sea CBD 22		Route truncated to Alaska Jct-White Center																										
23	30	30			Wht Cntr-Seattle 23					Fiscal Crisis reduction																							
24	20	30	15	30	Magnolia-Sea CBD 24	Ballard-Magnolia-Sea CBD		Revise routing in Magnolia and extend to Ballard rail station.															x										
25	30	120			Lrlhrst-Mntlk-Sea 25																												
26	20	30	XX	XX	Grnlk-Dexter-CBD 26	DELETE		DELETE	DELETE																								
26X	15	-	12	XX	Grnlk-Fremnt-CBD 26X				Improve Frequency																x								
27	30	30			Colm Pk-Lschi-Sea 27																												
28E	15		12	XX	Broadview-Fremnt 28E				Improve Frequency															x	x								
28	20	30	XX	XX	Broadview-Fre-CBD 28	DELETE		DELETE	DELETE																								
29			20	30		Sunset Hill-Fremont-UW		New route between Sunset Hill and UW through Ballard and Fremont	Compliments Route 31 between Fremont and UW														x										
30	15	30	XX	XX	Sea Ctr-UW-Sand Point 30	DELETE		DELETE	DELETE																								
31	26	30	20	30	UW-Fremnt-Magnlia 31				Improve frequency																		x						
32	NA				Rain Bch-Sea CBD 32					Route deleted due to LINK																							
32			20	30		Discovery Pk-Sea CBD		New route from Discovery Park to Seattle CBD via 28th Ave W																									
33	20	30			Magnolia-Sea CBD 33																												
34	NA				Rain Bch-Sea CBD 34					Route deleted																							
34X	60	-			Rainier Bch-Seattle CBD		No change			Added per service change implemented Sept 2009	x																						
35	NA				Harbor Island 35					Route deleted, see Route 39																							
36	8	10			Othello Station-Beacon Hill-Sea CBD		Modify Route to end at Othello Station (All trolley bus operation)			Fiscal Crisis reduction																							
37E	30				Adm Dst-Alki-CBD 37E					Fiscal Crisis reduction																							
38	20	20			Mount Baker Transit Center-Beacon Hill Station 38		Route revised to serve Mount Baker Transit Center to Beacon Hill Station.																										

			SR-520 Light Rail			SR-520 Light Rail		SR-520 Light Rail																								
	2030 Headways		2030 Headways								Link Stations (East Link)												Link Stations (SR-520 Link)										
Route	Peak 3	Midday	Peak	Midday	Route Description	Route Description Change	Path Changes	Path Changes	Comments	Comments	Rainier	Mercer Is	S. Bellevue	East Main	BTC	Ashwood/Hospital	122nd	130th	Overlake Village	OTC	SE Redmond	Downtown Redmond	Ballard	Fremont	Aurora	Wallingford	Brooklyn	Husky Stadium	Evergreen Point	South Kirkland	Kirkland TC	Totem Lake TC	Overlake Hospital
39	30	30			Othello Station-Seward Park-Beacon Hill-Downtown Seattle 39		Route revised to serve Othello Station-Seward Park-Beacon Hill-Downtown Seattle																										
41	15	15			Northgte-SeaCBD 41ER		Route truncated with LRT to Northgate operates between Northgate and Lake City																										
41E	NA				Northgate-Seacbd 41E					Route does not operate when LINK to Northgate																							
42	60	60			Columbia City-Pioneer Sq		No change			Added per service change implemented Sept 2009	x																						
42X	NA				Rainier View-CBD 42X					Route deleted due to Light Rail																							
43	12	15			CBD-Montlake-UW 43					Fiscal Crisis reduction																							
43	30				Cap Hill-Mntlk-UW 43					Fiscal Crisis reduction																	x	x					
44	10	10			Ballard-UW-Montlk 44																						x	x					
45	45	-			Q Anne-Wlngfrd-UW 45																						x						
46	60				Ballard Locks-UW 46																												
48	10	10			Loyal Heights-Mt. Baker		In September 2009, Route 48 will be revised to end at Mount Baker Transit Center.				x																x	x					
49	15	15			SCBD-Broadway-UW 49																						x						
51	30	30			Admrl-WSea Jct VN 51																												
53		60			W Sea-Alki 53																												
54X	NA				Fauntleroy-Sea 54X					Route deleted due to West Seattle BRT																							
54	NA	NA			W Sea-WhtCtr 54					Route deleted due to West Seattle BRT																							
55	NA				CBD-Admiral 55					Route deleted due to West Seattle BRT (change to peak pm only)																							
55	NA	NA			Admiral-CBD 55					Route deleted due to West Seattle BRT (change to peak am only)																							
56E	30				Alki-Seattle CBD 56E																												
56	30	30			Alki-Seattle CBD 56																												
57	30				W Sea-Sea CBD 57																												
60	30	30			Georgtwn-Broadway 60																												
62	**15**	**30**	**XX**	**XX**	**Ballard-Ngate-Lk City 62**	**DELETE**		**DELETE**	**Delete, Rapid Ride D Line will proivde Northgate-Ballard connection**	**New route replacing Route 75 west of Lake City**																							
64E	26				Lkcty-Wedgwd-CBD 64E																												
65	**26**		**XX**	**XX**	**UW-LakeCity 65R**	**DELETE**		**DELETE**	**Deleted as full route is upgraded to 2-way frequent**																								

			SR-520 Light Rail			SR-520 Light Rail		SR-520 Light Rail																									
	2030 Headways		2030 Headways								Link Stations (East Link)												Link Stations (SR-520 Link)										
Route	Peak 3	Midday	Peak	Midday	Route Description	Route Description Change	Path Changes	Path Changes	Comments	Comments	Rainier	Mercer Is	S. Bellevue	East Main	BTC	Ashwood/Hospital	122nd	130th	Overlake Village	OTC	SE Redmond	Downtown Redmond	Ballard	Fremont	Aurora	Wallingford	Brooklyn	Husky Stadium	Evergreen Point	South Kirkland	Kirkland TC	Totem Lake TC	Overlake Hospital
									service.																								
65	**18**	**30**	**12**	**30**	**LakeCity-UW 65**			**Revise routing between 35th/65th and UW Campus**																									
66	**30**	**30**	**30**	**XX**	**Ngate-UW-Sea CBD 66**				**Delete midday service**																		**x**						
67	**30**	**30**	**15**	**15**	**Northgate TC-UW 67**		**Modify route to serve UW Husky Station**		**Improve Frequency**																		**x**						
68	22	30			Northgate-UW 68																												
70	**15**	**15**	**10**	**15**	**UW-Seattle CBD 70**		**Modify route to serve UW Husky Station**		**Improve frequency**																			**x**					
71E	15	15			SCBD-Wedgewood (UW) 71E		Truncate route to serve UW Husky Station, serve Roosevelt Station																					x					
72E	NA	NA			LkCty-UW-CBD 72E					Route replaced by expanded Route 372																							
73E	NA	NA			Jackson-UW-SeaCBD 73					Route replaced by expanded Route 373																							
73E	NA	NA			Cwn Pk-UW-Sea CBD 73E					Route deleted due to Light Rail																							
74	-				NOAA-UW-Sea CBD 74E					Route deleted due Light Rail																							
75	-				UW-Lk City-NGate 75		Only operate segment to Lake City																										
75	-				Ballard-NrGate-UW 75		Only operate segment to Lake City																										
75	**15**	**30**	**10**	**15**	**NGate-Lk City-UW 75**		**Modify route to serve UW Husky Station. Only operate between Lake City and UW.**	**Operate between Northgate and UW.**	**Improve Frequency**																			**x**					
76X	NA				Wedgewood-SCBD 76X					Route replaced by upgraded Route 71 serving Roosevelt Station																							
77E	15				Jacksn Prk-SCBD 77E		Truncate at Roosevelt Station																										
79E	NA				Lake City-SCBD 79E					Route replaced by expanded service on Route 372																							
99	26	30			Waterfront Stcar 99																												
101	20	30			Renton-Seattle 101																												
102	30				Fairwd-Rentn-Sea 101					Fairwood Trips changed to Route 102																							
105	30	30			Kennydale-Renton 105																												
106	15	30			Renton-Sea CBD 106		Route modified to serve Rainier Beach Station, Beacon Hill and SODO.																										

	2030 Headways		SR-520 Light Rail 2030 Headways			SR-520 Light Rail		SR-520 Light Rail			Link Stations (East Link)												Link Stations (SR-520 Link)										
Route	Peak 3	Midday	Peak	Midday	Route Description	Route Description Change	Path Changes	Path Changes	Comments	Comments	Rainier	Mercer Is	S. Bellevue	East Main	BTC	Ashwood/Hospital	122nd	130th	Overlake Village	OTC	SE Redmond	Downtown Redmond	Ballard	Fremont	Aurora	Wallingford	Brooklyn	Husky Stadium	Evergreen Point	South Kirkland	Kirkland TC	Totem Lake TC	Overlake Hospital
107	15	30			Rentn-Rainier Bch 107		Extend route to serve Rainier Beach stations, revise to serve Rainier View.																										
108	30	30			Prentice Street – Rainier Beach		New route replacing Prentice Street tail of Route 7 and connecting to Rainier Beach Station.			New route replacing Prentice Street tail of Route 7 and connecting to Rainier Beach Station.																							
110	30				Renton Circulatr 110																												
111	25	-			Renton – Bellevue		Route 111 would be rerouted to downtown Bellevue, serving the South Bellevue station. Between I-405 and South Bellevue, it would use the same path as current Route 560.			p.m. layover needed			x		x																		
113	36				Shorewood-Sea CBD 113																												
114	35	-			Renton-Bellevue		Route 114 would be rerouted to downtown Bellevue, serving the South Bellevue station. Between I-405 and South Bellevue, it would use the same path as current Route 560			p.m. layover needed			x		x																		
116E	26				Fauntlry-CBD 116E																												
118X	90				Tahlqh-Vash-Sea 118X																												
118	45	180			Tahlquah-Vsh Hts 118																												
119X	75				Docktn-Vash-Sea 119X																												
119	90	150			Dockton-Vash Hts 119																												
120	10				Sea-Burien 120																												
120	15	15			Sea-Burien 120																												
121	30	30			Burien-CBD 121																												
122	30				Burien-CBD 122																												
123	36				Burien-CBD 123E																												
124	15	30			Tukwila Int'l Station-Seattle CBD 124					Replaces Route 174 between SeaTac and Seattle CBD																							
125	15	30			WC-Shwd-CBD 125																												
128	15	30			W Seattle Scentr 128																												
129	30				Riverton Hghts – Tukwila Int'l Station																												
131	40	30			Burien-CBD 131		Route truncated to Burien-Seattle CBD																										
132	20	30			Des Moines-SCBD 132		Route truncated to Burien-Seattle CBD																										
133X	45				Burien P&R-UW 133X																												

	2030 Headways		SR-520 Light Rail 2030 Headways			SR-520 Light Rail		SR-520 Light Rail			Link Stations (East Link)											Link Stations (SR-520 Link)											
Route	Peak 3	Midday	Peak	Midday	Route Description	Route Description Change	Path Changes	Path Changes	Comments	Comments	Rainier	Mercer Is	S. Bellevue	East Main	BTC	Ashwood/Hospital	122nd	130th	Overlake Village	OTC	SE Redmond	Downtown Redmond	Ballard	Fremont	Aurora	Wallingford	Brooklyn	Husky Stadium	Evergreen Point	South Kirkland	Kirkland TC	Totem Lake TC	Overlake Hospital
134	40	40			Burien-CBD 134																												
139	30	30			Burien-Greg Hts 139																												
140	-	-			Rentn-SeaTac-Bur 140		Delete			Route to serve Tukwila Commuter Rail Station. Becomes RapidRide F Line; 2030 headway is 10 minutes																							
143	36				Blk Dia-Rent-Sea 143																												
148	30	30			Fairwood-Renton 148																												
149	60	120			Blk Dia-Rent Van 149																												
150	15	15			Kent TC-Sea CBD 150		Route truncated to Kent-Seattle only																										
150	NA				Aub-Kent TC-Sea 150		Route truncated to Kent-Seattle																										
152	36				Auburn-Sea CBD 152E																												
153	30				Kent-Renton 153																												
154	30				Boeing-Auburn 154		Truncate route to Tukwila-Duwamish																										
155	30	60			Fairwood-Sthcntr 155																												
156	30	30			Tukwila-SeaTac-Des Moines 156		New Route connecting Des Moines, SeaTac and Tukwila																										
157	45				Lake Meridian P&R-Seattle 157		New route from Lake Meridian P&R to Seattle.																										
158	NA				Lk Meridian-Sea 158					Route deleted with full Sounder Service																							
159	NA				Timberlane-Sea 159					Route deleted with full Sounder service																							
161	30				Meridian Pk-CBD 161																												
162	15				Kent-Seattle CBD 162					Replaces lost service on Routes 158 and 159																							
164	30	30			Green Rv CC-Kent 164																												
166	30	30			Hghlne CC-Knt TC 166		Route extended to Burien from Des Moines																										
167	30	-	XX	XX	Renton-Univ Dist	DELETE	No change	DELETE	DELETE																		x	x					
168	30	30			Timberlane-Kent 168																												
169	15	30			Kent TC-Rentn TC 169																												
170	-				Mcmicken Hts-CBD 170					Route deleted																							
173	90				Boeing-FedWay 173																												
174	NA	NA			Fed Way-STac-Sea 174					Route deleted with creation of Rapid Ride																							
175	45				Dash Pt-Sea 175E																												
177	12				Fedrl Way Tc-Sea 177																												
179	20				Twin Lakes P&R-CBD 1																												
180	30	30			Kent-Auburn 180																												
181	30	30			Fed Way-Auburn 181																												

Route	2030 Headways Peak 3	2030 Headways Midday	SR-520 Light Rail 2030 Headways Peak	SR-520 Light Rail 2030 Headways Midday	Route Description	SR-520 Light Rail Route Description Change	Path Changes	SR-520 Light Rail Path Changes	SR-520 Light Rail Comments	Comments	Link Stations (East Link): Rainier	Mercer Is	S. Bellevue	East Main	BTC	Ashwood/Hospital	122nd	130th	Overlake Village	OTC	SE Redmond	Downtown Redmond	Link Stations (SR-520 Link): Ballard	Fremont	Aurora	Wallingford	Brooklyn	Husky Stadium	Evergreen Point	South Kirkland	Kirkland TC	Totem Lake TC	Overlake Hospital
182	30	60			Fed Wy-NE Tacoma 182																												
183	45	60			Fed Way-Kent Van 183																												
187	30	30			Twin Lk-FedTC VN 187																												
190	30				Star Lk-Sea 190																												
191	NA				Pac Hwy S EX 191					Deleted with Link Integration																							
192	45				Star Lk-Sea 192																												
194	NA	NA			Airport-Fed Way 194					Route deleted due to Light Rail																							
194	NA	NA			Airport-Fed Way 194					Route deleted due to Light Rail																							
196	22				S Fed Wy P&R-Sea 196																												
197	20				Federal Way-Univ 197																												
200	20	30			Issaquah-Issaquah Highlands		Route 200 will operate at a two-way loop routing connecting North and South Issaquah with Issaquah Highlands, Issaquah Transit Center and the Talus neighborhood.			Funded by Transit Now Service Partnership beginning in 2010																							
201	60	-			Mercer Island West		No change					x																					
202	-	-			Mercer Is - Seattle CBD		Delete			Route deleted due to Link																							
203	30	30			Mercer Island North		Extend west to First Hill (on Mercer Island) via NE 24th Street and West Mercer Way.					x																					
204	15	30			Mercer Island Central		No change					x																					
205	-	-			Mercer Island - Univ Dist		Delete			Route deleted due to Link																							
209	30	30			North Bend - Issaquah		No change			Improved headway																							
210	40	-			Issaquah – S Bellevue		I-90 to S Bellevue Station			Revise route to go to Bellevue via South Bellevue P&R			x																				
211	-	-			Eastgate - Seattle CBD		Delete			Transit Now Service Partnership may fund improvements beginning in 2011																							
212	8	-			Eastgate - Seattle CBD		No change				x																						
213	30	30			Mercer Island North		Extend west to First Hill (on Mercer Island) via NE 24th Street and West Mercer Way.					x																					
214	15	-			Issaquah - Seattle CBD		No change			See Route 215 for North Bend-Seattle connection	x																						
215	30	-			North Bend - Seattle CBD		New direct route from downtown Seattle to North Bend via Snoqualmie Ridge, Issaquah, Eastgate freeway stop and I-90.			New route implemented in September 2008	x																						

			SR-520 Light Rail			SR-520 Light Rail		SR-520 Light Rail																									
	2030 Headways		2030 Headways								Link Stations (East Link)												Link Stations (SR-520 Link)										
Route	Peak 3	Midday	Peak	Midday	Route Description	Route Description Change	Path Changes	Path Changes	Comments	Comments	Rainier	Mercer Is	S. Bellevue	East Main	BTC	Ashwood/Hospital	122nd	130th	Overlake Village	OTC	SE Redmond	Downtown Redmond	Ballard	Fremont	Aurora	Wallingford	Brooklyn	Husky Stadium	Evergreen Point	South Kirkland	Kirkland TC	Totem Lake TC	Overlake Hospital
216	30	-			Samm - Seattle CBD		No change				x	x																					
217	-	-			Issaquah - Seattle CBD		Delete			Delete and merge into expanded Route 212																							
218	12	-			Issq - Highlds - Seattle CBD		No change			Surprised to see the equilibrated headways lengthened; ridership is strong	x																						
219	60	-			Newcastle		No change																										
220	NA	NA			Rdmnd-S Krk-Bellv 2					Route deleted																							
221	15	15			Redmond - Eastgate		Revise to use NE 31st overcrossing.			Implemented in February 2008; improved headway by 2020										x		x											
222	30	30			Eastgate - Bellevue		No change			Route revised in February 2008. Interline with Route 249 if Route 233 is deleted			x		x																		
223	**30**	**30**	**15**	**30**	**South Kirkland P&R-Eastgate**				**Improve frequency**	**New Route connecting South Kirkland P&R-140th - Eastgate**						**x**														**x**			**x**
224	**30**	**30**	**30**	**30**	**Overlake-Crossroads-Phantom Lake-Eastgate**				**This is the same route as 227 listed below, only one route is necessary.**	**New route replacing parts of Route 225, 230 East and 926.**										**x**													
225	-	-			Overlake - Seattle CBD		Delete			Trips added on 212. See 212 and 245																							
227	**30**	**30**	**XX**	**XX**	**Overlake - Eastgate**	**DELETE**	**Route 227 will connect Eastgate and Overlake TC via BCC (see current route 926), SE 24th Street, 148th Avenue SE, SE Eastgate Way, 161st Avenue SE, SE 24th Street, 166th Avenue SE, SE 14th Street, 164th Avenue SE, Main Street, 156th Avenue NE, NE 8th Street (see current route 230), Northup Way, 164th Avenue NE, NE 24th Street, 152nd Avenue NE (Overlake P&R), NE 31st Street, 156th Avenue NE, Overlake TC.**	**DELETE**	**Delete, this is the same as Route 224.**	**Implementation with Rapid Ride Line B (see route 253)**									**x**	**x**													
229	-	-			Overlake - Seattle CBD (229E)		Delete			Trips added on 212																							

	2030 Headways		SR-520 Light Rail 2030 Headways			SR-520 Light Rail		SR-520 Light Rail			Link Stations (East Link)											Link Stations (SR-520 Link)											
Route	Peak 3	Midday	Peak	Midday	Route Description	Route Description Change	Path Changes	Path Changes	Comments	Comments	Rainier	Mercer Is	S. Bellevue	East Main	BTC	Ashwood/Hospital	122nd	130th	Overlake Village	OTC	SE Redmond	Downtown Redmond	Ballard	Fremont	Aurora	Wallingford	Brooklyn	Husky Stadium	Evergreen Point	South Kirkland	Kirkland TC	Totem Lake TC	Overlake Hospital
230	**15**	**30**	**XX**	**XX**	**Brickyard - Kirkland via Kingsgate and TLTC**	**DELETE**	**Delete Portion of route 230 between Kirkland and Redmond. New route 230 will connect Kirkland TC and Brickyard via the path of the current route 230 to Totem Lake, serve the Totem Lake TC on NE 128th Street, and follow the path of the current route 255 to Brickyard.**	**DELETE**	**DELETE**	**See routes 253 and 227. Route 255 would be truncated at Totem Lake TC. Provides Kingsgate local service. Serves NE 128th Street, providing connections with routes 311 and 532-535**																							
231	**15**	**15**	**15**	**15**	**Kirkland - Issaquah**	**Brickyard P&R - South Kirkland**	**Kirkland TC, State Street, NE 68th Street, Lakeview Drive NE, Lake Washington Boulevard NE, NE 38th Place/Northup Way (one-way couplet), South Kirkland P&R, Bellevue Way NE, NE 8th Street, 108th Avenue NE, follow current route 271 path to Issaquah via BCC and Eastgate.**	**Operate between Brickyard and South Kirkland via Totem Lake, Juanita and Kirkland TC and 108th Ave NE.**	**Serves portions of routes 230, 238 and 255.**	**Combines segments of routes 230 and 271; in no build, could pulse with Route 550**					**x**															**x**	**x**	**x**	
232	30	-			Duvall - Redmond		Truncated with improvements to ST routes 542, 545, and 556			Route revised in February 2008												x											
233	30	30			Redmond - Bellevue		Delete			Routing duplicated by Link																							
234	**20**	**30**	**15**	**15**	**Kenmore - Bellevue**	**Kenmore - South Kirkland**	**The southern end of route 234 would be revised to extend to South Bellevue P&R via 108th Avenue SE.**	**Route will operate the same between Kenmore and Kirkland. Between Kirkland and South Kirkland will use Lakeview and Lake Washington Blvd**	**Improve frequency**	**See route 240.**			**x**		**x**															**x**	**x**		

	2030 Headways		SR-520 Light Rail 2030 Headways			SR-520 Light Rail		SR-520 Light Rail			Link Stations (East Link)											Link Stations (SR-520 Link)											
Route	Peak 3	Midday	Peak	Midday	Route Description	Route Description Change	Path Changes	Path Changes	Comments	Comments	Rainier	Mercer Is	S. Bellevue	East Main	BTC	Ashwood/Hospital	122nd	130th	Overlake Village	OTC	SE Redmond	Downtown Redmond	Ballard	Fremont	Aurora	Wallingford	Brooklyn	Husky Stadium	Evergreen Point	South Kirkland	Kirkland TC	Totem Lake TC	Overlake Hospital
235	30	30	15	15	S Kirkland - Eastgate	S Kirkland - Eastgate	New route 235 would connect Eastgate and South Kirkland P&R via BCC, 145th Place SE, 140th Avenue SE, 140th Avenue NE, Bell-Red, 124th Avenue NE, Northup Way, and 108th Ave Ne. Serves Sammamish High.	Route 235 should connect South Kirkland, Bellevue TC and Eastgate via the current paths of Route 234 and 271.									x													x			x
236	30	30	15	30	Woodinville - Kirkland		No change	Revise to serve 132nd Ave NE , Central Way between Totem Lake and Downtown Kirkland	Improve frequency	Timed to meet Route 255.																					x	x	
237	30	-	XX	XX	Woodinville - Bellevue	DELETE	No change	DELETE	DELETE																								
238	30	30	15	30	Bothell - Kirkland	Bothell - Overlake	No change	Revised to serve Overlake (instead of Kirkland) and operate on NE 124th Ave NE (Rose Hill)	Improve frequency	Timed to meet Route 255.										x												x	
239	30	60			Redmond Ridge - Overlake		New route 239 would connect Redmond Ridge with Redmond via Avondale Road NE, Novelty Hill Rd, SR-520, terminating at Overlake TC.			New route.										x													
240	15	15	15	15	Renton - Bellevue	Renton - South Kirkland	Route 240 would be truncated in Downtown Bellevue; when another route serves 108th Ave SE (234), route 240 would shift to 112th Avenue SE. Route 921 would serve Clyde Hill.	Extend route to South Kirkland P&R via Clyde Hill		Improved headway.			x		x															x			
242	20	-	XX	XX	Overlake - Ridgecrest	DELETE	No change	DELETE	DELETE																								
243	30	-	XX	XX	Jackson Park - Bellevue	DELETE	From NE 4th St, take 112th Ave S, SE 8th St, 118th Ave SE and terminate at Wilburton P&R	DELETE	DELETE	Use 108th Ave NE center access ramp																							
244	-	-			Kenmore - Overlake		Delete			Route revised in September 2008; funded by Transit Now Service Partnership																							
245	15	15			Kirkland - Factoria		No change			Improved headway										x											x		

	2030 Headways		SR-520 Light Rail 2030 Headways			SR-520 Light Rail		SR-520 Light Rail			Link Stations (East Link)												Link Stations (SR-520 Link)										
Route	Peak 3	Midday	Peak	Midday	Route Description	Route Description Change	Path Changes	Path Changes	Comments	Comments	Rainier	Mercer Is	S. Bellevue	East Main	BTC	Ashwood/Hospital	122nd	130th	Overlake Village	OTC	SE Redmond	Downtown Redmond	Ballard	Fremont	Aurora	Wallingford	Brooklyn	Husky Stadium	Evergreen Point	South Kirkland	Kirkland TC	Totem Lake TC	Overlake Hospital
246			30	30		Issaquah - Eastgate - S Kirkland		New route connecting Issaquah, Eastgate, Bellevue TC and South Kirkland via paths of Routes 246(921) and 271	Part of this route was actually created in June 2010 as it was renumbered from Route 921																					x			
247	-	-			Overlake – Kent		Delete			low ridership																							
248	15	15			Redmond - Kirkland		No change			implemented in February 2008												x									x		
249	30	30	XX	XX	Bellevue/S Kirkland - Overlake TC	DELETE THIS VARIANT	shift to 112th Ave NE	DELETE THIS VARIANT	DELETE THIS VARIANT	Route revised in February 2008. if Route 233 deleted, interline with Route 222																							
249	30	30	30	30	Bellevue-Overlake 249	Overlake-Overlake Village		Route operates between Overlake TC and Overlake Village only											x	x													
250	-	-			Redmond - Seattle CBD		Delete			Low ridership; connect with 545																							
251	30	30			Bothell -Redmond		No change			Route revised in February 2008												x											
252	-	-			Kingsgate - Seattle CBD		Delete			Kingsgate riders may access Route 311 at NE 128th Street Direct Access ramp.																							
253	NA	NA			Rdmnd-Ovrlk-Belv 253					Route deleted for Rapid Ride																							
254		NA								Route deleted																							
255	XX	XX	15	15	Totem Lake - Seattle CBD	DELETE	Route 255 would connect downtown Seattle and the Totem Lake TC on NE 128th Street via its current path to NE 128th Street. If joint operations is not allowed, route 255 would use 2nd and 4th avenues in downtown Seattle	DELETE		See Route 231 for replacement coverage																							
256	-	-			Overlake - Seattle CBD		Delete			Route deleted and replaced by upgraded service on Route 255																							
257	-	-			Kingsgate - Seattle CBD		Delete			Kingsgate riders may access Route 311 at NE 128th Street Direct Access Ramp																							
260	-	-			Juanita - Seattle CBD		Delete			Low ridership																							
261	-	-			Overlake - Seattle CBD		Delete			RR corridor																							
265	15	-	XX	XX	Redmond - Seattle CBD	DELETE	Delete	DELETE	DELETE	Note poor equilibrium																							
266	-	-			Redmond - Seattle CBD		Delete			low ridership; connect with 545																							
268	30	-	XX	XX	Redmond - Seattle CBD	DELETE	No change	DELETE	DELETE																								

			SR-520 Light Rail			SR-520 Light Rail		SR-520 Light Rail																									
	2030 Headways		2030 Headways								Link Stations (East Link)											Link Stations (SR-520 Link)											
Route	Peak 3	Midday	Peak	Midday	Route Description	Route Description Change	Path Changes	Path Changes	Comments	Comments	Rainier	Mercer Is	S. Bellevue	East Main	BTC	Ashwood/Hospital	122nd	130th	Overlake Village	OTC	SE Redmond	Downtown Redmond	Ballard	Fremont	Aurora	Wallingford	Brooklyn	Husky Stadium	Evergreen Point	South Kirkland	Kirkland TC	Totem Lake TC	Overlake Hospital
269	20	30			Overlake - Issaquah		Terminate at Overlake TC.			Link provides connection between OTC and Overlake Village										x													
269	20	30			Overlake - Issaquah		No change.																										
271	**10**	**10**	**XX**	**XX**	**Bellevue - Univ Dist**	**DELETE**	**Route 271 would be truncated at the Bellevue TC; would connect the University District and downtown Bellevue via 116th Ave NE and 108th Ave NE center access.**	**DELETE**	**DELETE**	**See route 231 to Issaquah connection**																							
272	-	-			Issaquah - Univ Dist		Delete			RR corridor.																							
277	**30**	**-**	**XX**	**XX**	**Kingsgate – Univ Dist**	**DELETE**	**No change**	**DELETE**	**DELETE**	**Low ridership; connect with routes 255, 265**																							
291	30	-			Kingsgate – Redmond		Through-route with new Route 239 (Redmond Ridge) if East Link terminates in Redmond			Routing south of RTC eliminated												x										x	
292	30				Redmond Ridge – Overlake					New commuter route from Redmond Ridge – Overlake																							
301	**10**		**10**	**15**	**Aurora TC – Scbd 301**	**Aurora TC - 185th Station**		**Only operate between Aurora Village TC and 185th St Station**	**Add midday service**																								
301	**30**		**30**	**XX**	**Rchmnd Bch-Scbd 301R**	**Richmond Highlands - 185th Station**		**Only operate between Richmond Highlands and 185th St Station**																									
303	**15**		**XX**	**XX**	**Shrln-Nthgt-CBD-1st**	**DELETE**		**DELETE**	**DELETE**																								
304	15				Rchmnd Bch-Scbd 304		End at 145th St Link Station																										
306	30				Kenmore-Sea CBD 306E																												
308	30				Hrzn VW-Sea CBD 308E		End at 145th St Link Station																										
311	**12**	**-**	**10**	**XX**	**Duvall - Seattle CBD**	**Duvall - Totem Lake**	**Two variants: Duvall and Woodinville**	**Operate between Duvall and Totem Lake only**																								**x**	
312	10				UWB/CCC-Lkcty-Sea 312																												
312	30				Kenmre-Lkcty-Sea 312																												
316	20				Meridn Pk-CBD 316		End at Roosevelt Station																										
330	30	30			Lake City-Shln CC					Add midday service to connect with Link																							
331	30	30			Knmre-Aur V-Shln CC																												
331	NA				Aur V-Shln CC 331																												
342	30	-			Shoreline-Bellevue		Truncate at BTC								x																		
345	30	30			Shln CC-N Sea CC-Nth																												

Route	2030 Headways Peak 3	2030 Headways Midday	SR-520 Light Rail 2030 Headways Peak	SR-520 Light Rail 2030 Headways Midday	Route Description	SR-520 Light Rail Route Description Change	Path Changes	SR-520 Light Rail Path Changes	SR-520 Light Rail Comments	Comments	Link Stations (East Link) Rainier	Mercer Is	S. Bellevue	East Main	BTC	Ashwood/Hospital	122nd	130th	Overlake Village	OTC	SE Redmond	Downtown Redmond	Link Stations (SR-520 Link) Ballard	Fremont	Aurora	Wallingford	Brooklyn	Husky Stadium	Evergreen Point	South Kirkland	Kirkland TC	Totem Lake TC	Overlake Hospital
346	30	30			Aur V-N Sea CC-Nrth																												
347	30	30			Mntlk Tr-Nrth City-N																												
348	30	30			Rchmd Bch-Jcksn Pk-N																												
355	15				Shorln CC-SeaCBD 355																												
358	NA	NA			Aurora V358					Route replaced by Aurora Rapid Ride																							
358	NA				Aurora V EX 358XR					Route replaced by Aurora Rapid Ride																							
372	15	15			Woodinville-UW 372E																												
372	15				Kenmore-UW 372E																												
373	15	15			Shln-Jcksn Pk-UW 373					Route replaces Route 73																							
400	10	15			W Sea BRT					C Line: West Sea – Sea CBD																							
400	10	15			W Sea BRT					C Line: Sea CBD – West Sea																							
401	**10**	**15**	**7.5**	**10**	**Ballard BRT-CBD**	**Northgate - CBD**		**Extend route to Northgate via path of Route 75**	**Improve frequency**	**D Line: Ballard – Sea CBD**													**x**										
401	**10**	**15**	**7.5**	**10**	**CBD – Ballard BRT**	**CBD - Ballard**		**Extend route to Northgate via path of Route 75**	**Improve frequency**	**D Line: Sea CBD – Ballard**													**x**										
402	9	10			RR - Redmond-Bellevue		B Line would be a RapidRide BRT service between Bellevue TC and Redmond TC via Overlake TC. NE 8th Street (stops could be consolidated), 156th Avenue NE, NE 40th Street, 148th Avenue NE (stops could be consolidated or served by underlying routes), NE 90th Street, 160th Avenue NE, NE 85th Street, 161st Avenue NE, NE 83rd Street.			B Line: Routes 221 and 245 provide underlying service; B Line may have limited stops. Match LRT headway.					x					x		x											
403	10	15			South BRT					A Line: Pacific Highway (Fed Way – Tukwila)																							
404	**10**	**15**	**6**	**10**	**Aurora BRT**				**Improve frequency**	**E Line: Aurora RapidRide**															**x**								
405	10	15			Burien-Renton BRT					F Line: Burien-Renton																							
441	90	-			Edmonds - Overlake		No change			Operated by CT									x	x													
510	**30**	**30**	**15**	**15**	**Everett-Sea CBD 510**	**Everett-Lynnwood**		**Truncate at Lynnwood**																									
511	**30**	**30**	**XX**	**XX**	**AshWy-Sea CBD 511**	**DELETE**		**DELETE**	**DELETE, North Link**																								
513	**30**		**30**	**XX**	**Everett-Sea CBD 513**	**Everett-Lynnwood**		**Truncate at Lynnwood**																									
522	20	30			Woodvil-Sea 522		Route truncated at Roosevelt station with rail to Northgate																										

	2030 Headways		SR-520 Light Rail 2030 Headways			SR-520 Light Rail		SR-520 Light Rail			Link Stations (East Link)											Link Stations (SR-520 Link)											
Route	Peak 3	Midday	Peak	Midday	Route Description	Route Description Change	Path Changes	Path Changes	Comments	Comments	Rainier	Mercer Is	S. Bellevue	East Main	BTC	Ashwood/Hospital	122nd	130th	Overlake Village	OTC	SE Redmond	Downtown Redmond	Ballard	Fremont	Aurora	Wallingford	Brooklyn	Husky Stadium	Evergreen Point	South Kirkland	Kirkland TC	Totem Lake TC	Overlake Hospital
522	20	30			Sea-Woodvil 522		Route truncated at Roosevelt station with rail to Northgate																										
530		NA			Bel-Everett 530					Route Deleted per ST																							
532	**10**	**-**	**10**	**XX**	**Everett - Bellevue**	**Everett - Totem Lake**	**Extend south to S Bellevue Station, using existing 550 route between BTC and S Bellevue P&R**	**Operates between Everett and Totem Lake only**		**Operated by CT**																						**x**	
535	**20**	**30**	**20**	**30**	**Lynnwood - Bellevue**	**Lynnwood - Totem Lake**	**Extend south to S Bellevue Station, using existing 550 route between BTC and S Bellevue P&R**	**Operates between Lynnwood and Totem Lake only**		**Operated by CT**																						**x**	
540	**15**	**30**	**XX**	**XX**	**Kirkland - Univ Dist**	**DELETE**		**DELETE**	**DELETE**	**Ref SR 520 BRT Plan**																							
542	**15**	**30**	**XX**	**XX**	**Redmond - U. Dist**	**DELETE**	**SR 520**	**DELETE**	**DELETE**	**Ref ST2 and SR 520 BRT Plan**																							
545	**8**	**10**	**XX**	**XX**	**Redmond - Seattle CBD**	**DELETE**	**No change - Possibly truncate at Redmond?**	**DELETE**	**DELETE**	**Ref ST2 and SR 520 BRT Plan**																							
550	-	-			Bellevue - Seattle CBD		Delete and shift resources to 520 BRT and I-405 BRT																										
554	15	20			Issq Highl-Mercer Island		Truncate route at Mercer Island					x																					
555	**15**	**20**	**15**	**20**	**Issq Highl-Bellevue**	**Issaquah - South Kirkland**	**Truncate route to Bellevue and shift resources to 520 BRT and I-405 BRT**	**Operate between South Kirkland and Issaquah via Eastgate and Bellevue**					**x**		**x**															**x**			
556	-	-			Issq Highl-U District		Delete																										
560	30	30			Bellevue-West Seattle		No change						x		x																		
564	-	-			South Hill – Overlake		Delete			February 2010 Serv Chg																							
565	-	-			Federal Way – Bellevue		Delete			February 2010 Serv Chg																							
566	8	30			Auburn-Bellevue		Truncate route to Bellevue and shift resources to 520 BRT and I-405 BRT								x																		
574	30	30			Lakewood-SeaTac 574																												
577	15				Fedrl Way TC – Sea 577																												
582	30				Bonney Lk-TAC 582					Peak direction																							
582	30				TAC-Bonney Lk 582					Off-peak direction																							
585	NA				Lakewood-Auburn 585					Route Deleted per ST																							
586	NA				Tacoma-UW 586					Route Deleted in 2016 per ST																							
590	20				Tacoma-Seattle 590X																												
591	NA				SR512-Tac-Seattle 591X					Route Deleted per ST																							
592	20				Dupont-Lakewood-Seattle 592X																												
594	30	30			Sea-Tac-SR512 594R																												

			SR-520 Light Rail			SR-520 Light Rail		SR-520 Light Rail																									
	2030 Headways		2030 Headways								Link Stations (East Link)												Link Stations (SR-520 Link)										
Route	Peak 3	Midday	Peak	Midday	Route Description	Route Description Change	Path Changes	Path Changes	Comments	Comments	Rainier	Mercer Is	S. Bellevue	East Main	BTC	Ashwood/Hospital	122nd	130th	Overlake Village	OTC	SE Redmond	Downtown Redmond	Ballard	Fremont	Aurora	Wallingford	Brooklyn	Husky Stadium	Evergreen Point	South Kirkland	Kirkland TC	Totem Lake TC	Overlake Hospital
595	45				Gig Har-TCC-Sea 595X																												
921	**30**	**30**	**XX**	**XX**	**Eastgate-Bellevue**	**DELETE**	**Extend to Yarrow Point via 100th Ave NE, NE 24th St., 84th Ave NE, NE Points Drive turnaround and lay atop lid.**	**DELETE**	**DELETE, replaced by Route 246**	**Route revised in September 2008**																							
925	-	-			Newcastle DART		No change																										
926	-	-			Crossroads-Eastgate		Delete.			see 227																							
927	-	-			Sammamish DART		No change																										
929	60	60			Fall City -Redmond		No change			Route revised in September 2008												x											
935	30	30			Northshore-Totem Lake		No change			Improved midday headway																						x	
952	45	-			Auburn-Boeing Everett		No change																										
MS Shuttle	-	-			OTC – Microsoft		No change													x													
Rail	10	10			South Lake Union Street Car					Streetcar																							
Rail[1]	10	10			First Hill Streetcar[1]		Assumes two way Broadway			Streetcar																							
Rail	25				Everett to Seattle					Sounder Commuter Rail peak direction service																							
Rail	20				Lakewood to Seattle					Sounder Commuter Rail peak direction service																							
Rail	40				Lakewood to Seattle					Sounder Commuter Rail non-peak direction service																							
Rail	7.5	10			Lynnwood Station to Star Lake/Redondo					Link Light Rail																							
Rail	7.5	-			Lynnwood Station to Overlake Transit Center					East Link Light Rail																							x
Rail	-	10			Northgate to Overlake Transit Center					East Link Light Rail																							x
Rail	10	10			Tacoma LR																												
401	16				N. Lynwood-Sea 401																												
402	14				Lynwood PR-Sea 402																												
404	22				Edmonds-Sea CBD 404																												
406	30				Seaview-CBD 406																												
408	25				Mtlk Ter-Sea CBD 408																												
410	22				Mariner PR-SCBD 410																												
411	30				Boe-Mrnr Pr-Scbd 411																												
412	20				Silver Firs-Scbd 412																												
413	15				Swamp Cr P&R CBD 413																												
414		60			McCllm P&R-CBD 414																												
415	30				Lk Sere-Sea CBD 415																												
416	22				Edmonds-Sea CBD 416																												
417	36				Mukilteo-CBD 417																												
421	22				Marysville-Sea CBD 421																												
422	60				Stnwd-Mryvl-Scbd 422																												
424	45				Snohom-Monr-Scbd 424																												

			SR-520 Light Rail			SR-520 Light Rail		SR-520 Light Rail																									
	2030 Headways		2030 Headways								Link Stations (East Link)											Link Stations (SR-520 Link)											
Route	Peak 3	Midday	Peak	Midday	Route Description	Route Description Change	Path Changes	Path Changes	Comments	Comments	Rainier	Mercer Is	S. Bellevue	East Main	BTC	Ashwood/Hospital	122nd	130th	Overlake Village	OTC	SE Redmond	Downtown Redmond	Ballard	Fremont	Aurora	Wallingford	Brooklyn	Husky Stadium	Evergreen Point	South Kirkland	Kirkland TC	Totem Lake TC	Overlake Hospital
425	45				Lk Stevens-CBD 425																												
435	25				Canyon Park-Scbd 435																												
441	90				Edmonds-Overlake 441																												
477	25				Brier-Sea CBD 477																												
810		60			Mariner P&R-UW 810																												
810		60			Mariner P&R-UW 810R																												
812	45				McColl PR-UW 812																												
821	45				Marysvil-UW 821																												
851	30				Mtlk Ter-UW 851																												
855	30				Lynnwood-UW 855E																												
855		60			Lynnwood-UW 855ER																												
860	45				Mariner PR-UW 860																												
860		60			Everett-UW 860R																												
870	45				Edmonds-UW 870																												
871	90				Edmonds-UW 871																												
880	36				Mukilteo-UW 880																												

Sources: Sound Transit (November 5, 2009) and King County Metro (March 18, 2010).
Note: Sound Transit's East Link transit integration information is shown in italics.
South-Renton BRT Aurora RapidRide

[1]The headways used for the First Hill Streetcar were obtained from the refined City of Seattle model used for the Alaskan Way Viaduct and Seawall Replacement SDEIS 2 process.

[a] This Table 4 is from the "Final FEIS 2030 No Build Alternative Definition" memorandum dated 5/10/2010 distributed from SR 520 office.

SR 520 Toll Sensitivity Analysis

Washington State Department of Transportation

SR 520 Bridge Replacement and HOV Program

STATE ROUTE 520

SR 520 Toll Sensitivity Analysis
Technical Memorandum

Prepared for

Washington State Department of Transportation

Lead Author

Parametrix, Inc.

Consultant Team

Parametrix, Inc.
Parsons Brinckerhoff

June 2011

Table of Contents

List of Exhibits

List of Attachments

Acronyms and Abbreviations

ESHB	Engrossed Substitute House Bill
ESSB	Engrossed Substitute Senate Bill
Final EIS	final environmental impact statement
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
FY	fiscal year
GP	general-purpose (lane)
HCT	high-capacity transit
HOV	high-occupancy vehicle
PSRC	Puget Sound Regional Council
RCW	Revised Code of Washington
SR	State Route
TTR	Toll Traffic and Revenue Technical Report
WSDOT	Washington State Department of Transportation

Purpose of the SR 520 Tolling Sensitivity Analysis

Overview

The purpose of this technical memorandum is to provide the context for the tolling assumptions used in the Final Environmental Impact Statement and Final Section 4(f) and 6(f) Evaluations (Final EIS) for the SR 520, I-5 to Medina: Bridge Replacement and HOV Project. This is intended to provide a basic understanding about how various tolls and toll strategies might affect traffic in the SR 520 corridor and the regional transportation system. Because the SR 520 Bridge Replacement and HOV project is an infrastructure project, the project team received and concurred with guidance from the State Urban Corridors office with regard to what toll rates would be used for analysis in the environmental process. Guidance from the Urban Corridors Office was based on consistency between the current EIS process, the Tolling Implementation Committee, and the SR 520 financial feasibility studies. Furthermore, the toll rate used for the EIS process would need to represent a reasonable and feasible level of toll that could be applied for comparable analysis of all alternatives for the corridor. Since toll rates are determined by many factors, they were analyzed as a background element of each alternative.

This technical memorandum reviews the potential effect that tolling could have on State Route (SR) 520 and the regional transportation system, as identified by a series of policy and financial planning studies that examined tolling approaches for the SR 520 corridor. These studies provide reviews of alternative tolling scenarios developed through the 520 Tolling Implementation Committee's Tolling Report prepared for the Washington State Legislature in January 2009, the SR 520 Finance Plan, and supporting tolling implementation studies conducted by the Washington State Department of Transportation (WSDOT). These other planning efforts considered tolling prior to the Evergreen Point Bridge replacement (generally 2011 to 2016), as well as during post-completion.

In addition to these studies, WSDOT, with the Federal Highway Administration (FHWA), published an Environmental Assessment (April 9, 2009) for the variable tolling project on SR 520, which disclosed the results of WSDOT's analysis of the effects of implementing tolling on the corridor prior to and during construction (2010 through 2016). The FHWA issued a Finding of No Significant Impact (FONSI) for the variable tolling project on June 5, 2009. The analysis of tolls in the referenced policy and financial planning studies considered alternatives that would toll the corridor before and after construction. They concluded that tolling has the potential to result in changes in travel demand and behavior, including changes in the mode of travel, the volume of travel, time of the trip, the route travelers may use to cross Lake Washington, or the destinations they may choose. The analysis has also helped to identify ways that tolling and other facility and system management decisions can help to manage the overall transportation system and provide other benefits.

Tolling on the Evergreen Point Bridge

All-electronic tolling is expected to start on the floating portion of the Evergreen Point Bridge in the spring of 2011, following recommendations by the Washington State Transportation Commission. The SR 520 Bridge Replacement and HOV Program has a gap in funding relative to the SR 520, I-5 to Medina project's anticipated cost. From inception, this project has been envisioned and publicly discussed as a toll project, and tolls on the facility are anticipated regardless of the final alternative selected for the bridge. The Washington State Legislature, with Engrossed Substitute Senate Bill (ESSB) 6392, provided that revenue generated from the tolls implemented on the SR 520 corridor can be used to fund several portions of the SR 520 corridor program, including program elements that have already completed their environmental review and are proceeding toward construction. These elements include the Evergreen Point Bridge, its landings, and other project elements that are still undergoing environmental review. Other primary program elements that are expected to proceed independently from the SR 520, I-5 to Medina project include the SR 520, Medina to SR 202: Eastside Transit and HOV Project, as well as construction of the pontoons in Aberdeen, Washington necessary for replacement of the Evergreen Point Bridge in the event of a catastrophic failure.

In a true “no build” configuration for the SR 520, I-5 to Medina project, the bridge and landings would not be constructed; however, revenue from an SR 520 toll could still be used to pay for the SR 520, Medina to SR 202 project and the SR 520 Pontoon Construction Project by the year 2030, as well as provide funding for replacement facilities in the event the existing bridge failed.

The Transportation Commission adopted tolling rates in early 2011 after studying a variety of tolling levels and potential toll rates. The Commission identified a variable tolling approach based on travel by time of day, with a lower toll rate for vehicles with *Good To Go!* accounts, and a higher rate for vehicles that receive a bill and pay by mail. With *Good To Go!* toll rates that vary from $1.60 to up to $3.50, depending on the time of day, the tolls are designed to encourage driving during less-congested periods. For example, the highest toll rates are defined for weekday morning and afternoon peak periods, and lower rates would be in effect during off-peak hours and weekends; trips between midnight and 5 a.m. would have no toll. Tolls would be collected traveling both east and west across the Evergreen Point Bridge.

The SR 520 Preferred Alternative

When complete, the Preferred Alternative for the Evergreen Point Bridge will include six continuous lanes, comprised of two general-purpose (GP) lanes and one carpool/transit lane in each direction. The new carpool lanes will accommodate an expected increase in public transit services along the corridor. The Preferred Alternative will have a walking and bicycle path as well as shoulder lanes to keep traffic flowing in the event of a vehicle breakdown. The Preferred Alternative also assumes tolls will be in effect pre-completion (during construction) and post-completion (2016/2017). For analysis purposes, because the toll levels had not been set at the time the Final EIS was being developed, the Final EIS assumed pre-completion peak period tolls of $2.80 (AM peak) to $3.50 (PM peak) in 2010 dollars, and post-completion (2016/2017) tolls of $3.85 (AM peak) to $4.75 (PM peak) using 2016 dollars. Tolls would then increase each year through the Final EIS 2030 horizon year, reaching $5.45 (AM peak) to $6.70 (PM peak) in 2030 using 2030 dollars.

The No Build Alternative

The No Build Alternative being examined in the Final EIS does nothing to improve the existing facility from the east side of Lake Washington to I-5. The study area and its transportation functions are assumed to remain as they are today, providing a four-lane highway crossing the lake, with no pedestrian or bicycle facilities, no shoulders, and no high-occupancy vehicle (HOV) or transit facilities. The existing Portage Bay and Evergreen Point bridges crossing Lake Washington and its bays may not remain intact through 2030, the project’s design year, but for purposes of analysis, the facility and its functions are assumed to remain available for use.

Planning Efforts Involving Tolling

There have several years of detailed policy, public outreach and financial planning analyses conducted on tolling in the SR 520 corridor and possibly the I-90 corridor. The 520 Tolling Implementation

Committee, a multi-agency partnership, was formed to focus on maximizing outreach to the public and regional decision-makers regarding the regional policy questions of tolling. These issues include tolling rates, timing of tolling (pre-construction and post-construction scenarios), and the general revenue and project funding implications of tolling. The SR 520 Finance Plan was a linked effort designed to support the work of the Committee, while focusing on the more detailed financial aspects of tolling related to project implementation. These issues included the cost and timing of expenditures, and the use of bonds or other funding mechanisms that would be available.

The Puget Sound Regional Council (PSRC) regional travel demand model was applied to help support the analyses, using the same assumptions on land use, population, and employment growth that have been used in the forecasts for the Final EIS.

Analysis of SR 520 Tolling and Traffic (2008 and 2009)

In April 2009, WSDOT completed the SR 520 Toll Traffic and Revenue Technical Report (TTR), analyzing the SR 520 tolling scenarios that had been developed by the 520 Tolling Implementation Committee for the purposes of the SR 520 Finance Plan. The report documented the methodology and technical findings of the toll traffic and revenue projections prepared for SR 520 and I-90, and updated an earlier draft report that had been developed in 2008. These efforts were directed by the Washington State Legislature and the Governor through ESSB 6099 and Engrossed Substitute House Bill (ESHB) 3096, in support of developing the SR 520 Finance Plan. They augmented the work performed by the Committee, as well as a 2004 SR 520 Toll Feasibility Study, and a Funding Alternatives Report by the Washington State Treasurer completed in early 2007.

The TTR comprised the following:

- Examined a range of variable toll strategies, including 13 tolling scenarios considered in the SR 520 Finance Plan.
- Evaluated effects of tolling “short segment” trips between I-5 and I-405 that do not cross Lake Washington.
- Evaluated tolling the existing bridge prior to construction.
- Assessed the potential cross-lake traffic impacts of alternative future highway and transit network assumptions, including the various improvements to SR 520.
- Included detailed model forecasts of travel demand on SR 520 and the regional transportation system with variable toll strategies, compared to existing conditions and future No Build conditions.
- Provided predictions of changes in the mode of travel as well as potential diversion of trips with various toll scenarios, compared to a baseline six-lane SR 520 scenario with no tolls.

Modeling Tools Applied

Two sets of highway and transit networks were used in the analysis of toll scenarios in 2008. These networks were based upon the assumptions for the level of development of other “background” highway and transit facilities as well as either the existing or replaced Evergreen Point Bridge. The two basic network assumptions were categorized as a “Pre-completion” Transportation Network (2010 through 2016), and a “Post-completion” Transportation Network (2016 through 2030).

The pre-completion network reflected today's transportation system, while the post-completion network assumed a variety of currently funded projects throughout the region, including high-capacity transit (HCT). The pre-completion highway networks assumed the same operating conditions on I-90, SR 520, I-405, and SR 522 as today, including today's reversible roadway operations on I-90. The primary change to today's transit networks was to assume some level of increased transit service to match what is proposed as part of the Lake Washington Urban Partnership, which would increase transit service across SR 520 in the near term.

520 Tolling Implementation Committee Tolling Report

This Committee report, developed in response to direction provided by the Washington State Legislature in 2008, evaluated tolls as a means of financing a portion of the SR 520 Bridge Replacement and HOV Program. The Committee's members were Bob Drewel, Executive Director of PSRC; Paula Hammond, Washington State Transportation Secretary; and Richard "Dick" Ford, Washington State Transportation Commissioner. The Committee's work efforts included research into other tolling programs, detailed travel demand modeling by applying the PSRC's regional model, financial analysis and planning, and extensive public and interagency outreach. The Committee also recommended potential mitigation measures for diversion and other effects that could possibly result from tolls. The Committee's efforts engaged citizens as well as local and regional leadership in the evaluation, which was conducted through open houses, workshops, presentations, surveys, and draft findings provided for public review. The Committee reported to the Governor and the State Legislature in 2009.

The Committee and its staff developed and evaluated ten scenarios with tolls on SR 520 or on both SR 520 and I-90, and presented its results to the public in the summer of 2008. Based upon the comments received, six scenarios were defined, analyzed, and brought back for further public review in the fall. The scenarios included tolls on SR 520 only, or tolls on both SR 520 and I-90, and examined the effects of different rates and timelines for tolling on one or both of the facilities, as well as whether tolls would be imposed at a single location in a corridor or in several locations.

Other Resources

In addition to the technical and policy efforts undertaken by the Committee, an independent peer review was also undertaken of the tolling model and the traffic efforts. The peer review panel members were Chuck Purvis of the Metropolitan Transportation Commission (San Francisco), Erik Sabina of the Denver Regional Council of Governments, Teresa Slack of the Georgia State Road & Tollway Authority, and Richard Walker from the Portland Metro MPO.

The peer review group was charged with evaluating the modeling techniques used to generate information on traffic, particularly for reliability and credibility, assessing the model assumptions on tolling and traffic, and recommending any additional refinements or changes to the modeling procedures and processes.

The SR 520 Variable Tolling Project

The SR 520 Variable Tolling Project will implement variable pricing (tolls) from 2011 through project construction on all through-lanes of SR 520 between I-5 and I-405. All tolls will be collected electronically. Revenue generated will be invested in the SR 520 corridor, subject to legislative appropriation, as required by state law (Revised Code of Washington [RCW] 47.56.820). The State Legislature passed ESHB 2211 on April 25, 2009, authorizing the tolling of the existing Evergreen Point Bridge and directing the revenue from these tolls to help finance construction of the bridge replacement.

Tolling Scenarios

Type of Tolling Likely to be Implemented

As the Final EIS and this technical memorandum were being developed, the Washington State Transportation Commission was scheduled to identify the initial toll structure and rates for the Evergreen Point Bridge by early 2011, with tolls to take effect in spring 2011 before the construction of the replacement bridge begins. The Commission's current focus is on this initial pre-completion tolling period. The Commission will identify subsequent toll levels after the completion of the Final EIS and final design, and the confirmation of the project to be built.

Direction provided by the Legislature and the Governor with ESSB 6392 (March 2010) instructed the Commission to set a variable schedule of toll rates to maintain travel time, speed, and reliability on the corridor, and to generate the necessary revenue for the SR 520 Bridge Replacement and HOV Program. The Commission is to recommend the initial variable schedule, with the schedule potentially changing annually after this initial decision. Some aspects of the tolling authority remain to be confirmed by the Washington State Legislature in 2011.

The factors affecting toll levels include the time of day, type of vehicle, and payment method, along with possible toll exemptions, as well as the ongoing escalation in toll rates required to ensure that net revenues are sufficient to cover operating costs, ongoing debt service, and other commitments.

In fall 2010, the Commission identified an initial structure of the tolling system, which would consist of:

- All electronic tolls on SR 520, with no toll booths
- *Good To Go!* accounts or pay by mail
- One tolling location on the existing bridge at the east highrise
- Tolls collected in both directions
- Variable tolls, with rates varying by time of day, with highest rates in effect during peak periods
- Tolls to help manage congestion and encourage some travelers to travel at off-peak hours.

Tolling Assumptions Included in the Final EIS Analysis

For the purposes of the analysis of transportation and related environmental effects, the Final EIS is assuming that the tolling for a six-lane facility completed in mid-2016/fiscal year (FY) 2017 (post-completion) would involve the following:

- 2016/FY 2017 PM peak weekday toll of $4.75 (year 2016 dollars)
- 2016/FY 2017 AM peak weekday toll of $3.85 (year 2016 dollars)
- Overnight tolling to begin at a minimum toll of approximately $1.00
- Over a 24-hour weekday, the variable toll structure could allow tolls to change 11 times, representing seven different price levels
- Over a 24-hour weekend day, tolls are assumed to change four times, representing three different price levels

- A 2.5 percent annual toll escalation is then assumed with each fiscal year, with the analysis of 2030 conditions reflecting the following:
    - 2030/FY 2031 PM peak weekday toll of $6.70 (year 2030 dollars)
    - 2030/FY 2031 AM peak weekday toll of $5.45 (year 2030 dollars)

These rates are similar to those used in Scenario 7 of the 2008 Toll Implementation Committee planning efforts described below. The toll levels and structures subsequently identified by the Commission in January 2011 remained consistent with this approach, and also remained within the range of the scenarios considered through the Tolling Implementation Committee and the Final FEIS analysis.

What alternative tolling approaches were previously examined in the policy and financial planning studies?

520 Tolling Implementation Committee

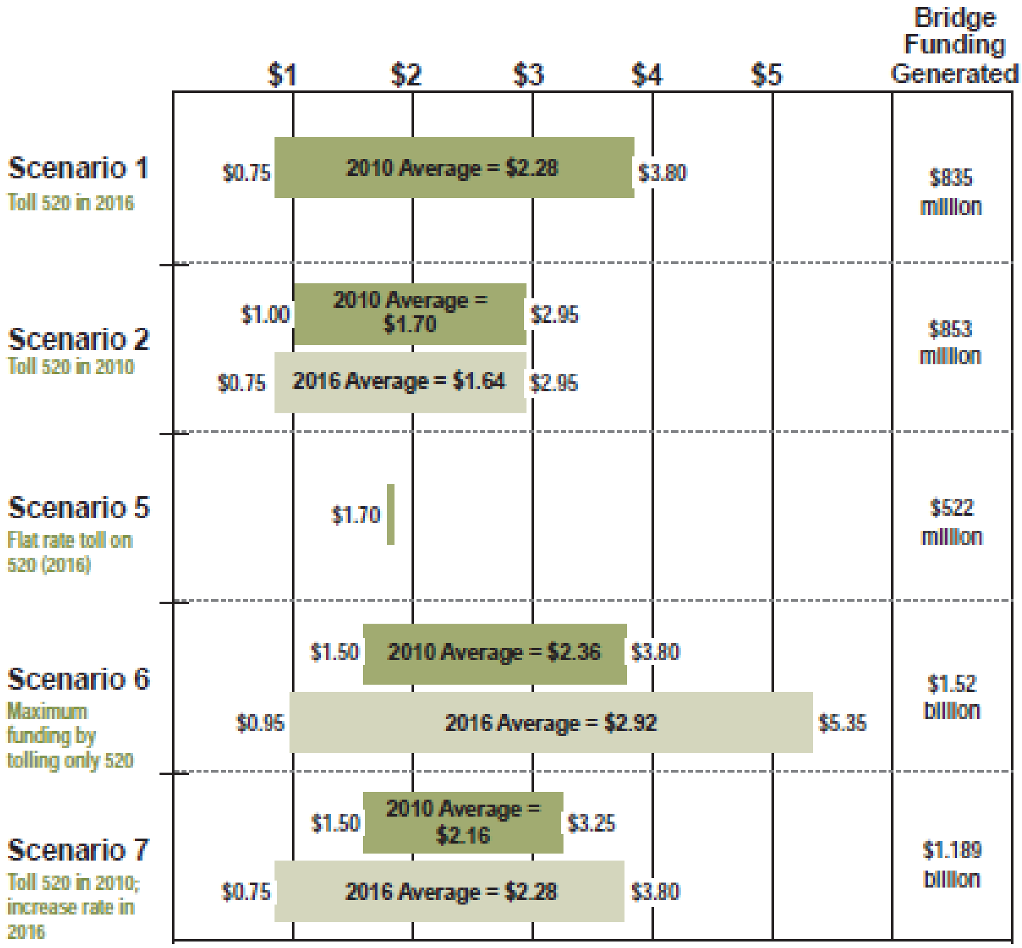
The State Legislature directed the Committee to study three basic tolling approaches:

- Toll SR 520 when the new bridge opens;
- Toll the existing Evergreen Point Bridge; and
- Toll both the Evergreen Point and I-90 bridges and fund improvements on both.

The Committee's efforts considered ten options, with four initial options. Those results were refined into six additional scenarios that underwent further detailed analysis. Although the scenarios are identified by numbers 1 to 10, they fell into two groups: SR 520-only or two-bridge scenarios. In addition, the Committee's work examined the effect of tolls on different segments of SR 520 or I-90, compared to a single-point tolling approach. Finally, they considered tolling when construction begins, or waiting until 2016 when construction is complete. Their work was primarily focused on the initial tolling period from pre-completion to the year 2016. The following pages provide figures from the Committee's report depicting the scenarios.

520-only Toll Scenarios

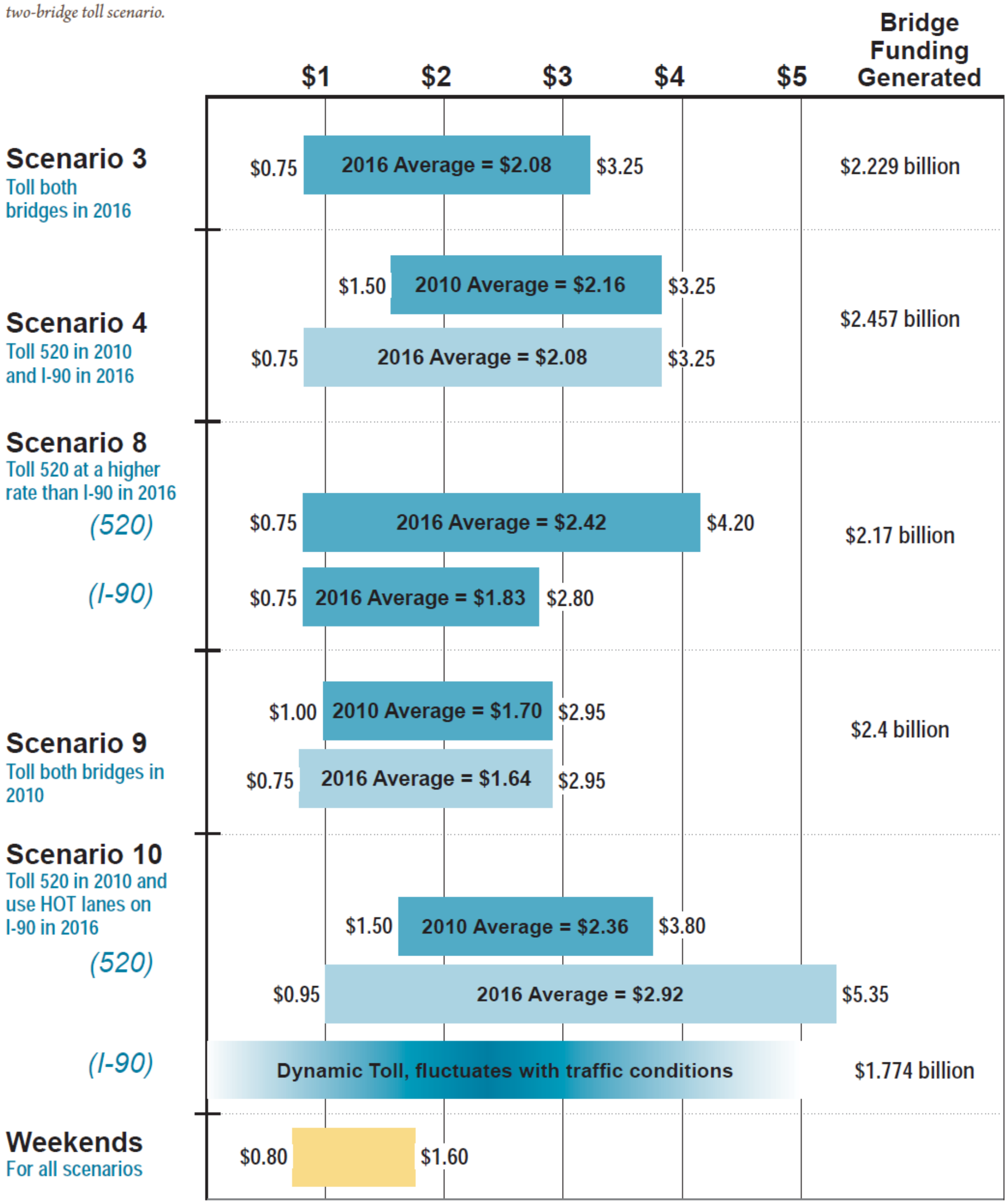
Figure 8. 520-only toll scenario rates, one-way, expressed in 2007 dollars.
Chart shows minimum toll, maximum toll and average toll paid in each 520-only toll scenario.



Two-bridge (520 and I-90) Scenarios

Figure 9. Two-bridge (520 and I-90) toll scenario rates, one-way, expressed in 2007 dollars.

Chart shows minimum toll, maximum toll and average toll paid in each two-bridge toll scenario.



Toll Collection Points

The Committee's review also explored decisions about tolling locations, such as at a single point at the eastern approach of the Evergreen Point Bridge, or several tolling locations, where drivers would pay a partial toll for using just a portion of the SR 520 corridor, such as for trips between I-5 and the Montlake interchange in Seattle. Some toll scenarios were modeled with single-point tolls and some with segment tolls.

SR 520 Finance Plan

The Finance Plan addressed the same scenarios initially defined by the 520 Tolling Implementation Committee reviews, but the analyses carried tolling and traffic levels out beyond year 2030 to provide additional information on potential transportation demand effects, as well as the potential revenue generation of the scenarios. The Finance Plan analyses incorporated other refinements in costs and phasing, other considerations related to the plan, as well as several variations on the Committee's tolling scenarios.

Potential Effects of Tolling on Transportation Conditions

Traffic Findings from the 520 Tolling Implementation Committee

The Committee's report concluded that all of the tolling scenarios (with tolling either before the SR 520 Program was completed or after, or both) had the ability to influence traffic patterns and travel behavior, including changes in traffic volumes, trip mode, trip timing, destinations, and routes. The amount of the toll clearly affected how much travel behavior could change. Toll rates in the scenarios for year 2016 forecasts ranged from $0.75 to $5.35 in 2007 dollars and were variable (tolls were to adjust higher or lower throughout the day); the average toll ranged from $1.64 to $2.92 in 2007 dollars.

Changes were depicted for the SR 520 pre-completion and post-completion scenarios with different baselines that were used to compare against the tolling scenarios:

- The Committee's review of the pre-completion tolling scenarios was compared to having no tolls on the existing structure in the year 2010. No other corridor improvements were assumed, so the assumed conditions were similar to a No Build (such as what was assumed in the Variable Tolling Project Environmental Assessment).
- For the post-completion scenarios, the Committee's work compared a tolled six-lane facility to a baseline untolled six-lane facility, which did not include a No Build, focusing on the year 2016. This approach reflected the Committee's mandate to investigate scenarios that would help fund the SR 520 Program because the forecasts of traffic on an untolled SR 520 represented the likely maximum "market" of travelers that could be drawn to the improved corridor. The various tolling scenarios showed how that travel market would change depending on the cost of using the corridor at different types of day, with higher tolls occurring during the weekday peak periods.

With the post-completion scenarios, the Committee's comparison of an untolled SR 520 in 2016 to a variety of tolling approaches showed that the magnitude and locations of diversion depends on the toll rates and the structure of the tolling scenarios. (It also compared effects from having one or both of the corridors tolled, but this memorandum is focused primarily on the SR 520-only tolling scenarios.) However, the Committee's work found that the higher the toll rate on SR 520, the more people were expected to change how they travel. The report identified the following types of changes:

- People shifting from driving alone to carpools and transit
- People diverting to alternative routes including I-90, SR 522, or I-405
- People shifting to alternative times for their trips
- People choosing a different destination, i.e., not crossing the lake

The results for all scenarios showed generally consistent patterns in forecasted traffic conditions. When SR 520 was tolled and more transit service was added, the report provided estimates of travel speeds, showing SR 520 would be likely to improve compared to conditions with no tolls. (This is primarily a regional demand model-based calculation that reflects slower speeds the closer a facility gets to its capacity.) When travel speeds on SR 520 increased, the model predicted little or no change on alternative routes.

Potential Changes in Travel Patterns from Tolling

The Tolling Implementation Committee Report (April 2009) noted that tolling had the potential to change travel patterns. Key findings from the committee's report are shown in Attachment A. While in all scenarios most travelers would remain on SR 520, compared to forecasts with no tolls, some travelers might change routes and use SR 522, I-90, or I-405, or they could change their destinations. However, most people were predicted to continue to use the tolled bridge, either by paying the toll, carpooling, taking transit, or changing the time of their trip.

While some travelers would change their route or destinations, the overall effect of those changes tends to be distributed across the transportation system. The diversion or change of trip effects was lowest when two-bridge scenarios were assumed, and highest when the tolls were on SR 520-only.

Peak-period trips on SR 520 would decrease as tolls increase, because some people would choose other routes, choose not to make the trip at that time, or to travel to other destinations. For example, for the year 2016, the no-toll volume (with an expanded SR 520) was estimated to be 134,000. The 2016 SR 520-only scenarios reduced this vehicle volume by between 16 and 33 percent (22,000 to almost 45,000 vehicles), compared to conditions with the untolled six-lane SR 520 facility.

In the other facilities that could be diversion routes (and using the Committee's method of comparing the six-lane toll to the tolled scenarios), the findings were as follows:

- Peak-period traffic on I-90 would increase less than 5 percent, except in the highest toll SR 520-only scenario where it increases 8 percent.
- Peak-period traffic on SR 522 (at 61st Avenue in Kenmore) could increase by up to 5 percent.
- Peak-period traffic on I-405 (at SR 167 in Renton) could increase by up to 3 percent.

Changes in Mode

The report's forecasts predicted that some travelers would choose to remain on SR 520, but would switch from driving to transit. The analysis indicated that during peak periods, a 15- to 30-percent increase in SR 520 corridor transit ridership would occur, provided the service capacity is in place. This would represent about 3 percent of all SR 520 travelers.

Shifts in the Time of Travel

Between 3 and 11 percent of trips are predicted to occur at a different time of day, but would still make a trip on SR 520 rather than shifting destinations or routes.

Changes in the Trip Destination

Other travelers are expected to continue to make a trip, but were expected to switch to a different destination that would not require crossing Lake Washington. The estimated percentage of travelers who would choose not to cross the lake during peak periods ranged from 0 to 5 percent during the peak periods in 2010, and between 6 and 11 percent during the off-peak periods in 2010. In 2016, the range was between 0 and 14 percent during the peak periods, and between 6 and 15 percent during the off-peak periods.

Given the fairly high level of changes in the trip destination predicted by 2016, an independent peer review panel questioned whether this was a reasonable expectation. Experience in other areas of the country tended to show that people would be less likely to change their destinations and more likely to change the mode of travel, the time of travel, or their routes. The panel recommended more analysis of the types of trips that would be diverted, and also encouraged more review of the start and end points of diverted trips, to help confirm if this prediction was reasonable.

Traffic Findings from the SR 520 Toll Traffic and Revenue Technical Report - 2008 (April 2009)

For 2016, the TTR yielded the same findings as the 520 Tolling Implementation Committee Report; however, it also produced year 2030 results and provided additional comparative information on the relative impacts of the various tolling decisions, both in terms of the revenue produced and the transportation effects. The report also included a discussion of the modeling assumptions that were used. Because the report also provided forecasts for the year 2030, it allows more comparisons to the SR 520, I-5 to Medina project's Final EIS forecasts in 2030. (The analysis also projected continued growth in travel through 2056.) The transportation findings of the report focused on the following:

- The SR 520-only tolling scenarios created the highest increases in total vehicle trips on I-90, both assuming pre-completion tolling for year 2010 (FY 2011) conditions as well as year 2030.
- Scenarios with higher toll rates generated lower traffic volumes on SR 520 and traffic flow and speeds improved.
- A variable tolling method provided congestion management benefits when applied to one or both corridors, compared to scenarios with fixed-rate tolling; variable-rate tolling applied the highest tolls during the peak travel periods, which encouraged travelers to shift their trips to a less congested time period, or to take transit.
- Scenarios providing toll exemptions for HOV/transit vehicles found that when 3+ HOVs are toll-free, HOV volumes increase on SR 520 and/or I-90; however, when 3+ HOVs must pay a toll, some HOVs may divert from SR 520 and I-90, while other travelers may form new carpools in order to share the new toll cost.
- On weekends, the levels of diversion could be higher than on weekdays because other routes may be less congested and more attractive, and weekend traffic features different types of trips compared to a weekday (more often discretionary and less likely to be a work commute); transit service levels are also lower than on a weekday.

Range of Transportation Effects by Type

The TTR provided a number of model-based outputs showing the potential changes in travel demand occurring in the SR 520 corridor and on other facilities with the varying toll scenarios, with forecasts provided for the years 2011 and 2030, as well as projections in demand beyond 2030. Attachment B provides further detailed tables from the report.

Because these effects represent regional travel demand outputs, they reflect how tolling could change the demand for trips on regional facilities, considering the available modes and theoretical capacity of regional facilities and tolling. The levels of predicted demand do not always reflect the operations that a facility or a connection would provide in the future, or, in some cases, the facility would not be able to accept the trips and the travel times, or the alternative route would be slower than the model indicates, making the choice of a diversion less rational for a traveler. This could overstate the predicted levels of diversion between facilities. Still, the values listed in Exhibit 1 below can be seen as representing the comparative range of trips that could occur on SR 520 or I-90 by mode and by time of day, given the range of tolling scenarios considered.

The methods show the range covered by the scenarios, the values predicted for Scenario 7, and then the values for the Final EIS for the six-lane Preferred Alternative in 2030, with a toll assumed. Finally, Exhibit 1 provides the values for the No Build Alternative in 2030.

While the vehicle trip values were available from the TTR, not all person trip data were available; therefore, some comparisons between data sets have not been made.

Conclusions on Effects of Tolling on Daily Vehicle Trips

Although the Final EIS and tolling forecasts used different versions of the regional travel demand model, they showed a number of similar patterns at the daily level:

- The forecasts for GP vehicle trips from a sensitivity test of the Preferred Alternative providing six lanes for SR 520 were nearly the same in both the TTR and FEIS models for year 2030.
    - The sensitivity test forecasts for an untolled Preferred Alternative on SR 520 were within 1 percent of the TTR untolled forecasts for SR 520.
    - The Final EIS has more trips for I-90 and no tolling at the cross-lake levels compared to the TTR, or a variance of 8 percent for I-90, and nearly 4 percent for total daily trips on I-90 and SR 520 combined.
    - The TTR tolling forecasts for an untolled six-lane facility predicted nearly 6 percent fewer vehicles on I-90 than the SR 520 forecasts. Because this was the baseline used by I-90, it could tend to overstate potential diversions from SR 520 to I-90 when tolling is applied to SR 520.

EXHIBIT 1. DAILY VEHICLE TRIPS IN 2030 ON I-90 AND SR 520 (TOLL TRAFFIC AND REVENUE TECHNICAL REPORT COMPARED TO FINAL EIS MODEL RESULTS)

Scenario	SR 520 GP Lanes	SR 520 Total Volumes	I-90 GP Lanes	I-90 Total Volumes	Total 520 and I-90
TTR SR 520-only Tolled Scenarios	95,100 to 114,400	100,800 to 129,100	155,400 to 163,700	166,000 to 173,500	
TTR Scenario7 Tolled	106,520	115,670	161,700	168,540	284,210
TTR Percent Change Tolled to Untolled	-17	-16	6	6	-4
TTR Baseline (6-lane untolled)	129,010	137,340	151,890	158,850	296,190
Final EIS Preferred Alternative (includes toll)	111,600	121,100	171,900	178,200	299,300
Final EIS No Build	127,600	127,600	166,800	176,100	303,700
Final EIS Preferred Alternative Sensitivity Test (untolled)	129,500	136,400	164,300	170,500	306,900
Percent Variance Final EIS Preferred Alternative Sensitivity Test (untolled) Trips to TTR 6-lane Untolled Trips	0.4	-0.7	8.2	7.3	3.6
Percent Variance Final EIS Preferred Alternative (tolled) and TTR Scenario 7 Tolled	4.8	4.7	6.3	5.7	5.3
Mimic TTR Comparison: Final EIS Percent Change Tolled to Untolled	**-13.82**	**-11.22**	**4.63**	**4.52**	**-2.48**
Percent Change Final EIS Tolled to Final EIS No Build	**-12.5**	**-5.1**	**3.1**	**1.2**	**-1.4**

- A six-lane tolled/untolled comparison was not used for the Final EIS impact assessments because a six-lane untolled facility is not affordable and, therefore, not a viable project alternative; however, a sensitivity test of a tolled and untolled SR 520 Preferred Alternative using the Final EIS model shows similar but lesser cross-lake vehicle trip changes compared to the TTR. The comparison is outlined below to show the similarities:
    - For SR 520, the Final EIS forecasts 14 percent fewer SR 520 GP trips compared to the TTR's 17 percent.
    - The Final EIS has 11 percent fewer total daily vehicle trips on SR 520 compared to a TTR drop of 17 percent.
    - The Final EIS findings indicate that more people would switch from the SR 520 GP lanes to the SR 520 HOV lanes than the TTR model predicts, rather than diverting to I-90 or using other modes.
    - Vehicle trips on I-90 would increase using a tolled/untolled comparison, but the increase is 4.5 percent compared to the 6 percent increase predicted by the TTR methods.
    - Total cross-lake (I-90 and SR 520) trips also would be less affected with the Final EIS forecasts compared to the TTR, or about 2.5 percent fewer daily cross-lake trips compared to the 4 percent predicted by the TTR.
- The TTR forecasts do not provide a No Build Alternative for comparison. Using the Final EIS No Build Alternative against either the Final EIS's tolled Preferred Alternative or the TTR Scenario 7 would have similar results because both the TTR and the Final EIS untolled six-lane forecasts are similar as follows:
    - With the Final EIS forecasts, tolling would reduce GP vehicle trips on SR 520 by 12.5 percent daily. HOV trips on SR 520 would increase, showing that some travelers would be more likely to transfer to HOV trips than change corridors to avoid the toll, resulting in only a 5 percent drop in daily vehicle trips on SR 520.
    - On I-90, GP trips would increase by 3 percent daily, but HOV trips would increase about 1 percent. Overall daily trips on I-90 would increase about 2 percent.
    - Total trans-lake corridor trips would drop by 1.4 percent daily, indicating that most of the effects would remain within the corridor.

Conclusions on Effects of Tolling on PM Peak Vehicle Trips

As indicated in Exhibit 2, some of the same patterns seen in the daily comparisons show up in the PM peak Final EIS and TTR forecasts; however, the TTR model appears to under predict the SR 520 trips when comparing both the tolled and untolled SR 520 forecasts as follows:

- The Final EIS sensitivity test forecasts for an untolled SR 520 with the Preferred Alternative configuration for SR 520 are about 11 percent higher for GP trips, and 9 percent higher for HOV trips than the TTR's six-lane untolled; on I-90, they are about 2 percent lower.
- The Final EIS's overall forecasts for cross-lake trips with SR 520 untolled are 3 percent higher than the TTR forecasts show.
- The TTR volume under predictions carries over to the tolling results. Compared to the TTR Scenario 7, the Final EIS Preferred Alternative scenario (including tolls) is 9 percent higher for GP traffic and 6 percent higher for HOV traffic across the board (both the SR 520 and I-90

corridors individually), and the Final EIS predicts 16 percent more PM peak trips for the combined corridors.

- The Final EIS Preferred Alternative compared to a No Build condition shows that while GP trips on SR 520 would decrease, total trips would remain about the same, with the primary diversion being vehicle trips moving to the HOV lanes (which would not have been available in the No Build Alternative).
- Less than 2 percent increases are seen on I-90; I-90/SR 520 combined show a reduction of 1 percent, indicating that most of the changes in traffic remain within the SR 520 corridor.

EXHIBIT 2. PM PEAK VEHICLE TRIPS IN 2030, ON I-90 AND SR 520 (TOLL TRAFFIC AND REVENUE TECHNICAL REPORT COMPARED TO FINAL EIS)

Scenario	SR 520 GP Lanes	SR 520 Total Volumes	I-90 GP Lanes	I-90 Total Volumes	Total 520 and I-90
SR 520-only Scenarios	20,400 to 24,800	21,300 to 25,900	33,700 to 34,400	36,200 to 38,100	
TTR Scenario 7 Tolled	22,200	25,100	33,990	36,520	56,220
TTR Percent Change Tolled to Untolled	-13	-11	3	2	-12
TTR Baseline (6-lane untolled)	25,530	28,180	33,050	35,640	63,800
Final EIS Preferred Alternative (tolled)	24,200	26,600	37,000	38,700	65,300
Final EIS No Build	26,600	26,600	36,500	39,400	66,000
Percent Change Final EIS Tolled to No Build	**-9.0**	**0.0**	**1.4**	**-1.8**	**-1.1**
Final EIS Sensitivity Test Preferred Alternative (untolled)	26,800	29,100	36,300	38,000	67,100
Percent Variance Final EIS Sensitivity Test (Preferred Alternative untolled) Trips to TTR 6-lane Untolled Trips	10.7	9.4	-1.9	-1.8	2.8
Percent Variance Final EIS Preferred Alternative and TTR Scenario 7 Tolled	9.0	6.0	8.9	6.0	16.2
Mimic TTR Comparison: Final EIS Percent Change Tolled to Untolled	**-9.70**	**-8.59**	**1.93**	**1.84**	**-2.68**

Conclusions on Effects of Tolling on Daily Person Trips

As indicated in Exhibit 3, the results of the comparisons of daily person trips were more constrained because the TTR and supporting documents did not report person trips for all scenarios, including the untolled baseline. However, there are several important control points that do line up as follows:

- Total person trips on SR 520 are similar for both models.
- Total daily person trips on both corridors are within 3 percent between the two models.
- The Final EIS forecasts for transit vary more sizably in percentage terms when compared to the TTR (Final EIS daily transit trips on SR 520 are more than 35 percent lower than the TTR, and nearly 11 percent higher for transit trips on I-90); however, in the number of trips that difference becomes 3,000 fewer transit trips on SR 520 and 3,000 more trips on I-90. This likely indicates a difference in the transit networks assumed.

Given these relatively minor changes, the Final EIS comparison to the No Build Alternative would likely represent what would happen if the TTR Scenario 7 had been compared to a No Build Alternative:

- The Final EIS Preferred Alternative (including a toll) compared to a No Build condition shows that an improved corridor would nearly double transit use on SR 520, and the corridor would carry about 6 percent more travelers.
- I-90 person trips would actually decrease for both transit and all trips because more transit and HOV trips are attracted to the SR 520 corridor.
- Total person trips in both corridors combined are essentially flat when SR 520 is tolled, with most of the changes in behavior appearing to be confined to the corridors. These charges reflect more travelers taking transit, or switching to HOV, or changing time of day, but with fewer travelers migrating to other corridors.

EXHIBIT 3. DAILY TRANSIT TRIPS AND TOTAL PERSON TRIPS IN 2030, ON I-90 AND SR 520

Scenario Types	Transit Trips on SR 520	Transit Trips on I-90	Total Person Trips on SR 520	Total Person Trips on I-90	Total 520 and I-90
SR 520-only Scenarios	10,400 to 11,600	35,400 to 39,300	139,800 to 176,800	251,800 to 262,700	
SR 520-only Scenarios	10,400 to 11,600	35,400 to 39,300	139,800 to 176,800	251,800 to 262,700	
TTR Scenario 7 Tolled	10,800	36,500	167,500	252,100	419,600
TTR Baseline (6-lane untolled)	Not avail	Not avail	Not avail	Not avail	Not avail
Final EIS Preferred Alternative (tolled)	7,050	40,350	167,880	262,680	430,560
Final EIS No Build	3,670	43,380	158,780	271,620	430,400
Percent Change Final EIS Tolled to No Build	**92.1**	**-7.0**	**5.7**	**-3.3**	**0.1**
Percent Variance Final EIS 6-lane Tolled and TTR Scenario 7 Tolled	-34.7	10.5	0.2	4.2	2.7

Conclusions on Effects of Tolling on PM Peak Person Trips

As indicated in Exhibit 4, similar to forecasts for daily trips, a comparison of PM person trips predicted by the two models show the following:

- Total person trips on SR 520 are similar for both models (1.5 percent difference).
- Total person trips on both corridors are within 1 percent between the two models.
- The same variances in transit occur (Final EIS PM transit trips on SR 520 are more than 35 percent lower than the TTR, and about 14 percent higher for transit trips on I-90). Again, this likely indicates a difference in the transit networks assumed.

Again, given these relatively minor changes, the Final EIS comparison to the No Build Alternative would likely represent what would happen if the TTR Scenario 7 had been compared to a No Build Alternative as indicated below:

- The Final EIS Preferred Alternative (including a toll) compared to a No Build condition shows that an improved corridor would more than double transit use on SR 520 at the PM peak period, and the corridor would carry almost 18 percent more travelers.
- I-90 person trips would drop 14 percent for transit and 7.5 percent for all trips because more transit and HOV trips are attracted to the SR 520 corridor.

Total person trips in both corridors combined remain essentially flat when SR 520 is tolled, with most of the changes in behavior appearing to be confined to the corridors. These changes indicate more people would take transit, switch to HOV, or change time of day, but it shows fewer travelers would be likely to shift to other corridors.

EXHIBIT 4. PM PEAK TRANSIT TRIPS AND TOTAL PERSON TRIPS IN 2030, ON I-90 AND SR 520

Scenario	Transit Trips on SR 520	Transit Trips on I-90	Total Person Trips on SR 520	Total Person Trips on I-90	Total Persons Trips I-90 and 520
SR 520-only Scenarios	3,400 to 3,800	11,700 to 13,000	30,900 to 40,500	60,800 to 64,700	
TTR Scenario 7 Tolled	3,600	12,000	39,300	60,800	100,100
TTR Baseline (6-lane untolled)	Not available	Not available	Not available	Not available	Not available
Final EIS Preferred Alternative	2,350	13,760	38,710	62560	101,270
Final EIS No Build	1,130	14,930	32,880	67,600	100,480
Percent Change Final EIS Tolled to No Build	**108.0**	**-13.6**	**17.7**	**-7.5**	**0.9**
Percent Variance Final EIS 6-lane Tolled and TTR Scenario 7 Tolled	-34.7	14.7	-1.5	2.9	1.2

Overall Conclusions

The TTR and the work of the 520 Tolling Implementation Committee predicted changes in travel behavior when tolling occurred, but used tolled and untolled SR 520 scenarios with improvements as a baseline for predicting traffic and revenue effects of tolling beyond 2017/corridor completion. While this is a reasonable way to evaluate how SR 520 could be tolled to support the project's financial plan and maximize revenue, it was not designed to be a detailed impact analysis of the traffic and transportation effects of tolling, including the effects on other facilities, or the use of different modes of travel.

Although it remains a theoretical exercise, an improved SR 520 with no toll (the other studies' baseline), if it could be implemented, becomes very attractive to a large number of GP drivers because it would increase east-west capacity and provide the shortest route for a large number of people. The completed HOV lane would also attract HOV trips and make transit trips more attractive. In this situation, both vehicle trips and person trips would rise on SR 520. In the Committee report and the TTR model, this tends to draw trips from other corridors. When tolling is added (particularly high cost tolls), the reports showed SR 520 vehicle trips drop by up to 17 percent compared to the baseline, while vehicle trips on I-90, SR 522, and other corridors went up 3 to 4 percent. The reports described the forecasted drop in trips on SR 520 and comparative rises in other corridors as "trip diversion."

The Final EIS uses a No Build scenario to measure how tolling on an improved SR 520 would affect conditions, which is a widely accepted method for evaluating impacts in an EIS. It is also a more accurate representation of the future conditions with the project. The Final EIS alternatives do not include an untolled Preferred Alternative because the revenues from tolling are needed in order to build the Preferred Alternative.

The forecast volumes provided by the Committee's work and the TTR overall are generally consistent with the forecasts for the Final EIS, particularly in the overall estimates for person trips and vehicle trips across the lake. The models included similar tolling approaches to those now assumed in the Final EIS. The Final EIS model also reasonably replicated other patterns shown in the TTR and the Committee reports. The major difference is that the Final EIS provides No Build forecasts for comparison, while the TTR and the Committee analyses used an improved but untolled corridor as the baseline for comparison. However, given the similarities between the forecast volumes among the models, a No Build comparison to the TTR or the Committee tolling forecasts would likely yield similar findings to the Final EIS forecasts. Exhibits 5, 6, and 7 show how close the forecasts were for similar measures such as daily and peak vehicle trips, and daily and peak person trips. Key findings are summarized below:

- For vehicle trips, the Final EIS Preferred Alternative (tolled) compared to a No Build condition for daily and peak periods shows that tolling would reduce GP trips on 520 by 9 percent (peak) to 12 percent (daily).
- Total trips on SR 520 (GP and HOV) would drop by about 5 percent daily as some of the vehicle trips move to the SR 520 HOV lanes. During the peak when tolls are highest, this shift is more distinct, because while GP trips would drop by 9 percent compared to the No Build Alternative, total vehicle trips on SR 520 would be the same as for the No Build condition, thus reflecting the shift of vehicles from GP lanes to the HOV lanes, but largely remaining within the corridor.
- Even with tolling, more people would use the SR 520 corridor compared to the No Build Alternative. For person trips, the Final EIS forecasts for SR 520 show that the Preferred

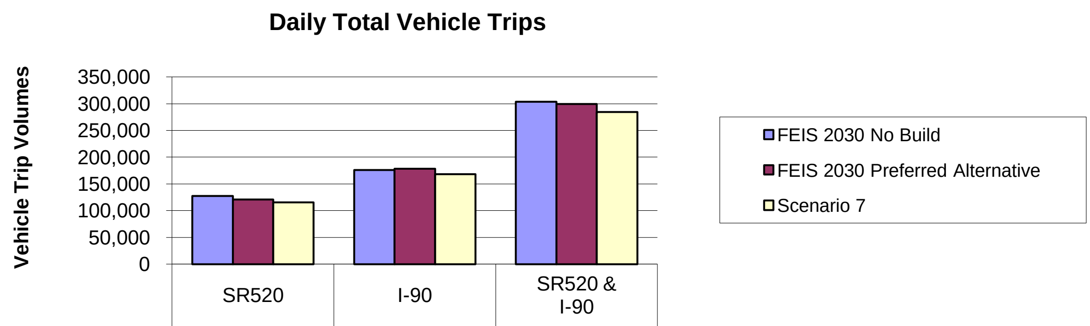
Alternative, including SR 520 tolling, would increase by about 6 percent daily, and nearly 18 percent at the peak period compared to the No Build Alternative.

- I-90 would experience less than a 2 percent total increase in traffic on a daily basis or at PM peak compared to the No Build condition.
- When daily and peak-period traffic volumes on I-90 and SR 520 are combined, the total is within 1 percent of the No Build Alternative.
- The Final EIS six-lane (Preferred Alternative) tolled compared to a No Build condition shows that an improved corridor with SR 520 tolling could nearly double transit use on SR 520.
- I-90 person trips would drop due to lower levels of transit use and lower overall person trips because more transit and HOV trips are attracted to the SR 520 corridor.

All of the model forecasts show similar patterns: with tolling on SR 520 only, daily vehicle trips remain flat or declining on SR 520, while daily person trips increase. There is little evidence of diversion or lost trips, with only modest changes on I-90 or other corridors (1 percent or less).

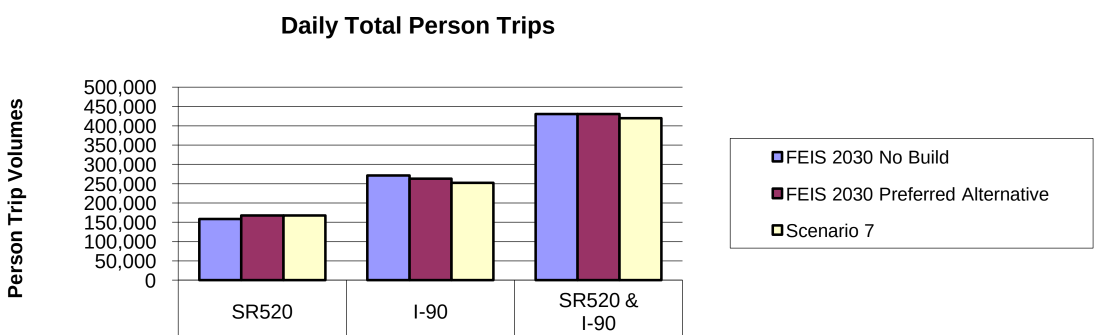
Traffic volumes in all, except one, of the single bridge tolling options is higher than or equal to existing traffic volume. Given this finding and the existing need for an improved corridor, this data illustrates that tolling would not result in traffic reductions low enough to change the project's Preferred Alternative. The one tolling scenario that showed a substantial trip reduction required a $5.35 in 2007 dollars or about $5.90 in 2011 dollars.

EXHIBIT 5. DAILY TOTAL VEHICLE TRIPS



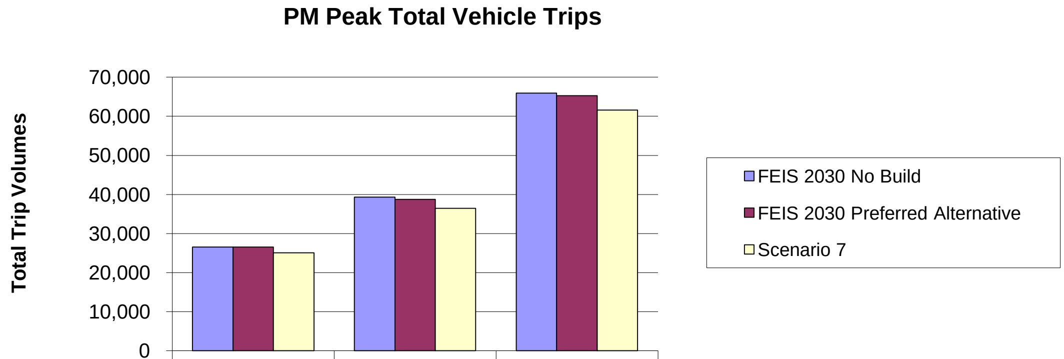
	SR520	I-90	SR520 & I-90
FEIS 2030 No Build	127,570	176,160	303,730
FEIS 2030 Preferred Alternative	121,110	178,230	299,340
Scenario 7	115,700	168,500	284,200

EXHIBIT 6. DAILY TOTAL PERSON TRIPS

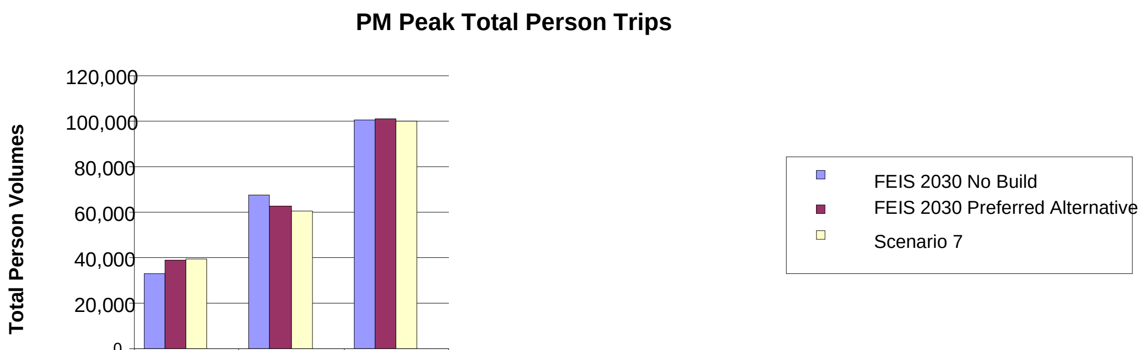


	SR520	I-90	SR520 & I-90
FEIS 2030 No Build	158,780	271,620	430,400
FEIS 2030 Preferred Alternative	167,880	262,680	430,560
Scenario 7	167,500	252,100	419,600

During the peak period, when travel demand is highest and the tolling rate is also highest, vehicle trips remain flat compared to the No Build Alternative and person trips increase by nearly 18 percent. I-90 trips also drop slightly as the improved SR 520 corridor absorbs more of the peak travel demand compared to the No Build Alternative.



	SR520	I-90	SR520 & I-90
FEIS 2030 No Build	26,570	39,360	65,930
FEIS 2030 Preferred Alternative	26,550	38,740	65,290
Scenario 7	25,100	36,500	61,600



	SR520	I-90	SR520 & I-90
FEIS 2030 No Build	32,880	67,600	100,480
FEIS 2030 Preferred Alternative	38,710	62,560	101,270
Scenario 7	39,300	60,800	100,100

Route Name

EXHIBIT 7. PM PEAK TOTAL SCENARIOS

Attachment A: 520 Tolling Implementation Committee Evaluation Results for 520-only Scenarios - 2010 and 2016

520-Only Bridge Scenarios: 2010 and 2016

520 Tolling Implementation Committee Evaluation Results for All Scenarios

Released: November 10, 2008

520-Only Scenarios: 2010 *(Example toll rates only)*	**Scenario 1**: Toll 520 in 2016, when project is complete	**Scenario 2**: Toll 520 in 2010, when construction begins	**Scenario 5**: Flat rate toll on 520 in 2016, when project is complete	**Scenario 6**: Maximize funding by tolling only 520 (starting 2010)	**Scenario 7**: Toll 520 in 2010; increase rate in 2016
Estimated Bridge Funding	$835 M	$853 M	$522 M	$1,520 M	$1,189M
Toll Rates (Shown in 2007 dollars)*					
Morning (5 – 9 AM)		$2.15		$3.05	$2.60
Mid-day (9 AM – 3 PM)		$1.05		$2.65	$2.10
Afternoon (3 – 7 PM)		$2.95		$3.80	$3.25
Evenings (7 – 10 PM)		$1.30		$2.10	$2.10
Nights (10 PM – 5 AM)					
Weekends		$0.75 to $1.50		$0.80 - $1.60	$0.80 - $1.60
Segment					
Average Toll Paid		$1.70		$2.36	$2.16

Route	Baseline		Scenario 1		Scenario 2		Scenario 5		Scenario 6		Scenario 7	
	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
2010 Vehicle Volume (Does not include transit riders)												
520 Midspan	44,640	73,590			37,990	60,350			35,590	54,910	37,170	54,430
I-90 Midspan	63,540	86,730			65,230	90,350			66,370	94,520	65,280	92,880
SR 522 at 61st	20,210	29,790			20,560	29,870			21,000	31,370	20,560	30,360
I-405 at SR 167	55,990	101,770			57,150	104,850			57,020	106,030	56,730	104,730
Total Change	184,380	291,880			180,930	285,420			179,980	286,830	179,740	282,400
2010 Vehicle Volume Changes (Compared with the 2010 Baseline volumes - excludes transit riders)												
520 Midspan					-6,650	-13,240			-9,050	-18,680	-7,470	-19,160
I-90 Midspan					1,690	3,620			2,830	7,790	1,740	6,150
SR 522 at 61st					350	80			790	1,580	350	570
I-405 at SR 167					1,160	3,080			1,030	4,260	740	2,960
Total Change					-3,450	-6,460			-4,400	-5,050	-4,640	-9,480
Percent Change in Vehicle Volume (Compared with the 2010 Baseline Condition - excludes transit riders)												
520 Midspan					-15%	-18%			-20%	-25%	-17%	-26%
I-90 Midspan					3%	4%			4%	9%	3%	7%
SR 522 at 61st					2%	0%			4%	5%	2%	2%
I-405 at SR 167					2%	3%			2%	4%	1%	3%
Total Change					-2%	-2%			-2%	-2%	-3%	-3%
2010 Person Volumes (Includes transit riders)												
520 Midspan	56,300	90,850			50,400	75,500			48,140	69,160	49,750	68,600
I-90 Midspan	84,990	109,950			87,310	114,910			88,290	119,790	87,260	118,260
SR 522 at 61st	24,950	37,130			25,490	37,340			25,790	38,860	25,460	37,850
I-405 at SR 167	76,170	136,930			78,190	141,100			77,490	141,470	77,490	141,230
Total Change	242,410	374,860			341,390	368,850			239,710	369,280	239,960	365,940
2010 Person Volume Changes (Compared with the 2010 Baseline Person volumes - includes transit riders)												
520 Midspan					-5,900	-15,350			-8,160	-21,690	-6,550	-22,250
I-90 Midspan					2,320	4,960			3,300	9,840	2,270	8,310
SR 522 at 61st					540	210			840	1,730	510	720
I-405 at SR 167					2,020	4,170			1,320	4,540	1,320	4,300
Total Change					-1,020	-6,010			-2,700	-5,580	-2,450	-8,920
Percentage Change in Person Volume (Compared with the 2010 Baseline Condition - includes transit riders)												
520 Midspan					-10%	-17%			-14%	-24%	-12%	-24%
I-90 Midspan					3%	5%			4%	9%	3%	8%
SR 522 at 61st					2%	1%			3%	5%	2%	2%
I-405 at SR 167					3%	3%			2%	3%	2%	3%
Total Change					0%	-2%			-1%	-1%	-1%	-2%

Type of Diversion	Scenario 1		Scenario 2		Scenario 5		Scenario 6		Scenario 7	
	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Person Changes by Type of Change (Compared with the 2010 Baseline Condition for each Route)										
Shift to Transit			1,470	480			1,850	680	1,630	650
Shift to I-90			2,320	4,960			3,300	9,840	2,270	8,310
Shift to SR 522			540	210			840	1,730	510	720
Shift to I-405			2,020	4,170			1,320	4,540	1,320	4,300
Changes Destination			-1,020	-6,010			-2,700	-5,580	-2,450	-8,920
Total			-7,370	-15,830			-10,010	-22,370	-8,180	-22,900
Shift Time of Day			4,460				6,520		8,940	
Percentage of Total Person Changes by Type of Change										
Shift to Transit			20%	3%			18%	3%	20%	3%
Shift to I-90			31%	31%			33%	44%	28%	36%
Shift to SR 522			7%	1%			8%	8%	6%	3%
Shift to I-405			27%	26%			13%	20%	16%	19%
Changes Destination			14%	38%			27%	25%	30%	39%
Total			100%	100%			100%	100%	100%	100%
Percentage of Person Changes by Type of Change (Compared with the 2010 Baseline Persons on SR 520)										
Shift to Transit			3%	1%			3%	1%	3%	1%
Shift to I-90			4%	5%			6%	11%	4%	9%
Shift to SR 522			1%	0%			1%	2%	1%	1%
Shift to I-405			4%	5%			2%	5%	2%	5%
Changes Destination			2%	7%			5%	6%	4%	10%
Total			13%	17%			18%	25%	15%	25%
Shift Time of Day			4%				6%		8%	

Speeds	Baseline		Scenario 1		Scenario 2		Scenario 5		Scenario 6		Scenario 7	
	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Average Peak Direction Corridor Travel Speeds from I-5 to I-405 (Except I-405 which is from I-90 to I-5 in Tukwila)												
520 GP Lanes	22	35			35	48			38	54	36	54
I-90 GP lanes	32	52			31	50			29	47	31	48
SR 522 GP Lanes	17	31			16	29			16	28	16	29
I-405 GP Lanes	23	32			23	31			22	31	23	32
Change in Average Peak Direction Corridor Travel Speeds from I-5 to I-405 (cxcept I-405 which is from I-90 to I-5 in Tukwila)												
520 GP Lanes					14	13			16	19	15	19
I-90 GP lanes					-1	-2			-2	-5	-1	-4
SR 522 GP Lanes					-1	-2			-1	-3	-1	-2
I-405 GP Lanes					0	0			0	-1	0	1

* These are example toll rates for planning purposes. Actual toll rates will depend on a final finance plan and determined by the State Transportation Commission with approval by the State Legislature.

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520_OneBridgeScenarios_UPDATED03172009.xlsx

520-Only Bridge Scenarios: 2010 and 2016

520 Tolling Implementation Committee
Evaluation Results for All Scenarios

Released: November 10, 2008

520-Only Scenarios: 2016 *(Example toll rates only)*	**Scenario 1**: Toll 520 in 2016, when project is complete	**Scenario 2**: Toll 520 in 2010, when construction begins	**Scenario 5**: Flat rate toll on 520 (in 2016)	**Scenario 6**: Maximize funding by tolling only 520 (starting 2010)	**Scenario 7**: Toll 520 in 2010; increase rate in 2016
Estimated Bridge Funding	$835 M	$853 M	$522 M	$1,520 M	$1,189 M
"Reasonableness" of Toll Rates* (Toll Rates are shown in 2007 dollars)					
Morning (5 – 9 AM)	$3.05	$2.15	$1.70	$4.25	$3.05
Mid-day (9 AM – 3 PM)	$2.10	$1.05		$2.75	$2.10
Afternoon (3 – 7 PM)	$3.80	$2.95		$5.35	$3.80
Evenings (7 – 10 PM)	$1.95	$1.30		$2.10	$1.50
Nights (10 PM – 5 AM)	$0.90	$0.75		$0.95	$0.75
Weekends	$0.85 to $1.60	$0.80 to $1.60		$0.40 - $0.80	$0.80 - $1.60
Segment	$0.40 to $0.80				
Average Toll Paid	$2.28	$1.64	$1.70	$2.92	$2.28

Estimated Daily Travel Changes

Route	Baseline		Scenario 1		Scenario 2		Scenario 5		Scenario 6		Scenario 7	
	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
2016 Vehicle Volume (Does not inlcude transit riders)												
520 Midspan	51,430	82,380	41,660	62,560	43,840	68,030	46,530	60,830	34,320	54,860	41,060	61,680
I-90 Midspan	62,877	87,633	64,519	91,881	65,353	90,178	64,661	92,882	67,980	95,480	64,580	91,750
SR 522 at 61st	20,370	30,360	21,820	32,170	20,810	31,490	20,670	32,250	21,730	33,630	21,000	32,050
I-405 at SR 167	67,970	118,540	70,140	122,970	69,210	122,920	69,240	123,390	68,970	120,490	69,040	124,020
Total Change	202,647	318,913	198,139	309,581	199,213	312,618	201,101	309,352	193,000	304,460	195,680	309,500
2016 Vehicle Volume Changes (Compared with the 2016 Baseline volumes - excludes transit riders)												
520 Midspan			-9,770	-19,820	-7,590	-14,350	-4,900	-21,550	-17,110	-27,520	-10,370	-20,700
I-90 Midspan			1,642	4,248	2,476	2,545	1,783	5,249	5,103	7,847	1,702	4,117
SR 522 at 61st			1,450	1,810	440	1,130	300	1,890	1,360	3,270	630	1,690
I-405 at SR 167			2,170	4,430	1,240	4,380	1,270	4,850	1,000	1,950	1,070	5,480
Total Change			-4,508	-9,332	-3,434	-6,295	-1,547	-9,561	-9,647	-14,453	-6,968	-9,413
Percent Change in Vehicle Volume (Compared with the 2016 Baseline Condition - excludes transit riders)												
520 Midspan			-19%	-24%	-15%	-17%	-10%	-26%	-33%	-33%	-20%	-25%
I-90 Midspan			3%	5%	4%	3%	3%	6%	8%	9%	3%	5%
SR 522 at 61st			7%	6%	2%	4%	1%	6%	7%	11%	3%	6%
I-405 at SR 167			3%	4%	2%	4%	2%	4%	1%	2%	2%	5%
Total Change			-2%	-3%	-2%	-2%	-1%	-3%	-5%	-5%	-3%	-3%
2016 Person Volumes (Includes transit riders)												
520 Midspan	68,870	102,270	59,150	80,280	61,110	86,040	63,780	78,380	47,170	68,140	58,310	79,110
I-90 Midspan	90,179	115,608	92,020	120,220	93,370	118,480	92,610	121,340	98,456	126,999	92,220	120,020
SR 522 at 61st	24,700	36,740	26,270	39,190	25,580	38,690	25,440	39,430	26,770	41,460	25,750	39,170
I-405 at SR 167	92,620	158,960	95,310	164,190	94,360	164,570	94,600	164,850	94,110	161,360	94,060	165,300
Total Change	276,369	413,578	272,750	403,880	274,420	407,780	276,430	404,000	266,506	397,959	270,340	403,600
2016 Person Volume Changes (Compared with the 2016 Baseline Person volumes - includes transit riders)												
520 Midspan			-9,720	-21,990	-7,760	-16,230	-5,090	-23,890	-21,700	-34,130	-10,560	-23,160
I-90 Midspan			1,841	4,612	3,191	2,872	2,431	5,732	8,277	11,391	2,041	4,412
SR 522 at 61st			1,570	2,450	880	1,950	740	2,690	2,070	4,720	1,050	2,430
I-405 at SR 167			2,690	5,230	1,740	5,610	1,980	5,890	1,490	2,400	1,440	6,340
Total Change			-3,619	-9,698	-1,949	-5,798	61	-9,578	-9,863	-15,619	-6,029	-9,978
Percentage Change in Person Volume (Compared with the 2016 Baseline Condition - includes transit riders)												
520 Midspan			-14%	-22%	-11%	-16%	-7%	-23%	-32%	-33%	-15%	-23%
I-90 Midspan			2%	4%	4%	2%	3%	5%	9%	10%	2%	4%
SR 522 at 61st			6%	7%	4%	5%	3%	7%	8%	13%	4%	7%
I-405 at SR 167			3%	3%	2%	4%	2%	4%	2%	2%	2%	4%
Total Change			-1%	-2%	-1%	-1%	0%	-2%	-4%	-4%	-2%	-2%

Type of Diversion	Scenario 1		Scenario 2		Scenario 5		Scenario 6		Scenario 7	
	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Person Changes by Type of Change (Compared with the 2016 Baseline Condition for each Route)										
Shift to Transit	630	400	560	290	430	320	520	400	540	370
Shift to I-90	1,841	4,612	3,191	2,872	2,431	5,732	8,277	11,391	2,041	4,412
Shift to SR 522	1,570	2,450	880	1,950	740	2,690	2,070	4,720	1,050	2,430
Shift to I-405	2,690	5,230	1,740	5,610	1,980	5,890	1,490	2,400	1,440	6,340
Change Destination	-3,619	-9,698	-1,949	-5,798	61	-9,578	-9,863	-15,619	-6,029	-9,978
Total	-10,350	-22,390	-8,320	-16,520	-5,520	-24,210	-22,220	-34,530	-11,100	-23,530
Shift Time of Day	7,060		4,180		13,140		4,930		6,970	
Percentage of Total Person Changes by Type of Change										
Shift to Transit	6%	2%	7%	2%	8%	1%	2%	1%	5%	2%
Shift to I-90	18%	21%	38%	17%	44%	24%	37%	33%	18%	19%
Shift to SR 522	15%	11%	11%	12%	13%	11%	9%	14%	9%	10%
Shift to I-405	26%	23%	21%	34%	35%	24%	7%	7%	13%	27%
Change Destination	35%	43%	23%	35%	0%	40%	44%	45%	54%	42%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Percentage of Person Changes by Type of Change (Compared with the 2016 Baseline Persons on SR 520)										
Shift to Transit	1%	0%	1%	0%	1%	0%	1%	0%	1%	0%
Shift to I-90	3%	5%	5%	3%	4%	6%	12%	11%	3%	4%
Shift to SR 522	2%	2%	1%	2%	1%	3%	3%	5%	2%	2%
Shift to I-405	4%	5%	3%	5%	3%	6%	2%	2%	2%	6%
Change Destination	5%	9%	3%	6%	0%	9%	14%	15%	9%	10%
Total	15%	22%	12%	16%	8%	24%	32%	34%	16%	23%
Shift Time of Day	5%		3%		9%		4%		5%	

Speeds	Baseline		Scenario 1		Scenario 2		Scenario 5		Scenario 6		Scenario 7	
	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Average Peak Direction Corridor Travel Speeds from I-5 to I-405 (except I-405 which is from I-90 to I-5 in Tukwila)												
520 GP Lanes	21	37	33	57	33	51	28	54	47	59	36	56
I-90 GP lanes	26	53	26	49	26	51	26	50	25	47	26	49
SR 522 GP Lanes	15	30	14	27	14	28	14	28	14	27	14	27
I-405 GP Lanes	25	36	24	36	25	36	25	36	25	36	25	36
Change in Average Peak Direction Corridor Travel Speeds from I-5 to I-405 (except I-405 which is from I-90 to I-5 in Tukwila)												
520 GP Lanes			13	20	12	14	7	16	26	21	16	19
I-90 GP lanes			0	-4	0	-1	0	-2	-1	-6	0	-3
SR 522 GP Lanes			-1	-3	-1	-2	-1	-2	-1	-3	-1	-2
I-405 GP Lanes			-1	0	0	0	0	0	0	0	0	-1

* These are example toll rates for planning purposes. Actual toll rates will depend on a final finance plan and determined by the State Transportation Commission with approval by the State Legislature.

Attachment B: Results from the SR 520 Toll Traffic and Revenue Technical Report – 2008 (April 2009)

Exhibit 18 – 2030 PM Peak Toll Analysis Comparison Matrix – Post-Completion Scenarios

		Scenario	Scenario Elements			Maximum PM Peak Bridge Toll		2030 PM Peak Toll Model Outputs for SR 520 & I-90 Bridges										Toll Impacts on 2030 PM Peak Traffic (Relative to Toll-Free Build Condition)					
			Toll Configuration	Toll Strategy	Toll Exemptions	2007 $s	Opening Year 2016 $s	Vehicles in GP Lanes		Vehicles in HOV Lanes		Total Vehicles		Transit Person Trips		Total Persons (Including Transit)		Net Toll Diversion (%)		Transit Mode Shift (%)		HOV Mode Shift (%)	
								SR 520	I-90	SR 520	I-90	SR 520	I-90	SR 520	I-90	SR 520	I-90	SR 520	I-90	SR 520	I-90	SR 520	I-90
ONE BRIDGE TOLLED	Lower	Scenario 2	SR 520: Bridge Only	Variable Toll Schedule (Lowest)	Transit & HOV 3+	$2.95	$3.70	23,100	33,800	2,800	2,600	25,900	36,400	3,800	13,000	40,500	61,700	– 10%	+ 2%	+ 23%	+ 4%	+ 7%	– 1%
ONE BRIDGE TOLLED	Lower	Scenario 5	SR 520: Bridge Only	Fixed-Rate Toll	Transit & HOV 3+	$1.70	$2.15	24,800	33,700	2,800	2,600	27,600	36,200	3,400	12,300	42,000	60,800	– 3%	+ 2%	+ 10%	– 1%	+ 7%	– 1%
ONE BRIDGE TOLLED	Medium	Scenario 1	SR 520: Bridge + Short Segments	Variable Toll Schedule (Medium)	Transit & HOV 3+	$3.80	$4.75	22,700	34,100	3,000	2,600	25,700	36,700	3,700	12,100	40,400	61,100	– 11%	+ 3%	+ 19%	– 3%	+ 13%	– 1%
ONE BRIDGE TOLLED	Medium	Scenario 7	SR 520: Bridge Only	Variable Toll Schedule (Medium)	Transit & HOV 3+	$3.80	$4.75	22,200	34,000	2,900	2,500	25,100	36,500	3,600	12,000	39,300	60,800	– 13%	+ 3%	+ 14%	– 3%	+ 9%	– 2%
ONE BRIDGE TOLLED	Higher	Scenario 6	SR 520: Bridge + Short Segments	Variable Toll Schedule (Higher)	No Toll Exemptions	$5.35	$6.65	20,400	34,400	900	3,700	21,300	38,100	3,500	11,700	30,900	64,700	– 21%	+ 4%	+ 13%	– 6%	– 64%	+ 44%
TWO BRIDGES TOLLED	Lower	Scenario 9	SR 520: Bridge Only I-90: Bridge Only	Variable Toll Schedule (Lowest)	Transit & HOV 3+	$2.95	$3.70	24,200	29,200	2,800	2,700	26,900	31,900	3,400	12,800	41,100	56,400	– 5%	– 12%	+ 8%	+ 3%	+ 4%	+ 5%
TWO BRIDGES TOLLED	Lower	Scenario 3	SR 520: Bridge + Short Segments I-90: Bridge + Island Segments	Variable Toll Schedule (Lower)	Transit & HOV 3+	$3.25	$4.05	24,800	30,600	3,100	2,800	27,800	33,400	3,500	13,200	42,900	58,800	– 3%	– 7%	+ 12%	+ 6%	+ 16%	+ 8%
TWO BRIDGES TOLLED	Lower	Scenario 4	SR 520: Bridge + Short Segments I-90: Bridge + Island Segments	Variable Toll Schedule (Lower)	Transit & HOV 3+	$3.25	$4.05	24,800	30,600	3,100	2,800	27,800	33,400	3,500	13,200	42,900	58,800	– 3%	– 7%	+ 12%	+ 6%	+ 16%	+ 8%
TWO BRIDGES TOLLED	Lower	Scenario 13	SR 520: Bridge Only I-90: Bridge Only	Variable Toll Schedule (Lower)	Transit & HOV 3+	$3.25	$4.05	24,900	30,800	3,000	2,900	27,900	33,700	3,300	12,700	42,700	58,800	– 3%	– 7%	+ 6%	+ 2%	+ 15%	+ 13%
TWO BRIDGES TOLLED	Mixed	Scenario 8	SR 520: Bridge Only I-90: Bridge Only	Variable Toll Schedule: Higher on SR 520 Lower on I-90	Transit & HOV 3+	SR 520: $4.20 I-90: $2.80	SR 520: $5.25 I-90: $3.50	23,400	30,700	3,000	2,700	26,400	33,400	3,500	13,100	41,100	58,500	– 8%	– 7%	+ 13%	+ 5%	+ 14%	+ 6%
TWO BRIDGES TOLLED	Mixed	Scenario 12	SR 520: Bridge Only I-90: Bridge Only	Variable Toll Schedule: Higher on SR 520 Lower on I-90	Transit & HOV 3+	SR 520: $4.20 I-90: $2.80	SR 520: $5.25 I-90: $3.50	23,400	30,700	3,000	2,700	26,400	33,400	3,500	13,100	41,100	58,500	– 8%	– 7%	+ 13%	+ 5%	+ 14%	+ 6%
TWO BRIDGES TOLLED	Higher	Scenario 10	SR 520: Bridge + Short Segments I-90: (2+2) HOT Lanes I-5 to I-405 & (1+1) HOT I-405 to Issaquah	SR520: Variable Toll Schedule (Higher) I-90: Dynamic Tolls (Weekday Peaks/Midday)	Transit & HOV 3+	SR 520: $5.35 I-90: $0.95 per mile	SR 520: $6.65 I-90: $1.18 per mile	22,100	22,800	3,500	11,500	25,600	34,300	3,500	11,700	40,900	56,800	– 14%	– 31%	+ 13%	– 6%	+ 32%	NA
TWO BRIDGES TOLLED	Higher	Scenario 11	SR 520: Bridge Only I-90: Bridge Only (Option K on SR 520)	Variable Toll Schedule (Higher)	Transit & HOV 3+	$5.35	$6.65	23,700	27,400	3,200	2,600	26,900	30,100	3,300	12,800	41,800	54,100	– 7%	– 17%	+ 7%	+ 3%	+ 21%	+ 2%
DIAGNOSTIC TESTS		Scenario 6.1	SR 520: Bridge + Short Segments	Variable Toll Schedule (Higher)	Transit & HOV 3+	$5.35	$6.65	19,900	34,300	2,900	2,500	22,800	36,900	3,600	11,800	36,600	60,900	– 22%	+ 4%	+ 15%	– 6%	+ 10%	– 2%
DIAGNOSTIC TESTS		Scenario 7.1	SR 520: Bridge Only (Existing 4 Lane Bridge)	Variable Toll Schedule (Medium)	Transit Only	$3.80	$4.75	22,500	34,000	NA	4,000	22,500	38,100	3,100	12,200	30,100	65,800	NA	NA	NA	NA	NA	NA
DIAGNOSTIC TESTS		Scenario 7.2	SR 520: Bridge Only (HOV2+ on SR 520)	Variable Toll Schedule (Medium)	Transit & HOV 2+	$3.80	$4.75	20,100	32,600	8,300	6,700	28,400	39,300	3,500	12,300	53,700	72,500	NA	NA	NA	NA	NA	NA
DIAGNOSTIC TESTS		Scenario 12.1	SR 520: Bridge Only I-90: Bridge Only	Variable Toll Schedule: 25% Higher Tolls than Scenario 12	Transit & HOV 3+	SR 520: $5.25 I-90: $3.50	SR 520: $6.56 I-90: $4.35	22,700	30,000	3,100	2,700	25,800	32,800	3,600	13,200	40,600	57,900	– 11%	– 9%	+ 15%	+ 6%	+ 17%	+ 6%

Exhibit 19 – 2030 Daily Toll Analysis Comparison Matrix – Post-Completion Scenarios

Scenario			Scenario Elements			Maximum PM Peak Bridge Toll		2030 Daily Toll Model Outputs for SR 520 & I-90 Bridges										Toll Impacts on 2030 Daily Traffic (Relative to Toll-Free Build Condition)					
			Toll Configuration	Toll Strategy	Toll Exemptions	2007 $s	Opening Year 2016 $s	Vehicles in GP Lanes		Vehicles in HOV Lanes		Total Vehicles		Transit Person Trips		Total Persons (Including Transit)		Net Toll Diversion (%)		Transit Mode Shift (%)		HOV Mode Shift (%)	
								SR 520	I-90	SR 520	I-90	SR 520	I-90	SR 520	I-90	SR 520	I-90	SR 520	I-90	SR 520	I-90	SR 520	I-90
ONE BRIDGE TOLLED	Lower	Scenario 2	SR 520: Bridge Only	Variable Toll Schedule (Lowest)	Transit & HOV 3+	$2.95	$3.70	114,400	159,300	8,900	6,800	123,200	166,000	11,600	39,300	176,800	251,800	–11%	+5%	+23%	+4%	+7%	–3%
		Scenario 5	SR 520: Bridge Only	Fixed-Rate Toll	Transit & HOV 3+	$1.70	$2.15	111,700	161,600	9,000	6,800	120,700	168,400	10,400	37,400	172,800	252,800	–13%	+6%	+10%	–1%	+8%	–2%
	Medium	Scenario 1	SR 520: Bridge + Short Segments	Variable Toll Schedule (Medium)	Transit & HOV 3+	$3.80	$4.75	108,900	161,900	9,400	6,800	118,300	168,700	11,300	36,700	171,500	252,400	–16%	+7%	+19%	–3%	+13%	–3%
		Scenario 7	SR 520: Bridge Only	Variable Toll Schedule (Medium)	Transit & HOV 3+	$3.80	$4.75	106,500	161,700	9,200	6,800	115,700	168,500	10,800	36,500	167,500	252,100	–17%	+6%	+14%	–3%	+10%	–2%
	Higher	Scenario 6	SR 520: Bridge + Short Segments	Variable Toll Schedule (Higher)	No Toll Exemptions	$5.35	$6.65	96,600	163,700	4,200	9,800	100,800	173,500	10,700	35,400	139,800	262,700	–26%	+8%	+13%	–6%	–50%	+41%
TWO BRIDGES TOLLED	Lower	Scenario 9	SR 520: Bridge Only I-90: Bridge Only	Variable Toll Schedule (Lowest)	Transit & HOV 3+	$2.95	$3.70	124,300	137,500	8,800	8,300	133,200	145,800	10,200	38,900	187,100	230,100	–4%	–9%	+8%	+3%	+6%	+19%
		Scenario 3	SR 520: Bridge + Short Segments I-90: Bridge + Island Segments	Variable Toll Schedule (Lower)	Transit & HOV 3+	$3.25	$4.05	125,700	139,200	9,700	8,400	135,500	147,600	10,600	40,000	192,100	233,400	–3%	–8%	+12%	+6%	+17%	+20%
		Scenario 4	SR 520: Bridge + Short Segments I-90: Bridge + Island Segments	Variable Toll Schedule (Lower)	Transit & HOV 3+	$3.25	$4.05	125,700	139,200	9,700	8,400	135,500	147,600	10,600	40,000	192,100	233,400	–3%	–8%	+12%	+6%	+17%	+20%
		Scenario 13	SR 520: Bridge Only I-90: Bridge Only	Variable Toll Schedule (Lower)	Transit & HOV 3+	$3.25	$4.05	123,300	135,600	9,000	7,200	132,300	142,800	10,000	38,600	186,400	224,100	–4%	–11%	+6%	+2%	+9%	+3%
	Mixed	Scenario 8	SR 520: Bridge Only I-90: Bridge Only	Variable Toll Schedule: Higher on SR 520 Lower on I-90	Transit & HOV 3+	SR 520: $4.20 I-90: $2.80	SR 520: $5.25 I-90: $3.50	120,200	141,100	9,600	8,500	129,800	149,600	10,700	39,600	185,100	235,800	–7%	–7%	+13%	+5%	+15%	+22%
		Scenario 12	SR 520: Bridge Only I-90: Bridge Only	Variable Toll Schedule: Higher on SR 520 Lower on I-90	Transit & HOV 3+	SR 520: $4.20 I-90: $2.80	SR 520: $5.25 I-90: $3.50	120,200	141,100	9,600	8,500	129,800	149,600	10,700	39,600	185,100	235,800	–7%	–7%	+13%	+5%	+15%	+22%
	Higher	Scenario 10	SR 520: Bridge + Short Segments I-90: (2+2) HOT Lanes I-5 to I-405 & (1+1) HOT I-405 to Issaquah	SR520: Variable Toll Schedule (Higher) I-90: Dynamic Tolls (Weekday Peaks/Midday)	Transit & HOV 3+	SR 520: $5.35 I-90: $0.95 per mile	SR 520: $6.65 I-90: $1.18 per mile	107,200	126,800	9,000	39,900	116,200	166,700	10,700	35,400	167,200	245,400	–17%	+5%	+13%	–6%	+8%	NA
		Scenario 11	SR 520: Bridge Only I-90: Bridge Only (Option K on SR 520)	Variable Toll Schedule (Higher)	Transit & HOV 3+	$5.35	$6.65	119,300	124,400	9,500	6,800	128,800	131,200	10,100	38,800	183,100	209,500	–8%	–18%	+7%	+3%	+14%	–3%
DIAGNOSTIC TESTS		Scenario 6.1	SR 520: Bridge + Short Segments	Variable Toll Schedule (Higher)	Transit & HOV 3+	$5.35	$6.65	95,100	163,500	9,200	6,900	104,200	170,300	10,800	35,600	153,800	253,400	–26%	+8%	+15%	–6%	+10%	–2%
		Scenario 7.1	SR 520: Bridge Only (Existing 4 Lane Bridge)	Variable Toll Schedule (Medium)	Transit Only	$3.80	$4.75	108,800	161,800	NA	10,300	108,800	172,100	9,300	37,100	139,900	263,600	NA	NA	NA	NA	NA	NA
		Scenario 7.2	SR 520: Bridge Only (HOV2+ on SR 520)	Variable Toll Schedule (Medium)	Transit & HOV 2+	$3.80	$4.75	96,700	155,400	32,300	22,100	129,100	177,400	10,600	37,300	228,600	293,200	NA	NA	NA	NA	NA	NA
		Scenario 12.1	SR 520: Bridge Only I-90: Bridge Only	Variable Toll Schedule: 25% Higher Tolls than Scenario 12	Transit & HOV 3+	SR 520: $5.25 I-90: $3.50	SR 520: $6.56 I-90: $4.35	117,500	139,100	9,900	9,000	127,400	148,100	10,900	40,000	183,100	235,300	–9%	–8%	+15%	+6%	+19%	+30%