



SOUND TRANSIT
HCT Planning

Sound Transit Long-Range Plan Update

Issue Paper N.2.S: Light Rail on SR 99, Supplement to Issue Paper N.2: I-5 Corridor Northgate to Everett HCT Assessment

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Sound Transit

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FINAL

May 2005

Foreword

This issue paper is part of a series of reports designed to inform the Sound Transit Board in its decision-making on the Regional Transit Long-Range Plan update for the Sound Transit service area. Each issue paper provides information about a specific element or area of the Long-Range Plan and potential options. These reports focus on issues such as costs, ridership, engineering feasibility and operations.

The environmental impacts of the updated Long-Range Plan and Options, as well as potential mitigation measures, are examined in the Draft Supplemental EIS for the Regional Transit Long-Range Plan (December 2004). The Draft SEIS supplements the 1993 EIS prepared on the Regional Transit System Plan, and it generally updates that information and analysis through the year 2030. Public and agency comments on the 2004 Draft Supplemental EIS have been received and will be responded to in a final SEIS to be issued in June 2005.

The Sound Transit Board anticipates identifying a draft updated Long-Range Plan in the spring of 2005. There will be an opportunity for public review and comment on the draft Plan. The Board will adopt a final updated Long-Range Plan after public comments are received on the draft plan and the final SEIS is issued.

References in these reports to Sound Transit's existing Long-Range Plan are to the 1996 Regional Transit Long-Range Vision, which functions as the agency's Long-Range Plan. Discussion of the updated Long-Range Plan refers to the Plan being developed by Sound Transit over the coming months.

The following issue papers are being prepared:

East Corridor

E.1 – I-90 Corridor / East King County High Capacity Transit Analysis

North Corridor

N.1 – BRT in SR 99 Corridor

N.2 – I-5 Corridor Northgate to Everett HCT Assessment

N.2.S – I-5 Corridor Northgate to Everett HCT Assessment Supplement—SR 99 to Everett

N.3 – Seattle Streetcar Options

N.4 – SR 522 Corridor HCT Assessment

N.5 – Convertibility of BRT to Light Rail

South Corridor

S.1 – Tacoma Link Integration with Central Link

S.2 – Potential Rail Extensions to Frederickson and Orting

S.3 – HCT System Development Issues in the South Corridor

S.4 – Potential Tacoma Link Extension – West

S.5 – Rail between Burien and Renton

S.6 – Potential Tacoma Link Extension – East

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1. Introduction and Summary

1.1. Purposes of this Paper

Sound Transit's 1996 Long-Range Plan includes potential future light rail from Northgate to Everett following an I-5 alignment. As part of the process of updating the Plan, Sound Transit is assessing such an extension and whether it should remain in the Long-Range Plan. The purpose of this paper is to supplement *Issue Paper N.2: I-5 Corridor Northgate to Everett HCT Assessment*, which focused on the I-5 alignment for light rail from Northgate to Everett. This supplemental paper examines a different alignment from Northgate to Everett generally following the SR 99 corridor (see Figure 1). This paper provides the following information for the purpose of comparison to the I-5 alignment:

- Ridership forecasts and estimated travel times in the corridor, and
- Estimated potential costs for the SR 99 corridor option, highlighting cost differences from the I-5 alignment, in current 2005 dollars.

For the purposes of comparing the two alignments (I-5 corridor vs. SR 99 corridor from Northgate to Everett), the following assumptions were made in the development of the SR 99 alignment:

- The same number of stations was assumed for the SR 99 alignment at roughly the same cross streets as along I-5 (a total of 12 stations), however, the location varies slightly to suit the SR 99 alignment.
- Though total park and ride demand for the SR 99 corridor is roughly the same as for the I-5 corridor, parking requirements at specific locations have not been analyzed. Rather, the parking demand for each station has been allocated on a per mile basis for costing purposes.
- Section lengths for cost comparison remained generally the same.
- The level of light rail transit service and speeds via SR 99 would be similar to those modeled for the I-5 corridor.

1.2. Key Findings

- Construction of rail along the SR 99 corridor from Northgate to Everett is feasible, however building light rail along SR 99 would be more complex than along the I-5 corridor. The SR 99 corridor has the following general constraints:
 - Both sides of the SR 99 corridor are heavily developed, generally with commercial businesses that require frontage access and exposure.
 - The existing road cross section varies from five lanes wide (two lanes in either direction and a center turn lane) at the southern end to seven lanes wide (two general traffic lanes plus a transit lane in both directions and a center turn lane), in sections at the northern end of the corridor. Existing rights-of-way available for light rail are limited especially at the station locations.

- The SR 99 corridor also has a large number of overhead utilities.
- Assuming the same relative station locations and level of service to be provided for the SR 99 alignment as for the I-5 alignment, light rail along SR 99 would carry approximately 3,000 (8%) more riders than for the I-5 corridor near 164th Street in Lynnwood, but about 2,000 (3%) less at 175th Street in Shoreline. A passenger traveling from Everett to downtown Seattle could do so in about 49 minutes.
- This paper assumed that the light rail alignment would be almost entirely elevated rail, following the center of the SR 99 alignment with aerial stations straddling the existing SR 99 arterial road. The total capital cost of providing a light rail service along the SR 99 corridor similar to that assumed for the I-5 corridor is approximately 40% to 45% more. The SR 99 light rail alignment is approximately one mile longer than the I-5 alignment, however the main difference in the alignments resulting in the cost variance between the I-5 corridor and the SR 99 corridor are as follows:
 - The majority of the LRT guideway assumed for the SR 99 corridor is elevated. The I-5 alignment allows for more at-grade facilities.
 - All 12 stations along the SR 99 corridor are elevated. Along the I-5 corridor eight stations are at-grade and four are elevated. Additional rights-of-way are also required on the SR 99 corridor at each station location.
 - A section of bored tunnel, from Northgate Station heading in a northwesterly direction to 125th St on Aurora Ave N, is included in the SR 99 corridor cost which would not occur in the I-5 corridor.
 - Substantial amounts of additional rights-of-way would be required for park and ride facilities on the SR 99 alignment. Further investigation is required into whether these facilities can be provided without adverse impacts on the local road network and to confirm right-of-way requirements. The I-5 alignment utilizes existing park and ride locations therefore no additional rights-of-way are required for park and ride facilities.
 - SR 99 has significant overhead utilities which would require relocation or undergrounding in all areas where the utility crosses the arterial. This issue is not significant in the I-5 freeway corridor.
 - Greater traffic management costs would be incurred along the SR 99 alignment due to the central alignment and existing arterial road conditions.
- Annual light rail operating costs on the SR-99 alignment would be about \$4 million more than along the I-5 alignment.

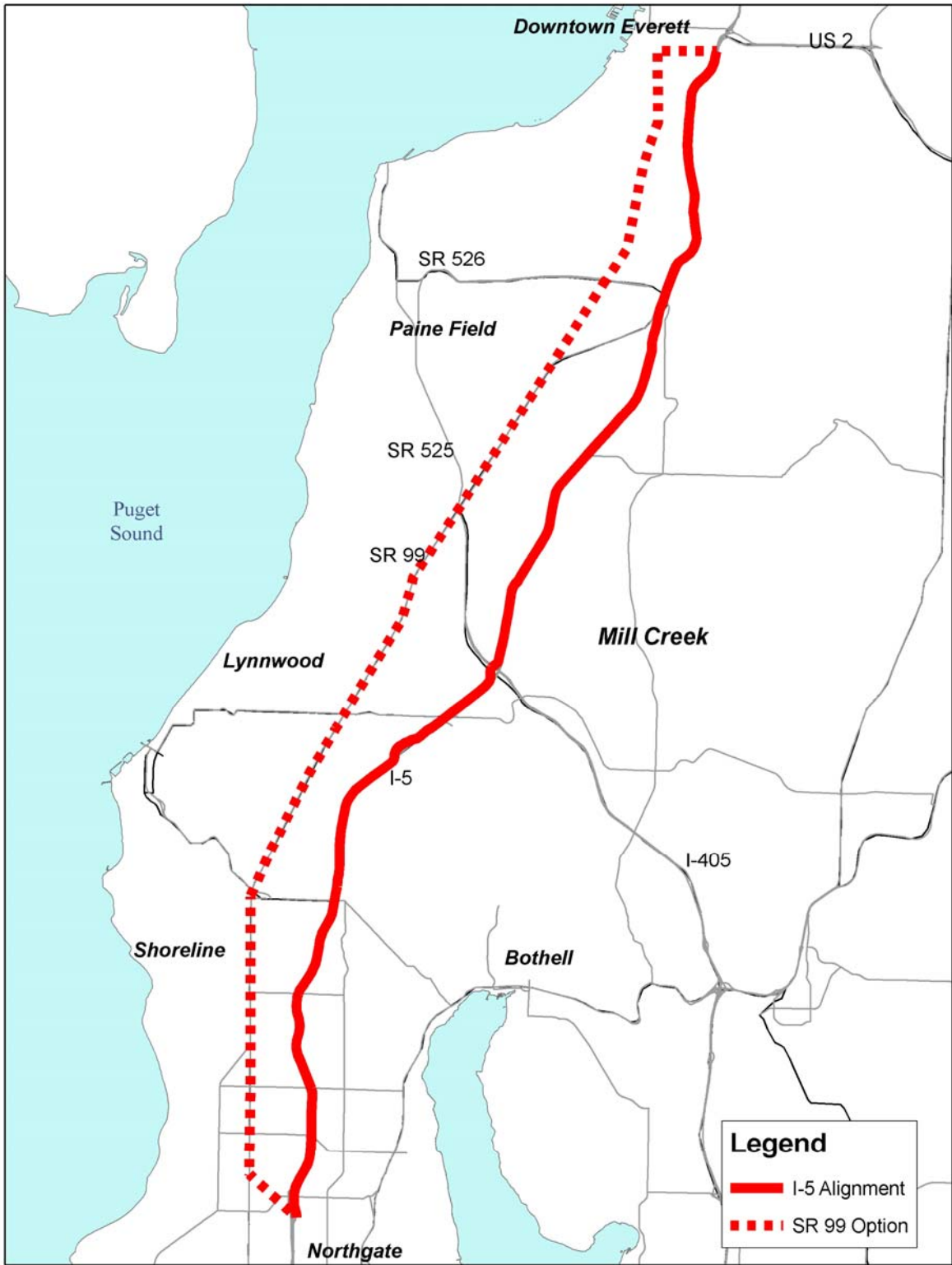


Figure 1. I-5 and SR 99 Northgate to Everett Potential Light Rail Routings

1.2.1. Summary Findings

Table 1 presents a summary of findings for the assessment of light rail routing options between Northgate and Everett.

Table 1. Routing Options Assessment Summary

Issue	Location	I-5 Alignment	SR 99 Option
Travel Time ¹	NA	49 min	49 min
Ridership ²	North of Ash Way At 175th Street	38,000 66,000	41,000 64,000
Guideway Type	NA	At-grade with some aerial	Aerial with some tunnel
Capital Cost	NA	\$3.34 B – \$4.21 B	\$4.69 B – \$6.05 B
O&M Cost	NA	\$90 M	\$94 M

¹ Everett Station to downtown Seattle, an example long distance regional trip in the corridor

² Screenline daily volumes

2. SR 99 Corridor Option

This section presents assessment results for a potential route option that would deviate from the I-5 corridor between Northgate and Everett. The alignment studied, shown in Figure 2, is along SR 99 from Northgate to downtown Everett.

2.1. Assumptions

2.1.2. SR-99 Routing

Fully grade-separated facilities are assumed for the routing option outside of the I-5 corridor, primarily to maintain system speed and reliability and to minimize impacts that at-grade light rail would have on the existing arterial system. To minimize costs, elevated guideways are the first choice, with tunnels only proposed where at-grade or elevated guideways are not feasible.

The SR 99 option investigated in this analysis assumes that light rail would follow the SR 99 corridor between Northgate and Everett. The SR 99 alignment would leave Northgate Station, departing I-5 north of Northgate and head in a northwesterly direction to SR 99 south of N. 130th St. The alignment would then follow SR 99 to Evergreen Way, then north on Evergreen Way and Rucker Street to the intersection of Hewitt Street in downtown Everett. At Hewitt Street, the alignment would head east along Hewitt Street. It is proposed that the alignment will terminate at the existing Everett Station.

There are several possible alignments to the Everett Station from the eastern end of Hewitt Street. For the costing purposes, elevated guideway has been assumed from

Hewitt Street to the existing Everett Station. Further refinement of the alignment could result in an at-grade alignment to the Everett Station.

For this analysis, stations are assumed in similar locations on SR 99 corresponding to the station locations assumed for the I-5 corridor alignment as discussed in *Issue Paper N.2: I-5 Corridor Northgate to Everett HCT Assessment*. Figure 2 provides a comparison of the station locations between the I-5 and SR 99 corridors.

2.1.3. Service Levels

At its highest level, rail service could operate in each direction every 2.5 minutes during the peak periods and every 3.75 minutes during off-peak periods. However, forecast 2030 demand suggests that less service frequency would be needed at various points along the line at different times of day. The bi-directional operating frequencies in 2030 presumed for this analysis are shown in Table 2.

Table 2. Assumed Operating Frequencies

Segment	Peak Periods	Off-Peak Period
Everett – Ash Way (164 th St. S.W.)	4.6 minutes	7.5 minutes
Ash Way – Northgate	2.4 minutes	7.5 minutes
Northgate – Seattle CBD	2.4 minutes	3.75 minutes

2.1.4. Market Focus

For the purpose of comparison between the I-5 corridor alignment and the SR 99 alignment, it was assumed that, as for the I-5 alignment, routing light rail along SR 99 would serve current long-distance park and ride-based commuting patterns, as well as shorter distance station-to-station travel needs.

Many of the stations along the I-5 alignment are presumed to have significant park and ride capacity, similar to today, as well as connecting local transit services. Park and ride stations assumed for the I-5 alignment are also assumed in the SR 99 corridor. Additional rights-of-way would be required for park and ride lots at most stations along SR 99. Further investigation is required into whether these facilities on SR 99 can be provided without major adverse impacts on the local road network and to confirm right-of-way requirements.

Because light rail in exclusive rights-of-way would generally provide quicker and more reliable service in 2030 than buses operating in the HOV system along I-5, the SR 99 light rail alignment has been assumed to replace Sound Transit’s regional express buses in the I-5 corridor, as well as many of today’s point-to-point, park and ride-based commuter express bus services.

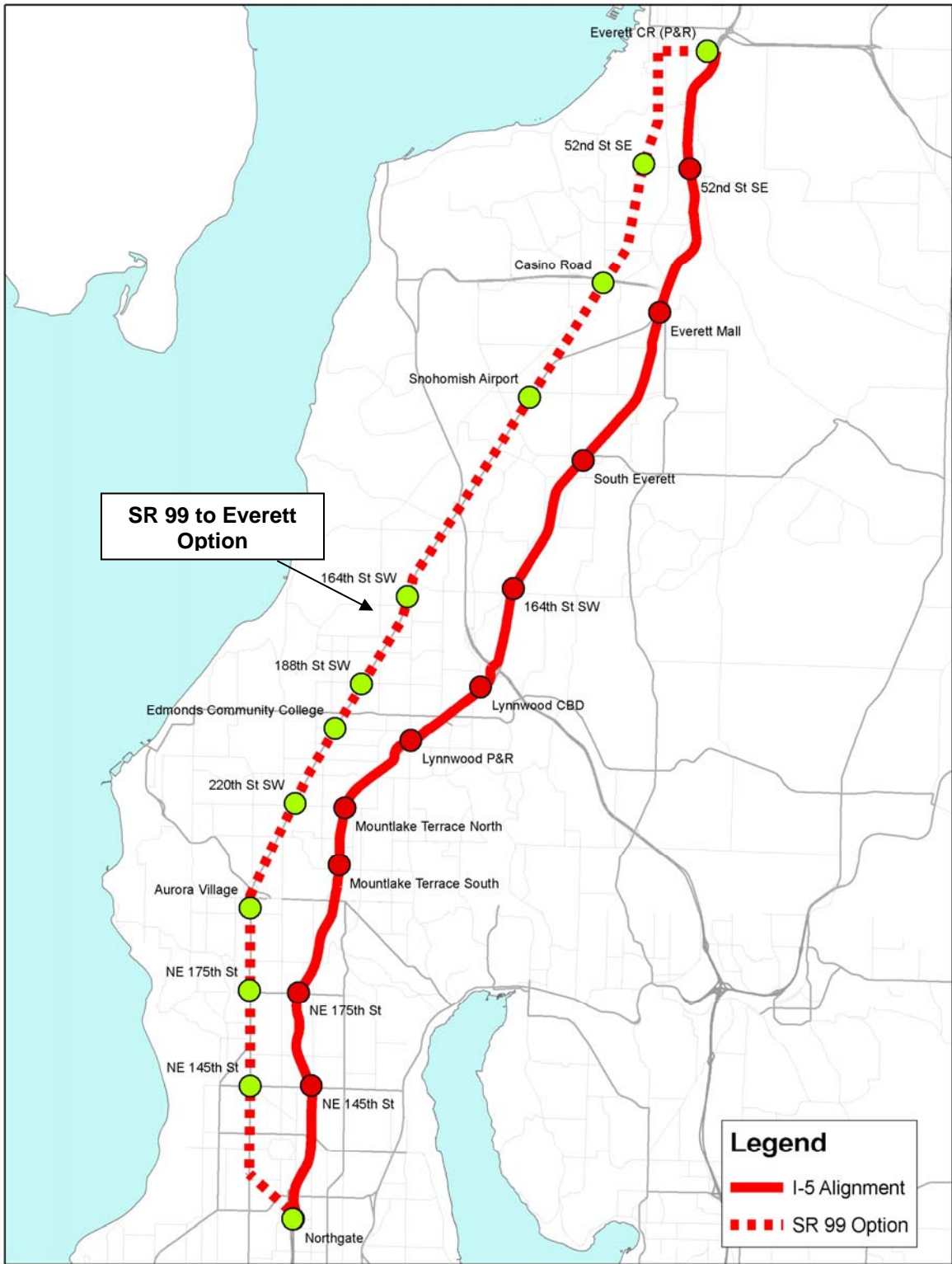


Figure 2. Light Rail Routing Options and Assumed Station Locations

2.2. Travel Times

Table 3 presents the estimated light rail travel times for the I-5 alignment and SR 99 route option between downtown Seattle and three locations along the I-5 corridor. These examples are meant to illustrate typical long-distance trips along the corridor, and are not intended to imply more importance than other trips that might be made via light rail.

Table 3. Change in Estimated Travel Times to Downtown Seattle

Starting Location	I-5 Alignment	SR 99 Option
Everett Station	49 minutes	49 minutes
Lynnwood Park & Ride	29 minutes	31 minutes
Shoreline (N.E. 175 th Street)	21 minutes	23 minutes

2.3. Ridership

Table 4 presents the estimated 2030 daily ridership volumes for the I-5 alignment and the SR 99 route option at three locations along the I-5 corridor. Ridership forecasts are based on the highest potential service frequencies.

Table 4. 2030 Screenline Daily Ridership – Route Options

Screenline Location	Daily Ridership Volume		Difference
	I-5 Alignment	SR 99 Option	
North of Ash Way P&R (164 th St. S.W.)	38,000	41,000	3,000
South of Lynnwood Park & Ride	50,000	49,000	(1,000)
Shoreline (N.E. 175 th Street)	66,000	64,000	(2,000)

3. Estimated Costs

3.1. Capital

3.1.5. Purpose and Scope

Conceptual capital cost estimates were developed for a light rail line from Northgate to Everett along the I-5 corridor and the SR 99 routing option. The cost estimates were developed using quantifiable construction items, to capture and sufficiently represent the total capital cost.

3.1.6. Limitations

The gross generalizations used to develop these order of magnitude comparative cost estimates do not allow sufficient accuracy to develop specific project budgets. These cost estimates were solely intended to permit relative comparisons among the studied scenarios. The estimated capital costs have been provided as a range between -5% to +30% of the developed estimate.

3.1.7. Inclusions

The capital cost estimates attempt to capture the full project costs of implementing light rail. These costs include:

- Infrastructure, including guideways, stations, parking, systems, traffic control, stormwater management, and roadway modifications;
- Traffic maintenance during construction;
- Environmental mitigation;
- Agency costs including design and environmental review, construction engineering, and administration;
- Right-of-way acquisition and easements including administrative and legal costs;
- Vehicles and maintenance yard.

3.1.8. Methodology

The general methodology used for this report is similar to the *I-90 Corridor / East King County High Capacity Transit Analysis* cost estimate. Many of the unit prices adopted were based on unit prices developed for that report and for WSDOT's *Trans-Lake Washington HCT Capital Cost Methodology* report.

Roadway costs not included in items noted above were determined by identifying standard WSDOT items and the typical costs for those items.

All costs were adjusted to 2005 dollars.

3.1.9. Non-Quantified Items

Special traffic control and environmental mitigation costs were difficult to quantify due to the conceptual nature of the design. Allowances for these items were accomplished by assigning a percentage ranging between 10% and 15% of the total cost of the select construction items.

Environmental mitigation was assumed to be 15% of the total construction cost.

3.1.10. Design and Construction Contingency

Depending on the type of facility, design contingencies ranging from 15% to 35% were applied to account for the conceptual nature of the design. A construction contingency of 10% for above ground construction was applied to account for unforeseen conditions arising during construction.

3.1.11. Agency Costs

Agency costs to deliver the transit project include design engineering, environmental review, permitting, agency management and administration, construction management, design support during construction, and third-party construction assistance. 35% of all construction cost (extended cost plus design and construction contingencies) was used to approximate agency costs.

3.1.12. Right-of-Way

Unit prices for right-of-way acquisition were obtained from the *Trans-Lake Washington HCT Capital Cost Methodology* report. The unit prices include relocation costs, administrative costs, and contingency equivalent to 100 percent of the purchase value. The report categorized right-of-way acquisition unit prices as suburban takes (when compared to the East corridor which has both Urban and Suburban). The suburban unit prices applied to all other areas including commercial, industrial, and retail takes as this corridor is outside of the urban core.

3.1.13. Inflation

All construction cost regardless of their sources, were adjusted to 2005 dollars using the average inflation rate based on:

- Seattle's Building Cost Index (BCI);
- Seattle's Construction Cost Index (CCI);

Right-of-way prices developed by the Trans-Lake Washington Project for HCT capital costs were adjusted from 2001 dollars to 2005 dollars by using an inflation rate of 7% per year, provided by ST.

3.1.14. Capital Cost Estimates

Cost estimates are presented by segment in Table 5 and Table 6 and in Figure 3.

Table 5. Cost Estimate Range for Light Rail from Northgate to Downtown Everett (I-5 Alignment)

Segment	Cost Estimate Range		
Construction			
Northgate to Mountlake Terrace	\$600 M	to	\$820 M
Mountlake Terrace to Lynnwood P&R	\$320 M	to	\$430 M
Lynnwood P&R to Ash Way P&R (164 th St. S.W.)	\$400 M	to	\$550 M
Ash Way P&R to SR 526	\$580 M	to	\$790 M
SR 526 to Downtown Everett	\$490 M	to	\$670 M
<i>Total Construction</i>	<i>\$2,390 M</i>	to	<i>\$3,260 M</i>
Vehicles & Maintenance Facility	\$950 M	to	\$950 M
Total Cost Estimate	\$3,340 M	to	\$4,210 M

Table 6. Cost Estimate Range for Light Rail from Northgate to Downtown Everett (SR 99 to Everett Option)

Segment	Cost Estimate Range			Change from I-5 Alignment		
Construction						
Northgate to Mountlake Terrace (220 th on SR 99)	\$1000 M	to	\$1,370 M	\$400 M	to	\$550 M
Mountlake Terrace to Lynnwood P&R (196 th SW on SR 99)	\$550 M	to	\$760 M	\$230 M	to	\$330 M
Lynnwood P&R to Ash Way P&R (164 th St SW on SR 99)	\$410 M	to	\$560 M	\$10 M	to	\$10 M
Ash Way P&R to SR 526 (Casino Rd on SR 99)	\$860 M	to	\$1,180 M	\$280 M	to	\$390 M
SR 526 to Downtown Everett	\$860 M	to	\$1,170 M	\$370 M	to	\$500 M
<i>Total Construction</i>	<i>\$3,680 M</i>	to	<i>\$5,040 M</i>	<i>\$1,290 M</i>	to	<i>\$1,780 M</i>
Vehicles & Maintenance	\$1,010 M	to	\$1,010 M	\$60 M	to	\$60 M
Total Cost Estimate	\$4,690 M	to	\$6,050 M	\$1,350 M	to	\$1,840 M

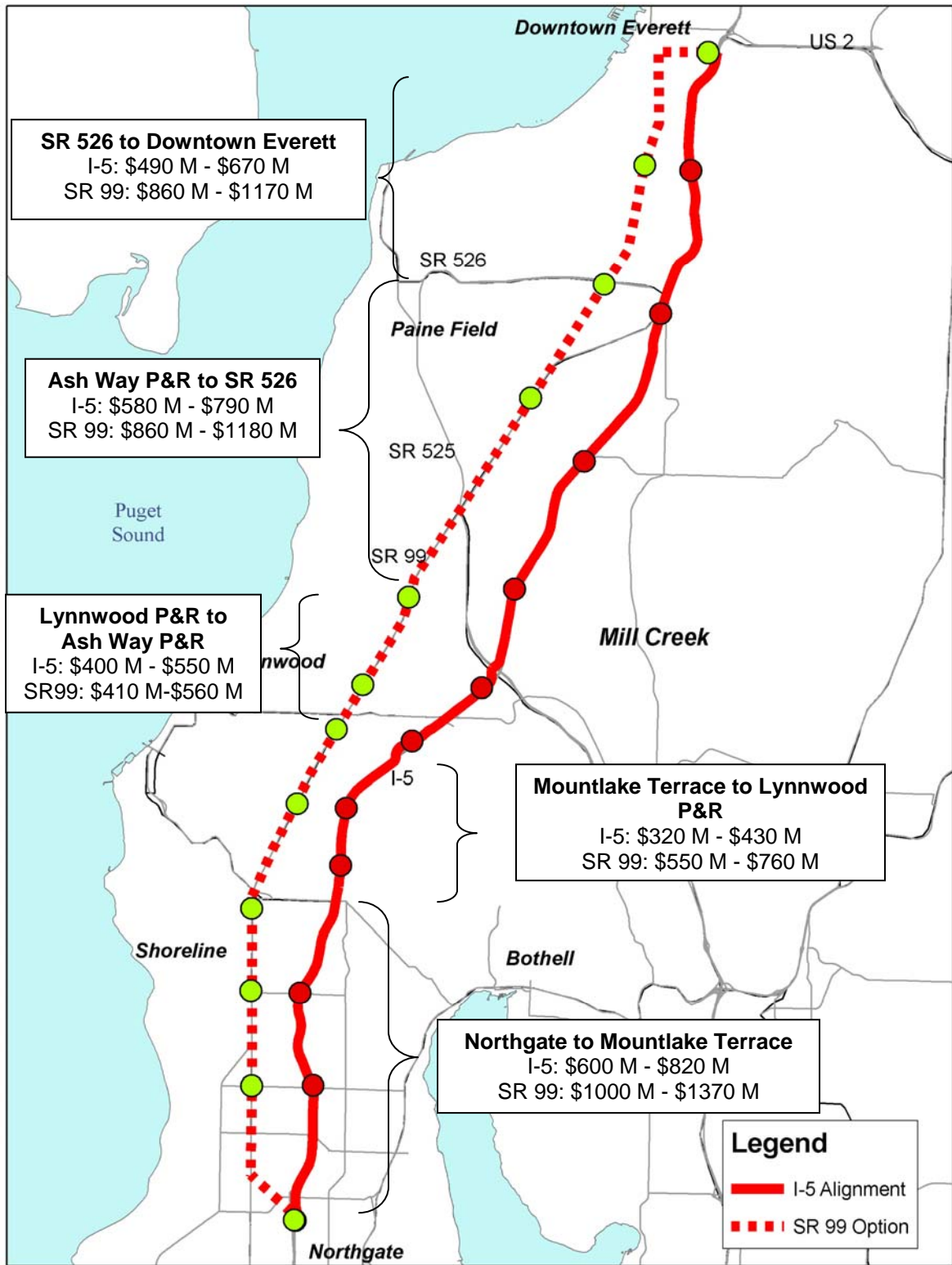


Figure 3. Capital Cost Estimate by Segment

3.2. Operations and Maintenance

Light rail in this corridor, regardless of any possible route deviations, would use the support facilities (maintenance base, command and control center, etc.) currently planned for Central Link until, and if such time arises, that new facilities are required. However, to encompass the full range of potential costs that extending light rail to Everett might entail, this analysis assumes that new operations and maintenance capacity beyond that available at the Central Link facility will be necessary, and is therefore included in the cost estimates.

Annual costs for operations and maintenance were estimated using the following assumptions:

- LRT train size: Three vehicles during peak periods, Two vehicles during off-peak periods
- LRT cost = \$86.88 X annual train revenue hours + \$8.21 x annual vehicle revenue miles

Table 7 presents the estimated annual costs for operations and maintenance for the two potential alignments.

Table 7. Estimated Light Rail Operations and Maintenance Costs

	I-5 Alignment	SR 99 Option
O&M Cost	\$90 million	\$94 million