



**SOUND TRANSIT**  
**HCT Planning**

**Sound Transit Long-Range Plan Update**

**Issue Paper N.2: I-5 Corridor Northgate to Everett  
HCT Assessment**

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Sound Transit

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**FINAL**

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## 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.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 current Long-Range Plan includes potential future light rail from Northgate to Everett generally along the I-5 corridor as an extension of the Central Link north-south light rail line now under construction. As part of the process of updating the Plan, Sound Transit seeks to reaffirm the feasibility of such an extension and whether it should remain in the Plan. To help answer those questions, this paper provides information regarding potential future extensions in the following areas:

- Providing ridership forecasts and estimated travel times in the corridor, and
- Discussing cost differences among potential alignments along the corridor in current 2005 dollars

This assessment is not considered to be project-level planning, but rather preliminary assessment of some of the routing options for going north from Northgate with light rail. All travel times, ridership forecasts, and estimated costs are for light rail only.

The potential rail routes studied for this paper are shown in Figure 1. The Long-Range Plan Alternative alignment follows the I-5 rights-of-way as much as possible. Three optional alignments were identified during scoping for Sound Transit's Draft Supplemental Environmental Impact Statement for its Long-Range Plan. They are examined here and include deviating out of the I-5 rights-of-way to serve SR-99 or 15<sup>th</sup> Avenue NE in Shoreline, and to serve the Paine Field area and Evergreen Way in Everett.

## 1.2 Key Findings

- Construction of rail on the I-5 corridor from Northgate to Everett is feasible.
- Light rail along I-5 would carry a substantial number of riders, but at substantial cost. This route would carry up to 38,000 daily riders near Ash Way and up to 66,000 daily riders near 175<sup>th</sup> Street in Shoreline. A rider traveling from Everett to downtown Seattle could do so in about 49 minutes. Within the I-5 alignment, the line could be built as a mix of surface and elevated rail entirely within exclusive rights-of-way. The capital cost of this alignment would range from \$3.3 to \$4.2 billion.
- Building light rail in the I-5 alignment may be more difficult than originally envisioned. Road expansion since 1996 has used some highway rights of way, and plans for further expansion will use even more. This will continue to be an issue in the period leading up to rail construction of any alignment along public road rights of way.
- Compared to the Long Range Plan Alternative, routing light rail via Paine Field adds riders along some parts of the line, but also adds cost. The deviation would add about 10 minutes to trips between Everett and downtown Seattle, and could cost up to \$760 million more than the Long Range Plan route, primarily because it would be almost entirely grade-separated.

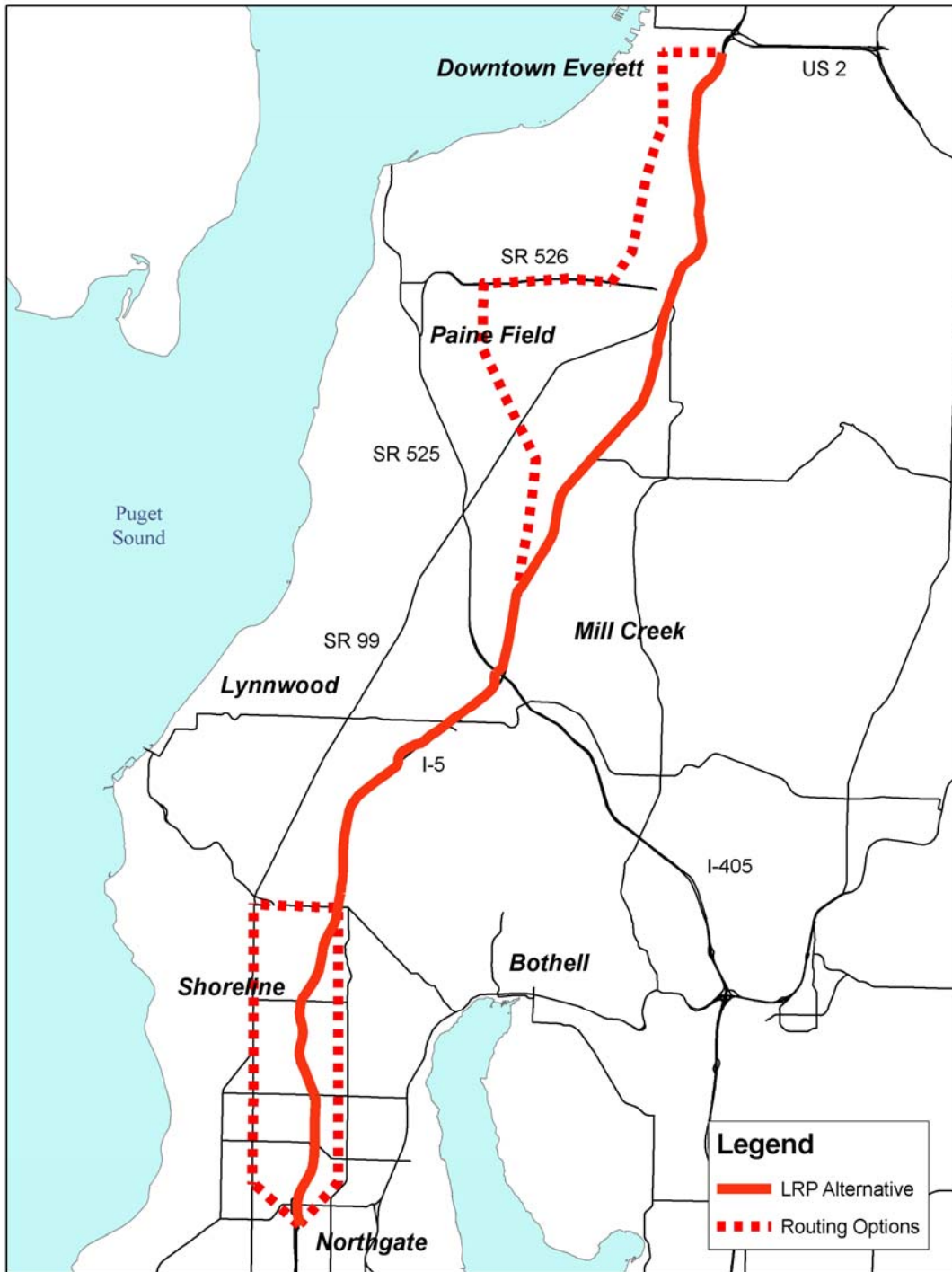


Figure 1. I-5 Northgate to Everett Potential Light Rail Routings

- Compared to the Long Range Plan Alternative, routing light rail via either SR-99 or 15<sup>th</sup> Avenue NE through Shoreline slightly increases ridership in some places, and slightly decreases it in others, but adds costs. These deviations could also add one to four minutes additional travel time between Everett and downtown Seattle, and \$200 - \$760 million in capital costs, again primarily because they would be almost entirely grade-separated.
- Depending on specific alignment, annual light rail operating costs between Northgate and Everett would range between \$90 and \$116 million.
- Different routes would serve different ridership markets, and would require different approaches to integrating with other transit services. The Long-Range Plan Alternative route would provide fast, direct trips up and down I-5. It would be supported by park and ride lots at many of the stations, and would serve current commuting patterns between King and Snohomish counties well, replacing ST Express services many current commuter bus routes. The optional alignments would rely more heavily on walk access in activity centers surrounding the stations rather than park and rides. Many bus services designed to serve current commuting patterns along I-5 would likely continue to operate as today in mixed HOV traffic along I-5.

### 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	LRP Alternative	Paine Field	SR 99	15 <sup>th</sup> Ave NE
Travel Time <sup>1</sup>	49 min	+10 min	+1 min	+4 min
Ridership <sup>2</sup>	38,000	+6,000	+500	+100
Guideway Type	At-grade with some aerial	Aerial	Aerial with some tunnel	Aerial
Capital Cost	\$3.3 B – \$4.2 B	+\$630 M – +\$760 M	+\$590 M – +\$760 M	+\$150 M – +\$200 M
O&M Cost	\$90 M	+\$18 M	+\$8 M	+\$1 M

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

<sup>2</sup> Screenline daily volume measured south of Ash Way P&R

## 2. Long-Range Plan Alternative

### 2.1 Assumptions

#### 2.1.1 Routing

The Long-Range Plan Alternative routing assumes that light rail would be built along the I-5 corridor between Northgate and Everett Station in downtown Everett, generally within the I-5 rights-of-way. The alignment would be in exclusive right-of-way in an at-grade configuration adjacent to the existing right-of-way line on the east or west sides of I-5, or in the median of the freeway. Because of the existing sloping terrain between the roadway and the ROW lines, these at-grade sections would be retained cut or fill sections built along the slopes. However, there are many instances where there is not sufficient space between the roadway and the right-of-way lines to accommodate an at-grade guideway. In these sections, the guideway would need to be grade-separated. Grade separation would also be required where the alignment crosses ramps accessing and exiting I-5, or where rail crosses from one side of I-5 to the center median or opposite side. Grade separation can be accomplished by incorporating elevated or tunnel structures.

For this analysis, stations are assumed at Northgate, NE 145<sup>th</sup> Street, NE 175<sup>th</sup> Street, 236<sup>th</sup> Street SW, 220<sup>th</sup> Street SW, Lynnwood Transit Center, Lynnwood CBD, 164<sup>th</sup> Street SW, 128<sup>th</sup> Street SW, Everett Mall, 41<sup>st</sup> Street SE and Everett Station.

#### 2.1.2 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**

<b>Segment</b>	<b>Peak Periods</b>	<b>Off Peak Periods</b>
Everett – Ash Way	4.6 minutes	7.5 minutes
Ash Way – Northgate	2.4 minutes	7.5 minutes
Northgate – Seattle CBD	2.4 minutes	3.75 minutes

#### 2.1.3 Market Focus

Routing light rail along I-5 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 this alignment are presumed to have significant park and ride capacity, similar to today, as well as connecting local transit services. 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, it would replace Sound Transit's

regional express buses in the corridor, as well as many of today’s point-to-point, park and ride-based commuter express bus services.

## **2.2 Travel Times**

Table 3 presents estimated travel times via light rail 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. 2030 Estimated Travel Times to Downtown Seattle – I-5 Routing**

<b>Starting Location</b>	<b>Travel Time, min</b>
Everett Station	49
Lynnwood Transit Center	29
Shoreline (175 <sup>th</sup> Street)	21

## **2.3 Ridership Forecast**

Table 4 presents daily ridership volumes expected in 2030 at three locations along the I-5 corridor. These forecasts are based on the highest level of service that could be provided along the corridor, but do not vary significantly even with the lower operating frequencies assumed to be provided in 2030. This is largely because even at lower frequencies, most competing bus services are assumed to be replaced, making light rail the primary way to complete transit trips along the I-5 corridor.

**Table 4. 2030 Screenline Ridership – I-5 Routing**

<b>Screenline Location</b>	<b>Daily Ridership Volume</b>
South of Ash Way P&R	38,000
South of Lynnwood Transit Center	50,000
South of Shoreline (175 <sup>th</sup> Street)	66,000

### **3. Routing Options**

This section presents assessment results for three potential route options that would deviate off of the I-5 corridor between Northgate and Everett. The three alternative alignments studied, shown in Figure 2, are:

- Paine Field (Ash Way P&R to Everett Station)
- SR 99 (Northgate to Mountlake Terrace)
- 15<sup>th</sup> Ave NE (Northgate to Mountlake Terrace)

#### ***3.1 Assumptions***

##### **3.1.1 Routings**

Fully grade-separated facilities are assumed for the routing options 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.

##### ***Paine Field***

The Paine Field alignment would depart I-5 at the 164th Street SW station, head in a northwesterly direction to Airport Road, and then follow Airport Road to Paine Field. From Paine Field, the alignment would head east along SR 526 to Evergreen Way, where it would turn north and follow Evergreen Way to downtown Everett, then turn east to Everett Station. Stations along this deviation are assumed at Airport Rd./SR-99, Paine Field, Boeing, Casino Rd./SR-526, Evergreen Way/41<sup>st</sup> Street SW, and downtown Everett.

##### ***SR 99***

The SR 99 alignment would leave Northgate station following I-5, depart I-5 north of Northgate and head in a northwesterly direction to SR 99 south of N 130<sup>th</sup> Street. The alignment would then follow SR 99 to Aurora Village. At Aurora Village, the alignment would head east along SR 104 to I-5, and then turn north and follow I-5 to the station at 236<sup>th</sup> Street SW. Stations along this deviation are assumed at NE 145<sup>th</sup> Street, NE 175<sup>th</sup> Street, and Aurora Village Transit Center.

##### ***15<sup>th</sup> Ave NE***

The 15<sup>th</sup> Ave NE alignment would leave Northgate station following I-5, depart I-5 at approximately N 125<sup>th</sup> Street, head east to 15<sup>th</sup> Ave NE, then head north on 15<sup>th</sup> Ave NE to Mountlake Terrace, where it intersects with Ballinger Way and I-5, then turn west to I-5, following I-5 to the 236<sup>th</sup> Street SW station. Stations along this deviation are assumed at NE 145<sup>th</sup> Street and NE 175<sup>th</sup> Street.

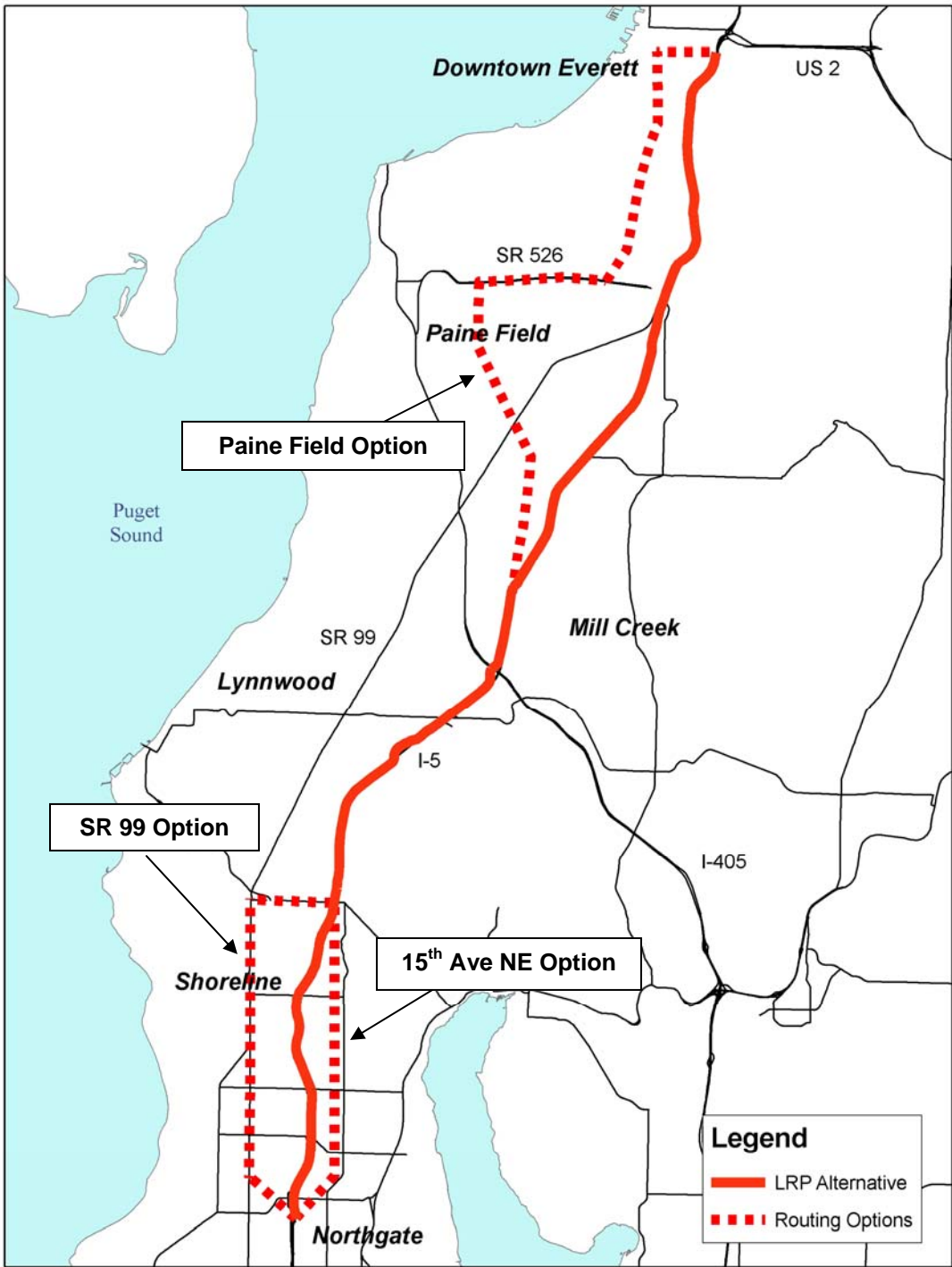


Figure 2. Light Rail Routing Options

### 3.1.2 Service Levels

Assumed service levels for all of the routing options are the same as for the Long Range Plan Alternative.

### 3.1.3 Market Focus

All of these possible route deviations are intended to serve markets different than those served by a continuous I-5 alignment. This analysis assumes that new park and ride capacity would generally not be available along these deviations, and that access to the rail system would rely more heavily on connecting transit services, walking and biking in existing and developing activity centers along the line. Commuters who do not rely on park and ride access along these routes would be served well, but bus commuters using park and rides along I-5 would likely continue to do so as long as bus services provide competitive travel times and reliability for longer-distance commutes. Some Sound Transit regional express bus service and more point-to-point park and ride-based commuter express bus services would likely remain in the system, relying on the freeway HOV and park and ride system.

## 3.2 Travel Times

Table 5 presents the estimated change in light rail travel times from the Long-Range Plan Alternative for the three route options 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 5. Change in Estimated Travel Times to Downtown Seattle**

Starting Location	Change in Travel Time, min		
	Paine Field	SR 99	15 <sup>th</sup> Ave NE
Everett Station	+10	+1	+4
Lynnwood Transit Center	0	+1	+4
Shoreline (175 <sup>th</sup> Street)	0	+1	+1

### **3.3 Ridership**

Table 6 presents the estimated 2030 daily ridership volumes for the Long Range Plan Alternative and the three route options at three locations along the I-5 corridor forecast based on the highest potential service frequencies. Differences reflect varying travel times and rider market access as discussed in Section 3.1.3.

**Table 6. 2030 Screenline Daily Ridership – Route Options**

<b>Screenline Location</b>	<b>Change in Daily Ridership Volume</b>			
	<b>LRP</b>	<b>Paine Field</b>	<b>SR 99</b>	<b>15<sup>th</sup> Ave</b>
South of Ash Way P&R	38,000	44,000	39,000	39,000
South of Lynnwood Transit Center	50,000	49,000	49,000	47,000
South of Shoreline (175 <sup>th</sup> Street)	66,000	66,000	65,000	65,000

## 4. Estimated Costs

### 4.1 Capital

#### 4.1.1 Purpose and Scope

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

#### 4.1.2 Limitations

The gross generalizations used to develop these 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.

#### 4.1.3 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 (e.g., noise abatement, hazardous material disposal and wetlands replacements);
- Agency costs including design and environmental documentation, construction engineering, and administration;
- Right-of-way acquisition and underground easements including administrative and legal costs;
- Vehicles and maintenance yard.

#### 4.1.4 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.**

#### **4.1.5 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 5% and 20% of the total cost of the select construction items.

Environmental mitigation (e.g., wetland mitigation, noise abatement, and hazardous waste disposal) was assumed to be 15% of the total construction cost.

#### **4.1.6 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.

#### **4.1.7 Agency Costs**

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

#### **4.1.8 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.

#### **4.1.9 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.

## 4.1.10 Capital Cost Estimates

Cost estimates are presented by segment in Tables 7 through 10 and in Figure 3.

**Table 7. Cost Estimate Range for Light Rail from Northgate to Downtown Everett  
Long-Range Plan Alternative (I-5 Alignment)**

Segment	Cost Estimate Range	
<b>Construction</b>		
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	\$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>	<i>to \$3,260 M</i>
<b>Vehicles &amp; Maintenance Facility</b>	\$950 M	to \$950 M
<b>Total Cost Estimate</b>	<b>\$3,340 M</b>	<b>to \$4,210 M</b>

**Table 8. Cost Estimate Range for Light Rail from Northgate to Downtown Everett  
Paine Field Route Options**

Segment	Cost Estimate Range		Change from LRP	
<b>Construction</b>				
Northgate to Mountlake Terrace	\$600 M	to \$820 M	\$0 M	to \$0 M
Mountlake Terrace to Lynnwood P&R	\$320 M	to \$430 M	\$0 M	to \$0 M
Lynnwood P&R to Ash Way P&R	\$400 M	to \$550 M	\$0 M	to \$0 M
Ash Way P&R to SR 526	\$720 M	to \$990 M	\$140 M	to \$200 M
SR 526 to Downtown Everett	\$680 M	to \$930 M	\$190 M	to \$260 M
<i>Total Construction</i>	<i>\$2,720 M</i>	<i>to \$3,720 M</i>	<i>\$330 M</i>	<i>to \$460 M</i>
<b>Vehicles &amp; Maintenance Facility</b>	\$1,250 M	to \$1,250 M	\$300 M	to \$300 M
<b>Total Cost Estimate</b>	<b>\$3,970 M</b>	<b>to \$4,970 M</b>	<b>\$630 M</b>	<b>to \$760 M</b>

**Table 9. Cost Estimate Range for Light Rail from Northgate to Downtown Everett  
SR 99 Route Option**

Segment	Cost Estimate Range		Change from LRP	
<b>Construction</b>				
Northgate to Mountlake Terrace	\$1,060 M	to \$1,450 M	\$460 M	to \$630 M
Mountlake Terrace to Lynnwood P&R	\$320 M	to \$430 M	\$0 M	to \$0 M
Lynnwood P&R to Ash Way P&R	\$400 M	to \$550 M	\$0 M	to \$0 M
Ash Way P&R to SR 526	\$580 M	to \$790 M	\$0 M	to \$0 M
SR 526 to Downtown Everett	\$490 M	to \$670 M	\$0 M	to \$0 M
<i>Total Construction</i>	<i>\$2,850 M</i>	<i>to \$3,890 M</i>	<i>\$460 M</i>	<i>to \$630 M</i>
<b>Vehicles &amp; Maintenance Facility</b>	\$1,080 M	to \$1,080 M	\$130 M	to \$130 M
<b>Total Cost Estimate</b>	<b>\$3,930 M</b>	<b>to \$4,970 M</b>	<b>\$590 M</b>	<b>to \$760 M</b>

**Table 10. Cost Estimate Range for Light Rail from Northgate to Downtown Everett  
15<sup>th</sup> Ave NE Route Option**

<b>Segment</b>	<b>Cost Estimate Range</b>		<b>Change from LRP</b>	
<b>Construction</b>				
Northgate to Mountlake Terrace	\$730 M	to \$1,000 M	\$130 M	to \$180 M
Mountlake Terrace to Lynnwood P&R	\$320 M	to \$430 M	\$0 M	to \$0 M
Lynnwood P&R to Ash Way P&R	\$400 M	to \$550 M	\$0 M	to \$0 M
Ash Way P&R to SR 526	\$580 M	to \$790 M	\$0 M	to \$0 M
SR 526 to Downtown Everett	\$490 M	to \$670 M	\$0 M	to \$0 M
<i>Total Construction</i>	<i>\$2,520 M</i>	<i>to \$3,440 M</i>	<i>\$130 M</i>	<i>to \$180 M</i>
<b>Vehicles &amp; Maintenance Facility</b>	\$970 M	to \$970 M	\$20 M	to \$20 M
<b>Total Cost Estimate</b>	<b>\$3,490 M</b>	<b>to \$4,410 M</b>	<b>\$150 M</b>	<b>to \$200 M</b>

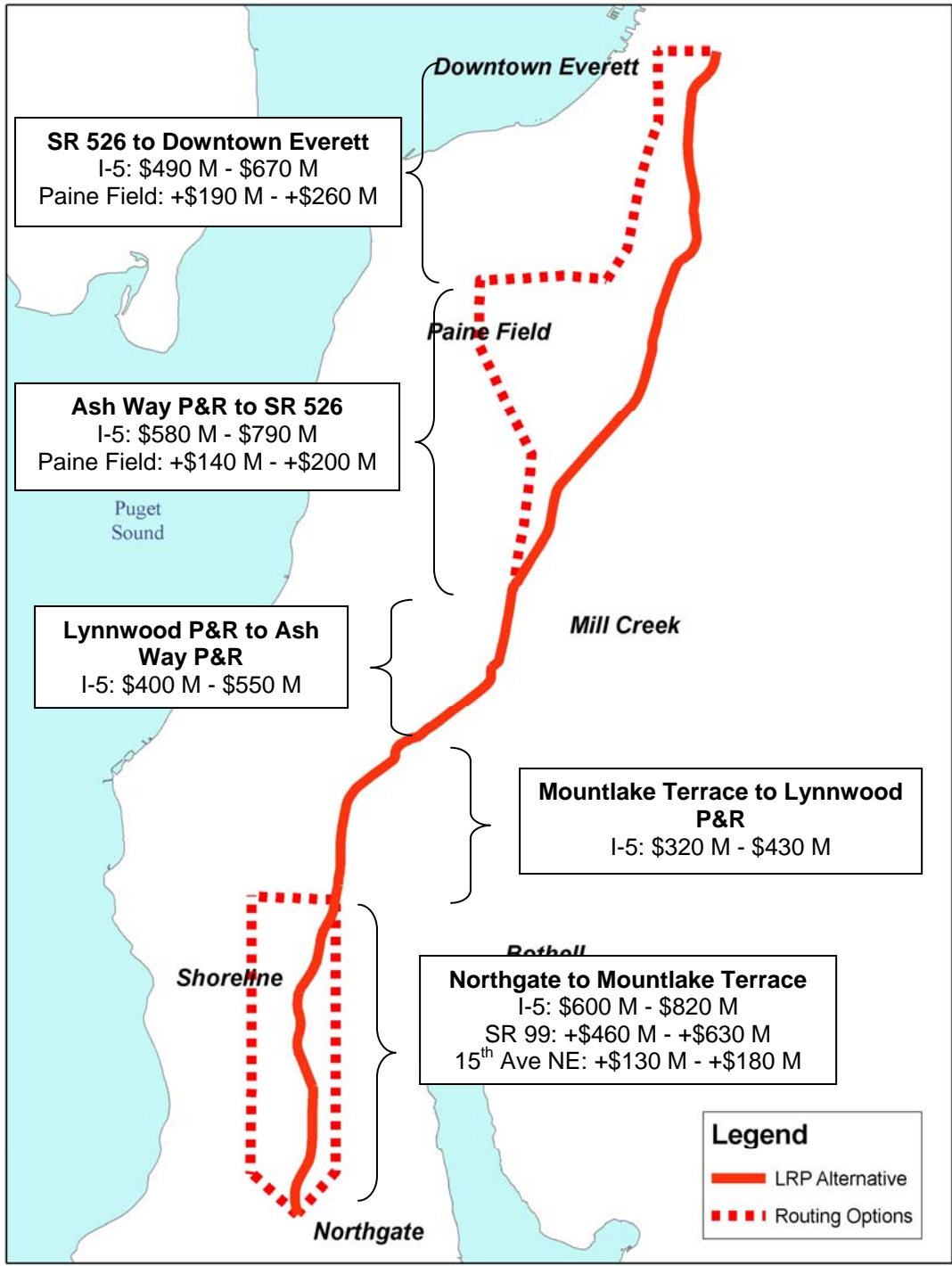


Figure 3. Capital Cost Estimate by Segment

## 4.2 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: 3 vehicles during peak periods, 2 vehicles during off-peak periods
- LRT cost = \$86.88 X annual train revenue hours + \$8.21 x annual vehicle revenue miles

Table 11 presents the estimated annual costs for operations and maintenance for the potential alternative alignments.

**Table 11. Estimated Light Rail Operations and Maintenance Costs**

	<b>LRP</b>	<b>Paine Field</b>	<b>SR 99</b>	<b>15<sup>th</sup> Ave NE</b>
O&M Cost	\$90 million	+\$18 million	+\$8 million	+\$1 million