Sound Transit 2 Planning

BNSF Eastside Corridor Commuter Rail Feasibility Study

Phase II Technical Memorandum: Feasibility Study

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FINAL

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Executive Summary

Background
In 2008, the state legislature passed Substitute House Bill 3224, directing Sound Transit and the Puget Sound Regional Council (PSRC) to complete a feasibility study to “determine whether commuter rail service between eastern Snohomish county and eastern King county … can be a meaningful component of the region’s future transportation system” and develop a cost estimate for commuter rail and a concurrent bicycle/pedestrian trail.

The Eastside BNSF corridor extends 34 miles from north Renton, through Bellevue and Woodinville, and on to Snohomish. The corridor also includes a 7-mile spur from Woodinville to Redmond. It is extensively single-tracked, with mostly 100-foot wide right-of-way and includes 24 bridge crossings, 97 curves and 107 at-grade crossings. The railbed area is level but the adjacent right-of-way on either side of the track is often sloped. In some areas, it appears the right of way has been encroached upon by adjacent uses or portions have been sold. The map locates the corridor in relation to other rail lines and trails in the region.

Future use of the corridor has been the topic of discussion among various groups in the region for several years. Burlington Northern Santa Fe (BNSF) is in the process of abandoning the corridor and the Port of Seattle has committed to acquiring it through the federal rail-banking process. Once acquired, King County intends to purchase an easement within the corridor from the Port for a bicycle and pedestrian trail. Potential future uses of the corridor, or certain segments, may include commuter/passenger rail, excursion trains, short haul freight service, and a regional trail. The Port anticipates closing on the acquisition in the first quarter of 2009.
The feasibility study builds on previous studies of commuter/passenger rail on the corridor and augments that base of information by estimating potential future ridership in the corridor, identifying potential station locations, reviewing the suitability of the existing tracks for commuter/passenger rail, estimating the effect commuter/passenger rail service might have on freight rail and tourism in the region, developing cost estimates for commuter/passenger rail and a concurrent parallel bike/pedestrian trail, and identifying the most beneficial and cost-effective segments.

The analysis was guided by the following general assumptions, derived from information about the condition of the rail infrastructure in the corridor and the potential safety issues for commuter/passenger rail operation:

- Upgrades were identified and costs were estimated at permanent commuter/passenger rail infrastructure standards including full replacement of the track, ties and railbed (a demonstration project and/or a project implemented by private entities could be accomplished differently with potentially lower costs).
- Service could be provided with either Sounder-style vehicles (locomotives and bi-level coaches) or diesel multiple units (DMUs)
- Complete signal/communication for train detection and control, centralized train control would be provided
- All public and private grade crossings would be upgraded
- No new grade-separated crossings were included
- No evaluation has been made of the condition of existing bridges
- One small new yard and shops facility, likely located somewhere along the line north of downtown Bellevue
- Average speed, including stops = 24 mph along corridor
- Two-way service, 30 minute headways, 16 hours per day (weekdays only)

The study does not identify the optimal solution, a preferred alternative, or the lowest cost or most cost-effective option. That information would be developed later, in subsequent studies if deemed appropriate. Because only limited conceptual engineering data is available, the cost estimates and ridership forecasts are conservative, meaning it is recognized that the broad assumptions required during conceptual planning and design, such as installing control systems at all public and private grade crossings, may be revised through more detailed study in preliminary engineering/environmental analysis and final design. The capital cost estimates were developed using the methods employed by Sound Transit for its ST2 Plan. As required by State law, those methods were reviewed by the State's independent Expert Review Panel.

Consistent with the directing legislation, the feasibility analysis includes cost estimates and potential ridership information for various segments of the corridor that may have independent utility. Those segments are:

- Renton-to-Bellevue (Gene Coulon Park in north Renton to Bellevue CBD)
- Bellevue CBD to Woodinville
The study has been guided by a Steering Committee comprised of representatives of the Port of Seattle, King County, Snohomish County, PSRC and Sound Transit. The Ad Hoc Advisory Committee comprised of jurisdictions potentially affected by commuter/passenger rail service and/or a trail (the cities of Snohomish, Woodinville, Kirkland, Bellevue, Newcastle, Renton, King County and Snohomish County) reviews materials and provides input. The Ad Hoc Advisory Committee has met three times during the feasibility study process. In addition, the meetings are open to the public and feasibility study materials and reports are available on the PSRC website.

**Key Findings**

- The operation of commuter/passenger rail on the corridor is feasible through a variety of capital improvements to facilitate higher speeds than can be achieved today and to improve the safety of the track, structures, and roadway crossings in the corridor.
- The capital cost estimate for commuter/passenger rail is within the range for other lines that have been implemented across the country, although at the high end of that range. This is due to the neglected condition of the corridor and the lack of safety and communication systems along the line.
- The BNSF Eastside Corridor has the potential for significant transit ridership, connecting the regional growth centers of Renton, Bellevue, Kirkland/Totem Lake and Redmond, with trips as high as 6,070 per day.
- Downtown Bellevue is the key ridership destination along the corridor, due to its concentrations of population, employment and commercial activity.
- Implementation of service along the corridor requires a vehicle storage and maintenance facility, which appears to be located most readily north of downtown Bellevue where there are appropriately-zoned large parcels adjacent to the track.
- A pedestrian/bike trail could also fit within the existing right-of-way throughout much of the corridor. However, in some locations, property acquisition would be required to accommodate commuter/passenger rail and a trail.
- The estimated capital cost for a fully improved pedestrian/bike trail parallel to the rail line ranges from $297 million to $432 million depending on the width of the trail area.

The following capital cost estimates were developed based on a conceptual design and include broad assumptions for track and trackbed, rail bridges, signals/train control/crossings, stations and right-of-way, and soft costs (such as administration, design and environmental review and construction management). The cost estimates include significant contingencies appropriate to the conceptual level of analysis.
### Capital costs for commuter/passenger rail (2nd Qtr 2008 Millions$)

<table>
<thead>
<tr>
<th>Segment</th>
<th>Description</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segment 1</td>
<td>North Renton (Coulon Park) - Bellevue</td>
<td>$220</td>
<td>$286</td>
</tr>
<tr>
<td>Segment 2</td>
<td>Bellevue - Woodinville</td>
<td>$230</td>
<td>$299</td>
</tr>
<tr>
<td>Segment 3</td>
<td>Woodinville - Snohomish</td>
<td>$224</td>
<td>$291</td>
</tr>
<tr>
<td>Segment 4</td>
<td>Redmond - Woodinville</td>
<td>$116</td>
<td>$150</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td>$789</td>
<td>$1,026</td>
</tr>
<tr>
<td><strong>Yard &amp; Shop</strong></td>
<td></td>
<td>$57</td>
<td>$74</td>
</tr>
<tr>
<td><strong>Vehicles (assumes DMU)</strong></td>
<td></td>
<td>$64</td>
<td>$74</td>
</tr>
<tr>
<td><strong>Corridor Acquisition (by the Port of Seattle)</strong></td>
<td></td>
<td>$107</td>
<td>$107</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>Low</strong></td>
<td><strong>High</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$1,017</td>
<td>$1,280</td>
</tr>
</tbody>
</table>

### Operating costs for commuter/passenger rail

Operating costs for commuter/passenger rail service are estimated at $24 to $32 million per year (2008$) based on two-way service on the corridor with 30 minute headways for 16 hours per day (weekdays only). The costs include vehicle operations and maintenance, maintenance of way, and overhead and other costs.

### Ridership Forecast

<table>
<thead>
<tr>
<th>Segment</th>
<th>Cumulative Segments</th>
<th>Trips in 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segment 2</td>
<td>Bellevue-to-Woodinville</td>
<td>1,770</td>
</tr>
<tr>
<td>Segment 1+2</td>
<td>Coulon Park-to-Woodinville</td>
<td>4,580* (2,810)</td>
</tr>
<tr>
<td>Segment 1+2+3</td>
<td>Coulon Park-to-Snohomish</td>
<td>5,015 (435)</td>
</tr>
<tr>
<td>Segment 1+2+3+4</td>
<td>Coulon Park-to-Snohomish with South Woodinville-to-Redmond Spur</td>
<td>6,070* (1,055)</td>
</tr>
</tbody>
</table>

* ridership adjusted for southern terminus at Coulon Park, rather than Renton CBD

### Sound Transit 2

Sound Transit 2, the high capacity transit package of investments approved by voters in November 2008, includes a $50 million capital contribution to a potential passenger rail partnership. If a partnership is not implemented by the end of 2011, the funds will be reprogrammed to further the implementation of HOV BRT service in the I-405 corridor. Sound Transit 2 does not include any additional funds for commuter or passenger rail on the Eastside BNSF corridor.
1. Introduction

1.1 Context

Substitute House Bill (SHB) 3224, passed by the 2008 Legislature and signed by the Governor, requires Sound Transit, in conjunction with the Puget Sound Regional Council (PSRC), to do the following:

- Review existing studies and other relevant information to determine whether commuter rail service between Snohomish County and eastern King County can be a meaningful component of a future regional plan;
- Conduct a feasibility study\(^1\) if the initial review does not provide sufficient information to:
  - Assess ridership potential;
  - Identify which locations would most benefit from service;
  - Identify and evaluate station sites;
  - Analyze the ability of the existing track structure to accommodate commuter rail service, coordination with freight operations, and how tourism in the region might be affected;
  - Estimate costs for establishing a concurrent bicycle and pedestrian pathway along or near the Woodinville Subdivision;
  - Identify which segments of the Subdivision would be most beneficial and cost-effective for commuter rail service; and
- Submit a joint report on the review and/or study to the transportation committees of the House of Representatives and Senate by February 1, 2009.

It is the purpose of this evaluation to satisfy the requirements of SHB 3224 and to provide information to support future decisions by the Sound Transit Board of Directors regarding the potential funding of facilities and/or commuter rail service along the BNSF Woodinville Subdivision (Eastside) corridor.

Note: For purposes of this document, the term “commuter rail” is used to describe the type and purpose of transit service provided rather than the type of vehicle technology used for that service. Commuter rail is commonly described as a type of passenger rail transit service that is primarily oriented toward peak commute periods and directions of travel. For this document, the term “commuter rail” encompasses any of a variety of typical vehicle technologies, such as diesel multiple unit (DMU) trains and Sounder-type locomotive-hauled passenger trains.

1.2 BNSF Woodinville Subdivision (Eastside) Corridor

The corridor to be studied is the BNSF Woodinville Subdivision (Eastside) corridor. The Eastside corridor is a contiguous right-of-way that stretches 39 miles from the Black River Junction in Renton (MP\(^2\) 0) to the city of Snohomish (MP 39). Also included in the

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\(^{1}\) A feasibility study is a preliminary study undertaken to determine and document a project's viability.

\(^{2}\) All mileposts identified are approximate.
The corridor is a seven-mile spur line that stretches from Woodinville (MP 0) to Redmond (MP 7.3). The existing rail line and rail bridges are primarily single track.

This report focuses on the portion of the right-of-way that is the subject of the negotiated purchase and sale agreement between BNSF, the Port of Seattle and King County. The right-of-way being sold by BNSF is the 34-mile portion of the Woodinville Subdivision north of MP 5 and the seven-mile Redmond spur line. BNSF will remain the owner and rail operator of the Woodinville Subdivision south of MP 5. Subject to federal Surface Transportation Board approval, this purchase and sale agreement is anticipated to close in early 2009. As part of the purchase and sale agreement for the Eastside corridor, BNSF intends to transfer (i.e., sell) an easement to a third party operator (TPO), which would then have the exclusive rights to operate rail service along the northern portion of the Woodinville subdivision mainline (i.e., Woodinville to Snohomish). GNP/Ballard (a joint venture of GNP Rly Inc. and Ballard Terminal Railroad Company, LLC) has been selected by BNSF as the TPO. A separate easement covers maintenance, repair, replacement and use of the existing railroad bridge across the Snohomish River by the Port of Seattle, BNSF and the TPO.

In addition to the corridor right-of-way being acquired by the Port of Seattle, the representative commuter rail system assumes use of approximately one (1) mile of track between Gene Coulon Park/Scopa (MP 4.1) and MP 5 and also assumes use of the Snohomish River Bridge. Use of those portions of track (to be retained by BNSF) would require negotiations with BNSF (and its designated Third Party Operator and Port of Seattle for the Snohomish River Bridge) for trackage/other rights, the cost for which is not included in the cost estimate. In addition, a track extension would be required along approximately one-half (1/2) mile of former BNSF right-of-way (now owned by the City of Snohomish) located between the assumed Snohomish CBD station and the north end of the Snohomish River Bridge. Tracks were previously removed along this section of the former BNSF right-of-way (and replaced with a trail in parts) but would be replaced by the representative commuter rail system to provide rail access to the Snohomish CBD station.

The representative commuter rail system described in this document – and evaluated for purposes of determining the feasibility of commuter rail in the corridor – has (with some limited exceptions) been defined for the portion of the right-of-way being sold by BNSF (i.e., 34-mile portion of Woodinville subdivision and the seven-mile Redmond spur). However, the evaluation completed for this study has also considered and briefly describes – at a qualitative level only for ridership forecasting but not for cost estimate purposes – the potential to extend commuter rail service to Tukwila Sounder Station via Black River Junction and the BNSF Seattle Subdivision mainline on the south and to Everett Station via the BNSF Scenic Subdivision (Line Segment 37) on the north as a means of inter-connecting with existing Sound Transit regional commuter rail services.

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3 Form of Freight Easement Sale Agreement, Exhibit H to Purchase and Sale Agreement: Woodinville Subdivision - North Rail Line (approved by BNSF, Port of Seattle and King County, May 2008).
For purposes of this feasibility evaluation, the Eastside corridor under study has been subdivided into the following four segments:

1. **Renton at MP 4.1** (Gene Coulon Park/Scopa/north of spur 4125 to Boeing plant) to **Bellevue at MP 12.4** (south of proposed NE 6th Street extension, north of at-grade crossing of Main Street/SE 1st Street). Note that the Port of Seattle acquisition starts at MP 5.0.

2. **Bellevue at MP 12.4** to **Woodinville at MP 26.37** (Snohomish/King county boundary)

3. **Woodinville at MP 26.37** to 4th Street in downtown **Snohomish at MP 39**. Note that the Port of Seattle acquisition ends at the southern end of the Snohomish River Bridge.

4. Redmond (Issaquah) spur line, from **Woodinville at MP 0** to **Redmond at MP 7.3**.

### 1.3 Contents of this Report

Per SHB 3224, the commuter rail feasibility evaluation has been completed in two phases. The initial phase was a review of previous plans, studies and other reports that have included analysis relevant to the evaluation of commuter rail in the BNSF Eastside corridor. A technical memorandum documents the results of the first phase\(^5\).

The first phase was followed by a second phase feasibility study addressing those elements listed previously (i.e., ridership forecasts, cost estimates, etc.) where the first phase analysis did not produce conclusions sufficient to satisfy the requirements of SHB 3224. As described in the first phase technical memorandum, the requirements of SHB were not satisfied by work conducted for the previous plans, studies and other documents. Therefore, a second phase feasibility study was required to address all of the elements identified in SHB 3224. This report documents the second phase of the feasibility study. Ridership forecasts were prepared by PSRC and are included in this report.

The next section of this report provides a set of assumptions guiding the development of a representative commuter rail system definition and cost estimates for the representative commuter rail system and parallel trail. The description of the representative commuter rail system and parallel trail are included in Section 3. Section 4 provides a conceptual capital cost estimate for the representative commuter rail system and parallel trail. A commuter rail ridership forecast is presented in Section 5. Potential environmental impacts, mitigation and permits are discussed in Section 6. The SHB 3224 requirements are addressed in Section 7. Conclusions are provided in Section 8.

Appendix A contains the conceptual capital cost estimate prepared for the representative commuter rail system and parallel trail. A conceptual alignment for the representative commuter rail system is included as Appendix B. Appendix C, D and E present evaluations of track, bridges, and signals/train control/crossings, respectively. An

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\(^5\) BNSF Eastside Corridor Commuter Rail Feasibility Study, Phase I Technical Memorandum: Review of Previous Plans, Studies and Other Documents (Sound Transit, September 17, 2008).
evaluation of the potential for transit- and pedestrian-oriented development around the
assumed station areas is included as Appendix F. Appendix G provides typical cross
sections for a parallel trail, while Appendix H summarizes potential environmental
considerations and permit requirements for the representative commuter rail system.
Appendix I applies performance measures to the representative commuter rail system.
Comment letters received from jurisdictions and others are included as Appendices J and
K, respectively.

2. Assumptions

A summary of the assumptions used in this feasibility study is provided in the box that
follows. These assumptions underlie the definition of the representative commuter rail
system and parallel trail as well as the cost estimates described in this report. The
assumptions are further described in this section.
Summary of Feasibility Study Assumptions

**General Assumptions:**
- Feasibility study purpose is to identify at least one feasible option (if possible), not optimized, preferred and/or lowest cost solution
- Approximately one (1) percent level of engineering design
- Very limited engineering-quality data available on existing terrain, track horizontal and vertical geometry, bridge/trestle designs and conditions, environmental conditions, limited field study, etc.
- Cost estimate includes contingency percentages that are appropriate to the current level of engineering design.

**Major Commuter Rail System Assumptions:**
- Accommodate all potential railroad vehicle types in corridor
- Permanent (e.g., 50 year) level of public infrastructure investment quality.
- All track (rails, ties, fasteners and ballast) completely replaced along entire corridor.
- Assumes existing track alignment, with average passenger train speed (including stations stops) of approximately 24 mph.
- Five (5) passing sidings provided (four at stations) for commuter rail trains.
- Three (3) significant new rail bridges and two (2) other bridges replaced.
- Complete signal/communication system for train detection and train control, with onboard pro-active speed enforcement.
- Centralized train locator and dispatch
- Upgrade all public and private at-grade crossings
- Full maintenance facility provided along the corridor
- 16 stations (most with parking).
- Cost estimate include allowances for hazardous materials/soils removal, utility modifications, and environmental mitigation.
- Cost estimate includes construction management, environmental clearance and preliminary engineering, final design and specifications, design services during construction, design review by others, permitting, and agency administration.

**Major Trail Assumptions:**
- Consistent with SHB 3224, it is assumed that the representative trail would be located parallel to the track(s) in the right-of-way (generally 100' wide) of the Eastside corridor. South of MP 8.65, constrained right-of-way may limit the potential width of the trail in places.
- A new pedestrian/bicycle trail bridge provided at the location of each existing rail bridge, with some exceptions.
- Cost estimate includes construction management, environmental clearance and preliminary engineering, final design and specifications, permitting, and agency administration.

**General Assumptions**
The following are general assumptions for this feasibility study:
- Feasibility study purpose is to identify at least one feasible option (if possible), not optimized, preferred and/or lowest cost solution
- Approximately one (1) percent level of engineering design
Very limited engineering-quality data available on existing terrain, track horizontal and vertical geometry, bridge/trestle designs and conditions, environmental conditions, limited field study, etc.

The capital cost estimates prepared for this study are based on a definition for each element of the representative commuter rail system and parallel trail (see Section 3) that was completed at a conceptual, feasibility level of detail. The definition described in this report represents only one potential implementation approach for the representative commuter rail system and parallel trail and was produced in order to develop a conceptual cost estimate. This study does not attempt to define all possible approaches nor is the definition described in Section 3 considered a final or preferred approach. Numerous alternative options could be defined and evaluated during system development phases. It is anticipated that this initial effort will be supplemented by additional engineering, alternatives analyses and environmental studies, if commuter rail (and/or a parallel trail) is implemented in the corridor.

Cost Estimating Methodology
The methodology used for developing the conceptual-level capital cost estimate for the representative commuter rail system and parallel trail is based on the capital cost estimating methodology documented in the report Sound Transit 2 Planning Capital Cost Estimating Methodology Report, March 2007 and reviewed by an independent Expert Review Panel. Therefore, the capital cost estimates in this report are directly comparable to the capital cost estimates prepared for the ST2 Plan, which was approved by voters in the Sound Transit district on November 4, 2008. Capital cost estimates are organized by standard FTA capital cost categories. The capital cost estimates covered in this report are based on three major elements:

1) Conceptual-level system definitions based on existing information, aerial photos (with geographic information where available), estimated quantities, and typical cross sections; and

2) Unit costs for various system components. The unit costs, expressed in 2nd Quarter 2008 dollars, are based on information gained from Sound Transit experience under Sound Move, as well as Parsons Brinckerhoff’s national cost estimating experience.

3) Right-of-way acquisition costs were estimated at $78 per sq. ft., plus contingency.

Commuter Rail System Assumptions
In addition to general assumptions identified previously, the following are the assumptions upon which the capital cost estimate for the representative commuter rail system is based:

- Accommodate all potential railroad vehicle types in corridor
  - No decision yet on passenger rail vehicle type (e.g., Sounder-type or DMU)
  - Do not preclude heavy locomotive-hauled trains such as freight trains or Spirit of Washington Dinner Train)
  - Affects design loads for new/replaced rail bridges. Bridges specifically designed for lighter-weight rail vehicle loads could potentially be lower in cost.
- Permanent (e.g., 50 year) level of public infrastructure investment quality, not
demonstration level (a demonstration project and/or a project implemented by
private entities could be accomplished differently with potentially lower costs).
- All track (rails, ties, fasteners and ballast) completely replaced along entire
corridor. Use of existing track could potentially be lower in initial cost.
- Assumes existing track alignment, with average passenger train speed (including
stations stops) of approximately 24 mph. Existing maximum passenger train
speed limits vary between 10 mph and 30 mph based on Track Charts.
- Five (5) passing sidings provided (four at stations) for commuter rail trains (based
on 30 minute headways, each direction).
- Three (3) significant new rail bridges:
  o New rail/trail bridge over I-405 southbound lanes at location of previous
    Wilburton Tunnel
  o New rail bridge parallel to Wilburton Trestle with existing historic trestle
    converted to bicycle/pedestrian trail use
  o New rail bridge parallel to Snohomish River Bridge with existing bridge
    converted to bicycle/pedestrian trail use
- Replace two (2) existing rail bridges that have substandard underclearances and
  obvious visible damage (from overweight trucks)
- Minimal repairs to the other 20 existing rail bridges:
  o Add safety walkways with railings
  o Add inner guard rails (keep trains correctly aligned)
  o Other than new or replaced bridges, cost estimate excludes strengthening
    of rail bridges (existing bridge plans, design load criteria and detailed
    evaluation were not available for this study). That specificity requires
    engineering beyond the feasibility or conceptual level.
- No new grade separated crossings are included. Grade separations could be
  evaluated by an entity proposing implementation.
- Complete signal/communication system for train detection and train control. The
  Eastside corridor currently has no signal/communication system and is considered
  “dark” territory.
- Active train control (onboard pro-active speed enforcement to automatically slow
  or stop trains if needed)
- Centralized train locator and dispatch (example: BNSF currently provides train
  dispatch and control for Sounder)
- Upgrade all public and private at-grade crossings with four quadrant gates,
  flashers and bells. During design, crossing improvements would be evaluated on a
  case-by-case basis. Note that use of public funds for private crossing
  improvements might not be allowed.
- Full maintenance facility provided along the corridor
- Stations provided at 16 locations with parking assumed at most stations.
- Cost estimate provided for Diesel Multiple Unit (DMU) or locomotive-hauled cab
  cars and coaches options
- Cost estimate includes allowances for hazardous materials/soils removal, utility
  modifications, and environmental mitigation.
Cost estimate includes construction management, environmental clearance and preliminary engineering, final design and specifications, design services during construction, design review by others, permitting, and agency administration.

Cost estimate includes contingency percentages that are appropriate to the current level of engineering design.

**Trail Assumptions**

In addition to general assumptions identified previously, the following are the assumptions upon which the capital cost estimate for the representative parallel trail is based:

- Consistent with SHB 3224, it is assumed that the representative trail would be located parallel to the track(s) in the right-of-way (generally 100’ wide) of the Eastside corridor. For purposes of this study, it assumed that the parallel trail will fit within the available right-of-way. South of Bagley Lane (approx. MP 8.65 near Newcastle Beach Park in South Bellevue), constrained right-of-way (approximately 10-35 feet in width in places) and/or potential encroachment may limit the potential width of the trail in places. In addition, the planned widening of I-405 may have right-of-way impacts in this area. Therefore, the Higher Cost option trail cost estimate provides for only the minimum (12 foot) trail cross section between Gene Coulon Park and Bagley Lane with the 29 foot cross section assumed elsewhere in King County. The Lower Cost option trail cost estimate assumes the minimum 12 foot cross section for all segments in King County. Right-of-way limitations along the corridor have not been identified or evaluated as part of this study. An evaluation of available right-of-way would need to be completed during design.

- North of I-90, two cross section width options were developed, providing a cost range for development of the representative trail. An evaluation of available right-of-way would need to be completed during design.

- A new pedestrian/bicycle trail bridge is assumed to be provided at the location of each existing rail bridge, except as follows:
  - No new trail bridge at the location of an existing rail bridge crossing Ripley Lane North at approximately MP 6.7. This rail bridge does not cross a waterway or stream, so it assumed that the parallel trail could be located at-grade.
  - Trail crossing is combined with rail crossing on new rail/trail bridge over I-405 southbound lanes at location of previous Wilburton Tunnel.
  - Existing historic Wilburton Trestle converted to bicycle/pedestrian trail use.
  - Existing Snohomish River Bridge converted to bicycle/pedestrian trail use.
  - In the Snohomish County flood plain area, new bicycle/pedestrian trail bridges would not be provided at locations of the four (4) existing rail trestles that do not cross waterways/streams. Assume that trail is provided at-grade (lower cost option) or on embankment/fill (higher cost option) at these locations.
3. Description of Representative Commuter Rail System and Parallel Trail

This document describes a representative commuter rail system and a parallel trail facility between Gene Coulon Park/Scopa (MP 4.1) in Renton and the City of Snohomish (MP 39) along the Woodinville Subdivision and between South Woodinville (MP 1.7) and downtown Redmond (MP 7.3) along the Redmond spur line. To provide rail service to the assumed station location in the Snohomish CBD, a short section of new track would be required between the Snohomish River Bridge and the station. Trackage rights would also be required for use of the Snohomish River Bridge right-of-way.

Consistent with SHB 3224, it is assumed that the representative trail would be located parallel to the track(s) in the right-of-way (generally 100’ wide) of the Eastside corridor. For purposes of this study, it assumed that the parallel trail will fit within the available right-of-way. South of Bagley Lane (approx. MP 8.65 near Newcastle Beach Park in South Bellevue), constrained right-of-way (approximately 10-35 feet in width in places) and/or potential encroachment may limit the potential width of the trail in places. In addition, the planned widening of I-405 may have right-of-way impacts in this area. Therefore, the Higher Cost option trail cost estimate provides for only the minimum (12 foot) trail cross section between Gene Coulon Park and Bagley Lane with the 29 foot cross section assumed elsewhere in King County. The Lower Cost option trail cost estimate assumes the minimum 12 foot cross section for all segments in King County. Right-of-way limitations along the corridor have not been identified or evaluated as part of this study. An evaluation of available right-of-way would need to be completed during design.

The definition of the representative commuter rail system includes a conceptual alignment and representative commuter rail stations and is the primary source of information used to prepare conceptual cost estimates. This report presents the supporting documentation for the major design issues, technical assumptions and considerations that were used in developing conceptual cost estimates for the conceptual alignment, stations and other facilities for the representative commuter rail system. The report also describes the basis for the conceptual cost estimate for a parallel trail in the corridor.

The definition of the representative commuter rail system and parallel trail described in this section represents only one potential implementation approach and was produced in order to develop a conceptual cost estimate. This study does not attempt to define all possible approaches nor is the system definition described in this section considered a final or preferred approach. Numerous alternative options could be defined and evaluated.
during system development phases. It is anticipated that this initial effort will be supplemented by additional engineering, alternatives analyses and environmental studies, if commuter rail (and/or a parallel trail) is implemented in the corridor.

### 3.1 Commuter Rail System

Note: For purposes of this analysis, implementation of commuter rail by a public agency was assumed in the Eastside corridor. Sound Transit may contribute to a partnership for commuter rail in the corridor. A capital contribution of $50 million is included in the Sound Transit 2 Plan approved by voters in November 2008. However, the northern (Snohomish County) portion of the Eastside corridor is outside the Sound Transit district. Sound Transit funds cannot be spent outside of the Sound Transit district.

This cost estimate covers commuter rail operations along two intersecting rail lines almost entirely within the Port of Seattle right-of-way acquisition area. A north-south commuter rail line would operate between Gene Coulon Park/Scopa (MP 4.1) in Renton and the City of Snohomish (MP 39) along the Woodinville Subdivision mainline with intermediate station stops. An east-west commuter rail service would operate between South Woodinville (MP 1.7) and downtown Redmond (MP 7.3) along the Redmond spur line in a shuttle operation. It is assumed that the Redmond spur train would be “captive” to the rail spur line (i.e., operate between Woodinville and Redmond only) and would not interline with trains operating north-south along the Woodinville Subdivision mainline. Because BNSF will retain ownership of the corridor south of MP 5, commuter rail operations between MP 4.1 and MP 5 would require negotiations with BNSF for trackage rights, the cost of which is not included in the cost estimate. Use of the Snohomish River Bridge right-of-way would require negotiations with BNSF (and its Third Party Operator and the Port of Seattle) for trackage/other rights, the cost of which is not included in the cost estimate. In addition, a track extension would be needed along publicly-owned (formerly BNSF-owned) property in the City of Snohomish to access the assumed Snohomish CBD station; costs for that track extension are included in the cost estimate.

Assumed commuter rail stations along both lines are shown in Figure 3.1. This study evaluated sixteen (16) stations, which is a relatively high number of stations for a commuter rail corridor of this length. Close station spacing increases train travel time and delay and increases operational and capital costs. It is possible that fewer stations might be implemented by a commuter rail operator. Fourteen (14) stations are assumed at the following locations (listed south to north) along the Woodinville Subdivision mainline (mileposts are approximate):

1. Renton/Gene Coulon Park (terminal) (MP 4.1)
2. Renton/Port Quendall/NE 44th Street (MP 6.3)
3. Bellevue/Newport Park-and-Ride/112th Avenue NE (MP 8.0)
4. Bellevue/NE 6th Street (MP 12.6)
5. Bellevue/NE 12th Street (MP 13.2)
6. South Kirkland Park-and-Ride (MP 14.7)
7. Kirkland/NE 85th Street (MP 17.5)
8. Kirkland/Totem Lake (MP 19.8)
9. South Woodinville/NE 145th Street (provides transfer via 400’ walk to Redmond
spur line service) (MP 22.7)
10. Woodinville CBD (MP 24.7)
11. North Woodinville/NE 195th Street (MP 25.9)
12. Maltby (MP 29.9)
13. Cathcart (MP 33.9)
14. Snohomish CBD (terminal) (MP 38.9)

Two (2) stations are assumed at the following locations (listed west to east) along the
Redmond spur line:

15. South Woodinville/NE 145th Street (terminal; provides transfer via 400’ walk to
mainline service) (MP 1.4)
16. Redmond CBD (terminal) (MP 6.8)

The following sections identify the assumed track, bridge, signals/train control/crossings,
maintenance facility, stations, vehicles and operations plan to support the representative
commuter rail system. A brief description of potential commuter rail extensions and
associated issues is also included. A drawing set of the representative commuter rail
system is included as Appendix B.
Figure 3.1: BNSF Eastside Corridor Map

BNSF Eastside Corridor
(N Renton to Snohomish & Redmond Spur)
Existing Rail Lines and Regional Trails

BNSF Stations
- Maintenance Base
- Redmond Spur Line
- Snohomish-Renton Line
- BNSF Eastside Corridor Under Study
- Black River Junction to Gene Coulon Park
- Existing Sounder Commuter Rail
- Potential Sounder Extension to Lakewood
- Other Regional Rail Lines
- Regional Bike Routes/Trails
- Metropolitan Transportation System
- City Limits
- Urban Growth Area

Scale: 1:30,000

BNSF Eastside Corridor Commuter Rail Feasibility Study: Phase II Technical Memorandum
Final/December 2008
3.1.1 Track

Existing Conditions
The existing track conditions survey was conducted during August 2008 using a sampling approach. Twelve (12) sample locations were investigated at varying intervals, not exceeding five (5) miles apart. At each location, one-half (1/2) to one (1) mile of track was examined by walking the track. The items noted were only those that were obvious and included: rail section including year rolled; fastening system (type and size of plates); type of track construction (jointed/welded); tie conditions including size and spacing; ballast conditions and type; cross-level; surface and alignment conditions; drainage; and other miscellaneous conditions.

It is understood that the rail was recently inspected by a Sperry Rail/Star car. The Star car evaluated the track geometry. All defects were reported and marked with spray paint that was visible during the track inspection. A maintenance plan was developed and implemented by the BNSF which included crosstie renewal, minimal ballast, surfacing, lining and regulating work, although no drainage improvements. Due to a lack of funding, rail upgrading and renewal work was not performed. 1000 ties were placed through out the Woodinville Subdivision. Where these new crossties were located, excessive mudding formed around the new ties. There is clear evidence that the ballast section is not properly draining through the track bed. According to the Track Charts, existing speed limits on the railroad are between 10 and 30 MPH. Without track and/or bridge upgrades, therefore, potential commuter rail operations on the existing track would be limited to a maximum operating speed of 10-30 MPH.

Track Upgrades
The highest priority in upgrading a rail line to acceptable standards for regular passenger service is to provide a good, firm, consistent rail support, including rails, ties and ballast. For purposes of this conceptual cost estimate, it is assumed that the existing rails, ties and ballast will be completely replaced along the entire corridor to FRA Class 3 track standards, allowing up to 60MPH (passenger) and up to 40MPH (freight) train speeds. Standard track upgrades include new rail (likely 112# or 115#, to be determined during design), concrete ties, along with new ballast and fasteners. An additional approximately one-half (1/2) mile of new track alignment is assumed to be needed between the Snohomish River Bridge and the Snohomish CBD station.

It is assumed that track connections would be provided to the BNSF Scenic Subdivision (south of Snohomish) and/or the BNSF Seattle Subdivision (via Black River Junction) to accommodate train vehicle delivery. The use of BNSF tracks would require negotiations with BNSF, and no costs are included regarding this need.

Passing Sidings
It is assumed that passing sidings will be provided for commuter rail trains at five (5) locations along the corridor. These sidings would allow a two-car commuter rail train to stop outside of the mainline to allow another train to pass. Four (4) of the passing sidings would be located at stations (i.e., Maltby, North Woodinville/NE 195th Street,
Bellevue/NE 12th Street and Bellevue/Newport Park-and-Ride/112th Avenue SE) while one would be located at approximately MP 21.5 between the Kirkland/Totem Lake and South Woodinville/NE 145th Street stations. At stations with passing sidings, the configuration of the platform(s) would allow for two commuter rail trains to stop at the station at the same time. These siding locations were determined on a preliminary, conceptual basis by Sound Transit staff (for purposes of this feasibility study only) and are based on assumed 30 minute headways in each direction. More frequent commuter rail service might require additional passing sidings. Additional information would be required to determine final passing siding locations. The five assumed passing sidings are shown on the drawing set (see appendices) and are included in the conceptual cost estimate.

A track evaluation report is included as Appendix C.

3.1.2 Bridges

Existing Conditions
During the August 2008 field study, the conditions of the 24 existing bridges were also observed. A total of 21 bridges along the Eastside corridor mainline (Woodinville Subdivision) and three (3) bridges along the Redmond spur line were visited and obvious existing conditions were observed and briefly recorded. It should be noted that the nature of this walk-through did not constitute a hands-on or arms-length inspection of the bridges and their components. The recorded conditions included verification of number of spans; types of superstructures (open deck or ballasted deck; timber or steel) and substructures (timber trestle bents; timber abutments and wingwalls or concrete piers and abutments); stream and roadway crossings; number of tracks on bridges and whether inner guard rails, safety walks and railing existed on those bridges. Also noted were failing components such as rotated retaining walls and abutment bulkheads; rotted, holed through, split or damaged timber components, which were obvious to the naked eye.

Based on BNSF records, the existing bridges were built within a hundred-year time frame; the oldest fabricated in year 1900 (main span of Bridge 6.2 over Sammamish River on Redmond spur line, which was placed in its current location in 1921), and the newest built in year 2000 (Bridge 9.05 over Coal Creek Parkway/118th Avenue SE in Bellevue. Consequently, all those bridges were originally designed to different loading conditions varying from E40 (Br. 6.2) to E80. Four of the bridges (Br. 9.05 and Br. 11.72 on the mainline, Br. 6.14 and Br. 6.36 on the Redmond spur line) were designed for E80 loading were built using steel and concrete superstructures and substructures in relatively recent years (1973 and later) and in “Good” to “Very Good” condition in general terms. Other design loadings of E72 (Br. 9.46, Br. 10B, Br. 24.1 and Br. 27), E70 (Br. 37, Br. 37.1 and Br. 37.2), and E55 (Br. 6, Br. 6.1, Br. 9, Br. 11.1, Br. 35 and Br. 36) represented the most common design loading for the bridges within this study. The lowest design loadings were E40 and E50. The design rating for the Snohomish River Bridge was not available. Depending on the years they were built, materials used, and maintenance and repairs they received, they exhibit varying obvious state of weathering and deterioration. Therefore, without additional data and evaluation, it is not possible to assess the current load carrying capacity of these structures based on their design loadings.
Crossing of I-405 Southbound Lanes
In south Bellevue, the structure which was known as Wilburton Tunnel and which carried the rail line over I-405 was removed during summer 2008 to accommodate the widening of I-405.

Wilburton Trestle
The most notable structure along the corridor is the historic Wilburton Trestle in Bellevue. It is known to be the longest wooden trestle in the Pacific Northwest measuring 977 feet in length. The bridge, which was originally constructed in 1904 and rehabilitated several times (most recently in 1943 due to the deterioration of timber), carries a single track of the Woodinville Subdivision line. Lake Hills Connector Road cuts through the trestle under a steel girder span supported by concrete piers, which replaced a portion of the original construction. Existing timber members in general exhibit cracks, splits and rot. Some of the columns and diagonal bracing members were already replaced, and splits in some of the columns repaired using galvanized steel compression bands and injecting fillers in openings. Although the BNSF bridge records indicate that the original design load was E55, the current load carrying capacity of the bridge may not be determined without assessing the condition of load carrying members through a careful inspection, material testing and bridge rating calculations. The overall condition of the bridge may be considered as “Fair”.

Snohomish River Bridge
Another significant bridge is located at the northern end of the line over the Snohomish River. The bridge is 1790-foot long and is composed of timber trestle spans in South and North Approaches and steel spans over the river. The four spans over the river are as follows: two-span cantilever deck truss turntable superstructure which has not been operational for a long time, riveted steel thru truss main span and a steel deck girder span over river. The substructure is composed of five concrete piers supporting steel spans; and timber trestle and timber abutments elsewhere. The design rating for the Snohomish River Bridge was not available. During the walk-through, steel spans over the river and the top of the deck were not accessed. All observations were made from the ground level. The overall condition of the bridge may be considered “Poor” due to the visibly poor condition of timber bulkheads and seats at abutments and some of the timber trestle columns and diagonal bracings, which exhibit cracks, splits, rot and apparent fire damage.

Substandard Bridges
Two bridges along the Eastside corridor were noted for their substandard underclearances over the roadways. The Br. 17 at MP 17.1 over Kirkland Way is a 43-foot long, single span bridge with steel girders. The posted underclearance at the bridge is 11’-6”. There is evident vehicle impact damage by overheight vehicles to the steel girders due to this substandard underclearance. Similarly, Br. 34 at MP 34.71 over Connelly Road has sustained vehicle impact damage to the timber stringers that support the track. The posted vertical underclearance at this bridge is 12’-0”, which is also substandard.
Assumed New Rail Bridges

The following describes five new rail bridges, which are assumed to be designed to Cooper E-80 load criteria (in accordance with AREMA and other applicable standards).

Replacement Rail Crossing of the I-405 Southbound Lanes (approx. MP 10.9)
The existing gap at the I-405 southbound location would require a new bridge. Based on the existing of the track approaches, the new rail bridge would be at a skewed angle to the direction of the I-405 lanes and would require a relatively long center span. Therefore, it is estimated that the total length of the bridge would be around 740 feet assuming a 500-foot center span over I-405 and two 120-foot side spans. For the purposes of this study, the center span could be a steel through truss or tied arch with a pedestrian/bicycle trail cantilevered brackets to the side; and the end spans could be steel through girders, possibly a three-girder through girder system providing a positive separation of rail traffic and pedestrian/bicycle traffic on the bridge. The substructure would be reinforced concrete piers, abutments and wing walls, possibly supported on drilled shafts. The closest edge of the trail area would be approximately 20’ from the track centerline on the bridge. In addition, a six foot tall barrier wall is assumed to be placed on the bridge between the track and the trail to keep trail users out of the track area. The type of the new structure would be determined during a design phase.

MP 11.57a New (Parallel) Wilburton Rail Bridge
Due to the condition of the existing timber trestle structure and the limited data and evaluation conducted for this feasibility study, it is assumed that the existing trestle bridge will be converted to use as a pedestrian/bicycle bridge (after performing evaluations for necessary repairs to provide a safe operation). Rail traffic would be re-routed to a new parallel structure. The type of the new structure would be determined during a design phase. For the purposes of developing an order-of-magnitude cost estimate for the new structure, a trestle type steel structure similar to the existing trestle approach spans is assumed for the approach spans to the south and north of the river spans with longer spans but matching every third existing trestle bent. The trestle bents may be composed of steel pipe piles or steel H-piles spaced in relation to their load carrying capacity and matching every third existing trestle bent, therefore creating a similar visual effect. Also assumed was an open deck superstructure with timber ties supported on steel girders. For egress and maintenance purposes safety walkways on both sides are included.

MP 38.25a New (Parallel) Snohomish River Rail Bridge
For the same reasons stated previously for the Wilburton Trestle, it is assumed that the existing bridge will be converted to use as a pedestrian/bicycle bridge (after performing evaluations for necessary repairs to provide a safe operation). Rail traffic would be re-routed to a new parallel structure. The type of the new structure would be determined during a design phase. For the purposes of developing an order-of-magnitude cost estimate for the new structure, a trestle type steel structure similar to the existing trestle approach spans is assumed for the approach spans to the south and north of the river spans with longer spans but matching every third existing trestle bent. The trestle bents may be composed of steel pipe piles or steel H-piles, therefore creating a similar visual effect. Four river spans were assumed to have two steel deck trusses. Also assumed was
an open deck superstructure with timber ties supported on steel girders. For egress and maintenance purposes safety walkways on both sides would be included. The substructure for the river spans would be reinforced concrete piers, possibly supported on drilled shafts. Reinforced concrete abutments and wing walls would be supported on H-piles or pipe piles.

**MP 17.1 New Rail Bridge over Kirkland Way**
A new single span bridge with ballasted deck supported by steel multi-girder superstructure is assumed to replace the existing bridge. Safety walkways on each side will be provided for egress and maintenance purposes. The profile will be raised enough to provide minimum required standard underclearances. The span length is also assumed to be longer than the existing to provide standard horizontal clearance. Reinforced concrete abutments and wing walls are also assumed. The type of the structure would be determined during a design phase.

**MP 34.71 New Rail Bridge over Connelly Road**
Similar to the bridge at MP 17.1 (over Kirkland Way), a new single span bridge with ballasted deck supported by steel multi-girder superstructure is assumed to replace the existing bridge over Connelly Road. Safety walkways on each side will be provided for egress and maintenance purposes. The profile will be raised enough to provide required minimum standard underclearances. The span length is also assumed to be longer than the existing to provide standard horizontal clearance. Reinforced concrete abutments and wing walls are also assumed. The type of the structure would be determined during a design phase.

**Assumed Repairs to Existing Rail Bridges**
For the other 20 rail bridges (i.e., other than the 3 new or 2 replaced bridges), consistent with the track upgrades discussed in Section 3.1.1, it is assumed that the minimum repairs would also include a complete rail and tie replacement over the bridges. For open deck bridges, it is assumed that timber ties would be used. Timber ties would be arranged to support a minimum 2’-6” safety walkway on each side by extending every third tie. Existing timber ties on ballasted decks will be replaced with concrete ties and safety walkways will be provided on both sides on new steel brackets for those bridges that are not wide enough to accommodate the walking surfaces on the ballast. Railings would be provided along the outer edge of safety walkways. Inner guard rails would be provided over the bridges. In addition, an allowance is included in the cost estimate for limited timber and steel member repairs to bring the structure components to a good state of repair. At this stage, cost estimates for strengthening of the components were not included due to limited data availability and the feasibility level of this evaluation.

Minimal repairs are included in the cost estimate for the following 20 bridges (photos of these bridges are provided in Appendix D):

- Segment 1: Br. 6 (May Creek), Br. 6.1 (Ripley Lane), Br. 9 (Coal Creek), Br. 9.05 (trail), Br. 9.1 (Lake Wash. Blvd.), Br. 9.46 (I-90), Br. 10b (Henry Bock Rd.), and Br. 11.72 (Lake Hills Blvd./116th Ave. SE).
Segment 2: Br. 16 (NE 68th St.), Br. 23 (Sammamish River), and Br. 24.1 (131st Ave NE).
Segment 3: Br. 27 (SR 522), Br. 35, Br. 36, Br. 37 (stream), Br. 37.1, and Br. 37.2.
Segment 4: Br. 6.1 (154th Ave NE), Br. 6.2 (Sammamish River), and Br. 6.4 (Redmond Way).

Assumed New Pedestrian/Bicycle Trail Bridges
For the purposes of this study, it is assumed that a parallel bridge structure will be constructed to carry the pedestrian/bicycle trail over each roadway and stream where there is an existing rail bridge, except at the three locations mentioned previously. Those locations are the new crossing of the I-405 southbound lanes (approx. MP 10.9) where a combined bridge for railroad and pedestrian/bicycle traffic is assumed, and at the Wilburton Trestle (MP 11.57) and Snohomish River (MP 38.25) bridges, where the existing bridges would be converted to bicycle/pedestrian use. In addition, it is assumed that at rail bridges at MP 6.7, MP 35.95, MP 36.92, MP 37.39 and MP 37.56 there will be no parallel pedestrian/bicycle bridge under the assumption that the assumed pedestrian/bicycle trail would be located roughly at-grade (no visible streams or wetlands at those locations). It is assumed that a 15-foot wide bridge providing 12-foot clear width for pedestrian/bicycle traffic and matching at least the span (length) of the existing rail bridge would be constructed at the following 16 locations:

Segment 1: MP 6.1, MP 9.1, MP 9.15, MP 9.94, MP 10.1, and MP 11.71
Segment 2: MP 16.32, MP 17.1, MP 23.92, and MP 24.67
Segment 3: MP 27.07, MP 34.71, and MP 37.14

New Bridge Design Criteria
Assumed design criteria for new rail bridges is per American Railroad Engineering and Maintenance-of-Way Association (AREMA) standards as described in the Manual of Railway Engineering.

Timber Structures
All timber structures that are subjected to Commuter Train/DMU vehicle loads would be designed in accordance with the provisions stipulated by AREMA Chapter 7.

Reinforced Concrete Structures
All reinforced concrete structures that are subjected to Commuter Train/DMU vehicle loads would be proportioned using the Load Factor Design method in accordance with the provisions stipulated by AREMA Chapter 8.

Service loads would be used when evaluating stability, crack control, deflection and fatigue criteria for all reinforced concrete structures.
Steel Structures

All steel structures that are subjected to Commuter Train/DMU vehicle loads would be proportioned using the Allowable Stress Design method in accordance with the provisions stipulated by AREMA Chapter 15.

Unless otherwise specified for this analysis, all steel structures that are not subjected to Commuter Train/DMU vehicle loads would be proportioned using the Allowable Stress Design method in accordance with the provisions stipulated by the American Institute of Steel Construction (AISC).

No New Grade Separated Crossings

In the capital cost provided for the representative commuter rail system and parallel trail, no new grade separated crossings are identified. Providing new grade separated crossings would increase the capital cost estimate for bridges/structures and could lead to the potential need for elevated commuter rail stations and/or passing sidings at some locations. Analysis of the potential benefits and costs of additional grade separated crossings (for commuter rail and/or parallel trail), however, was not part of this feasibility study. Skewed intersections such as Woodinville-Snohomish Road at 139th Avenue NE in Woodinville (track crosses diagonally through the center of the intersection) and 124th Avenue NE at NE 124th Street in Kirkland/Totem Lake (track crosses two legs near the center of the intersection) could be likely candidates to consider for grade separation.

A bridge evaluation report is included as Appendix D.

3.1.3 Signals, Train Control and Crossings

Because the Eastside corridor has no existing signal/communication system, a completely new system would need to be designed and installed to support train detection and control consistent with national industry practices. Utilizing a cab signal system with onboard speed enforcement (active train control) could provide for a safe and reliable commuter rail system. This system could require every engine and/or cab car to be equipped with a system that can receive the cab signal from the rail and display it to the engineer and also enforce the train speed if the engineer does not appropriately respond. This could lead to pro-active speed enforcement that would apply brakes to reduce the train to the required speed or, if appropriate, apply the brakes to bring the train to a complete stop.

A Centralized Train Control (CTC) system for the corridor is assumed to be located within a control center. The CTC should have complete control of all passenger and freight trains on the line. There should also be indications sent to the CTC to indicate all train movements along with information about all wayside and grade crossing locations on the line. Communication from the wayside system to the CTC could be by a fiber optic system with a radio backup system. The CTC could also have communication capability to each station platform to convey information to passengers for updates and for emergencies.
There are presently 107 locations where the tracks cross roadways/driveways/trails, of which 59 are private (i.e., not a public street). Many of the public and private crossings along the Eastside corridor may need upgrades, but a detailed evaluation has not been completed. The cost estimate provides for upgrades, including flashers, gates and bells, at all 107 (public and private) existing grade crossings along the corridor. Crossing improvements should be evaluated on a case-by-case basis by an entity proposing a commuter rail system. Note that use of public funds for private crossing improvements might not be allowed.

Upgrading the highway/rail crossings with Constant Warning Time Device (CWTD) features would enhance the safety and comfort of the communities. The CWTD would avoid situations where the crossing warning equipment is activated for an excessive amount of time, thus reducing traffic delays and pedestrian and vehicle violations of the train crossing devices. Because the trains would be traveling through residential areas, the utilization of a Train Horn System (wayside-mounted horns) could reduce the use of train horns and resulting complaints of residents about the noise interfering with their personal activities. Quiet Zones could be considered for locations along the corridor, subject to federal regulations. The cost of Quiet Zones is not included in this estimate.

The capital cost estimate assumes complete signals/communications, centralized train control, and grade crossing systems for the Eastside corridor. System elements could include Control center interface, fiber optic backbone, wayside signals and highway grade crossing improvements.

A signals/CTC/crossings evaluation report is included as Appendix E.

### 3.1.4 Maintenance Facility

It is anticipated that a full maintenance facility for a commuter rail system would be included along the Eastside Corridor. Based on operating plan assumptions defined by Sound Transit, this facility is assumed to be sized to accommodate the anticipated number of vehicles (up to 16 DMUs or up to seven locomotives and 16 passenger cars, including spares, based on a representative operating plan) that could operate in the corridor (including the Redmond spur line). The maintenance facility is sized to accommodate vehicle storage and wash facilities, vehicle maintenance, maintenance of way, and operator report and parking. Trains could potentially be stored overnight at the terminal stations.

A preferred site for a maintenance facility was not identified as part of this analysis. There are limited industrially-zoned sites of sufficient size adjacent to the corridor. These sites are located north of downtown Bellevue. For purposes of this feasibility study, a representative site was identified for the operations and maintenance facility. This site was assumed for the purpose of developing a conceptual capital cost estimate. The assumed maintenance base occupies approximately 2.5 acres and is located in the industrial area of south Woodinville west of Woodinville-Redmond Road.
The design of the maintenance facility civil, track, facilities, and systems work would be developed by an entity proposing a commuter rail system on the corridor.

**Alternative Options for Vehicle Maintenance and Repair**

This study assumes that a full maintenance facility for a representative commuter rail system would be included along the Eastside Corridor. However, depending on the commuter rail vehicle type ultimately selected for this corridor and other issues, alternative options could potentially exist in the future for maintaining and repairing the vehicles. Although expansion of the Amtrak facility could potentially provide additional future capacity for vehicle maintenance and storage, this option is not evaluated for this feasibility study. The Eastside corridor should include at least some vehicle maintenance and servicing resources. These needs could be met by one of the following options:

- Light/routine maintenance and servicing could be performed at a facility located along the corridor with heavier maintenance to occur elsewhere. No cost estimate is provided for this option.
- Light/routine and medium maintenance could be performed at a facility located along the corridor with maintenance of modular components conducted by third-party service providers. This scenario would require inclusion of facilities for wheel or even truck removal as well as all modular components (DMU propulsion engines, power generators, etc.). No cost estimate is provided for this option.
- Full service capability for maintaining all components of commuter rail vehicles at a new yard & shop facility could be provided along the corridor (as assumed in this report). This type of facility could be cost-effective if future corridor expansion is anticipated.

The final type and location of maintenance facility capacity would be dependent on several key issues, including the selection of vehicle equipment:

- Locomotives, cab cars and coaches; or
- DMUs

Once the desired equipment type is selected, the type of maintenance facilities needed would be more easily defined. If locomotives, cab cars and coaches are selected, resources must be provided for all three vehicle types. If DMUs are selected, there would be one equipment type but with a broader range of requirements. The modular design of DMUs such as those manufactured by Colorado Railcar could make the utilization of an on-corridor third-party maintenance provider feasible.

The level and capacity of maintenance to be provided on-corridor should also be determined. Factors that would drive this choice include:

- Train frequency and corridor length – how much equipment must be maintained
- Shop capacity and capability at other facilities (such as third-party service providers), including cycle time to the other facilities

The higher the level of train service desired in terms of both frequency and corridor length, the more equipment will be required. Lower levels of train service, with fewer train sets would suggest a lighter level of maintenance to be performed on-corridor. If
higher levels of train service are required, or as higher levels develop over time, on-
corridor maintenance could potentially become more cost-effective.

3.1.5 Stations

Conceptual evaluations of commuter rail stations included a very limited assessment of the existing site, access and circulation, parking requirements and adjacent land use activities. Maps readily available from the King County and Snohomish County Web sites were the primary sources of information on existing conditions, including topography, street network, parcel boundaries, etc.

Stations are assumed to be provided with platforms (primarily side configuration) that are 200 feet in length. These platforms would accommodate the assumed maximum design length of a two-car DMU or a locomotive hauling one passenger car and one cab car. Stations are assumed to conform to Americans with Disabilities Act (ADA) criteria.

Commuter rail stations are assumed at the following locations (listed south to north) along the Woodinville Subdivision mainline:

1. Renton/Gene Coulon Park (terminal)
2. Renton/Port Quendall/NE 44th Street
3. Bellevue/Newport Park-and-Ride/112th Avenue NE
4. Bellevue/NE 6th Street
5. Bellevue/NE 12th Street
6. South Kirkland Park-and-Ride
7. Kirkland/NE 85th Street
8. Kirkland/Totem Lake
9. South Woodinville/NE 145th Street (provides transfer to Redmond spur line service)
10. Woodinville CBD
11. North Woodinville/NE 195th Street
12. Maltby
13. Cathcart
14. Snohomish CBD (terminal)

Two (2) stations are assumed at the following locations (listed west to east) along the Redmond spur line:

15. South Woodinville/NE 145th Street (terminal; provides transfer to mainline service)
16. Redmond CBD (terminal)

This study evaluated sixteen (16) stations, which is a relatively high number of stations for a commuter rail corridor of this length. Close station spacing increases train travel time and delay and increases operational and capital costs. Fewer stations might be implemented by a commuter rail operator.
Station Descriptions

Following is a brief description of the assumed conditions, passenger facilities and other issues/considerations for each of the assumed stations. See Figure 3.1 for a map showing the station locations.

Many of the station locations described below are at or near existing transit centers, park-and-ride facilities or provide for other transit transfer opportunities. Possible station locations could be evaluated for opportunities to provide commuter rail patrons with access (via transfers) to employment, retail, intermodal (e.g., SeaTac Airport) and other destinations not located along the Eastside corridor.

Some portions of the BNSF Eastside corridor between NE 6th Street and NE 12th Street in Bellevue (station locations 4 and 5) and through downtown Redmond (station location 16) identified in this feasibility analysis are currently being considered in Sound Transit’s East Link project which extends light rail across I-90 from downtown Seattle to downtown Bellevue and east to the Overlake Transit Center and downtown Redmond. The portions of the BNSF under consideration include a segment between I-90 and 118th Avenue SE, a segment between NE 6th Street and just north of NE 12th Street, a crossing of the BNSF Eastside corridor north of NE 12th Street, and a segment through downtown Redmond. The BNSF Eastside corridor is generally 100 feet wide and could accommodate light rail, commuter rail and a pedestrian/bicycle trail in most locations. In areas where stations are under consideration (and in locations where the corridor is less than 100 feet wide), additional right-of-way would likely need to be acquired to accommodate the stations.

A draft environmental impact statement for the East Link project was issued on December 12, 2008 for public and agency review through February 25, 2009. The Sound Transit Board plans to identify a preferred alternative for the East Link project in spring 2009, informed by public and agency review and comment. A final EIS will be prepared in summer 2010. The Board will then select the project to be implemented. If the East Link preferred alternative includes use of the BNSF Eastside right-of-way in these sections, this would be coordinated with the owner of the right-of-way. If a commuter rail system was to be implemented, pedestrian and bicycle connections between the two modes could be provided to facilitate intermodal transfers. Commuter rail patrons could transfer to East Link light rail (and vice versa) for access to employment, retail and other regional destinations.

1. Renton/Gene Coulon Park (terminal) (approx. MP 4.1)
   An at-grade station with a 200’ side platform is assumed at this location, which is the southern terminus of the representative commuter rail operations. The station would be located at Gene Coulon Park in Renton. An additional siding track at this terminal station is assumed for operational flexibility.

   Walkways could be provided to connect the station platform to bus loading zones. The site is not sufficient to allow a separate parking lot, but it is assumed that commuter rail
passengers would use the existing parking lot at Gene Coulon Park. Commuter rail passenger parking may have different peak occupancy characteristics than park users, which could allow for shared use of the existing parking capacity.

It is assumed that all station facilities could be accommodated within the corridor right-of-way and/or existing public right-of-way.

The existing rail line continues south of this commuter station through Renton to the Black River Junction. That section of track is not being sold by BNSF and is not an integral part of this study. The station is located north of the long curve and north of the Boeing plant spur connection.

2. Renton/Port Quendall/NE 44th Street (approx. MP 6.3)
An at-grade station with a 200’ side platform is assumed at this location. The station would be located about 400 feet southwest of the I-405/NE 44th Street interchange in Renton. This arrangement makes the station available to patrons that live in the developing Newcastle area east of I-405.

The 30-acre Quendall Terminals site (part of Port Quendall area) is undergoing environmental clean-up, and future land uses have not been determined at this time. It is assumed that a small portion of the large undeveloped parcel (requiring some right-of-way acquisition) could be used for the station facilities, which would include the following:

- Side platform
- Bus loading zones
- Passenger drop-off area
- Parking (medium size surface lot assumed)
- Pedestrian and bicycle connections to (future) surrounding development

3. Bellevue/Newport Hills Park-and-Ride/112th Avenue NE (approx. MP 8.0)
An at-grade station with two 200’ side platforms is assumed at this location. A passing siding is assumed at this location, so two side platforms are assumed for this station. The station would be located southwest of the I-405/Lake Washington Boulevard/112th Avenue SE interchange in Bellevue.

The existing Newport Hills Park-and-Ride is located east of I-405 and north of 112th Avenue SE. It is assumed that commuter rail patrons would use this parking lot and/or bus connections. From the park-and-ride, patrons would walk across the freeway overpass and a short distance along 106th Avenue SE (along improved sidewalks). Due to the area’s steep topography, a system of walkways, stairways and elevators are assumed to provide access between the station platforms and the street.

It is assumed that all station facilities could be accommodated within the corridor right-of-way and/or existing public right-of-way.
4. Bellevue/NE 6th Street (approx. MP 12.6)
An at-grade station with a 200’ side platform is assumed at this location. This station would be located south of NE 8th Street and immediately north of the proposed NE 6th Street extension in Bellevue. Based on its proximity to downtown Bellevue employment and retail destinations, it is anticipated that this station would be a primary (inbound) destination of commuter rail trips.

The City of Bellevue proposes to extend NE 6th Street as a HOV-only facility from its current terminus in the I-405 median across the Eastside corridor to 120th Avenue NE. This project is currently unfunded. A pedestrian and bicycle pathway would be provided along the new street extension. The pathway would provide pedestrian and bicycle access from the station to downtown Bellevue. The proposed King County Bellevue-Redmond RapidRide could potentially use the new NE 6th Street corridor between the Bellevue Transit Center and 120th Avenue NE. If routed along NE 6th Street adjacent to the assumed commuter rail station, the RapidRide route could provide commuter rail patrons with frequent transit service to the Bellevue Transit Center. Prior to implementation of the NE 6th Street extension, the proposed RapidRide route would use NE 8th Street to cross over I-405; in this situation, commuter rail patrons could access the RapidRide route at NE 8th Street. Pedestrians and bicyclists could use the NE 4th Street or NE 8th Street bridges to get from the station to the Bellevue Transit Center and other downtown destinations. On-street bus loading zones could be provided at the commuter rail station. No parking would be provided at this station.

For this level of analysis, it is assumed that all commuter rail station facilities could be accommodated within the corridor right-of-way and/or existing/future public right-of-way.

5. Bellevue/NE 12th Street (approx. MP 13.2)
An at-grade station with two 200’ side platforms is assumed at this location. A passing siding is assumed at this location, so two side platforms are assumed for this station. The station would be located about 600 feet north of the existing NE 12th Street bridge over the tracks in Bellevue.

As part of a master plan for redevelopment of the Bel-Red Corridor, the City of Bellevue proposes to re-align NE 12th Street in this area. The station would be connected to the sidewalk of the new NE 12th Street bridge (which is assumed to have bus service) using a system of stairways and elevators. No parking would be provided at this station.

For this level of analysis, it is assumed that all station facilities could be accommodated within the corridor right-of-way and/or existing/future public right-of-way.

6. South Kirkland Park-and-Ride (approx. MP 14.7)
An at-grade station with a 200’ side platform is assumed at this location. The station would be located in the northeast corner of the existing South Kirkland Park-and-Ride.
Due to the site’s steep topography, a system of walkways, stairways and elevators are assumed to provide access between the station platform and the Park-and-Ride. Patrons could also use the sidewalk along NE 108th Avenue between the platform and the main entrance to the parking area. It is assumed that commuter rail patrons would use the existing bus loading and passenger drop-off areas at the Park-and-Ride.

A parking garage has been contemplated for future development on the site. If suitably located, the garage elevators could provide pedestrian access to/from the station platform if supplemented with elevated walkways.

It is assumed that all station facilities could be accommodated within the corridor right-of-way and/or existing/future public right-of-way.

7. Kirkland/NE 85th Street (approx. MP 17.5)
An at-grade station with a 200’ side platform is assumed at this location. The station would be located along tangent (straight) track north of NE 87th Street in Kirkland.

It is assumed that right-of-way acquisition would be required for this station. Assumed station facilities include the following:
- Side platform
- Bus loading zones
- Passenger drop-off area
- Parking (small size surface lot assumed)

8. Kirkland/Totem Lake (approx. MP 19.8)
An at-grade station with a 200’ side platform is assumed at this location. The station would be located immediately south of the intersection 124th Avenue NE (aka Totem Lake Boulevard) and NE 124th Street in Kirkland’s Totem Lake area.

It is assumed that right-of-way acquisition would be required for this station. Assumed station facilities include the following:
- Side platform
- Bus loading zones
- Passenger drop-off area
- Parking (small size surface lot assumed)

9. South Woodinville/NE 145th Street (provides transfer to Redmond spur line service) (approx. MP 22.7)
An at-grade station with a 200’ side platform is assumed at this location. This station would be located north of the Tolt Pipeline Trail crossing of the corridor in Woodinville.

This station serves also as a transfer point to the Redmond spur line. The Redmond spur line station would be located across Woodinville-Redmond Road from this station and would be accessed by pedestrian and bicycle connections.
It is assumed that right-of-way acquisition would be required for this station. Assumed station facilities include the following:

- Side platform
- Bus loading zones
- Passenger drop-off area
- Parking (medium size surface lot assumed)

10. Woodinville CBD (approx. MP 24.7)
An at-grade station with a 200’ side platform is assumed at this location. This station would be located west of 132nd Avenue NE in Woodinville.

Pedestrian and bicycle connections would be provided to new bus loading zones. No parking would be provided at this station.

It is assumed that all station facilities could be accommodated within the corridor right-of-way and/or existing public right-of-way.

11. North Woodinville/NE 195th Street (approx. MP 25.9)
An at-grade station with two 200’ side platforms is assumed at this location. A passing siding is assumed at this location, so two side platforms are assumed for this station. The station would be located immediately north of NE 195th Street in Woodinville.

It is assumed that right-of-way acquisition would be required for this station. Assumed station facilities include the following:

- Side platform
- Bus loading zones
- Passenger drop-off area
- Parking (small size surface lot assumed)

12. Maltby (approx. MP 29.9)
An at-grade station with one 200’ center platform is assumed at this location. A passing siding is assumed at this location and a freight siding (third track) also exists in this section, so a center platform is assumed for this station. The station would be located near the intersection of Yew Way and Paradise Lake Road.

It is assumed that right-of-way acquisition would be required for this station. Assumed station facilities include the following:

- Center platform
- Bus loading zones
- Passenger drop-off area
- Parking (small size surface lot assumed)

13. Cathcart (approx. MP 33.9)
An at-grade station with a 200’ side platform is assumed at this location. This station would be located at the north end of Railroad Way (north of Elliott Road) in the Cathcart area of Snohomish County.
It is assumed that right-of-way acquisition would be required for this station. Assumed station facilities include the following:

- Side platform
- Bus loading zones
- Passenger drop-off area
- Parking (small size surface lot assumed)

14. Snohomish CBD (approx. MP 38.9)
An at-grade station with a 200’ side platform is assumed at this location, which is the northern terminus of the representative mainline commuter rail system. This station would be located along Lincoln Avenue south of 4th Street in the City of Snohomish. The station would be located adjacent to the new City Library. An additional siding track at this terminal station is assumed for operational flexibility.

Walkways could be provided to connect the station platform to on-street bus loading zones. The site is not sufficient to allow a separate parking lot, but it is assumed that commuter rail passengers would use on-street stalls, or the existing parking lot at the City Library or City Park/Swim Center (one block south). Commuter rail passenger parking may have different peak occupancy characteristics than the library or park users, which could allow for shared use of the existing parking capacity.

It is assumed that all station facilities could be accommodated within the corridor right-of-way and/or existing public right-of-way.

This station location in Snohomish could preclude the ability to extend continuous commuter rail service to Everett Station along the BNSF Scenic Subdivision.

15. South Woodinville/NE 145th Street (Redmond spur line terminal; provides transfer to mainline service) (approx. MP 1.4)
An at-grade station with a 200’ side platform is assumed at this location, which is the western terminus of the representative Redmond spur line commuter rail system. This station would be located along Woodinville-Redmond Road in Woodinville. This station would be across the street from the mainline station, which would be accessed by pedestrian and bicycle connections.

This station would share passenger facilities with the mainline station. In addition, this station would provide some additional parking and passenger drop-off areas.

The Redmond spur line track continues north from this location and intersects with the mainline just south and west of the Woodinville CBD. South Woodinville was assumed as the transfer location to the mainline (instead of Woodinville CBD) to minimize out-of-direction travel for Redmond patrons headed for destinations to the south, such as Bellevue.
It is assumed that all station facilities could be accommodated within the corridor right-of-way and/or existing public right-of-way.

16. Redmond CBD (terminal) (approx. MP 6.8)  
An at-grade station with a 200’ side platform is assumed at this location, which is the eastern terminus of the representative Redmond spur line commuter rail system. This station would be located west of 166th Avenue NE, across from Redmond Town Center in Redmond. An additional siding track at this terminal station is assumed for operational flexibility.

Pedestrian and bicycle connections would be provided to new on-street bus loading zones. No parking would be provided at this station.

For this level of analysis, it is assumed that all station facilities could be accommodated within the corridor right-of-way and/or existing public right-of-way.

Alternative Location for Snohomish Station  
An alternative location for a station serving the City of Snohomish could be sited south of the Snohomish River. The alternative location could conceivably provide the potential for the extension of commuter rail service to Everett Station along the BNSF Scenic Subdivision and a connection to Harvey Airfield (costs for this extension are not included).

Potential for Transit- and Pedestrian-Oriented Development  
This study included a brief analysis of the potential for each assumed station area to support transit- and pedestrian-oriented development. Transit-oriented development (TOD) is a strategy available to help manage growth and improve the quality and functionality of communities. TOD provides communities with a more sustainable, integrated transportation and development alternative to low-density suburban sprawl and automobile-dependent land use patterns. It seeks to align transit investments with a community’s vision for how it wants to grow, creating more livable, higher density, mixed-use, and walkable “transit villages.” A successful TOD will reinforce both the community and the transit system.

In general, TOD is a more sustainable form of development because people living and working in TODs are more likely to walk, use transit, and own fewer cars. In addition, the higher density development found in TODs can reduce urban expansion pressures on surrounding resource land. TOD households own roughly one-half as many vehicles as the average U.S. household. At an individual station, TOD has been shown to increase transit ridership by 20 to 40 percent and even cause significant change at a regional level. People who live in a TOD are five times more likely to commute by transit than other area residents. Recent research conducted by the Transportation Research Board found that residential development in 17 residential developments in TODs generated 44% less
weekday traffic compared to accepted trip generation figures in the ITE (Institute of Transportation Engineers) *Trip Generation Handbook.*

Existing land use information, comprehensive plans, and development requirements were collected and evaluated for the eight jurisdictions along the Eastside corridor. The evaluation report considered:

- **Transit-Supportive Development Characteristics** that are necessary to create functionally successful integration of rail transit with the surrounding communities it serves. *Transit-Oriented Development (TOD)* is the term often used to refer to development characteristics that are pedestrian-friendly and conducive to successful integration of land development and transit.
- **Base Case Land Use Evaluation** that summarizes the key elements for transit-supportive development near potential future passenger rail stations; and
- **Summary Evaluation – Existing Land Use and Transit-Supportive Corridor Policies and Regulations** that provide an initial assessment of the corridor and its level of support for pedestrian activity and transit use.

The relative consistency of the existing land use and plan policies and regulations for each of the 16 assumed commuter rail station locations were evaluated against the following four basic TOD principles:

- Greater density than the community average;
- A mix of uses;
- Quality pedestrian environment; and
- A defined center.

**Summary/Conclusions**

Appendix F provides an evaluation report of the potential for each assumed station to support transit- and pedestrian-oriented development. Based on the analysis described in this report, the majority of the assumed station areas do not demonstrate the potential to support transit-and pedestrian-oriented development, based on their existing land uses, plan policies and regulations. In general, the BNSF Eastside corridor is not well oriented to serve the Eastside’s urban and activity centers and instead winds its way through low density residential and industrial areas. The corridor does not directly serve downtown Bellevue, the Eastside’s largest activity center (and a designated regional growth center). In addition, most of the Snohomish County portion of the corridor is outside the region’s designated urban growth area. However, some of the assumed station areas have existing or planned land uses and densities to potentially support TOD. The assumed stations that show the highest potential for TOD are the following (not in any order):

- Bellevue/NE 12th Street (included in Bellevue’s Bel-Red Corridor Study area)
- South Kirkland Park-and-Ride (TOD project by King County is in the planning stages)
- Kirkland/Totem Lake (designated regional growth center)

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*The corridor is located in portions of unincorporated King County, but no stations are assumed along those segments of the corridor. Stations are assumed in seven jurisdictions.*
3.1.6 Vehicles

Vehicle selection (train equipment type) would be a major consideration for any service along the Eastside corridor.

As described in Section 4, Sounder-type vehicles (i.e., diesel locomotives, cab cars and coaches) would likely be more expensive than DMU vehicles. In addition to cost, the final choice of equipment to be used for new service could depend on several factors, such as:

- What level of commuter rail service is desired?
  - What origin – destination pairs could be served?
  - What frequency of service could be required?
- Could DMUs adequately meet service requirements?
- Following detailed bridge evaluations, could the use of lighter-weight DMUs potentially reduce the cost to improve rail bridges along the corridor?
- Do the vehicles need to be Federal Railroad Administration (FRA) compliant (i.e., will freight trains be operating along the same tracks during the same periods of time)?

DMUs can be configured to match or exceed the passenger capacity of the Bombardier coaches. The Colorado Railcar bi-level can seat up to 185 passengers and weighs 163,000 lbs; the single-level seats 98 passengers and weighs 148,000 lbs. A Sounder F59PHI weighs in at 285,600 and the Bombardier bi-level weighs 118,500 lbs and will seat 140 passengers. However trains are configured, DMUs offer more seating capacity per pound of equipment weight. This weight difference could potentially become a significant factor in future structural load evaluations of the rail bridges along the Eastside corridor.

DMU equipment could be less expensive to acquire, operate, and maintain (unless new maintenance capacity is required for DMU only). The equipment is lighter in weight and could be relatively economical for start-up track and rail bridge rehabilitation.

FRA Compliant Vehicles

FRA-compliant equipment is built to strength standards established and required by the FRA and is intended to ensure that such equipment satisfies crash-worthiness requirements to operate safely in Class 1, 2, or 3 railroad environments. FRA non-compliant equipment is typically LRT and subway-type equipment that operate on isolated networks and never share facilities with FRA-compliant equipment.

The Eastside corridor serves existing active freight rail customers. These customers will be shipping and receiving freight by rail for the foreseeable future and additional freight rail customers could potentially be added. If commuter rail trains would be operating along the same tracks and during the same time periods as conventional freight rail trains, FRA-compliant equipment would be required. In some other rail corridors around the
U.S., temporal separation is used to maintain compliance, with freight trains operating only during nighttime hours.

If commuter rail operations were to be extended to Tukwila and/or Everett, operations along tracks that currently carry significant levels of freight traffic would require the use of FRA compliant equipment.

### 3.1.7 Commuter Rail Operations

For purposes of this study, it was assumed that trains would operate every 30 minutes in each direction all day along each line (i.e., mainline and Redmond spur line). Commuter rail trains were assumed to operate at a maximum of 60MPH for the majority of the corridor, with an average speed of 24MPH (including station stops)\(^8\). Train speeds were not evaluated or modeled in any detail for purposes of this feasibility study. For this study, commuter rail train speeds were based on FRA Class 3 track using the existing track alignment (including on curves and bridges), maximum allowed elevation/superelevation of track for passenger trains per AREMA specifications, and estimated acceleration/deceleration capabilities of DMU vehicles (DMU vehicles were assumed for illustrative purposes only). Detailed rail operations modeling (for all trains expected to use the corridor) would be completed during a future design phase.

Based on the assumed average train travel speed of 24MPH (including station stops), estimated train travel times are shown in Table 3.1.

#### Table 3.1: Commuter Rail Train Travel Time (Assuming 24MPH Average Speed)

<table>
<thead>
<tr>
<th>Segment</th>
<th>Travel Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segment 1 (8.2 miles)</td>
<td>Renton (Gene Coulon Park) to Bellevue</td>
</tr>
<tr>
<td>Segment 2 (13.5 miles)</td>
<td>Bellevue to North Woodinville</td>
</tr>
<tr>
<td>Segment 3 (12.4 miles)</td>
<td>North Woodinville to Snohomish</td>
</tr>
<tr>
<td>Segments 1+2+3 (34.1 miles)</td>
<td>Renton to Snohomish</td>
</tr>
<tr>
<td>Segment 4 (6.9 miles)</td>
<td>Redmond to South Woodinville via spur</td>
</tr>
</tbody>
</table>

### 3.1.8 Potential Extensions to Tukwila and Everett

While not part of the representative commuter rail system and not included in the capital cost estimate, the ability to potentially extend commuter rail operations to connect to Sound Transit commuter rail services at Tukwila and Everett was briefly considered at a qualitative level only, primarily for ridership forecasting purposes (see Section 5).

Extension of commuter rail service to the south to Tukwila Sounder Station would require the following:

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\(^8\) E-mail from Bob Harvey, Sound Transit, 9/24/2008.
• Replacement of a wye track connecting the Woodinville Subdivision with the BNSF Seattle Subdivision to the south. The wye track was previously removed from this location. Replacement would require a new rail bridge over the Black River (and possibly over Monster Road). These improvements are not included in the cost estimate.

• Approval from BNSF to operate on its Woodinville Subdivision and Seattle Subdivision tracks between the southern end of the acquisition area (i.e., Gene Coulon Park) and Tukwila Sounder Station. Approval from BNSF may require restrictions and/or costs that are not included in the cost estimate.

Extension of commuter rail service to the northwest to Everett Station would require the following:

• Approval from BNSF to operate on its Scenic Subdivision tracks. Approval from BNSF may require restrictions and/or costs (not included in the cost estimate). It is assumed that no spare track capacity exists along this single-track corridor, so construction of a second track could be required through the Snohomish River floodplain to Everett, including numerous new trestles across wetland areas. These improvements are not included in the cost estimate.

• Siting of the station to serve the City of Snohomish south of the Snohomish River rather than in the Snohomish CBD as assumed in this report. These improvements are not included in the cost estimate.

3.2 Trail

Per SHB 3224, this feasibility study is required to present a cost estimate for a concurrent (parallel) trail “along or near the Woodinville Subdivision.” Based on the limited geographic information available for the entire corridor and the conceptual level of this study, the cost estimate for the parallel trail should be considered very preliminary and conceptual in nature.

Consistent with SHB 3224, it is assumed that the representative trail would be located parallel to the track(s) in the right-of-way (generally 100’ wide) of the Eastside corridor. For purposes of this study, it assumed that the parallel trail will fit within the available right-of-way. South of Bagley Lane (approx. MP 8.65 near Newcastle Beach Park in south Bellevue), constrained right-of-way (approximately 10-35 feet in width in places) and/or potential encroachment may limit the potential width of the trail in places. In addition, the planned widening of I-405 may have right-of-way impacts in this area. Therefore, the Higher Cost option trail cost estimate provides for only the minimum (12 foot) trail cross section between Gene Coulon Park and Bagley Lane with the 29 foot cross section assumed elsewhere in King County. The Lower Cost option trail cost estimate assumes the minimum 12 foot cross section for all segments in King County. Right-of-way limitations along the corridor have not been identified or evaluated as part of this study. An evaluation of available right-of-way would need to be completed during design.
3.2.1 Trail Cost Estimate Approach

The general approach that was used to establish the cost estimate for the trail was to establish a limited set of typical trail cross-sections, and then to determine which of these cross-sections would apply along each section of the corridor. A rough order-of-magnitude cost estimate was generated by calculating the quantities of materials needed to build a trail based on the application of these simplified cross-sections throughout the corridor.

Each cross-section (see Appendix G) depicts a sectional view of the corridor with the various types of existing typical topographical features that are encountered. A representative trail section is also depicted on each sectional view, and it shows how the construction of the trail could be accomplished in conjunction with each type of existing topography. The cross-sections generally fall into one of three categories: (1) a trail constructed on retained fill on top of an existing rail bed side slope, (2) a trail constructed by cutting into a hillside adjacent to the existing rail bed, or (3) a trail constructed on top of level ground adjacent to the existing rail bed.

Using aerial photography, the corridor was analyzed to determine which of these cross-sections would apply to each section of the corridor. In sections where the track is bounded by a raised hillside on one side and a dropping side slope on the other, it was assumed that the trail would typically be constructed on retained fill on the downhill side of the rail in order to minimize construction costs (although in certain instances this assumption was not maintained due to other local constraints).

Due to differing county standards for trail construction, the assumed cross-section of the trail area varies by the county in which the trail would be located. In King County, two trail cross sections were used, one representing a “higher cost” option and the other representing a “lower cost” option. The higher cost option would provide a full-width trail per current (but not adopted) King County Parks Department recommendations, which call for:

- 5-foot left side vegetated clear distance (including a 1-foot shy distance)
- 5-foot soft widened shoulder
- 12-foot paved trail
- 2-foot soft shoulder
- 5-foot right-side vegetated clear distance (also including a 1-foot shy distance).

The minimum cost option is representative of minimum national practice guidance and would provide:

- 2-foot left-side shy distance
- 8-foot paved trail (minimum paved shared use trail width per AASHTO guidelines)
- 2-foot right-side shy distance

---

9 Due to constrained right-of-way south of approx. MP 8.65, only the “lower cost” option (minimum AASHTO guidelines) was applied to the trail in that section of the corridor.
The Snohomish County trail area cross section widths (based on Snohomish County trail construction standards) would be consistent between higher and lower cost options and would include the following elements:

- 4½-foot left-side shoulder
- 6-foot paved trail
- 4½-foot right-side shoulder

In sections where the track is located on an embankment, the lower cost option for Snohomish County would provide the trail at-grade. For those same sections, the higher cost option for Snohomish County would provide the trail at the same elevation as the track (on embankment). While the latter option could keep the trail out of the Snohomish River flood plain, the former option could result in periodic flooding of the trail area.

It was assumed that the trail would typically be located at the outer edge of the existing right-of-way, as far from the track centerline as possible (for a variety of reasons including trail safety, noise, vibration, aesthetics and access). To separate the trail area from the track(s), a six-foot tall barrier fence is assumed to be located at least 15 feet from the centerline of the nearest track. The purpose of the fence (required by the easement agreement between the Port of Seattle and King County) is to restrict trail users from entering the track area. The fence cost is included in the trail cost estimate.

Typical cross sections for the trail area are included in Appendix G.

### 3.2.2 Limitations of Conceptual Cost Estimate

For the purposes of this feasibility study, it was assumed that no additional private right-of-way would be acquired to accommodate the construction of the representative trail. The existing track typically runs down the center of a 100’ wide right-of-way corridor, allowing enough room to locate the trail area on either side of the track area. However, there are locations where the available right-of-way width has been narrowed due to the railroad selling off some portions of its property over the years and/or due to apparent encroachment. In certain locations this could necessitate the purchase of private property, either in fee or by rights, in order to construct and operate the trail. These locations (and potential options) would need to be identified and evaluated in a future design and environmental analysis phase. Based on the limited data available and the conceptual nature of this study, these potential right-of-way impacts and costs were not captured as part of this estimate.

The available data that was used to model the surface features of existing topography are not accurate enough for preliminary or final engineering/design. The existing topography was approximated from readily available contour data from various public agencies. The available data is low-resolution with limited use for engineering purposes. It is understood that this feasibility study is conceptual in nature and additional engineering and environmental analysis would need to be conducted in a later phase.

The existing track alignment and profile were generated using railroad track charts originally drawn in the early part of the 20th Century and updated over time. It is
understood that this feasibility study is conceptual in nature and additional engineering and environmental analysis would need to be conducted in a later phase.

This estimate should not be construed as being based on a formally-engineered trail design. The level of engineering that was used would be classified as “generalized” at best, with no detailed site engineering performed.

Detailed evaluation of a potential trail will require that these limitations be addressed by detailed property title research, field surveys, topographical data collection, etc., as well as detailed engineering design and environmental analysis.

### 3.2.3 Trail Bridges

A bridge for the trail has been assumed at the location of each existing rail bridge, with some exceptions. Trail bridges are described in Section 3.1.2 (Bridges).

### 3.2.4 Additional Information

#### Trail Access

This feasibility study did not develop a trail design. However, it is assumed that a trail in the Eastside corridor could be connected to other regional trails in the area. In addition, potential commuter rail stations could potentially serve as access points for the trail if appropriate connections and facilities are provided. Evaluation of these and other commuter rail and trail design elements (such as secure bicycle parking at commuter rail stations) would need to be completed during the design phase.

#### Bicycle Access to Sound Transit’s Sounder Commuter Rail System

*Note: the following information is not intended to provide a forecast of bicycle usage of the representative parallel trail or commuter rail system described in this report and is included for illustrative purposes only.*

According to a recent survey, 84 of the total 87 bicycle lockers at the Sounder commuter rail stations were occupied. In addition, Sound Transit has conducted surveys of the number of bicycles carried on-board its Sounder trains. In August 2008, on an average weekday, bicycles were brought on-board the trains a total of 275 times. For an average weekday in November 2008, bicycles were brought on-board the trains a total of 170 times. The generally higher use of bicycles during summer months in the Pacific Northwest climate may explain the difference between the counts during those two months.

According to a Sound Transit survey conducted at Sounder stations in 2004, approximately one (1) percent of respondents said that they used a bicycle to get to the station. By 2007, bicycling as a mode of access to the Sounder stations had increased to five (5) percent.
Use Data for King County Regional Trail System

Note: the following information is not intended to provide a forecast of usage of the representative parallel trail described in this report and is included for illustrative purposes only.

Based on information provided by the King County Parks Department, the number of users on the Burke-Gilman and Sammamish River Trails combined is between 1.5-2 million annually. Bicycling is the most popular use, especially where trails are interconnected and paved:

- 82% of users of Burke-Gilman and Sammamish River Trails (paved and interconnected) are bicycling
- 58% of users of South King County trails (paved and interconnected) are bicycling
- 33% of users of East Lake Sammamish Trail (soft-surface, limited existing connections) are bicycling

3.3 Basis of Definition for Representative Commuter Rail System and Parallel Trail

This section describes the basis of information used in this conceptual feasibility study.

3.3.1 GIS Data

All existing base mapping, aerial photography, topographic, and right-of-way information used to develop the representative commuter rail system and parallel trail was based on available information. GIS data were not consistently available for the entire corridor. Where available, information on other planned or proposed transportation improvements was considered in defining the representative commuter rail system and parallel trail.

3.3.2 Geotechnical

No geotechnical data was collected as part of this definition of the representative commuter rail system and parallel trail.

3.3.3 Utilities

No utility studies were prepared as part of this analysis. Anticipated utility work includes protecting and relocating typical existing utilities that would impacted by any construction. Existing aerial utilities impacted by construction, except high tension power lines, would be undergrounded as required by municipal code. No utility survey, test pits or pot holes were prepared as part of the utility investigations for this study and would be required during a design phase.
3.3.4 Right-of-Way Acquisition

Based on the conceptual nature of this study and limited GIS data available, right-of-way acquisition costs for the representative commuter rail system are only included for the assumed station and maintenance facility sites. Estimated right-of-way needs were determined based on the typical station features, such as parking and passenger drop-off areas, that could be potentially located at each station. Based on the facilities assumed for each particular station and the corridor width (typically 100 feet) and adjacent public right-of-way, the acquisition of private right-of-way may not be required for all station sites. Where identified, property impacts were generally assumed to be ‘full acquisitions’ of impacted parcels, unless the anticipated potential impact was substantially smaller than the total parcel size and obviously did not involve any existing buildings. Parcel boundaries were identified using parcel maps readily available from the King County GIS Center and Snohomish County Web sites. Subsequent design would be needed to confirm the right-of-way requirements, including temporary and permanent easements, necessary for construction and operation of a commuter rail system.

Based on the conceptual nature of this study and limited GIS data available, no identification was attempted of the potential right-of-way impacts of developing the representative parallel trail. For this study, it is assumed that the trail would be located within the approximately 100’ wide Eastside corridor. However, the corridor is significantly narrower than 100’ in some places and may not accommodate a parallel trail use within the right-of-way. Subsequent design would be needed to confirm the right-of-way requirements, including temporary and permanent easements and/or acquisitions, necessary for construction and operation of a parallel trail.

4. Cost Estimate

Note: As part of the purchase and sale agreement for the Eastside corridor, BNSF intends to transfer (i.e., sell) an easement\(^\text{10}\) to a third party operator (TPO), which would then have the exclusive rights to operate rail service along the northern portion of the Woodinville subdivision mainline (i.e., Woodinville to Snohomish). GNP/Ballard (a joint venture of GNP Rly Inc. and Ballard Terminal Railroad Company, LLC) has been selected by BNSF as the TPO\(^\text{11}\). A separate easement covers maintenance, repair, replacement and use of the existing railroad bridge across the Snohomish River by the Port of Seattle, BNSF and the TPO. This conceptual cost estimate does not attempt to identify or address any potential restrictions and/or requirements (such as capital infrastructure upgrades and/or financial payments) that the TPO (or others) may require from an entity for its operation of commuter rail service along the portion of the corridor subject to these easements.

---

10 Form of Freight Easement Sale Agreement, Exhibit H to Purchase and Sale Agreement: Woodinville Subdivision - North Rail Line (approved by BNSF, Port of Seattle and King County, May 2008).
4.1 Capital Cost Estimate

As described in this section, the total capital cost estimate to provide the representative commuter rail system and parallel trail is between $1.3 and $1.7 billion (2nd Qtr 2008$). The cost estimate is included as Appendix A.

4.1.1 Assumptions

Section 2 provides the assumptions upon which the following capital cost estimates for the representative commuter rail system and parallel trail are based.

4.1.2 Commuter Rail System Capital Cost Estimate

Estimated capital costs for design and construction of the representative commuter rail system (excluding maintenance facility and vehicles, see below) are shown in Table 4.1 along with key quantities. The table includes the capital cost for DMU vehicles (DMU vehicle costs are shown for illustrative purposes only). Locomotive-hauled vehicle equipment is estimated to cost approximately $6.01 to $6.91 million (2nd Qtr 2008$) more than DMU equipment. Costs for the maintenance facility and corridor acquisition (by the Port of Seattle) are also shown. Cost estimates are provided in ranges.
### Table 4.1: Commuter Rail System Capital Cost Estimate and Key Quantities

<table>
<thead>
<tr>
<th>Commuter Rail System: Key Quantities</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of Segment (miles)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of Curves (per Track Charts)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of Improved/New Rail Bridges</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of Significant* New Rail Bridges (also included in column “C”)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of Existing Grade Crossings (public + private)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Existing Grade Crossings per Mile (“E” ÷ “A”)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># of Stations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Segment 1 Renton-Bellevue
- Length of Segment: 8.2 miles
- # of Curves: 22
- # of Improved/New Rail Bridges: 10
- # of Significant* New Rail Bridges: 2
- # of Existing Grade Crossings: 15
- Existing Grade Crossings per Mile: 1.8
- # of Stations: 3

#### Segment 2 Bellevue-Woodinville
- Length of Segment: 13.5 miles
- # of Curves: 30
- # of Improved/New Rail Bridges: 4
- # of Significant* New Rail Bridges: 0
- # of Existing Grade Crossings: 32
- Existing Grade Crossings per Mile: 2.4
- # of Stations: 8

#### Segment 3 Woodinville-Snohomish
- Length of Segment: 12.4 miles
- # of Curves: 36
- # of Improved/New Rail Bridges: 8
- # of Significant* New Rail Bridges: 1
- # of Existing Grade Crossings: 20
- Existing Grade Crossings per Mile: 1.6
- # of Stations: 3

#### Segment 4 Redmond spur Redmond-Woodinville
- Length of Segment: 6.9 miles
- # of Curves: 9
- # of Improved/New Rail Bridges: 3
- # of Significant* New Rail Bridges: 0
- # of Existing Grade Crossings: 40
- Existing Grade Crossings per Mile: 5.8
- # of Stations: 2

**Total**
- Length of Segment: 41.1 miles
- # of Curves: 97
- # of Improved/New Rail Bridges: 25
- # of Significant* New Rail Bridges: 3
- # of Existing Grade Crossings: 107
- Existing Grade Crossings per Mile: 2.6
- # of Stations: 16

*Significant Bridges are: New Rail/Trail Bridge over I-405 Southbound and New Rail Bridges at Wilburton Trestle and Snohomish River

### Commuter Rail System: Costs

<table>
<thead>
<tr>
<th>Costs in 2nd Qtr 2008 $Millions*</th>
<th>Track and Trackbed</th>
<th>Rail Bridges</th>
<th>Signals/ Train Control/ Crossings</th>
<th>Stations</th>
<th>Right-of-Way</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segment 1 Renton-Bellevue Low</td>
<td>$41.22</td>
<td>$118.62</td>
<td>$41.09</td>
<td>$18.67</td>
<td>$0.11</td>
<td>$219.71</td>
</tr>
<tr>
<td>High</td>
<td>$53.58</td>
<td>$154.21</td>
<td>$53.41</td>
<td>$24.27</td>
<td>$0.15</td>
<td>$285.62</td>
</tr>
<tr>
<td>Segment 2 Bellevue-Woodinville Low</td>
<td>$68.16</td>
<td>$4.25</td>
<td>$76.27</td>
<td>$46.25</td>
<td>$35.09</td>
<td>$230.02</td>
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<tr>
<td>High</td>
<td>$88.61</td>
<td>$5.52</td>
<td>$99.16</td>
<td>$60.13</td>
<td>$45.61</td>
<td>$299.03</td>
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<tr>
<td>Segment 3 Woodinville-Snohomish Low</td>
<td>$61.13</td>
<td>$86.99</td>
<td>$47.22</td>
<td>$17.46</td>
<td>$10.75</td>
<td>$223.55</td>
</tr>
<tr>
<td>High</td>
<td>$79.47</td>
<td>$113.09</td>
<td>$61.39</td>
<td>$22.70</td>
<td>$13.97</td>
<td>$290.62</td>
</tr>
<tr>
<td>Segment 4 Redmond spur Redmond-Woodinville Low</td>
<td>$37.44</td>
<td>$1.57</td>
<td>$66.92</td>
<td>$9.74</td>
<td>$0.00</td>
<td>$115.67</td>
</tr>
<tr>
<td>High</td>
<td>$48.67</td>
<td>$2.04</td>
<td>$87.00</td>
<td>$12.66</td>
<td>$0.00</td>
<td>$150.37</td>
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<tr>
<td>Total for Segments Low</td>
<td>$207.95</td>
<td>$211.43</td>
<td>$231.51</td>
<td>$92.12</td>
<td>$45.95</td>
<td>$788.96</td>
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<tr>
<td>High</td>
<td>$270.34</td>
<td>$274.86</td>
<td>$300.96</td>
<td>$119.75</td>
<td>$59.73</td>
<td>$1,025.65</td>
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<tr>
<td>Maintenance Facility Low</td>
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<td></td>
<td></td>
<td>$56.58</td>
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<tr>
<td>High</td>
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<td></td>
<td></td>
<td>$73.55</td>
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<tr>
<td>Vehicles (assumes DMU) Low</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>$64.11</td>
</tr>
<tr>
<td>High</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$73.73</td>
</tr>
<tr>
<td>Corridor Acquisition by Port** Low</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$107.00</td>
</tr>
<tr>
<td>High</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$1,016.65</td>
</tr>
</tbody>
</table>

(System-wide costs)

*Costs include contingencies, construction mgmt, environmental clearance and PE, final design and specifications, design services during construction, design review by others, permitting and agency admin. Costs do not include any requirements and/or restrictions by the TPO.

**This corridor was recently acquired by the Port of Seattle for $107 million.
4.1.3 Comparison to Capital Costs of Other Commuter Rail Projects

Commuter rail projects in the US encompass a wide variety of corridors, communities, existing conditions, and levels/scopes of improvement. Recent experience indicates that commuter rail projects may cost less than $6 million per mile up to more than $20 million per mile, depending on the circumstances of each project. For example, costs for commuter rail extension projects implemented along well-maintained mainline railroad corridors may be comprised only of stations, vehicles and other minor improvements. For projects along corridors such as the BNSF Eastside corridor, the potential for needed upgrades to track, structures, signals/train control, and/or crossings (and associated costs) could be much greater. Table 4.2 compares the estimated capital cost for the representative commuter rail system in the Eastside corridor with capital costs for several recent projects in the U.S.
### Table 4.2: Capital Cost Comparison to Select Commuter Rail Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Location</th>
<th>Length</th>
<th># of Stations</th>
<th>Commuter Rail Cost Est. (Millions)</th>
<th>Commuter Rail Cost Est./Mile (Millions)</th>
<th>Status</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BNSF Eastside Corridor</strong></td>
<td>Renton to Snohomish, plus Redmond spur (Segments 1-4)</td>
<td>41.1</td>
<td>16</td>
<td>$1,016.7 to $1,279.9</td>
<td>$24.7 to $31.1</td>
<td>Conceptual, feasibility study</td>
<td>Cost includes maintenance facility and vehicles.</td>
</tr>
<tr>
<td><strong>Sprinter</strong></td>
<td>Escondido to Oceanside, CA</td>
<td>22</td>
<td>15</td>
<td>$484.0</td>
<td>$22.0</td>
<td>Began service in March 2008</td>
<td>Cost includes a 1.7 mile loop of new track alignment to serve the California State University San Marcos campus. Cost includes maintenance facility and vehicles.</td>
</tr>
<tr>
<td><strong>Utah Transit Authority (UTA) Frontrunner South</strong></td>
<td>Salt Lake City to Provo, UT</td>
<td>45</td>
<td>8</td>
<td>$878.5</td>
<td>$19.5</td>
<td>Under construction</td>
<td>Project uses UPRR Mainline Class 4 track (79 mph). 55 grade crossings. No maintenance facility. Construction Cost Index for Salt Lake City is 18% lower than Seattle area.</td>
</tr>
<tr>
<td><strong>Denver Northwest Rail Corridor</strong></td>
<td>Denver to Boulder and Longmont, CO</td>
<td>41</td>
<td>7</td>
<td>$796.0</td>
<td>$19.4</td>
<td>Planning phase; DEIS being prepared.</td>
<td>Project will use UPRR track from Denver Union Station to Pecos and BNRR track from Pecos to Longmont. Cost does not include maintenance facility.</td>
</tr>
<tr>
<td><strong>Sounder</strong></td>
<td>Everett to Seattle, WA and Seattle to Tacoma, WA</td>
<td>80</td>
<td>10</td>
<td>$991.5</td>
<td>$12.4</td>
<td>In operation</td>
<td>Excludes costs for Lakewood extension south of Tacoma Dome Station. Amounts shown include all costs in varying Year of Expenditure dollars.</td>
</tr>
<tr>
<td><strong>Washington County</strong></td>
<td>Beaverton to Wilsonville, OR</td>
<td>14.7</td>
<td>5</td>
<td>$163.2</td>
<td>$11.1</td>
<td>In testing; service begins Feb. 2009</td>
<td>Project includes track replacement, 200’ section of new track, improved crossings (14) and new signal/dispatch system, 8 new structures, 6-vehicle maintenance facility, etc.</td>
</tr>
<tr>
<td><strong>Northstar Commuter Rail</strong></td>
<td>Big Lake to Minneapolis, MN</td>
<td>40</td>
<td>6</td>
<td>$320.0</td>
<td>$8.0</td>
<td>Under construction; service begins late 2009</td>
<td>Cost includes maintenance facility and vehicles (locomotive-hauled coaches and cab cars).</td>
</tr>
<tr>
<td><strong>SMART</strong></td>
<td>Sonoma and Marin counties, CA</td>
<td>70</td>
<td>14</td>
<td>$449.8</td>
<td>$6.4</td>
<td>PE/EIS completed; sales tax passed voters 11/14/2008</td>
<td>Provides for parallel bicycle/pedestrian trail (not included in cost est.); tracks owned by SMART, current freight users pay track lease revenues. Cost includes maintenance facility and vehicles.</td>
</tr>
</tbody>
</table>

*BNSF Eastside Corridor Commuter Rail Feasibility Study: Phase II Technical Memorandum  
Final/December 2008*
4.1.4 Comparison to Capital Costs of ST2 Light Rail Transit (LRT) Projects

Table 4.3 provides a comparison of the estimated capital cost for the representative commuter rail system in the Eastside corridor with estimated capital costs for the LRT projects included in ST2.

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Project Limits</td>
<td>Renton to Snohomish, plus Redmond spur (Segments 1-4)</td>
<td>UW to Lynwood Transit Center</td>
<td>Seattle to Overlake Transit Center</td>
<td>Airport to Star Lake (S. 272nd St.)</td>
</tr>
<tr>
<td>Length</td>
<td>41.1</td>
<td>12.5</td>
<td>14.3</td>
<td>6.8</td>
</tr>
<tr>
<td># of Stations</td>
<td>16</td>
<td>7</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Cost Est. (Millions)</td>
<td>$1,016.7 to $1,279.9</td>
<td>$2,505.1 to $2,815.7</td>
<td>$2,349.2 to $2,701.7</td>
<td>$1,019.6 to $1,172.5</td>
</tr>
<tr>
<td>Cost Est./Mile (Millions)</td>
<td>$24.7 to $31.1</td>
<td>$200.4 to $225.3</td>
<td>$164.3 to $188.9</td>
<td>$149.9 to $172.4</td>
</tr>
<tr>
<td>Notes</td>
<td>Includes vehicles and maintenance facility.</td>
<td>Vehicles and maintenance facility capacity not included.</td>
<td>Vehicles and maintenance facility capacity not included.</td>
<td>Vehicles and maintenance facility capacity not included.</td>
</tr>
</tbody>
</table>

4.1.5 Comparison to Other Commuter Rail Cost Estimates for the BNSF Eastside Corridor

Other capital cost estimates for commuter rail service in the BNSF Eastside corridor were developed by various parties and were summarized in the Phase I technical memorandum prepared for this study. Those cost estimates were lower than the cost estimate described in this report. The earlier cost estimates may be based on different assumptions than the cost estimate described in this report. This cost estimate:

- Covers a full menu of potential commuter rail system elements that may all not necessarily be included in an actual constructed project. During a design phase, individual components of the representative commuter rail system could be evaluated and potentially reduced in scope or eliminated. This could result in lower overall costs at the construction stage.
- Reflects a permanent (e.g., 50 year) level of investment that is typical of the quality, durability and safety required for infrastructure designed and built by public agencies. These types of projects are open to all members of the public,

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12 BNSF Eastside Corridor Commuter Rail Feasibility Study, Phase I Technical Memorandum: Review of Previous Plans, Studies and Other Documents (Sound Transit, September 17, 2008).
create significant impacts to the traveling public when closed for maintenance or repair, and are therefore built to very high standards for quality, durability, and public safety/risk purposes.

- Includes allowances for hazardous materials/soils removal, utility modifications, and environmental mitigation.
- Includes construction management, environmental clearance and preliminary engineering, final design and specifications, design services during construction, design review by others, permitting, and agency administration.
- Includes contingency percentages that are appropriate to the current level (approx. 1%) of engineering design.
- Is based on the same capital cost estimating methodology (reviewed by an independent Expert Review Panel) that was used for projects in the ST2 Plan, which was approved by voters in the Sound Transit district on November 4, 2008.

4.1.6 Potential Options to Reduce Commuter Rail System Costs

As stated previously, this report describes a “full menu” of potential commuter rail system that may all not necessarily be included in an actual constructed project. During a design phase, individual components of the representative commuter rail system could be evaluated and potentially reduced in scope or eliminated to reduce costs. For example, this study evaluated 16 assumed stations, but costs could be reduced if fewer stations were implemented. In addition, the geographic coverage of commuter rail service could be limited, with only some sections of the corridor being implemented. The four segments of the corridor, as defined in this study, could be broken into smaller sections for evaluation and potential implementation. Finally, if a commuter rail project moves forward, it is anticipated that contingency factors could be reduced, appropriate to the level of engineering design during each stage of project development.

4.1.7 Trail Capital Cost Estimate

Estimated capital costs for design and construction of the representative parallel trail (including trail bridges) are shown in Table 4.4 along with key quantities. This table includes lower and higher cost options for trail construction, as described in Section 3.2 of this report. Cost estimates are provided in ranges.

4.1.8 Comparison to Cost Estimates for Other Trails

Per-mile capital costs for trails can vary significantly, depending on the circumstances of each project. Rail-to-trail projects (trail placed on the existing rail bed with track(s) removed), such as completed portions of the Centennial Trail in Snohomish County, may cost around $1 million per mile, excluding cost of structures and “soft” costs (e.g., design, environmental clearance and permits, agency administration). The cost estimate

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13 Source: Peter Camp, Snohomish County.
for the 11-mile East Lake Sammamish Trail has two options: (1) one time construction cost of $43 million or $3.9/mile to develop all 11 miles at once; or (2) phased approach over 6 years at a cost of $53 million or $4.8/mile with construction broken into one design phase followed by five construction phases.

As described in Section 2, the unit costs used in this report reflect recent experience for construction of similar projects (such as at-grade, retained cut, and retained fill types of civil infrastructure). The base per-mile costs for the at-grade parallel trail sections described in this report are comparable to the at-grade Centennial Trail and East Lake Sammamish Trail unit costs described previously. Due to the existing topography of the Eastside corridor, however, a significant portion of the corridor could require retaining wall(s) to create a wide, flat surface for the parallel trail. In column B, Table 4.4 shows the estimated percentage of each segment assumed to require retaining wall(s) (i.e., retained fill or retained cut). The remaining percentage of each segment is assumed to be located at-grade, on embankment, or on bridges. Trail sections requiring retaining wall(s) (and cut or fill material) would typically have a significantly higher unit cost than at-grade sections.

4.1.9 Potential Options to Reduce Costs for a Parallel Trail

As stated previously, this report describes a “full menu” of potential parallel trail elements that may all not necessarily be included in an actual constructed project. The report describes a lower cost and a higher cost option for the representative parallel trail. Use of a narrow trail cross section could reduce implementation costs. During a design phase, individual components of the representative parallel trail project could be evaluated and potentially reduced in scope or eliminated to reduce costs. For example, the north-south BNSF mainline and the Redmond spur parallel each other for approximately three miles in Woodinville. In addition, the existing Sammamish River Trail also parallels the two rail lines in this area. Potentially, the scope (length) of a trail constructed along the Eastside corridor could be reduced if duplicative trails were not desirable. In addition, the geographic coverage of the trail in other segments could be limited, with only some sections of the corridor being implemented. The four segments of the corridor, as defined in this study, could be broken into smaller sections for evaluation and potential implementation. As engineering progresses, a parallel trail could be designed to fit the corridor’s existing terrain with reduced levels of retained cut or fill sections than are assumed in this study, potentially reducing costs significantly. Finally, if a parallel trail project moves forward, it is anticipated that contingency factors could be reduced, appropriate to the level of engineering design during each stage of project development.

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14 Source: King County Parks Department. Cost is for a paved regional trail and includes design, permits, construction, contingency, and mitigation.
Table 4.4: Trail Capital Cost Estimate and Key Quantities

<table>
<thead>
<tr>
<th>TRAIL: Key Quantities</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Length of Segment (miles)*</td>
</tr>
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<td>Segment 1</td>
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<td>8.1</td>
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<tr>
<td>Segment 2</td>
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<td>7.1</td>
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<tr>
<td>Total</td>
<td>40.4</td>
<td>42%</td>
<td>19</td>
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**TRAIL: LOWER COST OPTION** *(Costs in 2nd Qtr 2008 $Millions)***

<table>
<thead>
<tr>
<th>Segment 1</th>
<th></th>
<th></th>
<th>Trail Construction</th>
<th>Trail Bridges</th>
<th>Total Trail Cost</th>
</tr>
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<tbody>
<tr>
<td>Renton-Bellevue</td>
<td>Low</td>
<td>$56.56</td>
<td>$10.16</td>
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<td></td>
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<tr>
<td></td>
<td>High</td>
<td>$73.53</td>
<td>$13.21</td>
<td>$86.74</td>
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</tr>
<tr>
<td>Segment 2</td>
<td></td>
<td></td>
<td>$105.34</td>
<td>$3.22</td>
<td>$108.56</td>
</tr>
<tr>
<td>Bellevue-Woodinville</td>
<td>Low</td>
<td>$136.95</td>
<td>$4.18</td>
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</tr>
<tr>
<td></td>
<td>High</td>
<td>$115.54</td>
<td>$8.20</td>
<td>$123.74</td>
<td></td>
</tr>
<tr>
<td>Segment 3</td>
<td></td>
<td></td>
<td>$88.88</td>
<td>$6.31</td>
<td>$95.19</td>
</tr>
<tr>
<td>Woodinville-Snohomish</td>
<td>Low</td>
<td>$115.54</td>
<td>$8.20</td>
<td>$123.74</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>$30.36</td>
<td>$4.68</td>
<td>$35.04</td>
<td></td>
</tr>
<tr>
<td>Segment 4</td>
<td></td>
<td></td>
<td>$23.36</td>
<td>$3.60</td>
<td>$26.96</td>
</tr>
<tr>
<td>Redmond spur</td>
<td>Low</td>
<td>$30.36</td>
<td>$4.68</td>
<td>$35.04</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>$41.16</td>
<td>$4.68</td>
<td>$45.84</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Low</td>
<td>$274.14</td>
<td>$23.29</td>
<td>$297.43</td>
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<tr>
<td></td>
<td>High</td>
<td>$356.37</td>
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**TRAIL: HIGHER COST OPTION** *(Costs in 2nd Qtr 2008 $Millions)***

<table>
<thead>
<tr>
<th>Segment 1</th>
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<th>Trail Construction</th>
<th>Trail Bridges</th>
<th>Total Trail Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renton-Bellevue</td>
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<td>$62.03</td>
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<tr>
<td></td>
<td>High</td>
<td>$80.63</td>
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<tr>
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<td>$124.87</td>
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<tr>
<td>Bellevue-Woodinville</td>
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<td>$162.34</td>
<td>$4.18</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>$117.40</td>
<td>$8.20</td>
<td>$125.60</td>
<td></td>
</tr>
<tr>
<td>Segment 3</td>
<td></td>
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<td>$90.31</td>
<td>$6.31</td>
<td>$96.62</td>
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<tr>
<td>Woodinville-Snohomish</td>
<td>Low</td>
<td>$117.40</td>
<td>$8.20</td>
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</tr>
<tr>
<td></td>
<td>High</td>
<td>$41.16</td>
<td>$4.68</td>
<td>$45.84</td>
<td></td>
</tr>
<tr>
<td>Segment 4</td>
<td></td>
<td></td>
<td>$31.68</td>
<td>$3.60</td>
<td>$35.28</td>
</tr>
<tr>
<td>Redmond spur</td>
<td>Low</td>
<td>$41.16</td>
<td>$4.68</td>
<td>$45.84</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>$401.52</td>
<td>$30.28</td>
<td>$431.80</td>
<td></td>
</tr>
</tbody>
</table>

*Trail length may be slightly different than commuter rail length for each segment.
**Remaining percentage of each trail segment is located at-grade, on embankment, or on bridges.
***Costs include contingencies, construction mgmt, environmental clearance and PE, final design and specifications, permitting and agency admin.
4.2 **Annual Operating Cost Estimate**

As shown in Table 4.5, operating costs for the representative commuter rail system are estimated at $24 to $32 million per year (2008$) based on two-way service on the corridor with 30 minute headways for 16 hours per day (weekdays only). The costs include vehicle operations and maintenance, maintenance of way, and overhead and other costs. Costs are based on estimated annual unit costs for Sprinter DMU service (Oceanside-Escondido, CA) provided by the North County Transit District.

<table>
<thead>
<tr>
<th></th>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Operations and Maintenance**</td>
<td>$6,000,000</td>
<td>$8,000,000</td>
</tr>
<tr>
<td>Maintenance of Way</td>
<td>$2,000,000</td>
<td>$3,000,000</td>
</tr>
<tr>
<td>Overhead/Other Costs***</td>
<td>$16,000,000</td>
<td>$21,000,000</td>
</tr>
<tr>
<td><strong>Total Annual O&amp;M Costs</strong></td>
<td><strong>$24,000,000</strong></td>
<td><strong>$32,000,000</strong></td>
</tr>
</tbody>
</table>

*Based on estimated annual unit costs for Sprinter DMU service (Source: North County Transit District)
**Assumes service every 30 minutes, all day, each direction (weekdays only)
***Includes agency management and administration, finance, marketing, safety and security, insurance, station maintenance
5. Ridership Forecasts

It should be noted that the ridership forecast and capital cost estimate are not directly comparable for Segment 1 (Renton to Bellevue) or for any combination of segments that include Segment 1. The capital cost estimate for Segment 1 does not include the cost for the assumed station at NE 6th Street in Bellevue (that station is included in the Segment 2 cost estimate). In addition, the ridership forecasts assume a rail connection to and a station in downtown Renton, which are not included in the cost estimate described in this report.

The commuter rail ridership forecasts and station location analysis for the BNSF Eastside rail corridor were done to respond to the questions asked by SHB 322 potential commuter rail ridership, potential station sites, and locations that may benefit from commuter rail service.

5.1 Overview

BNSF ridership forecasts were developed using two software tools recently developed for the PSRC by Cambridge Systematics15:

- The Transit Competitive Index (TCI) is used to understand markets. It evaluates how the conditions within each specific travel market dictate how well even the most effective transit service can compete for riders. It uses 2006 PSRC household survey research, highway congestion and cost, and land use and socioeconomic information to understand where the potential for transit ridership is highest. The competitive conditions for transit exist through the PSRC region regardless of what kind of transit service in currently deployed or could be deployed.

- The Sketch Planning Tool (SPT) is used to understand customers. It enables the regional and corridor level analysis of transit “supply” with potential “demand” for transit service within the Central Puget Sound Region. It uses information about highway and transit service configurations within travel markets (or pairings of origins with destinations), traveler attitudes, demographics and land use characteristics to predict change in transit service ridership. The SPT incorporates all of market research results to provide transit planners with capability on their desktops.

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to test alternative service concepts at a very detailed neighborhood level. Analysis is done using current data tested against possible future scenarios.

The integration of these tools provide insights into potential transit customer markets and transit service configurations based on a combination of 2006 attitudinal, socioeconomic and demographic data. This information in the TCI is at the transportation analysis zone (TAZ) level and the information in the SPT is at the Census Block Group (BG) level.

One core feature of both tools is the market segmentation for the PSRC region. There are 21 attitudinal characteristics derived from the 2006 household survey that are combined to produce six traveler attitudes as shown in Figure 5.1.

**Figure 5.1  Traveler Attitudes**

<table>
<thead>
<tr>
<th>Environmental Consciousness</th>
<th>Travel Stress</th>
<th>Time Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
<td><img src="image3" alt="Image" /></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Need for Travel Flexibility</th>
<th>Comfort and Time Use</th>
<th>Transit Receptiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image4" alt="Image" /></td>
<td><img src="image5" alt="Image" /></td>
<td><img src="image6" alt="Image" /></td>
</tr>
</tbody>
</table>

The six traveler attitudes are used to segment the travel market into eight market segments, based on their attitudes on transit receptiveness (high, medium or low), travel flexibility (high or low need), and comfort and time use (high, medium or low need). The market segmentation is presented in Figure 5.2.
Figure 5.2  Market Segment Assignments

All Travelers in the Puget Sound Region

The six travel attitudes (travel stress, environmental consciousness, time sensitivity, need for travel flexibility, comfort and time use, and transit receptiveness) and the eight market segments (Productive Riders, Mobile Riders, Routine Riders, Comfortable Movers, Easy Goers, No Frills 9 to 5’ers, Comfortable Drivers, and Multi-trip Drivers) are then used, along with service and demographic characteristics to estimate mode shifts between auto, bus and rail modes. Using this information, Figure 5.3 represents the transit mode split for the PSRC region as a whole.

Figure 5.3  Market Segment Sizes and Transit Mode Share
5.2 Transit Markets in the BNSF Corridor

As part of the BNSF Ridership Analysis, one of the elements evaluated was the transit competitiveness of various station areas along the railroad right-of-way. This analysis responds to one of the questions that SHB 3224 raises in locating optimal station sites. The TCI illustrates the potential competitiveness of a transit trip versus an auto trip for a certain origin – destination pair.

The transit market analysis was conducted in three stages:

1. An analysis of the entire corridor for work and non-work trips
2. Further analysis of areas with high TCI’s
3. More detailed analysis of terminal locations and the central location of Bellevue

For each major destination, a market shed of all TAZ groups within a reasonable driving area to all rail station with parking facilities along the route were identified. Then, a destination set of block groups for each major market in the route, such as Bellevue, Renton CBD, Kirkland, etc., were developed that represented a reasonable area that the stations would serve either by walking or taking transit from the rail station to the final destination. It was assumed that patrons using the rail facility may use transit to reach their final destination in the market area after leaving the rail station.

The TCI was used for three types of analysis requested in SHB 3224:

- Identify locations where riders may be attracted to a commuter rail transit system
- Identify and evaluate which locations would most benefit from commuter rail service
- Identify and evaluate potential station sites

5.2.1 Potential Riders

The TCI identified that there is a strong transit demand within the corridor, especially for non-work related trips, also known as “other” trips (shopping, medical appointments, recreation, etc.). These are presented in Figure 5.4. With a TCI over 100 considered transit competitive, the central corridor of Totem Lake to Renton through Bellevue with high TCI’s of 275 – 2900, illustrates the transit demand for non-work related “other” trips in this corridor, particularly to serve downtown Bellevue. This could be a reflection of the regional shopping destinations in Bellevue and other medical and recreational destinations along the corridor, which are grouped into the “other” category.
An extension to Tukwila would add strong other trips station with TCI’s from 360 – 415, while on the Redmond Spur the Redmond Station area is very strong with TCI’s in the mid-200’s for other trips. Ranges are given for TCI scores as they vary slightly from the extended corridor (Everett to Tukwila) from the baseline corridor (Renton/Coulon Park to City of Snohomish). The extended corridor analysis is presented in Figure 5.5.

**Figure 5.5 Transit Competitive Index for Commuter Rail Study Station Areas in the Extended Corridor (Tukwila to Everett)**
Equally, there is a strong demand for transit work trips within a slightly longer corridor of Woodinville to Renton with TCI’s from 103 – 217 at the ends of the corridor and Kirkland in the center with a strong transit work origin trips TCI of 378 and Bellevue being the major draw with work TCI’s of 1046 - 2283. The TCI’s for work trips that originate within the wider commuter rail corridor and have destinations within the station areas are low with a range of 0 – 135, excluding Bellevue’s high 1046 score. The TCI’s for work trips originating in the station areas and having destinations in the commuter rail corridor is much higher, with a range of 103 – 378 in station areas, excluding Bellevue’s very high 2283 score, which reflects its draw as a regional economic engine.

The far northern section of the BNSF corridor was less transit competitive, as might be expected from its more rural nature through the Snohomish River floodplain to the City of Snohomish with consistent TCI’s less than 100. For other trips in the baseline corridor analysis (Renton to Snohomish), the City of Snohomish was the most transit competitive destination with a TCI’s of 108-118 for other trips, while Woodinville’s TCI’s of 34-50 was slightly less. In the extended corridor analysis (Everett to Tukwila), Snohomish’s TCI score for other trips went down slightly to below 100, while Woodinville’s increased to the 45-59 range. These scores maybe reflective of the central grid network surround the station site in City of Snohomish and it’s recreational and shopping attractions., while Woodinville’s winery district are also regional attractions, as demonstrated by the Dinner Train’s stops.

Within the corridor, the Cities of Bellevue and Kirkland regularly had high TCI’s of 300+, only dropping down significantly as work destination, but being much stronger work origin sites, although 1000+ for Bellevue’s work destination is still a very strong TCI. Redmond as the terminus station site for the Redmond – Woodinville spur has high TCI’s as a both work and other origins and as an other destination, in the 200-300 range. This is reflective of the overall corridor, especially since the Redmond station area TAZ’s do not extend down to include the significant work attractions in Overlake with Microsoft’s campus.

5.2.2 Assumed Station Sites

The TCI maps were used to evaluate the potential station sites, however, station sites were combined to include several stations for analysis purposes. For example, the Coulon Park and Port Quendall/44th Street stations were combined because they are both within the same TAZ in Renton, which rates a high TCI of over 200+. The TCI evaluates the transit demand in comparison to an auto trip for a particular origin-destination pair, so both the potential station sites would be one end of the origin-destination pair. The strongest potential station areas based on the TCI results (shown in Figure 5.4), are:

- Downtown Bellevue with trip origin and destinations in the extremely strong TCI results in the 1000 – 3000 range
- Kirkland with TCI results in the 130 – 360 range
- Totem Lake with TCI results in the 100 – 320 range
- Renton with TCI result in the 90 – 280 range
- Redmond with TCI results in the 40 - 300 range
Some of the other station areas are likely to have park and rides which will increase the likelihood of additional transit demand at the station sites. The maps illustrate that to a certain extent the Woodinville and City of Snohomish Stations have the potential to capture additional riders from SR 9, SR 522 for Woodinville and SR 2 for City of Snohomish.

5.2.3 Locations that Benefit from Commuter Rail

**Bellevue**
For the BNSF Eastside Commuter Rail Feasibility Study, the TCI results show a strong work market for transit service within the corridor to and from Bellevue from the north and the south. These are presented in Figure 5.6. The home-based work trips are the largest market to Bellevue with the home-based other trips also a strong off-peak market.

While the strongest work market along the railroad tracks extends south to Renton and north to Woodinville, the strongest other market is shorter section along the east side of Lake Washington from Totem Lake to South Bellevue. Both markets are well positioned to being served by a potential Commuter Rail service to Bellevue along the BNSF Eastside Corridor.
Figure 5.6 Transit Competitive Index for Bellevue as a Destination for Work and Other Trips
Woodinville

The strongest demand for transit trips originating in Woodinville would be work trips to Bellevue with its TCI of 285, as shown in Figure 5.7. At the northern end of the central ridership corridor, walk-on ridership potential drops significantly. The TCI is not able to model the additional people who might drive to the potential Park and Rides at the commuter rail station sites in Woodinville, and the surrounding area is agricultural and low density residential, so the TCI’s are correspondingly low at below 100 for most calculations. The work trip origins are around 100 while the other trips are in the 40 – 60 range, well below the Transit Competitiveness range of TCI scores of 100+. Although the TCI scores are low, two Park and Rides are assumed for Woodinville (at North Woodinville and South Woodinville), to maximize the capture of potential riders driving to the stations which is reflected in the overall ridership estimate from the Sketch Planning Tool.
Figure 5.7 Transit Competitive Index for Woodinville as a Destination for Work and Other Trips
**Renton**

At the southern end of the Baseline corridor, the TCI identifies a stronger transit market than what is available in Woodinville or Snohomish. In previous TCI analyses, Renton comes up as fairly transit competitive with TCI’s in the 400’s, as shown in the Bellevue Work Destination, Figure 5.8. As a destination itself, Renton’s TCI scores are fairly low, definitely below the Transit Competitive threshold with the Coulon Park terminus, north of Downtown Renton and Boeing. A station in downtown Renton would significantly increase the TCI rating for the station area with the more pedestrian street network and more supportive types of retail and land use.

**Figures 5.8 Transit Competitive Index for Renton as a Destination for Work and Other Trips**
5.3 **Ridership Forecasts**

The BNSF corridor ridership forecasts were developed using the SPT, which contains a mode choice model that is based on the differences in transit service characteristics between bus and rail modes, market research and socio-economic characteristics, attitudinal factors, and retail intensities at the destination. Ridership forecasts were developed for each major market origin-destination pair.

5.3.1 **Ridership Markets**

For each BNSF route, a market shed of all block groups within a reasonable driving area to all rail stations with parking facilities along the route was identified. Then, a destination set of block groups for each major market in the route, such as Bellevue, Renton CBD, Kirkland, etc., was developed that represented a reasonable area that the stations would serve either by walking or taking transit from the rail station to the final destination. In Figure 5.9, the overall commuter shed for the entire BNSF corridor is identified and the market areas for each major market are also outlined.

5.3.2 **Ridership Data**

The SPT estimates weighted transit level of service characteristics between all the block groups of the origins along the rail segment for a given destination market. Based on assumed service characteristics with the introduction of a new rail service, we then estimated changes to existing service characteristics due to the BNSF rail service. We assumed that the rail service would be competitive with existing bus travel times but would have lower wait times due to rail’s higher level of reliability and an individual’s ability to schedule their arrivals at the station to start their rail trip. Ridership was developed for the trip purposes of home-based work and non-work trips. Each trip purpose is estimated for the a.m. peak and mid-day periods. These estimates are then factored to produce 24 hours (daily) ridership estimates attracted to the market area from the rest of the rail segment stations. Since each run of the model estimates trips between all origins along the rail segment and one market area destination, such as Bellevue, Kirkland etc., this method results in the number of trips attracted to each market area. The trips are then added together to produce total trips for the entire route.
Figure 5.9 BNSF Corridor Station Locations and Market Areas
5.3.3 Ridership by Scenario

The 2020 forecast is developed by growing the 2006 boardings by a two percent per annum growth rate. For each potential rail scenario, the distance and the total boardings forecast are presented in Table 5.1. For example, the baseline corridor of Coulon Park (Renton) to Snohomish segment is 32.4 miles long (one way) with a total forecast ridership of 5,015 boardings. This means that an individual going from Renton to Bellevue for work will also return home to Renton later in the day and this represents two boardings (one in each direction).

Table 5.1: BNSF Corridor 2020 Daily Ridership (Boardings)

<table>
<thead>
<tr>
<th>Potential Segment</th>
<th>Distance (one way), in miles</th>
<th>Total Boardings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tukwila to Everett</td>
<td>44.7</td>
<td>6,270</td>
</tr>
<tr>
<td>Tukwila to Snohomish</td>
<td>37.3</td>
<td>5,940</td>
</tr>
<tr>
<td>Renton CBD to Snohomish Redmond Spur</td>
<td>39.3</td>
<td>6,730</td>
</tr>
<tr>
<td>Renton CBD to Snohomish</td>
<td>34.2</td>
<td>5,560</td>
</tr>
<tr>
<td><strong>Coulon Park to Snohomish - Baseline</strong></td>
<td><strong>32.4</strong></td>
<td><strong>5,015</strong></td>
</tr>
<tr>
<td>Renton CBD to Woodinville</td>
<td>21.8</td>
<td>5,080</td>
</tr>
<tr>
<td>Bellevue to Snohomish</td>
<td>24.4</td>
<td>2,145</td>
</tr>
<tr>
<td>Bellevue to Woodinville</td>
<td>11.7</td>
<td>1,770</td>
</tr>
<tr>
<td>Bellevue to Redmond (Spur)</td>
<td>16.8</td>
<td>1,925</td>
</tr>
<tr>
<td>Woodinville to Snohomish</td>
<td>12.7</td>
<td>45</td>
</tr>
<tr>
<td>South Woodinville to Redmond</td>
<td>5.1</td>
<td>75</td>
</tr>
<tr>
<td>Bellevue to Renton CBD</td>
<td>10.1</td>
<td>1,805</td>
</tr>
</tbody>
</table>

Total boarding by rail segment depends upon the total market shed and the number of destination markets along the length of the segment. Figure 5.10 presents a comparison of rail segment boardings for the baseline and extended scenario combinations. The rail segment from Bellevue to Snohomish has a forecasted ridership of 2,145 boardings for 2020. Extending the segment south to Coulon Park increases the forecast by 2,870 boardings to a total of 5,015. The increase in ridership is due to the Renton area market being added and a large market shed of patrons driving to Coulon Park to board the train to access the rest of the markets on
the rail segment. It was assumed that the Bellevue stations did not have parking facilities. Therefore the Bellevue to Snohomish segment did not have a large set of individuals accessing the segment from the south.

Extending the Coulon Park to Snohomish rail segment further south to Renton adds additional 545 boardings for a total of 5,560 due to better access to the Renton CBD. Extending the segment to Tukwila adds 380 boardings for a total of 5,940. Extending the line to the north to reach Everett adds 330 boarding for a forecast total of 6,270 boardings.

Figure 5.11 presents the rail segment from Renton to Bellevue has a forecasted ridership of 1,805 boardings. The segment from Bellevue to Woodinville has a forecasted ridership of 1,770 boardings. The forecasted ridership for the Renton to Woodinville segment is 5,080. This is greater than the sum of the two smaller segments due to the ridership attracted to each market area comes from the market shed for the entire length of the Renton to Woodinville segment.

Figure 5.12 presents the effect of the Redmond Spur to ridership. The Bellevue to Woodinville segment has a forecasted Ridership of 1,770 boardings. The addition of the South Woodinville to Redmond Spur adds 155 boardings for a total of 1,925. There was an assumption that there would be a transfer at the north end of the Redmond Spur to the South Woodinville Station. The Renton to Snohomish segment has a forecasted ridership.
of 5,560 boardings. The addition of the South Woodinville to Redmond Spur added 1,170 boardings for a total of 6,730 total boardings.

Figure 5.12 Rail Segment Ridership South Woodinville to Redmond Spur

5.3.4 Ridership by Market
Forecasts of trips attracted to each destination market on the rail scenario are presented in Table 5.2. Destination markets are identified by the attractiveness of the area for work, shopping or other purposes. Using the same example, the two boardings (one from Renton to Bellevue and one from Bellevue back to Renton) are represented as boardings in the Bellevue destination market. If we had separately represented the origin markets, then Renton would have two boardings here as well, but these are not reported as they are duplicative. This means that 2,570 trips on the Coulon Park to Snohomish segment are attracted to Bellevue.

As illustrated in Table 5.2, the segment from Renton to Woodinville have the highest consistent daily attractions in 2020. Redmond has fairly significant attractions of 850 on the Renton CBD to Snohomish Redmond Spur Segment, while tending towards only 55 attractions on the other to spur connections.
### Table 5.2: BNSF Corridor 2020 Daily Attractions by Scenario

<table>
<thead>
<tr>
<th>Potential Segment</th>
<th>Daily Attractions in 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tukwilla</td>
</tr>
<tr>
<td>Tukwilla to Everett</td>
<td>325</td>
</tr>
<tr>
<td>Tukwilla to Snohomish</td>
<td>310</td>
</tr>
<tr>
<td>Renton CBD to Snohomish</td>
<td>655</td>
</tr>
<tr>
<td>Redmond Spur to Snohomish</td>
<td>645</td>
</tr>
<tr>
<td>Renton CBD to Woodinville</td>
<td>355</td>
</tr>
<tr>
<td>Renton CBD to Woodinville</td>
<td>640</td>
</tr>
<tr>
<td>Bellevue to Snohomish</td>
<td>1,145</td>
</tr>
<tr>
<td>Bellevue to Woodinville</td>
<td>950</td>
</tr>
<tr>
<td>Bellevue to Redmond (Spur)</td>
<td>1,000</td>
</tr>
<tr>
<td>Woodinville to Snohomish</td>
<td>35</td>
</tr>
<tr>
<td>South Woodinville to Redmond</td>
<td>20</td>
</tr>
<tr>
<td>Bellevue to Renton CBD</td>
<td>160</td>
</tr>
</tbody>
</table>
The contribution each of the market areas ridership for a rail segment is presented in Figure 5.13. Bellevue is the largest market attraction area for the rail segments that include Bellevue. Kirkland, Totem Lake, Renton and Woodinville represent secondary ridership attraction markets for the rail segments that include these areas. Tukwila, in the Tukwila to Everett and Tukwila to Snohomish rail segments is a smaller market attraction area. Maltby, Snohomish, and Everett represent very small market attraction areas. Redmond represents a market attraction area similar in size to Renton, Kirkland, Totem Lake, and Woodinville in the Renton to Snohomish Redmond Spur segment.

Figure 5.13  2020 Daily Attractions by Market
5.3.5 Commuter Rail Ridership Comparisons

The result for the Tukwila to Snohomish segment was compared to several commuter rail ridership estimates in Table 5.3. Several commuter rail ridership estimates for 2008 were obtained from the American Public Transit Association’s Ridership Report, Second Quarter 2008. From the data, a “riders per mile” estimate was made. The 2008 ridership was then factored to 2020 by a two percent annual growth rate. The low end of the range was identified as the Altamont Commuter Express service with 42 riders per mile, doubled to represent all day service for the BNSF corridor. The high end of the range was identified as the SFRTA Tri-Rail system because this service supports smaller cities connecting to a major hub rather than connecting major cities. For the 37 mile Tukwila to Snohomish segment a range of 3,900 to 9,800 riders was estimated. The Tukwila to Snohomish forecast for 2020 is 5,940, which is within the range of 3,900 to 9,800. This suggests that the SPT forecast of ridership for the BNSF corridor is reasonable.

Table 5.3: Comparison of Commuter Rail Ridership from Peer Cities

<table>
<thead>
<tr>
<th>Operator</th>
<th>City Served</th>
<th>Corridor Connections</th>
<th>Service</th>
<th>Miles</th>
<th>Riders per Mile</th>
<th>Total 2020 Boardings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caltrain</td>
<td>San Francisco and San Jose</td>
<td>Major Cities</td>
<td>All Day</td>
<td>77</td>
<td>457</td>
<td></td>
</tr>
<tr>
<td>SFRTA Tri-Rail</td>
<td>Miami</td>
<td>Smaller Cities To Major Hub</td>
<td>All Day</td>
<td>72</td>
<td>208</td>
<td></td>
</tr>
<tr>
<td>Trinity Railway Express</td>
<td>Dallas and Fort Worth</td>
<td>Major Cities</td>
<td>All Day</td>
<td>34</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>Sounder</td>
<td>Seattle</td>
<td>Smaller Cities To Major Hub</td>
<td>Peak</td>
<td>80</td>
<td>124</td>
<td></td>
</tr>
<tr>
<td>UTA FrontRunner</td>
<td>Salt Lake City</td>
<td>Smaller Cities To Major Hub</td>
<td>All Day</td>
<td>44</td>
<td>198</td>
<td></td>
</tr>
<tr>
<td>NCTD Coaster</td>
<td>San Diego</td>
<td>Smaller Cities To Major Hub</td>
<td>Peak</td>
<td>41</td>
<td>163</td>
<td></td>
</tr>
<tr>
<td>Altamont Commuter Express</td>
<td>San Jose</td>
<td>Suburban Cities</td>
<td>Peak</td>
<td>86</td>
<td>42</td>
<td></td>
</tr>
</tbody>
</table>

Expected Range Of Boardings For BNSF Corridor

<table>
<thead>
<tr>
<th></th>
<th>Snohomish to Tukwila</th>
<th>Suburban Cities</th>
<th>All Day</th>
<th>37</th>
<th>84</th>
<th>3,900</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Snohomish to Tukwila</td>
<td>Suburban Cities</td>
<td>All Day</td>
<td>37</td>
<td>208</td>
<td>9,800</td>
</tr>
</tbody>
</table>

http://en.wikipedia.org/wiki/List_of_United_States_commuter_rail_systems_by_ridership

data reported in 2008

For an average weekday in October 2008, Sounder carried 9,664 riders on the South line (Tacoma-Seattle) and 1,160 riders on the North line (Everett-Seattle).
6. Environmental Evaluation and Permits

Throughout the Eastside corridor, there are elements of the built and natural environment that may be impacted by construction and operation of the representative commuter rail system and/or parallel trail. These include parklands, trails, historic properties, streams, wetlands, businesses and residential areas. The representative commuter rail system and parallel trail could potentially have significant environmental impacts on these entities, requiring mitigation. In addition, a variety of federal, state and local permits could also be required. Temporary occupancy of private property or right-of-way for staging during construction could be needed in areas near the corridor. The capital cost estimate includes an allowance for environmental mitigation and permits.

The appendices include an evaluation of the potential environmental considerations and permit requirements.

7. Addressing SHB 3224 Requirements

As described in Section 1, SHB 3224 outlined several requirements for this feasibility study. This section addresses those requirements.

7.1 Ridership Forecasts for Commuter Rail

See Section 5 for a detailed description of the ridership forecasts prepared by PSRC for this study. The 2020 forecast is developed by growing the 2006 boardings by a two percent per annum growth rate. For each potential rail scenario, the distance and the total boardings forecast are presented in Table 7.1. For example, the baseline corridor of Coulon Park (Renton) to Snohomish segment is 32.4 miles long (one way) with a total forecast ridership of 5,015 boardings. This means that an individual going from Renton to Bellevue for work will also return home to Renton later in the day and this represents two boardings (one in each direction). Note that improvements and/or costs to provide operations to Everett, downtown Renton, and/or Tukwila are not reflected in the representative commuter rail system description (Section 3) or cost estimate (Section 4) of this report.
Table 7.1: BNSF Corridor Ridership Forecasts

<table>
<thead>
<tr>
<th>Potential Segment/Combination</th>
<th>Distance (one way), in miles</th>
<th>Total Boardings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tukwila to Everett</td>
<td>44.7</td>
<td>6,270</td>
</tr>
<tr>
<td>Tukwila to Snohomish</td>
<td>37.3</td>
<td>5,940</td>
</tr>
<tr>
<td>Renton CBD to Snohomish Redmond Spur</td>
<td>39.3</td>
<td>6,730</td>
</tr>
<tr>
<td>Renton CBD to Snohomish</td>
<td>34.2</td>
<td>5,560</td>
</tr>
<tr>
<td><strong>Coulon Park to Snohomish - Baseline</strong></td>
<td>32.4</td>
<td>5,015</td>
</tr>
<tr>
<td>Renton CBD to Woodinville</td>
<td>21.8</td>
<td>5,080</td>
</tr>
<tr>
<td>Bellevue to Snohomish</td>
<td>24.4</td>
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</tr>
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<td>75</td>
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<tr>
<td>Bellevue to Renton CBD</td>
<td>10.1</td>
<td>1,805</td>
</tr>
</tbody>
</table>

### 7.2 Locations That Would Benefit From Commuter Rail Service

See Section 6 for a detailed description of the transit compatibility index (TCI) and other ridership forecasting analysis completed by PSRC for this study. Note that improvements and/or costs to provide operations to Everett, downtown Renton, and/or Tukwila are not reflected in the representative commuter rail system description (Section 3) or cost estimate (Section 4) of this report.

**Bellevue**

For the BNSF Eastside Commuter Rail Feasibility Study, the TCI results show a strong work market for transit service within the corridor to and from Bellevue from the north and the south. The home-based work trips are the largest market to Bellevue with the home-based other trips also a strong off-peak market.

While the strongest work market along the railroad tracks extends south to Renton and north to Woodinville, the strongest other market is shorter section along the east side of Lake Washington from Totem Lake to South Bellevue. Both markets are well positioned to being served by a potential Commuter Rail service to Bellevue along the BNSF Eastside Corridor.

**Woodinville**

The strongest demand for transit trips originating in Woodinville would be work trips to Bellevue with its TCI of 285. At the northern end of the central ridership corridor, walk-on ridership potential drops significantly. The TCI is not able to model the additional people who might drive to the potential Park and Rides at the commuter rail station sites in Woodinville, and the surrounding area is agricultural and low density residential, so the TCI’s are correspondingly low at below 100 for most calculations. The work trip
origins are around 100 while the other trips are in the 40 – 60 range, well below the Transit Competitiveness range of TCI scores of 100+. Two Park and Rides are proposed for Woodinville (North Woodinville and South Woodinville), to maximize the capture of potential riders driving to the stations.

**Renton**

At the southern end of the Baseline corridor, the TCI identifies a stronger transit market than what is available in Woodinville or Snohomish. In previous TCI analyses, Renton comes up as fairly transit competitive with TCI’s in the 400’s. As a destination itself, Renton’s TCI scores are fairly low, definitely below the Transit Competitive threshold with the Coulon Park terminus, north of Downtown Renton and Boeing. A station in downtown Renton would significantly increase the TCI rating for the station area with the more pedestrian street network and more supportive types of retail and land use.

**Potential for Transit- and Pedestrian-Oriented Development**

Section 3.1.5 provides an evaluation of the potential for each assumed station area to support transit- and pedestrian-oriented development. Based on the analysis described in this report, the majority of the assumed station areas do not demonstrate the potential to support transit-and pedestrian-oriented development, based on their existing land uses, plan policies and regulations. The assumed stations that show the highest potential for TOD are the following (not in any order):

- Bellevue/NE 12th Street (included in Bellevue’s Bel-Red Corridor Study area)
- South Kirkland Park-and-Ride (TOD project by King County is in the planning stages)
- Kirkland/Totem Lake (designated regional growth center)
- Snohomish CBD
- Redmond CBD (designated regional growth center)

### 7.3 Potential Station Sites

See Section 3.1.5 of this report for a discussion of the assumed station locations. Commuter rail stations are assumed at the following locations (listed south to north) along the Woodinville Subdivision mainline:

1. Renton/Gene Coulon Park (terminal)
2. Renton/Port Quendall/NE 44th Street
3. Bellevue/Newport Park-and-Ride/112th Avenue NE
4. Bellevue/NE 6th Street
5. Bellevue/NE 12th Street
6. South Kirkland Park-and-Ride
7. Kirkland/NE 85th Street
8. Kirkland/Totem Lake
9. South Woodinville/NE 145th Street (provides transfer to Redmond spur line service)
10. Woodinville CBD
11. North Woodinville/NE 195th Street
12. Maltby
13. Cathcart
14. Snohomish CBD (terminal)

Two (2) stations are assumed at the following locations (listed west to east) along the Redmond spur line:
15. South Woodinville/NE 145th Street (terminal; provides transfer to mainline service)
16. Redmond CBD (terminal)

**Station Site Analysis**

See Section 6 for a detailed description of the transit compatibility index (TCI) and other ridership forecasting analysis completed by PSRC for this study. Note that improvements and/or costs to provide operations to Everett, downtown Renton, and/or Tukwila are not reflected in the representative commuter rail system description (Section 3) or cost estimate (Section 4) of this report.

The TCI maps were used to evaluate the assumed station sites, however, station sites were combined to include several stations for analysis purposes. For example, the Coulon Park and Port Quendall/44th Street stations were combined because they are both within the same TAZ in Renton, which rates a high TCI of over 200+. The TCI evaluates the transit demand in comparison to an auto trip for a particular origin-destination pair, so both the potential station sites would be one end of the origin-destination pair. The strongest potential station areas based on the TCI results (shown in Figure 5.4), are:

- Downtown Bellevue with trip origin and destinations in the extremely strong TCI results in the 1000 – 3000 range
- Kirkland with TCI results in the 130 – 360 range
- Totem Lake with TCI results in the 100 – 320 range
- Renton with TCI result in the 90 – 280 range
- Redmond with TCI results in the 40 - 300 range

Some of the other station areas are likely to have park and rides which will increase the likelihood of additional transit demand at the station sites. The maps illustrate that to a certain extent the Woodinville and City of Snohomish Stations have the potential to capture additional riders from SR 9, SR 522 for Woodinville and SR 2 for City of Snohomish.

**7.4 Ability of Existing Rail Lines and Sections to Accommodate Commuter Rail Service**

See Appendices C, D and E for evaluations of the existing track, bridges and signals/CTC/crossings, respectively. Based on the field survey along a sample of the corridor, the existing rail lines could accommodate commuter rail service at restricted speeds. However, existing passing sidings may not be located where needed for commuter rail trains to pass each other (or to pass other trains) while maintaining operating schedules.
Based on available information, track condition varies along the corridor but is generally poor with substantial railbed drainage problems. Existing track curvature and the lack of track elevation/superelevation contribute to curve speed restrictions. Signals, train control, and grade crossing protection infrastructure is minimal to non-existent along most of this corridor. There is existing freight rail service on the segment between Woodinville and Snohomish (south of the Snohomish River Bridge). The removal of the Wilburton Tunnel across the I-405 southbound lanes in summer 2008 means that there is no existing rail crossing at that location.

Due to the conceptual nature of this analysis, this feasibility study did not attempt to determine the existing structural/other condition of existing rail bridges to accommodate commuter rail service.

### 7.5 Effect on Existing and Planned Rail and Freight Operations

This study identifies a representative commuter rail system serving the Eastside corridor. The conceptual capital cost provides for infrastructure improvements in the corridor to support commuter rail service. These capital improvements could also provide benefits to other existing and future rail service, including freight. However, if freight rail operators propose to use heavier and/or longer trains than the representative commuter rail service and/or to operate during the same time periods, additional infrastructure investments could be required to accommodate those freight operations. These investments are beyond the scope of this study but could include additional and/or longer passing sidings. Costs associated with freight rail are not included in this report.

### 7.6 Effect on Tourism

This study identifies a representative commuter rail system serving the Eastside corridor. The conceptual capital cost provides for infrastructure improvements in the corridor to support commuter rail service. These capital improvements could also provide benefits to other potential passenger rail services, such as excursion trains potentially operated by the selected Third Party Operator (GNP/Ballard). However, if an operator of excursion trains proposes to use heavier and/or longer trains than the representative commuter rail service and/or to operate during the same time periods, additional infrastructure investments could be required to accommodate excursion train operations. These investments are beyond the scope of this study but could include additional and/or longer passing sidings, independent stations or depots and associated improvements, and/or longer station platforms. Costs associated with excursion trains are not included in this report.

The representative commuter rail service would not preclude operations of excursion trains (by others) to points along the BNSF Scenic Subdivision east of the city of Snohomish, such as Stevens Pass or Leavenworth. Note that the BNSF Scenic Subdivision passes under Stevens Pass in a deep, 7.8 mile-long tunnel (built in 1929 and
Capital and operating costs for such operations outside of the Eastside corridor are not included in this report. Use of the BNSF Scenic Subdivision would require negotiations with BNSF. A rail wye connection currently exists between the Eastside corridor (to the south) and the BNSF Scenic Subdivision (to the west and the east). No rail connections are provided between the east-west BNSF Scenic Subdivision and the Eastside corridor to the north due to the rail line’s close proximity to the Snohomish River. As part of this study, no evaluation was conducted of the existing condition and/or any needed additions/improvements (or costs) for the rail connections between the two corridors. Costs associated with excursion trains are not included in this report.

**Potential Tourist Attractions**

Commuter rail service along the Eastside corridor could potentially result in an increase in tourism near the stations. For the purpose of this analysis, tourism includes shopping, restaurants, entertainment, arts, cultural events, and lodging opportunities.

Following are potential tourism opportunities within approximately ½ mile of the assumed commuter rail stations (based on available information and may not be a comprehensive list):

- **Renton/Gene Coulon Park**: Gene Coulon Park.
- **Renton/Port Quendall**: Seahawks training facility.
- **Bellevue/NE 6th Street**: Retail and restaurants. Over ½ mile to Bellevue CBD (could possibly be connected via a shuttle), which has various restaurants, theatres, Bellevue Square Mall, other shopping, hotels, seasonal events.
- **Kirkland/NE 85th Street**: Kirkland Parkplace Mall, Kirkland Performance Center, shopping, restaurants, various seasonal special events.
- **Kirkland/Totem Lake**: Totem Lake Mall, shopping, restaurants, motels, movie theaters.
- **South Woodinville**: Various wineries (including concert series at Chateau Ste. Michelle), Redhook Brewery and pub, restaurants, Willows Lodge, Sammamish River Trail.
- **Woodinville CBD**: Shopping, restaurants, movie theaters, access to Sammamish River Trail, various seasonal events.
- **North Woodinville**: North Woodinville wineries.
- **Maltby**: Maltby Café, shops.
- **Snohomish CBD**: Downtown Snohomish historic district, shopping (including antiques), hotels, restaurants, parks, festivals and special events throughout the year,
Centennial Trail, trail along Snohomish River, Harvey Airfield, potential connection/transfer to tourism activities east and west via the BNSF Scenic Subdivision (described above).

**Redmond CBD:** Redmond Town Center shopping, hotels, restaurants and movie theaters; Cleveland Street Square shopping and restaurants; Redmond CBD shopping and restaurants; Sammamish River Trail; Marymoor Park (including concert series).

No tourism opportunities were identified for the Bellevue/Newport, Bellevue/NE 12th Street, Bellevue/Newport/112th Avenue SE, South Kirkland Park-and-Ride and Cathcart stations. Table 7.2 identifies the types of potential tourism opportunities in the vicinity of each assumed commuter rail station. Tourism opportunities are denoted as major (e.g., regional shopping centers) or minor.

Table 7.2: Tourism Activities by Station

<table>
<thead>
<tr>
<th>Station</th>
<th>Shopping</th>
<th>Restaurants</th>
<th>Trails</th>
<th>Parks</th>
<th>Movie Theaters</th>
<th>Hotels/Motels</th>
<th>Brewery/Wine</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renton/Gene Coulon Park</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>○</td>
</tr>
<tr>
<td>Renton/Port Quendall</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>○</td>
</tr>
<tr>
<td>Bellevue/Newport/112th SE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>○</td>
</tr>
<tr>
<td>Bellevue/NE 6th St</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Bellevue/NE 12th St</td>
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<td>●</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Kirkland Park-and-Ride</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>○</td>
</tr>
<tr>
<td>Kirkland/NE 85th St</td>
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<td>●</td>
<td>○</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Kirkland/Totem Lake</td>
<td>○</td>
<td>●</td>
<td></td>
<td></td>
<td>○</td>
<td>○</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>South Woodinville (both lines)</td>
<td>○</td>
<td>●</td>
<td></td>
<td></td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>●</td>
</tr>
<tr>
<td>Woodinville CBD</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>North Woodinville</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>○</td>
</tr>
<tr>
<td>Maltby</td>
<td></td>
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<td>Snohomish CBD</td>
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<td>●</td>
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<td>○</td>
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**KEY:**
- Major ●
- Minor ○
7.7 Cost Estimate for Concurrent Bicycle and Pedestrian Pathway

Section 4.1 of this report describes the capital cost estimate for a representative parallel trail. The capital cost estimate for a parallel trail (all 4 segments) is $297.4 to $386.7 million (2nd Qtr 2008$) for the lower cost option and $332.2 to $431.8 million (2nd Qtr 2008$) for the higher cost option.

7.8 Segments Most Beneficial and Cost-effective for Commuter Rail Service

Combining information presented in previous sections, Table 7.2 shows the estimated capital costs along with the forecasted daily trips in 2020 and the estimated annualized capital cost per trip in 2020. As shown in the table, the estimated annualized capital cost per trip in 2020 for the entire representative commuter rail system (all 4 segments) is between $22.05 and $28.67 (2nd Qtr 2008$).

Segment 2 (shown on first line) is assumed to be the “core” segment for this analysis because that segment includes the following:

- Downtown Bellevue (served by assumed Bellevue/NE 6th Street station) is the key ridership destination along the corridor, due to its concentrations of population, employment and commercial activity.

- Implementation of service along the corridor requires a vehicle storage and maintenance facility which appears to be located most readily north of downtown Bellevue where there are appropriately-zoned large parcels adjacent to the track(s).
Table 7.3: Estimated Annualized Capital Cost per Trip in 2020

<table>
<thead>
<tr>
<th>Commuter Rail Segments</th>
<th>Forecasted Daily Trips in 2020*</th>
<th>Cost Estimate Range</th>
<th>Capital Cost Estimate** (2nd Qtr 2008 $Millions)</th>
<th>Estimated Annualized Capital Cost** per Trip in 2020 (2nd Qtr 2008$)</th>
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<td>Segment 2 13.5 miles</td>
<td>Bellevue to Woodinville</td>
<td>1,770</td>
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<td></td>
<td></td>
<td></td>
<td>High</td>
<td>$299.03</td>
</tr>
<tr>
<td>Segments 1+2 21.7 miles</td>
<td>Coulon Park to Woodinville</td>
<td>4,580</td>
<td>Low</td>
<td>$449.73</td>
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<td></td>
<td></td>
<td></td>
<td>High</td>
<td>$584.65</td>
</tr>
<tr>
<td>Segments 1+2+3 34.1 miles</td>
<td>Coulon Park to Snohomish</td>
<td>5,015</td>
<td>Low</td>
<td>$673.29</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>High</td>
<td>$875.27</td>
</tr>
<tr>
<td>Segments 1+2+3+4 41.0 miles</td>
<td>Coulon Park to Snohomish plus spur</td>
<td>6,070</td>
<td>Low</td>
<td>$788.96</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>High</td>
<td>$1,025.65</td>
</tr>
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</table>

*Ridership forecasts reflect adjustments for southern terminus at Gene Coulon Park rather than Renton CBD (to match capital cost estimate).

**Costs exclude maintenance facility, vehicles, and corridor acquisition costs. Costs exclude any requirements and/or restrictions by the Third Party Operator.
8. Conclusions

This report presents the results of a study conducted to evaluate the feasibility of implementing commuter rail service along the BNSF Eastside corridor. The report includes a description of the representative commuter rail system, including potential improvements, needs and/or considerations for track, bridges, signals/train control/crossings, maintenance facility, stations, vehicles, and operations. Consistent with SHB 3224, this report provides a cost estimate for the representative commuter rail system and a parallel trail. The report also provides the results of a commuter rail ridership forecasting effort completed by PSRC. The information documented in this report and in the Phase I Technical Memorandum is intended to satisfy the requirements of SHB 3224.

The ST2 Plan approved by Sound Transit district voters on November 4, 2008 includes a $50 million capital funding contribution for vehicles, property or other capital components toward a potential passenger rail partnership in the corridor. The Sound Transit Board of Directors has identified several requirements associated with these funds, and approval of the Board of Directors would be required for their use. The information below is excerpted from the adopted ST2 Plan, pages 10 and 11:

“The ST2 Plan sets aside funds that may be used in connection with rail passenger development and associated work that may be undertaken by other local governments and public agencies for long-term passenger rail service on an existing BNSF line. This rail line, portions of which BNSF intends to abandon and which the Port of Seattle is purchasing through the federal rail-banking process, stretches from the city of Snohomish to the city of Renton, east of Lake Washington. The State of Washington has directed Sound Transit and the PSRC to complete a feasibility study of potential passenger rail on this corridor. In addition, other parties in the region have expressed an interest in passenger rail service on this line.

Any future passenger rail service along this corridor would be implemented and operated by other public and/or private parties, particularly along the portion of the corridor located in Snohomish County outside the Sound Transit District. The ST2 Plan does not include funds to operate such passenger rail service. Sound Transit’s investment in this corridor is limited to a maximum contribution of $50 million dollars, which may be used for engineering and design, and for the purchase of capital equipment and real estate that can either be sold or used on Sound Transit’s existing transportation system. Sound Transit’s investment is also contingent upon the satisfaction of the following conditions prior to December 31, 2011:

a. Completion of the Sound Transit/PSRC feasibility study and determination that passenger rail on the Eastside BNSF corridor is feasible

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16 BNSF Eastside Corridor Commuter Rail Feasibility Study, Phase I Technical Memorandum: Review of Previous Plans, Studies and Other Documents (Sound Transit, September 17, 2008).
and would be a meaningful component of the region’s future transportation system, as required by state law;
b. The Sound Transit Board’s determination that the ridership forecasts, financing plan, and capital and operating cost estimates and operating plan are reasonable and that the service will provide substantial benefits to the regional transportation system in the Sound Transit District; and
c. Execution of an agreement with other public or private parties regarding the implementation of a passenger rail system.

If a partnership for passenger rail on the BNSF corridor in East King County is not executed by December 31, 2011, the $50 million included in the ST2 Plan for a partnership will be reprogrammed to further the implementation of HOV BRT service in the I-405 corridor in East King County. Options for alternative investments in the I-405 corridor will be developed for Board review and approval prior to expenditure of these funds.”
Appendix A: Conceptual Capital Cost Estimate
<table>
<thead>
<tr>
<th>Project</th>
<th>Segment 1: Bellevue to Renton</th>
<th>Cost (2nd Qtr 2008 in millions)</th>
<th>Low</th>
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## BNSF Eastside Corridor Commuter Rail Feasibility Study

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### SOUND TRANSIT ST2
### HCT Planning
### BNSF Eastside Corridor Commuter Rail Feasibility Study
### Capital Cost Estimate

(2nd Qtr. 2008 Dollars in Millions)

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<th>Description</th>
<th>Segment 1</th>
<th>Segment 2</th>
<th>Segment 3</th>
<th>Segment 4</th>
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<th>Vehicles (Locomotive &amp; Coaches)</th>
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| Construction Subtotal (Sum Categories 10 - 50)   | $139.08    | $130.89    | $137.17    | $73.25     | $27.85          | $0.00          | $0.00                          |
| Change Order Contengency                         | $13.91     | $13.09     | $13.72     | $7.32      | $2.79           | $0.00          | $0.00                          |
| Construction Total                               | $152.99    | $143.98    | $150.88    | $80.57     | $30.64          | $0.00          | $0.00                          |
| 60 ROW, LAND, EXISTING IMPROVEMENTS              | $0.07      | $22.01     | $6.55      | $0.00      | $11.89          | $0.00          | $0.00                          |
| 70 VEHICLES                                      | $0.00      | $0.00      | $0.00      | $0.00      | $60.48          | $66.15         |                                |
| 80 PROFESSIONAL SERVICES                         |            |            |            |            |                 |                |                                |
| Construction Management                          | $13.00     | $12.24     | $12.83     | $6.85      | $2.60           | $0.00          | $0.00                          |
| Environmental Clearance and PE                   | $7.65      | $7.20      | $7.54      | $4.03      | $1.53           | $0.00          | $0.00                          |
| Final Design, Specs, Permitting                  | $19.12     | $18.00     | $18.86     | $10.07     | $3.83           | $0.00          | $0.00                          |
| Agency Admin (Calculated on subtotal of all items above) | $11.57  | $12.21     | $11.80     | $6.09      | $3.03           | $3.63          | $3.97                          |
| 90 UNALLOCATED CONTINGENCY                       | $15.30     | $14.40     | $15.09     | $8.06      | $3.06           | $0.00          | $0.00                          |

| Total Project Cost                               | $219.71    | $230.02    | $223.55    | $115.67    | $56.58          | $64.11         | $70.12                         |

A-8
## SOUND TRANSIT ST2

**HCT Planning**

**BNSF Eastside Corridor Commuter Rail Feasibility Study**

**Capital Cost Estimate**

(2nd Qtr. 2008 Dollars in Millions)

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Number of Revenue Vehicles: 16

Number of Maintenance Base: 3

Number of Vehicles (DMU): 8

Number of Coaches: 3

Number of Revenue Vehicles: 2

Length (Mile): 8.2

Number of Stops: 3832

Number of Revenue Vehicles: 16

Number of Revenue Vehicles: 23

Number of Revenue Vehicles: 16

Number of Revenue Vehicles: 23
## Segment

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Subtotal Category 30: $17.99

| 40.01   | Demolition, Clearing, Earthwork | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| 40.02   | Site Utilities, Utility Relocation | $2.19 | $3.59 | $3.30 | $3.30 | $3.30 | $1.85 |
| 40.03   | Haz. matl, contaminant soil removal/mitigation, ground water treatments | $1.30 | $2.13 | $1.95 | $1.95 | $1.95 | $1.09 |
| 40.04   | Environmental mitigation, e.g. wetlands, historic/archeologic, parks | $1.01 | $1.66 | $1.53 | $1.53 | $1.53 | $0.86 |
| 40.05   | Site structures including retaining walls, sound walls | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| 40.06   | Pedestrian / bike access and accommodation, landscaping | $0.71 | $1.57 | $0.35 | $0.35 | $0.35 | $0.30 |
| 40.07   | Automobile, bus, van accessways including roads, parking lots | $5.97 | $15.60 | $6.26 | $6.26 | $6.26 | $10.99 |
| 40.08   | Temporary Facilities and other indirect costs during construction | $0.56 | $1.23 | $0.67 | $0.67 | $0.67 | $0.75 |

Subtotal Category 40: $11.73 $25.78 $14.07 $15.84

| 50.01   | Train control and signals | $14.19 | $24.61 | $18.62 | $10.71 | $1.21 |
| 50.02   | Traffic signals and crossing protection | $7.01 | $14.96 | $6.55 | $18.70 | $0.00 |
| 50.03   | Traction power supply: substation | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| 50.04   | Traction power distribution: catenary and third rail | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| 50.05   | Communications | $1.82 | $3.31 | $2.57 | $1.58 | $0.00 |
| 50.06   | Fare collection system and equipment | $1.06 | $2.64 | $0.77 | $0.51 | $0.00 |
| 50.07   | Central Control | $0.00 | $0.00 | $0.00 | $0.00 | $8.65 |

Subtotal Category 50: $24.08 $45.53 $28.51 $31.50 $9.86

Subtotal Construction Costs: $139.08 $130.89 $137.17 $73.25 $27.85

Change Order Contingency: 10.0% $13.91 $13.09 $13.72 $7.32 $2.79

Total Construction Costs: $152.99 $143.98 $150.88 $80.57 $30.64

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### BNSF Eastside Corridor Commuter Rail Feasibility Study

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<tr>
<td></td>
<td>Contingency</td>
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<td>Total</td>
<td>$72.19</td>
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## BNSF Eastside Corridor Commuter Rail Feasibility Study

<table>
<thead>
<tr>
<th>Project</th>
<th>Cost (2nd Qtr 2008 in millions)</th>
<th>Low</th>
<th>High</th>
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<tbody>
<tr>
<td>Agency Admin</td>
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<td>Environmental Clearance and PE</td>
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<td>Final Design, Specs, Permitting</td>
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<td>Construction</td>
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<td>Cost (2nd Qtr 2008 in millions)</td>
<td>Low</td>
<td>High</td>
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BNSF Eastside Corridor Commuter Rail Feasibility Study

A-19

Version 1.0
Dec. 8, 2008
### Sound Transit ST2

**HCT Planning**

**BNSF Eastside Corridor Commuter Rail Feasibility Study**

**Capital Cost Estimate**

(2nd Qtr. 2008 Dollars in Millions)

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<thead>
<tr>
<th>Description</th>
<th>Segment 1</th>
<th>Segment 2</th>
<th>Segment 3</th>
<th>Segment 4</th>
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<td>Number of Stops:</td>
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<td>Number of Revenue Vehicles:</td>
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#### 10 GUIDEWAY & TRACK ELEMENTS

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<td>$0.00</td>
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#### 60 ROW, LAND, EXISTING IMPROVEMENTS

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#### 80 PROFESSIONAL SERVICES

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#### 90 UNALLOCATED CONTINGENCY

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A-20
### SOUND TRANSIT ST2

**HCT Planning**

**BNSF Eastside Corridor Commuter Rail Feasibility Study**

**Capital Cost Estimate**

**(2nd Qtr. 2008 Dollars in Millions)**

<table>
<thead>
<tr>
<th>CAT No.</th>
<th>Description</th>
<th>Segment</th>
<th>Segment</th>
<th>Segment</th>
<th>Segment</th>
<th>Segment</th>
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<tbody>
<tr>
<td></td>
<td>Length (Mile):</td>
<td>Ped/Bike Trail Low</td>
<td>Ped/Bike Trail Low</td>
<td>Ped/Bike Trail Low</td>
<td>Ped/Bike Trail Low</td>
<td>Ped/Bike Trail Low</td>
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<tr>
<td></td>
<td>Number of Stops:</td>
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<td>13.3</td>
<td>11.9</td>
<td>7.1</td>
<td>8.1</td>
<td>13.3</td>
<td>11.9</td>
</tr>
<tr>
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<td>Number of Revenue Vehicles:</td>
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</tbody>
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#### 10 GUIDEWAY & TRACK ELEMENTS

10.01 Guideway: At-grade exclusive right-of-way
10.02 Guideway: At-grade semi-exclusive (allows cross-traffic)
10.03 Guideway: At-grade in mixed traffic
10.04 Guideway: Aerial structure
10.05 Guideway: Built-up fill
10.06 Guideway: Underground cut & cover
10.07 Guideway: Underground tunnel
10.08 Guideway: Retained cut or fill
10.09 Track: Direct fixation
10.10 Track: Embedded
10.11 Track: Ballasted
10.12 Track: Special (switches, turnouts)
10.13 Track: Vibration and noise dampening

**Subtotal Category 10**

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<tr>
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<th>$0.00</th>
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<th>$0.00</th>
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</table>

#### 20 STATIONS, STOPS, TERMINALS, INTERMODAL

20.01 At-grade station, stop, shelter, mall, terminal, platform
20.02 Aerial station, stop, shelter, mall, terminal, platform
20.03 Underground station, stop, shelter, mall, terminal, platform
20.04 Other stations, landings, terminals: Intermodal, ferry, trolley, etc.
20.05 Joint development
20.06 Automobile parking multi-story structure
20.07 Elevators, escalators

**Subtotal Category 20**

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(A-21)
### SOUND TRANSIT ST2

**HCT Planning**

**BNSF Eastside Corridor Commuter Rail Feasibility Study**

**Capital Cost Estimate**

(2nd Qtr. 2008 Dollars in Millions)

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<th>CAT No.</th>
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<th>Ped/Bike Trail Low</th>
<th>Ped/Bike Trail Low</th>
<th>Ped/Bike Trail Low</th>
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<th>Ped/Bike Trail High</th>
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<td>30.01</td>
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# SOUND TRANSIT ST2
## HCT Planning
### BNSF Eastside Corridor Commuter Rail Feasibility Study
#### Capital Cost Estimate

(2nd Qtr. 2008 Dollars in Millions)

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Appendix B: Conceptual Alignment

Issued under separate cover
Appendix C: Track

This report documents a study of the track and track structure on the BNSF Woodinville Subdivision between Renton and Snohomish and the Redmond spur line between Redmond and Woodinville. Presently these rail lines are limited to a track speed of 10 mph. This limited analysis included an inspection, on a sampling basis, to evaluate the condition and size of the rail, ties and ballast for 34 miles of mainline track and one spur track, the Redmond spur. The inspected track was separated into four sections as follows:

- Renton to Bellevue
- Bellevue to Woodinville
- Woodinville to Snohomish
- Woodinville to Redmond (Redmond spur line)

Twelve (12) sample locations were investigated at varying intervals, not exceeding five (5) miles apart. At each location, one-half (1/2) to one (1) mile of track was examined by walking the track. The items noted were only those that were readily observed and included: rail section including year rolled; fastening system (type and size of plates); type of track construction (jointed/welded); tie conditions including size and spacing; ballast conditions and type; cross-level; surface and alignment conditions; drainage; and other miscellaneous conditions.

It is understood that the rail was recently inspected by a Sperry Rail/Star car. The Star car evaluated the track geometry. All defects were reported and marked with spray paint visible during the PB track inspection. A maintenance plan was developed and implemented by the BNSF which included crosstie renewal, minimal ballast, surfacing, lining and regulating work, although no drainage improvements. Due to a lack of funding, rail upgrading and renewal work was not performed. 1000 ties were placed throughout the Woodinville Subdivision. Where these new crossties were located, excessive mudding formed around the new ties. There is clear evidence that the ballast section is not properly draining through the track bed. A 10 mph speed restriction has been placed on the railroad.

![Figure 1: Mudding around a recently installed cross tie](image-url)
Section 1 – Renton MP 4.10 to Bellevue MP 12.40

A. Beginning at the intersection of Lake Washington Blvd. and Burnett Ave. (Milepost 5.0) - This section of track is comprised of 112# RE jointed rail in good condition. The rail is seated in 7 3/4" x 13" double shouldered tie plates and fastened to wood ties using cut spikes. The rail is anchored and is joined using 6 - hole joint bars. The ties are 7" x 9" x 8' - 6" and are in good condition. The ties are not end plated although a few are s-ironed and are spaced at an average of 20 inches. Approximately 30% of the ties need to be replaced. The ballast is clean and comprised of both river rock and granite. The ballast section is tight and the surface and alignment are good.

B. North of MP 6.0. Two private street crossings and Lake Washington Blvd. then Hazelwood Lane - A station platform is assumed off of Hazelwood lane. This section of track is comprised of 100# RE jointed rail and is in good condition. The rail is seated in 7 3/4" x 13" double shouldered tie plates fastened on wood ties with cut spikes. The rail is anchored and is joined using 6 - hole joint bars. Rail on the low side of the horizontal curves show significant head wear and has been transposed. Ties south of MP 7.0 are spaced at 20" and are in good to excellent condition. Ties north of MP 7.0 continuing past Hazelwood Lane SE crossing are in fair condition. Approximately 27% of the ties need to be replaced. A combination of river rock and granite ballast used in the shoulders and cribs are mostly full. The surface and alignment are good with some gauge rods installed in the spiral curve from Milepost 6.5 through Milepost 6.8.

C. 12th Street Crossing at MP 12.8 - The rail in this section is 100# RE jointed rail and is in fair to poor condition. The rail is chipped and flaking. The rail is seated in 7 3/4" x 13" double shouldered tie plates fastened on wood ties with cut spikes. The rail is missing anchors and is joined using both 4 & 6 - hole joint bars. The ties are 6" x 8" and 7" x 9" x 8' - 6" long, some with s-irons and are in poor condition. Approximately 50% of the ties need to be replaced. The ties are split and hollow and are slewed with the spacing varying between 20 to 24 inches. Some ties have been installed recently and appear to be new timber. The track bed is in fair to poor condition with some vegetation present and some ballast in the cribs and on the shoulders. Ballast is river stone similar to AREMA #5 or #57 gradation. The surface and line along this section is poor with many low joints and kinks.
Section 2 – Bellevue MP 12.40 to Woodinville MP 26.37
A. NE 87th Street MP 17.5 - The rail in this section is mainly 100# RE (rolled in 1926) with some 132# RE rail mainly in special track work (Street crossings). The mainline rail is in poor condition with evidence of chipped and lipped rail. Some rail has been transposed. The rail has few anchors and is seated in 7 3/4" x 13" double shouldered tie plates and in some instances the tie plates are missing. The siding tracks are out of service and the No.8 turnouts are in fair to poor condition. The ties are 6" x 8" x 8' - 6" and are in poor condition. Approximately 50% of the ties need to be replaced. The ties are split, hollow and killed in the bearing areas. Ties are slewed with the spacing varying between 20 to 24 inches. The track bed is in poor condition with vegetation present and very little ballast in the cribs and on the shoulders. Ballast present is a mixture of river rock and granite similar to AREMA #5 or #57 gradation. The surface and line along this section are poor with many low joints.
B. NE 145th Street MP 22.3 - The rail in this location is 112# RE. Inspected rail sections were rolled from 1924 to 1944. The jointed rail is in generally satisfactory condition. Sections of the older rail has chipped and lipped. There are shelled spots. The rail is seated in 7" x 10 3/4" double shouldered tie plates fastened on wood ties with cut spikes. The rail has no anchors and is joined using a mixture of 4 & 6 - hole joint bars. The ties are 6" x 8" and 7" x 8" x 8' - 6" long and are in poor condition. Approximately 52% of the ties need to be replaced. The ties are split and hollow and are slewed with the spacing varying between 20 to 24 inches. The track bed is in poor condition with vegetation present and some ballast in the cribs and on the shoulders. Drainage problems are very evident along the alignment. Ballast is a mixture of river rock and granite similar to AREMA #5 or #57 gradation. The surface and line along this section are poor with many low joints and kinks. The track south of the Redmond Spur turnout gradually gets worse with poor drainage conditions and the use of gauge rods on the curves.

C. State Route 202 MP 24.1 - The rail in this section is a mixture of 90# RE, 100#RE, 112#RE jointed rail. 132# RE rail is used in the special track work (Street crossings). The condition ranges from good to very poor. The rail is seated in 7 1/4" x 13" double shouldered tie plates fastened on wood ties with cut spikes. The rail is missing anchors and is joined using 6 - hole joint bars. The ties are 6" x 8", 7" x 8", and 7" x 9" x
8’ - 6" long and are in good condition. Approximately 20% of the ties need replacing in this area. The tie spacing varies between 19 to 21 inches. The track bed is in good condition with full cribs and sufficient shoulders. Ballast is a mixture of river rock and crushed stone similar to AREMA #3 and #57 gradation. The surface and line along this section are good.

Section 3 – Woodinville MP 26.37 to MP 39 (4th Street) in Downtown Snohomish

A. Private Crossing near the Snohomish County Line MP 26.7 - The rail in this section is 112# RE jointed rail with a section of 90# RE rail that was rolled in 1912. The track bed is in poor condition. The rail is chipped and is flaking. The rail is seated in 7" x 10" double shouldered tie plates fastened on wood ties with cut spikes. The rail is missing anchors and is joined using both 4 & 6 - hole joint bars. The ties are 6" x 8" and 7" x 9" x 8’ - 6" long with some s-irons found in the cross ties. The cross ties range from good to poor condition. Approximately 50% of the ties need to be replaced. The ties are split and hollow and are skewed with the spacing varying between 20 to 24 inches. Some ties have been recently installed. The track bed is in fair to poor condition with some vegetation present and some ballast in the cribs and on the shoulders. Ballast is a combination of river rock and granite similar to AREMA #5 or #57 gradation. The surface and line along this section are poor with many low joints and kinks.

B. State Highway 522 MP 27.2 - The rail in this section is 112# RE jointed rail and is in fair condition. The rail is seated in 7" x 10 3/4" double shouldered tie plates. The rail is missing anchors and is joined using 6 - hole joint bars. The ties are 6" x 8" x 8’ - 6" long and are in fair to poor condition. Approximately 40% of the ties need to be replaced. Many ties are split and hollow and are skewed with the spacing at 24 inches. The track bed is in very poor condition with vegetation present and the ties covered with silt. There is river rock ballast in the cribs and on the shoulders. The surface and line along this section are fair with some low joints and kinks.

C. 91st Ave MP 30.3 - The rail in this section is 112# RE jointed rail and is in fair condition. The rail is seated in 7" x 10 3/4" double shouldered and 7 1/2" x 14" double shouldered tie plates. Some ties are missing tie plates. The rail is missing anchors and is joined using 6 - hole joint bars. Some short sticks of rail, 11'- 4" long, have been installed. The ties are 6" x 8" x 8’ - 6" long and are in poor condition. New 6" x 8" ties have recently been installed. Approximately 39% of the ties need to be replaced. The tie spacing varies between 21 to 24 inches. The track bed is “tight”, comprised of river rock ballast and is in good condition. The surface, line, and cross-level along this section are fair with some low joints and kinks.

D. 180th Street MP 32.5 - The rail in this section is 112# RE jointed rail and is in fair condition. The rail is seated in 7" x 9", 7" x 11", and 7 1/2" x 10" double shouldered tie plates. The rail is missing anchors and is joined using 6 - hole joint bars. The ties are 6" x 8" x 8’ - 6" long and are in fair to good condition. New 6" x 8" ties have recently been installed. Approximately 30% of the ties need to be replaced. The tie spacing varies between 21 to 23 inches. The track bed is “tight”, comprised of crushed stone ballast and
is in good condition. The surface, line, and cross-level along this section are poor with many low joints and kinks.

Figure 5: Kinks and low joints along the alignment

E. Private grade crossing MP 37.0 - The rail in this section is a mixture of 112# RE and 132# RE jointed rail and is in fair condition. The 112# rail is lipped and chipped on the gage face and has significant head wear. The rail is seated in 7" x 9" and 7" x 11" double shouldered tie plates. The rail is not anchored and is joined using 6 - hole joint bars. Many of the joints are loose and some joint bars are cracked. The ties are 6" x 8" x 8' - 6" long and are in fair to good condition. New 6" x 8" ties have recently been installed. Approximately 30% of the ties need to be replaced. The tie spacing varies between 18 to 20 inches. The track bed is comprised of river rock ballast and is in good condition. The surface and line along this section is fair with some low joints and kinks. The cross-level is poor and is evident given the wear patterns exhibited on the rail.

Section 4 – Woodinville MP 0.00 to Redmond MP 6.90 (Redmond Spur)
The rail in this section is a combination of 90# RE and 100# RE jointed rail and is in fair to poor condition. The rail is chipped, lipped and has head wear. The rail is seated in 7" x 10" single shouldered tie plates. Some ties are missing tie plates. The rail is missing anchors and is joined using 4 & 6 - hole joint bars. The ties are 6" x 8" x 8' - 6" long and are in extremely poor condition. 100% of the ties need to be replaced. The ties are split and hollow, and many have disintegrated. The ties that are present are slewed with the spacing varying between 22 to 24 inches. The track bed is in very poor condition with significant vegetation present and the ties covered with silt and weeds. Brush cutting is required in this section. There is very little ballast in the cribs and on the shoulders. The surface and line along this section are fair to poor with many low joints and kinks.
Appendix D: Bridges

Existing Conditions and Suggested Bridge Repairs

This report documents a study of the bridges on the BNSF Eastside corridor (Woodinville Subdivision) between Renton and Snohomish and the Redmond spur line between Redmond and Woodinville. The following is a list of the Eastside corridor bridges, including type and span configuration. This section describes observed current conditions and suggested repairs to bring them to a good state of repair (as determined during a field study and BNSF Bridge Reports). Suggested repairs are provided for informational purposes only and are not reflected in the capital cost estimate.
Segment 1: Br. 6

- MP 6.1
- Line Segment 405
- Over May Creek
- Bridge Length = 60 ft
- 4 Spans
- Open Deck
- Existing Single Track
- Superstructure: Timber Trestle
- Substructure: Timber abutments and wing walls
- Condition: Some of the timber members exhibit signs of deterioration (weathering, cracks, and rot).
- Suggested Repairs: Replace 25% of all timber members.
Segment 1: Br. 6.1

- MP 6.7
- Line Segment 405
- Bridge Length = 406 ft
- 26 Spans
- Open Deck
- Existing Single Track
- Superstructure: Timber Trestle
- Substructure: Timber abutments and piers with wide flange beams as stringer bearings.
- Condition: Southwest wing wall is in poor condition.
- Suggested Repairs: Rebuild southwest wing wall and replace 25% of timber members at piers.
Segment 1: Br. 9

- MP 9.1
- Line Segment 405
- Over Coal Creek (waterway)
- Bridge Length = 133 ft
- 9 Spans
- Existing Single Track
- Superstructure: Timber Trestle
- Substructure: Timber abutments and wing walls supported by timber piles.
- Condition: Some timber members are weathered.
- Suggested Repairs: Replace 25% of timber members.
Segment 1: Br 9.05

- MP = 9.15 (approx.)
- Line Segment 405
- Over trail (Marker 25 in photo)
- Bridge Length = 85 ft (approx.)
- 3 Spans
- Ballasted
- Existing Single Track
- Superstructure: Pre-cast deck plate girders.
- Substructure: Abutments – pre-cast concrete members, piers – pre-cast cap beam supported by steel wide flange members.
- Condition: Signs of water leakage through deck plate girder joints.
- Suggested Repairs: Remove the rails and ballast, install new waterproofing membrane on top of deck plate girders then reinstall ballast and rails.
Segment 1: Br. 9.1

-MP 9.2
-Line Segment 405
-Over Lake Washington Blvd. (Marker 9 in photo)
-Bridge Length = 40 ft
-1 Span
-Open Deck
-Existing Single Track
-Superstructure: Riveted plate girders.
-Substructure: Plain concrete abutments.
-Condition: West girder exhibits section loss; both abutments exhibit spalling.
-Suggested Repairs: Repair west girder and fix all spalled areas.
Segment 1: **Br. 9.46**

- MP 9.94
- Line Segment 405
- Over I-90
- Bridge Length = 617ft
- 6 Spans
- Ballasted
- Existing Single Track
  - Superstructure: Riveted Thru Girder
  - Substructure: Reinforced concrete abutments and piers.
- Condition: Good, except for graffiti on girders.
- Suggested Repairs: Repaint steel structure.
Segment 1: Br. 10B

- MP 10.1
- Line Segment 405
- Over Henry Bock Road
- Bridge Length = 74 ft
- 5 Spans
- Ballasted
- Existing Single Track
- Superstructure: Timber Trestle
- Substructure: Timber abutments and wing walls.
- Condition: Timber members at north abutment exhibit rot, splits and checks.
- Suggested Repairs: Rebuild north abutment and replace 40% of timber members at trestles.
Segment 1: New Bridge over I-405

- MP 10.9
- New Bridge over widened I-405 southbound lanes
- 3 spans (assumed)
- Assumed Superstructure: Center span – steel through truss or tied arch with bike/ped trail on cantilevered bracket to the side; end spans – steel through girders possibly a three-girder through girder system providing a positive separation of rail traffic and pedestrian/bicycle traffic on the bridge.
- Assumed Substructure: Reinforced concrete piers, abutments and wing walls possibly supported on drilled shafts.
Segment 1: Br 11.1

-Wilburton Trestle
-MP 11.57
-Line Segment 405
-Bridge Length = 975 ft.
-15 Spans
-Open Deck
-Existing Single Track
-Substructure: 2 timber abutments, 12 timber trestles and two reinforced concrete piers
-Condition: Timber members exhibit cracks, splits and rot; some were already repaired (galvanized steel bands on trestle columns).
-Suggested Repairs: Repair/replace about 30% of all timber members for Build parallel bridge for bicycle/pedestrian trail use. Build new parallel bridge for rail traffic.
Segment 1:  Br. 11.72

- MP 11.71
- Line Segment 405
- Over Lake Hills Boulevard
- Bridge Length = 99ft
- 2 Spans
- Ballasted
- Existing Single Track
- Superstructure: Wide Flange beams.
- Substructure: Concrete Pier and Abutments.
- Condition: Good.
Segment 2: Br. 16

- MP 16.32
- Line Segment 405
- Over 68th Street
- Bridge Length = 126 ft
- 5 Spans
- Open Deck
- Existing Single Track
- Superstructure: Main span over roadway – rolled steel girders, remaining spans - Timber Trestle.
- Substructure: Two reinforced concrete piers at roadway; timber trestle and timber abutments elsewhere.
- Condition: Some timber members appear to be in poor condition (weathering, rot).
- Suggested Repairs: Replace 20% of existing timber members. Build parallel bridge for bicycle/pedestrian trail.
Segment 2: Br.17

- MP 17.1
- Line Segment 405
- Over Kirkland Way
- Bridge Length = 43 ft.
- 1 Span
- Ballasted
- Existing Single Track
- Deck Plate Girders w/ Concrete Abutments
- Superstructure: Riveted stringers and reinforced concrete fascia girders.
- Substructure: Plain concrete abutments.
- Condition: Bottom of the concrete girders exhibit signs on impact, exposed reinforcement, spalling.
- Suggested Repairs: Replace existing structure because of substandard underclearance. Build parallel bridge for bicycle/pedestrian trail.
**Segment 2:** Br. 23

- MP 23.92
- Line Segment 405
- Over Sammamish River
- Bridge Length = 159 ft
- 5 Spans
- Ballasted
- Existing Single Track
- Superstructure: Timber Trestle with Thru Girders over water
- Substructure: Timber abutments and reinforced concrete piers at river.
- Condition: Back wall and bridge seats at both abutments are in poor condition.
- Suggested Repairs: Replace 40% of all timber members. Build parallel bridge for bicycle/pedestrian trail.
Segment 2: Br. 24.1

- MP 24.67
- Line Segment 403
- Bridge Length = 83 ft
- 2 Spans
- Ballasted
- Existing Single Track
  - Superstructure: Deck plate girders.
  - Substructure: Reinforced concrete abutments and pier.
- Condition: Abutments and pier appear to be in good condition.
- Suggested Repairs: Track tie replacement. Build parallel bridge for bicycle/pedestrian trail.
Segment 3: Br. 27

- MP 27.07
- Line Segment 403
- Bridge Length = 292 ft.
- Existing Single Track
- Superstructure: Steel deck girders with concrete slab.
- Substructure: Reinforced concrete abutments and piers.
- Condition: Structure appears to be in good condition.
Segment 3: Br. 34

- MP 34.71
- Line Segment 403
- Bridge Length = 54 ft
- Open Deck
- Existing Single Track
- Superstructure: Timber Trestle.
- Substructure: Timber abutments.
- Condition: Overall condition of timber members is poor. Fascia stringers exhibit damage due to vehicle impact.
- Suggested Repairs: Replace existing bridge due to substandard underclearance (Posted vertical underclearance = 11’-6”). Build parallel bridge for bicycle/pedestrian trail.
Segment 3: Br. 35

- MP 35.95
- Line Segment 403
- Bridge Length = 1014 ft
- 69 Spans
- Open Deck
- Existing Single Track
- Superstructure: Timber Trestle.
- Substructure: Timber abutments.
- Condition: Structure appears to be in fair condition.
- Suggested Repairs: Replace 15% of all timber members.
Segment 3: Br. 36

- MP 36.92
- Line Segment 403
- Bridge Length = 649 ft
- 43 Spans
- Open Deck
- Existing Single Track
- Superstructure: Timber Trestle
- Substructure: Timber abutments.
- Condition: Six pier bents at north end are doubled up as part of earlier rehabilitation. Some of the diagonal bracing members are broken.
- Suggested Repairs: Replace 30% of all timber members.
Segment 3: Br. 37

MP 37.14
Line Segment 403
Bridge Length = 138 ft
10 Spans
Open Deck
Existing Single Track
Superstructure: Timber Trestle
Substructure: Timber abutments and wingwalls
Condition: Fair. All trestle members exhibit weathering, splits and cracks
Suggested Repairs: Repair estimated 40% of all timber members. Build parallel bridge for bicycle/pedestrian trail.
Segment 3: Br. 37.1

- MP 37.39
- Line Segment 403
- Bridge Length = 412 ft
- 31 Span
- Existing Single Track
- Open Deck
- Superstructure: Timber Trestle
- Substructure: Timber abutments.
- Condition: Some of the diagonal members are missing, other timber members are weathered.
- Suggested Repairs: Replace 25% of all timber members.
Segment 3: Br. 37.2

- MP 37.56
- Line Segment 403
- Bridge Length = 357 ft
- 26 Spans
- Open Deck
- Existing Single Track
- Superstructure: Timber Trestle
- Substructure: Timber abutments.
- Condition: Timber members are weathered, some exhibit splits and rot.
- Suggested Repairs: Replace 30% of all timber members.
Segment 3: Br. 38.25

-MP 38.25
-Line Segment 403
-Bridge Length = 1790 ft
-83 Spans
-Open Deck
-Existing Single Track
-Superstructure: South and North Approach spans composed of timber trestles, four spans over river are as follows: two-span cantilever deck truss turntable superstructure which has not been operational for a long time, riveted steel thru truss main span and a steel deck girder span over river.
-Substructure: Five concrete piers supporting steel spans, timber trestle and timber abutments elsewhere.
-Condition: Timber back walls are in poor condition, some of the timber trestle is in poor condition (exhibit cracks, splits).
-Suggested Repairs: Replace 40% of all timber members and utilize existing bridge as bicycle/pedestrian trail. Build a parallel bridge for rail traffic.
Segment 4: Br. 6.1

- MP 6.14
- Line Segment 404
- Bridge Length = 170 ft
- 4 Spans
- Ballasted Deck
- Existing Single Track
- Superstructure: Deck Plate Girders.
- Substructure: Concrete piers and abutments
- Condition: Structure appears to be in good condition.
- Suggested Repairs: Build parallel bridge for Bike/Ped Trail
**Segment 4:** Br. 6.2

- MP 6.2
- Line Segment 404
- Bridge Length = 225 ft
- 13 Spans
- Existing Single Track
- Open Deck
- Superstructure: Timber Trestle and steel deck truss at main span.
- Substructure: Timber abutments.
- Condition: Steel members appear to be in good condition; timber members exhibit signs of deterioration (weathering, splits, cracks).
- Suggested Repairs: Replace 30% of all timber members. Build parallel bridge for bicycle/pedestrian trail.
**Segment 4:** Br. 6.4

- MP 6.36
- Line Segment 404
- Bridge Length = 115 ft
- 1 Span
- Ballasted Deck
- Existing Single Track
- Superstructure: Riveted Steel Thru Truss
- Substructure: Concrete abutments
- Condition: Structure appears to be in good condition.
- Suggested Repairs: Build parallel bridge for bicycle/pedestrian trail.
Appendix E: Signals, CTC and Crossings

Existing Conditions
The BNSF Eastside corridor currently serves only freight (in sections), operating at speeds between 10 and 25 mph. This corridor is currently in “Dark Territory”; i.e., there is no existing train control system within the corridor. Radio communications are used to receive permission to enter or leave the territory. Radio communication is also required during operation within dark territory, as this is the only way to know the location of trains in the territory.

Presently the track is jointed rail that requires bonding the rails to accommodate track circuits (in this case crossing detection circuits) to travel along the required length of track.

On the industry switches and passing sidings that exist, hand throw switches are utilized at each switch point for switch operation. Radio communication is used for permission to operate these switches for train movements to and from the mainline track.

There are presently 107 Highway Grade crossings, of which 59 are private. The crossing warning systems utilizes mostly flashers and cantilevers, although some also have gates. There are some public crossings that only utilize stop signs and/or cross-bucks for warning. Private crossings also exist that utilize stop signs and/or cross-bucks, although some private crossings do not have any type of warning system. There are also private crossings that may have been created without the knowledge or consent of the railroad or DOT.

The train detection systems where used, are of a motion sensor type, which will detect motion towards the crossing to activate the crossing warning system. Train detection is only used where there is an active crossing warning system in use.

There are some existing pedestrian grade crossings within the corridor. Some existing pedestrian crossings are designed such that there is no pedestrian crossing protection, even if a highway grade crossing is located nearby. A few locations have pedestrian gates that will block the sidewalk at the pedestrian crossing and others are designed such that the highway gate will block the sidewalk crossing the tracks.

Traffic pre-emption is also utilized to ensure tracks are clear of automobiles prior to train arriving.

A segment of the Woodinville Subdivision, north of Maltby and south of Snohomish, is located in a flood plain which has previously flooded sections of this track. The maintenance personnel would attempt to remove equipment from signal houses prior to these occurrences to avoid water damage.
Section 1 – Renton MP 4.10 to Bellevue MP 12.40
This segment of track at present configuration could have a maximum freight speed of 40 mph, but there is a section of track that will be limited to 25 mph. The majority of the track could be set at a maximum of 35 mph for freight.

There are presently 15 highway/rail grade crossings in this segment, in which there are 2 that may be acceptable as-is and 1 that may only need minor upgrades. There are 8 private and 4 public highway/rail grade crossings with no active warning system and no train detection system.

There are 3 highway/rail grade crossings which currently have motion detection as the train detection system. These crossings are only set for 10 and 25 mph crossing starts. The existing warning equipment is mostly out of date and some do not meet the existing needs of the crossing location.

There are approximately (based on track charts) 5 hand throw switches off the mainline that are serving industries. These industries are no longer customers of the railroad.

Section 2 – Bellevue MP 12.40 to Woodinville MP 26.37
This segment of track at present configuration could have a maximum freight speed of 40 mph, but has sections of track that will be limited to 35 mph and a single section that is limited to 25 mph. The 25 mph section is limited to the connection to the Redmond Spur.

There are presently 32 highway/rail grade crossings in this segment, in which there are 11 that may be acceptable as-is and 7 that may only need minor upgrades. There are 13 private and one public highway/rail grade crossings with no active warning system and no train detection system.

There are 18 highway/rail grade crossings which currently have motion detection as the train detection system. These crossings are only set for 10 and 25 mph crossing starts. The existing warning equipment is mostly out of date and some do not meet the existing needs of the crossing location.

There are approximately 19 hand throw switches off the mainline that are serving industries. These industries are no longer customers of the railroad.

Section 3 – Woodinville MP 26.37 to Pearl Street in Downtown Snohomish
This segment of track in its present configuration could have a maximum freight speed of 40 mph, but it has some sections of track that will be limited to speeds between 25 and 35 mph. The Snohomish River Bridge is restricted to 15 mph but is currently out of service and not passable.

There are presently 20 highway/rail grade crossings in this segment, in which there are 2 that may be acceptable as-is and 1 that may only need minor upgrades. There are 7
private and 10 public highway/rail grade crossings with no active warning system and no train detection system.

There are 3 highway/rail grade crossings which currently have motion detection as the train detection system. These crossings are only set for 10 and 25 mph crossing starts. The existing warning equipment is mostly out of date and some do not meet the existing needs of the crossing location.

There are presently approximately 4 hand throw switches off the mainline that are serving industries. Many of these industries are no longer customers of the railroad.

Section 4 – Woodinville MP 0.00 to Redmond MP 6.90 (Redmond Spur)
This segment of track in its present configuration could have a maximum freight speed of 40 mph, but it has sections of track that will be limited to 35 mph and a single section that is limited to 30 mph. The 30 mph section is limited to the connection to the Woodinville Subdivision and at the end of the spur.

There are presently 40 highway/rail grade crossings in this segment, in which there are 6 that may be acceptable as-is. There are 30 private and 4 public highway/rail grade crossings with no active warning system and no train detection system.

There are 7 highway/rail grade crossings which currently have motion detection as the train detection system. These crossings are only set for 10 and 25 mph crossing starts. The existing warning equipment is mostly out of date and some do not meet the existing needs of the crossing location.

There are presently approximately 4 hand throw switches off the mainline that are serving industries. These industries are no longer customers of the railroad.

**Operating Needs/Issues**
For purposes of identifying conceptual signal and train control needs, it was assumed that both commuter rail and freight trains could operate in the corridor. It is assumed that the operating speeds could be up to 40 mph for freight and up to 60 mph for passenger trains, which would require FRA Class 3 Track. If freight and passenger trains were operating on the same tracks during the same time period, a train detection system could be required to protect against trains interference.

The wayside signal system could be required to handle a mix of freight and passenger trains and could be controlled by one centralized location. Sidings should be utilized for meet points and passing locations. These sidings could be signaled and controlled by the centralized control center.

With the varying train speeds that would occur at grade crossings, a train detection system could be utilized to ensure the public’s waiting time at the crossings would be consistent, regardless of train speed.
Many locations on this line are located in heavily urbanized areas that include significant pedestrian traffic. The addition of the assumed commuter rail stations could increase pedestrian traffic, resulting in the need to evaluate each pedestrian crossing of the track on an individual basis to determine the appropriate type of pedestrian warning equipment.

**Wayside/CTC**

Assuming a mixed operation of passenger and freight trains, the wayside signal system could have the capability to enforce speeds and eliminate human error. A cab signaling system has the capability to enforce speed and is widely regarded as the most reliable and safest system available. This system could require every engine and/or cab car to be equipped with a system that can receive the cab signal from the rail and display it to the engineer and also enforce the train speed if the engineer does not appropriately respond. This could lead to pro-active speed enforcement that would apply brakes to reduce the train to the required speed or, if appropriate, apply the brakes to bring the train to a complete stop.

All track conditions/information could be passed through the tracks by utilizing electronic coded track circuits. This information could assess the condition (speed restriction or occupancy) of the track ahead and determine the safety of allowing a train to proceed into the next block (track section that is between control points). This information could be continuously updated to ensure the proper determination is accurate. Electronic coded track circuits could also eliminate the need for a wayside pole line, which could increase system reliability and reduce maintenance costs.

The wayside signal system design could allow for passing sidings. These passing sidings could be control sidings which could allow train movements in and out of the sidings at a faster speed to keep all traffic moving.

At freight industry leads, electric lock type switches could be used along with derails placed on the industry leads to ensure freight cars do not accidentally enter the mainline clearance envelope. Derails could be located such that if a train does derail, it would be directed away from the main track. Where sidings are used for freight and where significant amounts of switching are taking place, a split point derail could be utilized.

The Centralized Train Control (CTC) system could be located within a control center CTC. The CTC should have complete control of all passenger and freight trains on the line. There should also be indications sent to the CTC to indicate all train movements along with information about all wayside and grade crossing locations on the line. Communication from the wayside system to the CTC could be by a fiber optic system with a radio backup system. The CTC could also have communication capability to each station platform to convey information to passengers for updates and for emergencies. Each Control Point could have a local control panel that would be able to be utilized in requesting signals and switches in the case of communication loss with CTC. One local control panel could be able to control both ends of a passing siding, which could decrease the number of maintenance personnel/panel operators required in the event of a loss of the CTC.
Section 1 – Renton MP 4.10 to Bellevue MP 12.40
In this 8.3 mile section there are 3 station platform locations assumed which could include 6 Control Points for Station Platforms. Additionally, there could be 2 Control Points for a passing siding, 11 Automatic Signal locations, and a possibility of 5 Electric Lock locations.

This section could be installed ahead of and independent of representative Sections 2, 3 or 4. The section design could be modified to allow for temporary storage at the north end near MP 12.40 if this section is completed and placed in service prior to representative Section 2 (Bellevue to Woodinville).

Section 2 – Bellevue MP 12.40 to Woodinville MP 26.37
In this 13.97 mile section there are 8 station platform locations assumed which could include 16 Control Points for Station Platforms. There could be no need for any additional passing siding due to the spacing of the stations Spur connection, 7 Automatic Signal locations, and a possibility of 19 Electric Lock locations.

This section could be installed ahead of and independent of representative Sections 1, 3 or 4, although the section design could be modified to allow for temporary storage at the south end near MP 12.40 and/or the north end at MP 26.37 if this section is completed and placed in service prior to representative Section 1 (Renton to Bellevue) and/or 3 (Woodinville to Snohomish).

Section 3 – Woodinville MP 26.37 to Pearl Street in Downtown Snohomish
In this 11.6 mile section there are 3 station platform locations assumed which could include 2 Control Points for Station Platforms; this is due to the 2 northern stations being single track platforms. This section could also include 4 Control Points for a passing siding, 1 control point at north end for train storage and turnaround tracks, 15 Automatic Signal locations, and a possibility of 4 Electric Lock locations.

This section could be installed ahead of and independent of representative Sections 2, 3 or 4. The section design could be modified to allow for temporary storage at the north end in Snohomish if this section is completed and placed in service prior to representative Section 2 (Bellevue to Woodinville).
Section 4 – Woodinville MP 0.00 to Redmond MP 6.90 (Redmond Spur)
In this 6.9 mile section there are 2 station platform locations assumed which could include 2 Control Points for Station Platforms. There could also be 2 Control Points for a passing siding, 9 Automatic Signal locations, and a possibility of 4 Electric Lock locations.

This section could be installed ahead of and independent of representative Sections 1, 2 or 3.

Grade Crossing Systems
There are presently 107 highway grade crossings, of which 59 are private. Many of the public and private crossings along the Eastside corridor may need upgrades, but a detailed evaluation has not been completed for each existing crossing. The cost estimate provides for upgrades, including flashers, gates and bells, at all 107 (public and private) existing grade crossings along the corridor. During design, crossing improvements would be evaluated on a case-by-case basis. Note that use of public funds for private crossing improvements might not be allowed.

The types of warning systems that could be considered are as follows:

- Four Quad gates with highway presence detectors placed between the gates.
- Two Quad gates with a center barrier that extends from the tip of gate to a minimum of 100’ away from tracks (to prevent maneuvering around the closed gate arm).
- Crossing Train Horn placed at the crossing. The Crossing Train Horn is intended to avoid the need for the train engineer to sound his on-board train horn. Therefore, an indication should be placed to indicate to the train engineer that the crossing warning equipment is working properly. If the crossing is not working properly the train engineer will then be able to use the train horn.
- Quiet Zones (where applicable; subject to federal regulation). Quiet zones could be considered on a case-by-case basis during design.

Pedestrian warnings could be added where there is pedestrian traffic. Sidewalks could be designed to allow the crossing gate to block the track crossing sidewalk if possible. Otherwise, additional pedestrian crossing gates could be considered, based on the expected volume of pedestrians at the crossing. Where pedestrians are present, crossing bells could be placed on both sides of the crossings and placed on top of the gate mast pole.

Crossing warning systems could be kept un-activated as much as safely possible to reduce delays or the temptation for pedestrians and/or vehicles from violating crossing warning systems. When passenger trains are stopped at stations for extended periods, the crossing warning system could de-activate; therefore, a method of activating the crossing prior to train crossing should be provided.
At each commuter rail station, pedestrians should be channelized or directed to cross the tracks at designated locations. Pedestrian warning systems could be placed at these locations, which could include gates, but should include flashers and bells. The warning system could have the capability to provide warning and indication for trains approaching on either track.

Trains operating on these tracks could be traveling at different speeds. The use of a Constant Warning Time Device (CWTD) could be used to allow the active warning systems at the crossing to activate for the same time period in advance of the train reaching the crossing, regardless of the train speed. This could lead pedestrians and motorist to understand that the gates will always be down for the same amount of time and reduce the temptation for pedestrians and/or vehicles to go around the gates.

Traffic pre-emption could be added at appropriate locations to ensure that motorists can clear the tracks prior to the train arrival.

Section 1 – Renton MP 4.10 to Bellevue MP 12.40

There are presently 15 highway/rail grade crossings in this segment. Each highway/rail grade crossing and pedestrian crossing could be reviewed on an individual basis to determine the exact crossing warning equipment required. All existing crossing warning equipment could be verified for possible reuse.

Section 2 – Bellevue MP 12.40 to Woodinville MP 26.37

There are presently 32 highway/rail grade crossings in this segment. Each highway/rail grade crossing and pedestrian crossing could be reviewed on an individual basis to determine the exact crossing warning equipment required. All existing crossing warning equipment could be verified for possible reuse.

Section 3 – Woodinville MP 26.37 to Pearl Street in Downtown Snohomish

There are presently 20 highway/rail grade crossings in this segment. Each highway/rail grade crossing and pedestrian crossing could be reviewed on an individual basis to determine the exact crossing warning equipment required. All existing crossing warning equipment could be verified for possible reuse.

Section 4 – Woodinville MP 0.00 to Redmond MP 6.90 (Redmond Spur)

There are presently 40 highway/rail grade crossings in this segment. Each highway/rail grade crossing and pedestrian crossing could be reviewed on an individual basis to determine the exact crossing warning equipment required. All existing crossing warning equipment could be verified for possible reuse.
Appendix F: Potential for Station-area Transit- and Pedestrian-Oriented Development

INTRODUCTION

This study reviewed the 16 assumed commuter rail station locations along the Eastside corridor to evaluate each location’s potential to support transit- and pedestrian-oriented development. This work effort involved the collection and evaluation of existing land use, comprehensive plans, and land use requirements for the eight jurisdictions along the Eastside corridor. The stations are listed below:

1. Renton/Gene Coulon Park (terminal)
2. Renton/Port Quendall/NE 44th Street
3. Bellevue/Newport Park-and-Ride/112th Avenue NE
4. Bellevue/NE 6th Street
5. Bellevue/NE 12th Street
6. South Kirkland Park-and-Ride
7. Kirkland/NE 85th Street
8. Kirkland/Totem Lake
9. South Woodinville/NE 145th Street (provides transfer to Redmond spur line service)
10. Woodinville CBD
11. North Woodinville/NE 195th Street
12. Maltby (unincorporated Snohomish County)
13. Cathcart (unincorporated Snohomish County)
14. Snohomish CBD (terminal)
15. South Woodinville/NE 145th Street (Redmond spur line; terminal; provides transfer to mainline service)
16. Redmond CBD (Redmond spur line; terminal)

This report considers:

- **Transit-Supportive Development Characteristics** that are necessary to create functionally successful integration of rail transit with the surrounding communities it serves. *Transit-Oriented Development (TOD)* is the term often used to refer to development characteristics that are pedestrian-friendly and conducive to successful integration of land development and transit.
- **Base Case Land Use Evaluation** that summarizes the key elements for transit-supportive development near potential future passenger rail stations; and
- **Summary Evaluation – Existing Land Use and Transit-Supportive Corridor Policies and Regulations** that provide an initial assessment of the corridor and its level of support for pedestrian activity and transit use.

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17 The Eastside corridor runs through portions of unincorporated King County, but no stations are proposed in those segments of the corridor.
BASE CASE LAND USE POLICIES AND REGULATIONS

What is Transit-oriented development (TOD)?
TOD is a strategy available to help manage growth and improve the quality and functionality of communities. TOD provides communities with a more sustainable, integrated transportation and development alternative to low-density suburban sprawl and automobile-dependent land use patterns. It seeks to align transit investments with a community’s vision for how it wants to grow, creating more livable, higher density, mixed-use, and walkable “transit villages.” A successful TOD will reinforce both the community and the transit system.

In general, TOD is a more sustainable form of development because people living and working in TODs are more likely to walk, use transit, and own fewer cars. In addition, the higher density development found in TODs can reduce urban expansion pressures on surrounding resource land. TOD households own roughly one-half as many vehicles as the average U.S. household. At an individual station, TOD has been shown to increase transit ridership by 20 to 40 percent and even cause significant change at a regional level. People who live in a TOD are five times more likely to commute by transit than other area residents. Recent research conducted by the Transportation Research Board found that residential development in 17 residential developments in TODs generated 44% less weekday traffic compared to accepted trip generation figures in the ITE (Institute of Transportation Engineers) Trip Generation Handbook.18

TOD Principles
The potential station locations were reviewed with four basic TOD design principles in mind:

• Greater density than the community average;
• A mix of uses;
• Quality pedestrian environment; and
• A defined center.

Greater Density than the Community Average
A key ingredient for walkable communities and support for transit is having sufficient residential densities to reduce walking distances between residences and other destinations, including commercial services, schools, parks, and transit. The appropriate density levels depend largely upon community character and desires, but generally speaking, a minimum of 8 to 9 units per acre is necessary to support any type of transit. The following elements contribute to appropriate density for transit:

• Densities that are higher than the community norm are located within ¼ to ½ mile of transit.
• Structured parking is used rather than surface lots in higher density areas.

• Site design for major projects allows for the intensification of densities over time.

A Mix of Uses
A transit-supportive and pedestrian-friendly environment includes a mixture of residential, commercial, service, employment, and public uses making many trips between destinations shorter and more walkable. In addition:
• First floor uses are “active” and oriented to serve pedestrians.
• Multiple compatible uses are permitted within buildings near transit.
• A mix of uses generating pedestrian traffic is concentrated within walking distance (¼ to ½ mile) of transit.
• Auto-oriented uses, such as service stations and drive-through facilities, are limited or prohibited near transit.

Quality Pedestrian Environment
Vibrant communities, with or without transit, always are convenient and comfortable places for pedestrians. There a number of components, which contribute to a quality pedestrian environment:
• Buildings and primary entrances are sited and oriented to be easily accessible from the street.
• Buildings incorporate architectural features convey a sense of place and relate to the street and the pedestrian environment.
• Amenities, such as storefront windows, awnings, architectural features, lighting, and landscaping, are provided to help create a comfortable pedestrian environment along and between buildings.
• The site layout, building design, and directory signs facilitate direct pedestrian movements between transit, mixed land uses, and surrounding areas.
• Most of the off-street parking is located to the side or to the rear of the buildings.
• Sidewalks are present along site frontages, which connect to sidewalks and streets on adjacent and nearby properties.
• Street patterns are based on a grid of an interconnected system that simplifies access for all modes.
• Pedestrian routes are buffered from fast-moving traffic and expanses of parking.
• Trees sheltering streets and sidewalks are provided along with pedestrian-scale lighting.
• Buildings and parks are used to provide a focal point or anchor for key areas or intersections.
A Defined Center
Transit is particularly successful in communities and neighborhoods, which have defined centers, by offering multiple attractions and reasons for pedestrians to frequent the area. These areas project a sense of place by including at least some of the following attributes:

- The density and buildings are highest near the transit station, moderating somewhat in the core that is within ¼ mile of the surrounding area, and ultimately transitioning in the edge match the character of surrounding development approximately ½ mile from the station.
- Buildings are located closer to the street and are typically taller than the surrounding area.
- Buildings are almost totally oriented to the street with window displays and main entrances.
- Off-street parking is less predominant being located to the rear and in parking structures. Parking requirements are reduced in close proximity to transit, compared to the norm.
- Secure and convenient bicycle parking is available.
- Sidewalks are wider than lower density areas, offering pedestrian amenities, such as street trees, benches, kiosks, and plazas.

EXISTING LAND USE AND DEVELOPMENT OVERVIEW

Land Use
The BNSF Eastside rail corridor was established in the late 1800’s to serve a variety of industrial uses. As a result it tends to travel through areas which are undeveloped or devoted to industrial and employment uses. Because it was not used to provide regular passenger service, adjacent residential, mixed-use, and civic land uses generally turn their back on this rail corridor. In many cases, the corridor is isolated and difficult to access. The exceptions to this pattern are the Redmond and Snohomish CBD stations, which have pedestrian-friendly and transit supportive characteristics today. The remainder would need significant redevelopment and re-orientation to become pedestrian-friendly TODs in the future.

Policies and Regulations
Looking to the future, the existing plan policies and regulations in Redmond and Snohomish CBDs promote the continuation of transit-supportive development around the station. Other locations that are not completely transit-supportive now, have policies and regulations in place to promote creation of a more transit-oriented development character in the future. Bellevue’s NE 12th Street station area, with the Bel-Red Subarea Plan, and Kirkland, with the plan policies and regulations related to the South Kirkland Park-and-Ride and Totem Lake station, are examples of future development potentially being transformed to encourage walking and transit use. Other potential station locations are
EVALUATION BY STATION

The following table provides a summary of the existing land use and development patterns at each of the potential stations. This is accompanied by an evaluation of the relevant plan policies and regulations. The relative consistency of the existing land use and plan policies and regulations are rated against the four TOD principles described above.

<table>
<thead>
<tr>
<th>STATION AREA EVALUATION</th>
<th>Consistency with TOD Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Withing 1/2-Mile</strong></td>
<td>Greater Density</td>
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<tr>
<td><strong>Highly consistent - ⬤</strong></td>
<td>⬤</td>
</tr>
<tr>
<td><strong>Moderately consistent - ○</strong></td>
<td>○</td>
</tr>
<tr>
<td><strong>Not consistent - ▼</strong></td>
<td>▼</td>
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</tbody>
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**Renton/Gene Coulon Park**

**Existing Land Use**
Located north of the NE Park Drive/I-405 interchange, this assumed station site is situated between Gene Coulon Park and Lake Washington Boulevard N. A multi-family development is on the east side of Lake Washington Boulevard N., and a single-family neighborhood lies on the east side of I-405. The street system is auto-oriented, and sidewalks are only available intermittently.

**Plan Policies and Regulations**

**Allowed uses** - This station site is zoned R-1 (1 du/ac). The land on the east side of Lake Washington Boulevard N. is zoned RM-U, which allows for multi-family development between 25 and 75 units per acre. The area to the southwest, immediately south of the park is zoned UC-N1 and UC-N2, Urban Center. The zones were established “... to provide an area for pedestrian-scale mixed-use development...”

**Design** - The development standards focus on proper construction and installation techniques along with aesthetic issues such as landscaping.

**Renton/Port Quendall-NE 44th Street**

**Existing Land Use**
This station site is immediately northwest of the NE 44th Street/I-405 interchange. A variety of light and heavy industrial uses are located to the west. Low to medium density luxury homes have been built recently to the south. The new Seattle Seahawks football training center is located to the north. A mix of commercial and residential uses is on the east side of I-405. Pedestrian facilities and amenities are generally absent throughout the area.
<table>
<thead>
<tr>
<th>Bellevue/Newport-112th Avenue SE</th>
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</thead>
<tbody>
<tr>
<td><strong>Existing Land Use</strong></td>
</tr>
<tr>
<td>Located between I-405 and Lake Washington, this potential station is near single-family homes lining the lake shore, and it is near the park-and-ride next to the freeway interchange. Other than lakefront homes, there is very little development near the site.</td>
</tr>
<tr>
<td><strong>Plan Policies and Regulations</strong></td>
</tr>
<tr>
<td><strong>Allowed uses</strong> - This station site is zoned COR Commercial/Office/Residential, which is intended to provide for “… a mix of intensive office, hotel, convention center, and residential activity …” A 30-acre area, which includes the assumed station site, needs to have contamination cleaned up before development may proceed. Future land uses for this area have not yet been determined.</td>
</tr>
<tr>
<td><strong>Design</strong> - The development standards focus on proper construction and installation techniques along with aesthetic issues such as landscaping.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bellevue/NE 6th Street</th>
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</thead>
<tbody>
<tr>
<td><strong>Existing Land Use</strong></td>
</tr>
<tr>
<td>Located southeast of the NE 8th Street/I-405 interchange, this potential station site is surrounded by commercial, light industrial, and employment activities. The rail alignment runs to the rear of these uses, which lie to the east and west. Auto dealers represent a common use type in the area. There is no residential development in the immediate area. The site is relatively isolated, and the street system includes large, multi-lane thoroughfares with few cross streets. Sidewalks are generally present, but there are gaps. Because of its proximity to the I-405 interchange, the intensity of development is relatively high.</td>
</tr>
<tr>
<td><strong>Plan Policies and Regulations</strong></td>
</tr>
<tr>
<td><strong>Allowed uses</strong> - This station site is within the Wilburton/NE 8th Street Subarea Plan, immediately south of the Bel-Red Corridor Plan area. Commercial and office zoning districts are predominant within ½-mile. The subarea plan recognizes the potential for transit supportive land use designations in the area around the station location and encourages further study.</td>
</tr>
<tr>
<td><strong>Design</strong> - The design requirements call for amenities such as street trees and landscaping, but they focus on aesthetic rather than urban design treatments. Street extensions are planned in this area. As with Bel-Red Corridor Plan, a trail - not commuter rail - was assumed. If commuter rail is implemented along the Eastside corridor, the city should consider adapting similar urban design tools for this area similar to those assumed for the Bel-Red and downtown areas.</td>
</tr>
<tr>
<td>Bellevue/NE 12th Street</td>
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<tr>
<td><strong>Existing Land Use</strong></td>
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<tr>
<td>The potential station site, located on the north side of NE 12th Street, has light industrial uses to the east, vacant land and multi-family residences to the west, and commercial uses on the south side of NE 12th Street. The station site is relatively isolated, and other than NE 12th Street, there are no street or pathway connections to the site. Sidewalks are often absent, along much of NE 12th Street.</td>
</tr>
<tr>
<td><strong>Plan Policies and Regulations</strong></td>
</tr>
<tr>
<td><strong>Allowed uses</strong> - The Bel-Red Corridor Plan recognizes the Eastside corridor as a potential trail. The vision statement calls for “vibrant, diverse neighborhoods” and a multi-modal transportation system. It promotes pedestrian-friendly and transit-oriented design and coordination with Sound Transit. It identifies a potential future east-west HCT corridor, which crosses 116th Avenue NE very close to the station site. An HCT station could be located in close proximity to the commuter rail station. The zoning calls for a mix of uses. However, with the station site located on the western edge of the planning area, it is designated primarily for employment uses. <strong>Design</strong> - Anticipated Bel-Red Corridor zoning changes feature many appropriate design standards that are consistent with the four TOD principles, such as active ground floor uses along key transit- and pedestrian-oriented streets, maximum parking standards, limitations on outdoor storage and surface parking, creation of a finer-grained street system, appropriate pedestrian facilities and amenities, build-to lines along specified pedestrian and transit streets, and building design oriented to identified pedestrian streets. In short, the plan has the necessary elements for a successful TOD. If commuter rail is implemented along the Eastside corridor, the plan would need to be amended to respond to this important transit facility.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>South Kirkland Park-and-Ride</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Existing Land Use</strong></td>
<td></td>
</tr>
<tr>
<td>The area surrounding this potential station consists of an existing park-and-ride lot, employment uses, and single and multi-family residences. Pedestrian access to and from the site is accommodated across a large parking lot and some of the local streets provide reasonably direct access, but sidewalks are often lacking. The density is somewhat higher than the surrounding areas, but the development pattern immediately adjacent to the station site does not create any kind of identifiable center. The park-and-ride lot is located partially in the City of Bellevue.</td>
<td></td>
</tr>
<tr>
<td><strong>Plan Policies and Regulations</strong></td>
<td></td>
</tr>
<tr>
<td>The City of Kirkland is currently studying amendments to its Comprehensive Plan to add policies supportive of TOD at this location. Ratings reflect anticipated approval of these changes. <strong>Allowed uses</strong> - The land use designation may be changed to allow a broader range of uses, including residential and incidental office and retail uses, to be accommodated at the site. <strong>Design</strong> - The design requirements could potentially be changed to create TOD-oriented design standards similar to those applied in Totem Lake.</td>
<td></td>
</tr>
</tbody>
</table>
## Kirkland/NE 85th Street

### Existing Land Use

Located north of NE 87th Street, this station site is adjacent to a low to medium density residential neighborhood on the east, employment uses to the west, and a combination of these two use types to the south. The grid street network to the east and west could provide reasonable pedestrian access, but sidewalks are generally absent, and the residential neighborhoods to the south are cut off by NE 85th Street. The densities are not particularly high compared to the surrounding areas, but they could be moderately supportive of future rail transit.

### Plan Policies and Regulations

**Allowed uses** - The station is within the LIT zoning district, which only allows a few specific commercial activities in addition to industrial uses. Lower density residential districts are to the north, and multi-family districts lie to the south.

**Design** - The design requirements call for street trees and landscaping, but they do not go much beyond aesthetic treatments. Design standards similar to those applied in Totem Lake would yield superior results from a TOD perspective.

## Kirkland/Totem Lake

### Existing Land Use

The assumed station location is in the midst of a variety of auto-oriented uses near an interchange with I-405 and the intersection of Totem Boulevard NE, NE 124th Street, and 124th Avenue NE. Retail, light industrial, office, restaurants, and storage are representative of the uses found in the area. There is no residential use in the area. The system of major streets and imposing intersections are not pedestrian-friendly, and sidewalks are only provided intermittently. The station is behind existing development with potential access via NE 124th Street to the north. The intensity of development is higher than the surrounding area, but individual developments are separated by the street system, and this area does not have the qualities of a true urban center. The proposed redevelopment of the Totem Lake Mall to the northwest of the station could help create a more vibrant center. This area is a designated regional growth center.

### Plan Policies and Regulations

**Allowed uses** - The station is within the second largest commercial center in the city, which is called “Totem Center”. The TL-4A zoning on the site requires active ground floor uses for a portion of new developments. This area is a designated regional growth center.

**Design** - Goal LU-5 and the supporting policies call for the elements described in the four TOD principles. Design Guidelines for the Totem Lake Neighborhood is intended to help the area “… evolve into an attractive urban center …”. The station is located on the northern edge of District TL 5, which is planned to become a mixed-use district with a finer grained street network. Streetscape improvements are also envisioned along major streets. The potential for HCT on the BNSF line is recognized. The document contains a comprehensive set of guidelines to orient buildings to the street, provide good pedestrian circulation and walking environments, and create a much more vibrant urban area compared to today’s character.
### South Woodinville/NE 145th Street (Mainline)

**Existing Land Use**

This an isolated station site, which has single-family development located to the northwest, open space to the west, light industrial uses to the east, and agri-tourism uses to the south. The transfer station for the Redmond spur line is located across the street. Residential densities and intensity of the surrounding uses are low. Pedestrian access is currently non-existent. This station location is not well-suited to support transit.

**Plan Policies and Regulations**

- **Allowed uses** - Industrial, and Residential (R-4) zones are within ½-mile. Residential uses are not allowed as part of an industrial development, and the R-4 zone only allows 4 units per acre. The existing zoning prohibits higher densities and a mix of uses.
- **Design** - Even the application of the city’s design requirements would not do much to change the definite non-transit orientation of this area.

### Woodinville CBD

**Existing Land Use**

This station location has good street access in an area characterized by a variety of auto-oriented commercial and employment uses. Compared to the general area, the densities and use mix are not any greater in this location. Open space and parks are located to the south. Bus service is available in the immediate area, enhancing access to the station. Although there are streets providing connections to the station site, the overall pedestrian environment is not particularly good, and sidewalks are lacking in many instances.

**Plan Policies and Regulations**

- **Allowed uses** - Central Business District, Industrial, and General Business zones are the predominant districts within ½-mile, and multi-family residential zones (R-18 and R-48) and Public designation are also on the southern edge of this area. Residential uses are not allowed as part of an industrial or business development.
- **Design** - The existing zoning does little to create higher densities or a mix of uses. As noted above, the Zoning Code (Ch. 21) contains design guidelines and requirements for commercial development to provide for a good pedestrian environment. Consistent application of these design elements could help transform this auto-oriented area into one that is more consistent with the four TOD principles.

### North Woodinville/NE 195th Street

**Existing Land Use**

Located immediately north of NE 195th Street, this station is adjacent to light industrial and employment uses. NE 195th Street and 139th Avenue NE provide reasonable access to the site from the surrounding area. However, sidewalks are generally absent, and the streets are almost exclusively designed for vehicular traffic. While it is not a mixed-use center, there are uses that could take advantage of rail transit in addition to the bus service in the area.
### Plan Policies and Regulations

**Allowed uses** - Industrial and General Business zones are the predominant districts within 1/2-mile, and single family residential zones (R-1 and R-6) are also on the fringe of this area. Residential uses are not allowed as part of an industrial or business development.

**Design** - The existing zoning does little to create higher densities or a mix of uses. The Zoning Code (Ch. 21) contains design guidelines and requirements for commercial development to provide, for example, convenient and pleasant pedestrian circulation, building entrance locations near street corners, street/site lighting, landscaping, and public spaces. The code also encourages reduced parking for joint developments as well as a maximum parking standard of 5 spaces per 1,000 square feet of floor area. If these design elements were applied near this station in the future, they could do much to create a higher quality pedestrian environment.

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### Maltby

**Existing Land Use**

**Allowed uses and design** - Light industrial warehouse and distribution uses are predominant in the surrounding area. Residential uses nearby are minimal. Access from the west is limited, and sidewalks are generally not present. This is an industrial center, but without the important mix-use element and pedestrian scale, it currently is not particularly transit-supportive.

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### Cathcart

**Existing Land Use**

This station is surrounded by low density rural homesites. The station is somewhat removed from nearby roads. Railroad Avenue to the southeast is the closest at several hundred feet distant. Access to and from the west and northeast is not available. While there is some residential development that could take advantage of transit, the current developed character is not pedestrian- or transit-supportive. This station is located outside the region’s designated urban growth area.

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### Snohomish CBD

**Existing Land Use**

There is a variety of residential and commercial uses within 1/2-mile of the assumed station. The density of development in this downtown location is clearly higher compared to the surrounding area. Development is organized around a grid street pattern, which facilitates convenient pedestrian circulation. Sidewalks are generally present, but there are gaps in the system, including Lincoln Avenue, which is adjacent to the station site. This is an easily identified center in the community. Other than creating higher density over time if rail transit is available in the future, the existing land use is pedestrian-friendly and capable of supporting transit.
Plan Policies and Regulations

Allowed uses - The designations surrounding the station are generally transit-supportive, including: High Density Residential allowing up to 24 dwelling units per acre (du/ac); Commercial allowing a variety of service/retail uses; Mixed Use allowing a combination of housing, shopping, and employment activities; and Historic District.

Design - Joint use and off-site parking are allowed, pedestrian walkways in parking lots are required, minimum parking requirements tend to be high, there are no parking maximums, and parking is allowed in front yard. The plan and code are generally transit-supportive, but the development standards could be amended to de-emphasize cars and parking and further enhance the pedestrian environment in the CBD.

South Woodinville/NE 145th Street (Redmond Spur Line)

Existing Land Use

See South Woodinville/NE 145th Street (Mainline station)

Plan Policies and Regulations

See South Woodinville/NE 145th Street (Mainline station)

Redmond CBD

Existing Land Use

The assumed station is located north of the Redmond Town Center and south of Cleveland Street Square. There is a considerable amount of commercial and employment development near the station site. The street grid pattern features relatively large blocks, which accommodate pedestrians reasonably well. Sidewalks are generally present, and a good pedestrian route connects the station site and Redmond Town Center. However, the scale and design of the transportation system is auto-oriented with multi-lane streets and limited crossing opportunities for pedestrians in other locations. The scale and density of development is greater than the community average, but residential uses found to the north are limited. This area is a designated regional growth center.

Plan Policies and Regulations

Allowed uses - The vision for downtown Redmond focuses on retaining the Old Town while developing a complementary mixed-use center adjacent to it. The Downtown section of the Redmond Comprehensive Plan calls for creation of distinctive, pedestrian-oriented districts. The plan expresses the intent to use the BNSF right-of-way for a trail and open space with HCT located along the SR 520 corridor on the south side of the Redmond Town Center. Multi-modal transportation improvements and mixed-use development are major components of the plan. This area is a designated regional growth center.

Design - The zoning requirements (20C.40) feature many appropriate design standards that are consistent with the four TOD principles, such as active ground floor uses along key transit- and pedestrian-oriented streets, creation of a finer-grained street system, appropriate pedestrian facilities and amenities, prohibition of surface parking between the sidewalk and building entrances, and building design oriented to identified pedestrian streets. This area is a designated regional growth center.
CONCLUSIONS
Based on the analysis described in this report, the majority of the assumed station areas do not demonstrate the potential to support transit-and pedestrian-oriented development, based on their existing land uses, plan policies and regulations. In general, the BNSF Eastside corridor is not well oriented to serve the Eastside’s urban and activity centers and instead winds its way through low density residential and industrial areas. The corridor does not directly serve Downtown Bellevue, the Eastside’s largest activity center (and a designated regional growth center). In addition, most of the Snohomish County portion of the corridor is outside the region’s designated urban growth area. However, some of the assumed station areas have existing or planned land uses and densities to potentially support TOD. The assumed stations that show the highest potential for TOD are the following (not in any order):

- Bellevue/NE 12th Street (included in Bellevue’s Bel-Red Corridor Study area)
- South Kirkland Park-and-Ride (TOD project by King County is in the planning stages)
- Kirkland/Totem Lake (designated regional growth center)
- Snohomish CBD
- Redmond CBD (designated regional growth center)

Further analysis could be completed to evaluate in more detail the potential for the assumed station areas to support TOD. In addition, additional study could help to identify other promising station locations and/or eliminate some of the assumed station locations from further consideration.
Appendix G: Trail Typical Cross Sections
KING COUNTY MIN. WIDTH
12' SECTION

TYPICAL RETAINED FILL SECTION
STATION 558+00

2'-0"
8'-0" PAVED
2'-0"

SHY

KING COUNTY
LOWER COST OPTION
SECTION TYPE 1
KING COUNTY MIN. WIDTH
12' SECTION

TYPICAL CUT SECTION
STATION 624+00

2'-0"  8'-0" PAVED  2'-0"
SHY      SHY

KING COUNTY
LOWER COST OPTION
SECTION TYPE 2
KING COUNTY MIN. WIDTH
12' SECTION

TYPICAL EMBANKMENT SECTION
STATION 1086+00

KING COUNTY
LOWER COST OPTION
SECTION TYPE 3
KING COUNTY MIN. WIDTH
12' SECTION

TYPICAL RETAINED FILL SECTION
STATION 558+00

KING COUNTY
HIGHER COST OPTION
SECTION TYPE 1
KING COUNTY MIN. WIDTH
12' SECTION

TYPICAL CUT SECTION
STATION 624+00
KING COUNTY MIN. WIDTH
12' SECTION

TYPICAL EMBANKMENT SECTION
STATION 1086+00

KING COUNTY
HIGHER COST OPTION
SECTION TYPE 3
SNOHOMISH COUNTY

TYPICAL EMBANKMENT SECTION
STATION 1906+00

SNOHOMISH COUNTY
HIGHER & LOWER COST OPTION
SECTION TYPE 1

TRAIL CROSS-SECTION
SNOHOMISH COUNTY

TYPICAL RETAINED FILL SECTION
STATION 1734+00

SNOHOMISH COUNTY
HIGHER & LOWER COST OPTION
SECTION TYPE 2

G-8
SNOHOMISH COUNTY

TYPICAL EMBANKMENT SECTION
STATION 1906+00

HEIGHT OF EXISTING VARIES

VARIES
TYP. TO FENCE
(15'-0" MIN.)

100' - 0" ROW (TYPICAL)

15'-0"
TRAIL SECTION
(TYP.)

G-9
SNOHOMISH COUNTY

TYPICAL EMBANKMENT SECTION
STATION 1906+00

HEIGHT OF EXISTING VARIES

VARIES

TYP. TO FENCE
(15'-0" MIN.)

15' - 0"

TRAIL SECTION
(TYP.)

VARIES BY FILL HEIGHT

100' - 0" ROW (TYPICAL)

SNOHOMISH COUNTY
HIGHER COST OPTION
SECTION TYPE 3

TRAIL CROSS-SECTION
Appendix H: Environmental Considerations and Permit Requirements

Based on the conceptual level of this feasibility study, this appendix presents a summary of potential environmental consideration and permit requirements for the representative commuter rail system and/or parallel trail. Information in this appendix was drawn primarily from the following existing documents:

- Central Puget Sound Region High Capacity Transit Corridor Assessment Technical Workbook (PSRC, August 2004)
- East Link Evaluation of Portions of BNSF Corridor for Light Rail Use
- ST Evaluation of portions of BNSF Corridor for HCT Use
- ST Long-Range Plan SEIS (Sound Transit, June 2005)
- WSDOT I-405 Corridor FEIS

EXISTING CONDITIONS
Throughout the Eastside corridor, there are elements of the built and natural environment that may be impacted by construction of commuter rail service. These include parkland, trails, historic properties, streams, wetlands, businesses and residential areas. The following sections provide an overview of the environmental elements found throughout the Eastside corridor.

Built Environment

Land Use
In addition to passing through six cities, the Eastside corridor runs through areas of unincorporated King and Snohomish counties. Most of the corridor is made up of dispersed commercial, office and industrial activity centers surrounded by high and low-density housing.

Land use in Renton comprises low- to medium-density industrial and residential developments with interspersed commercial uses. Bellevue and Redmond are major employment and commercial centers, with highest-density office and residential development and several fast-growing high-technology–based companies. Kirkland comprises moderate-density commercial and office land uses and a mix of low- and medium-density residential uses. Woodinville and Redmond include major retail and office uses. Renton includes low- to medium-density industrial, residential, and automobile-oriented commercial development.

Moving north into Snohomish County, land use patterns along the Eastside corridor change significantly and become much more rural in nature. Maltby and Cathcart are small census-designated unincorporated places with populations of approximately 3,000 and 8,200, respectively. The City of Snohomish has a population of approximately 8,500. These communities are surrounded by farmland and/or woodlands.
While farmlands are not dominant features within the corridor, they are deemed important and are protected in both King and Snohomish counties. During the 1980's, King County acquired the development rights on 12,600 acres of high quality farmland within its boundaries. Protected farmlands lie adjacent the Eastside corridor in both counties.

Transportation
The Eastside corridor crosses over a number of arterial streets and pedestrian at grade crossings throughout the corridor. Many private road crossings also exist along the corridor.

Several urban principal arterial and urban collector street that cross the Eastside corridor at-grade currently serve high traffic volumes. The BNSF Rail Corridor Preservation Study identified the following locations as ‘potential high impact locations’:
- NE 8th Street in the City of Bellevue
- NE 124th Street and Totem Lake Blvd in the City of Kirkland
- 132nd Place NE in the City of Kirkland
- NE 175th Street in the City of Woodinville
- The intersection of NE 190th Street and Woodinville-Snohomish Road NE in the City of Woodinville
- 170th Ave NE in the City of Redmond

A network of regional trails and other pedestrian and bicycle routes serve the Eastside, with many crossing the corridor.

Harvey Field Airport is located west of the corridor in Snohomish County.

Schools and Public Services
Public services, such as police, fire, medical, solid waste, and recycling, educational facilities, post offices, libraries, community centers, social service centers, and government offices lie within close proximity to the Eastside corridor as do a number of schools. Public service facilities adjacent to the alignment include:
- Overlake/Group Health Hospital and Medical Center
- Bellevue Public Works offices and Emergency Services Annex
- Tolt Pipeline Trail
- Brightwater Wastewater Treatment Plant (under construction)

Additional mapping and confirmation of schools and public services within the Eastside corridor will be required at the project-specific environmental analysis, documentation, and review stages.

There are numerous utility crossings over or along the existing Eastside corridor. Puget Sound Energy (PSE) currently has over 20 crossings including electric transmission and distribution and gas distribution it needs to preserve. PSE may be considering the siting of overhead electric infrastructure longitudinally along the corridor.
Recreational Areas, Parks and Trails
The Eastside corridor runs through six local and two county jurisdictions. Each jurisdiction has adopted park elements in their comprehensive plans, which define the level of service for park facilities and the policies for development and protection of the parks. These policies would be instrumental in developing mitigation measures/plans to minimize potential construction and operational impacts to public parklands (e.g., property acquisitions, traffic detours, limited access, noise, dust/air quality effects, etc.).

Based on previous studies of the I-405 corridor and aerial photographs of the existing rail corridor, several parks, recreational areas or trails are present in the Eastside corridor and adjacent to the rail line. They are shown in Table 1.

Table 1: Parks, Recreational Areas and Trails

<table>
<thead>
<tr>
<th>Parks, Recreational Areas or Trails</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kennydale Park and Beach</td>
<td>Renton</td>
</tr>
<tr>
<td>Gene Coulon Park and Trail</td>
<td>Renton</td>
</tr>
<tr>
<td>Ripley Lane Boat Launch</td>
<td>Renton</td>
</tr>
<tr>
<td>Cedar River Park and Trail</td>
<td>Renton</td>
</tr>
<tr>
<td>Liberty Park</td>
<td>Renton</td>
</tr>
<tr>
<td>Mercer Slough Environmental Center</td>
<td>Bellevue</td>
</tr>
<tr>
<td>Coal Creek Park</td>
<td>Bellevue</td>
</tr>
<tr>
<td>Newcastle Beach</td>
<td>Bellevue</td>
</tr>
<tr>
<td>Crestwood Park</td>
<td>Kirkland</td>
</tr>
<tr>
<td>Wilburton Park</td>
<td>Kirkland</td>
</tr>
<tr>
<td>Sammamish River Park/Trail</td>
<td>Woodinville</td>
</tr>
<tr>
<td>Bear Creek Trail</td>
<td>Redmond</td>
</tr>
<tr>
<td>Willows Run Golf Course</td>
<td>Woodinville</td>
</tr>
<tr>
<td>Wilmont Gateway Park</td>
<td>Woodinville</td>
</tr>
<tr>
<td>Centennial Trail</td>
<td>Woodinville</td>
</tr>
<tr>
<td>Watershed Park</td>
<td>Woodinville</td>
</tr>
<tr>
<td>Terrace Park</td>
<td>Woodinville</td>
</tr>
<tr>
<td>Tolt Pipeline Trail</td>
<td>Woodinville</td>
</tr>
<tr>
<td>Bob Heirman Wildlife Preserve</td>
<td>Snohomish</td>
</tr>
<tr>
<td>Centennial Trail</td>
<td>Snohomish</td>
</tr>
<tr>
<td>Cady Park (Boat Launch, Trail)</td>
<td>Snohomish</td>
</tr>
<tr>
<td>Hal Moe Pool &amp; Avril Youth Complex (Skate Park &amp; Youth Center)</td>
<td>Snohomish</td>
</tr>
</tbody>
</table>

Additional mapping and confirmation of park lands within the Eastside corridor would be required at the project-specific environmental analysis, documentation, and review stages.

Historic and Cultural Resources
Information contained in this section is derived from the I-405 Corridor Program EIS.
Historic Properties and Districts:
Recent work by WSDOT, Sound Transit and others in the I-405 Corridor and along the Eastside corridor has documented numerous historic properties, both listed and eligible for listing on the National Register of Historic Places, listed on the State Register and/or registered as local landmarks. Based on this information, five historic properties lie adjacent to the rail alignment. In addition, the Eastside corridor runs through an historic district.

Table 2: Historic Properties/Districts

<table>
<thead>
<tr>
<th>Historic Properties/Districts</th>
<th>Location</th>
<th>Historic Register</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilburton Trestle Bridge</td>
<td>Bellevue</td>
<td>Washington Heritage Register (may be eligible for listing on the National Register of Historic Places)</td>
</tr>
<tr>
<td>French House</td>
<td>Kirkland</td>
<td>Local Landmark</td>
</tr>
<tr>
<td>Hollywood Farm/Stimson House</td>
<td>Woodinville</td>
<td>Washington Heritage Register National Register of Historic Places Local Landmark</td>
</tr>
<tr>
<td>Hollywood School</td>
<td>Woodinville</td>
<td>Washington Heritage Register Local Landmark</td>
</tr>
<tr>
<td>City of Snohomish Historic District</td>
<td>Snohomish</td>
<td>National Register of Historic Places</td>
</tr>
<tr>
<td>Justice William White House</td>
<td>Redmond</td>
<td>Determined eligible for listing on the National Register of Historic Places</td>
</tr>
</tbody>
</table>

While Table 2 does not present a complete list of properties identified in the potential project area, it provides a sample of the types of properties that may be encountered in the corridor. Project-level analysis would be required to document all historic properties within the project area.

Archaeological Sites:
Archaeological sites that could be present along the Eastside corridor would consist of sites and artifacts from hunter-fisher-gatherer groups that occupied the Puget Sound region beginning around 11,000 years ago. Most tend to be associated with watercourses and shoreline areas and are often discovered in water-saturated contexts. Many of the known archaeological sites in the Puget Sound region have been disturbed or destroyed by modern industrial development. However, intact buried sites may be present beneath glacial till, outwash, and alluvium or may be associated with historic shorelines that are now submerged or developed.

While the potential project area has not been surveyed for archaeological resources, it is possible that archaeological ‘high probability areas’ (HPA’s) could be found on the eastern shores of Lake Washington and along the banks of the Cedar, Snohomish and Sammamish rivers. Project-level survey and/or research would be required to document the presence of known or potential archaeological sites.
Traditional Cultural Properties:
Traditional Cultural Properties (TCPs) are those properties associated with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community. In the Eastside corridor, TCPs are primarily associated with Native American groups. Identification of these properties occurs in consultation with those groups.

There are numerous Native American tribes in the Puget Sound region, both federally recognized (i.e., sovereign governments that must be consulted on a government-to-government basis) and non-federally recognized. Consultation with the appropriate tribes would be completed at the project design level by the lead federal agency with the assistance of the OAHP and the Governor’s Office of Indian Affairs.

Natural Environment
The natural environment includes ecological and natural resources their components structures and functions of ecosystems. Within the Eastside corridor there are many elements defining the existing conditions of the natural environment including landslide, liquefaction and other geologic hazard areas, steep slopes, riparian areas, streams, creeks and wetlands. In addition, the Eastside corridor lies adjacent to Lake Washington, several wetlands and three major rivers. The following provides additional information on existing conditions of the natural environment surrounding the Eastside corridor.

Steep Slopes, Slide and Geologic Hazard Areas
Slide hazards in the project area are associated with steep slopes or loose soils made unstable by geologic or man-made conditions. Factors that contribute to slope instability include over-steepening of naturally slopes; man-made fills, and the presence of groundwater in soils.

Steep slopes and geologic hazards areas have been categorized by King County, Snohomish County, Cities of Bellevue, Kirkland and Renton along the shores of Lake Washington.

There are many of these critical areas along or adjacent to the Eastside corridor. Project-level surveys and/or research would be required to confirm the location these areas.

Major Waterbodies
The Eastside corridor area lies within two major watersheds: the Cedar River/Lake Washington watershed (WRIA8) in the southern portion of the corridor and the Snohomish River Basin in the north (WRIA 7), with the majority of the corridor lying within WRIA 8.

WRIA 8 encompasses nearly 200 square miles. It includes all streams discharging through Lake Washington and the Lake Washington Ship Canal (including Union Bay,
Portage Bay, and Lake Union) to Puget Sound. The Cedar and Sammamish are the major rivers in this basin.

The area from Woodinville north to the City of Snohomish lies within WRIA 7. WRIA 7 encompasses more than 680 square miles from the Cascade Crest to the confluence with the Skykomish River north of Duvall, and spanning King and Snohomish Counties.

Based on information in the I-405 Corridor FEIS, there appear to be several major rivers, streams, and creeks lying adjacent to or crossed by the existing Eastside corridor (see Table 3).

**Table 3: Waterbodies**

<table>
<thead>
<tr>
<th>Waterbody</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>May Creek</td>
<td>Renton</td>
</tr>
<tr>
<td>Coal Creek</td>
<td>Bellevue</td>
</tr>
<tr>
<td>Mercer Creek/Slough</td>
<td>Bellevue</td>
</tr>
<tr>
<td>Kelsey Creek</td>
<td>Bellevue</td>
</tr>
<tr>
<td>Forbes Creek</td>
<td>Kirkland</td>
</tr>
<tr>
<td>Bear Creek</td>
<td>Woodinville</td>
</tr>
<tr>
<td>North Creek</td>
<td>Woodinville</td>
</tr>
<tr>
<td>Sammamish River</td>
<td>Woodinville</td>
</tr>
<tr>
<td></td>
<td>Redmond</td>
</tr>
<tr>
<td>Evans Creek</td>
<td>Snohomish County</td>
</tr>
<tr>
<td>Snohomish River</td>
<td>Snohomish County</td>
</tr>
<tr>
<td>Lake Washington</td>
<td>Kirkland</td>
</tr>
<tr>
<td></td>
<td>Bellevue</td>
</tr>
<tr>
<td></td>
<td>Newcastle</td>
</tr>
<tr>
<td></td>
<td>Renton</td>
</tr>
<tr>
<td>Lake Bellevue</td>
<td>Bellevue</td>
</tr>
</tbody>
</table>

The Snohomish River, Sammamish River, Kelsey Creek, Mercer Slough, and May Creek are also surrounded by major floodplains. These flood plains are either crossed by or are adjacent to the rail line.

In addition, Lake Washington, the Snohomish River, Sammamish River, May Creek and the Mercer Slough have been designated as state shorelines. State shorelines include the 200-foot-wide area landward from a designated shoreline, associated 100-year floodplains or associated wetlands and are regulated under Washington's Shoreline Management Act (SMA) (Chapter 90.58 RCW) and the local zoning ordinances.

**Wetlands**
The I-405 Corridor Study FEIS identified 2,395 existing discrete wetlands (1,066 complexes) within the I-405 Corridor. Based on this information, a number of important wetlands appear adjacent to or cross the Eastside corridor. These include:

- Kelsey Creek Drainage
- Mercer Slough
There are also a number of un-named wetlands along the existing rail alignment. Project-level survey and/or wetland delineations are required to confirm the locations of wetlands adjacent to the Eastside corridor.

**Groundwater**
While groundwater is prevalent in Washington State, there is no substantial regional groundwater flow system in Western Washington, and groundwater movement is generally toward stream drainages. There are however, certain areas of permeable underground rock or sand that hold or transmit groundwater below the water table. These are known as aquifers. Groundwater quality, particularly of groundwater in aquifers, is regulated both by the federal government and the State of Washington.

While, the majority of the cities within the study area are supplied by surface water, water supplies for a portion of Redmond, parts of Renton, Woodinville, Cathcart, Maltby and Snohomish could come from groundwater found in aquifers. Aquifers serving these communities include two sole source aquifers\(^\text{20}\): the Cedar Valley aquifer (a narrow strip along the Cedar River in Renton) and a small portion of the Cross Valley aquifer serving Woodinville and Snohomish County. The Eastside corridor lies adjacent to or crosses through these aquifers.

**Wildlife**
Puget Sound chinook salmon is listed as “threatened” under the Endangered Species Act and is a “candidate” for the State of Washington listing. Chinook salmon have been found in the Snohomish, Cedar and Sammamish rivers, as well as larger tributary streams including North Creek, Bear Creek, Little Bear Creek, Evans Creek, Mercer Slough, Coal Creek, May Creek, and Kelsey Creek. Puget Sound/Strait of Georgia coho salmon is currently a “candidate” species for federal listing and have also been found in the major streams and many smaller streams within both WRIA 7 and 8 and could be present within the Eastside corridor.

Other salmonids that could be present in streams within the Eastside corridor include several species not currently addressed by the ESA, including pink salmon (Oncorhynchus gorbuscha), chum salmon (O. keta), sockeye salmon (O. nerka), kokanee, steelhead trout (O. mykiss), coastal cutthroat trout (O. clarki), and mountain whitefish

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\(^{20}\) Sole source aquifers supply at least 50% of the area's drinking water and are designated by the U.S. Environmental Protection Agency.
(Prosopium Williamsii). Bull trout (Salvelinus confluentus) are currently listed as “threatened” under the Endangered Species Act as may be present in Lake Washington.

POTENTIAL IMPACTS AND MITIGATION

Land Use
Previous studies have identified a number of potential land use impacts associated with construction of high capacity rail transit and/or a bicycle/pedestrian trail along the Eastside corridor. Similar land use impacts to those previously identified could be expected with the construction of the representative system, including:

- Land acquisitions that could result in potential displacement of or impacts to residences, businesses and/or park land. This would be especially relevant around assumed station areas and the maintenance facility.
- Support for new development, redevelopment or infill and land use intensification.
- Temporary disruption and permanent changes to local traffic patterns and access to residences and businesses.
- Increased noise and vibration impacts to sensitive receptors (schools, parks, etc.) located immediately adjacent to the rail line.
- Changes in the existing zoning or character of the assumed station areas.
- Visual impacts at at-grade crossings due to signal installations and improvements and utility improvements.
- Increased pedestrian traffic at assumed stations.
- Loss or degradation of farm land through temporary uses for staging or clearing and grading.

Potential mitigation measures could include:

- The selection and design of station areas and maintenance facilities that minimizes displacements and encroachment on surrounding land uses
- Providing relocation and monetary assistance to impacted businesses and residences in accordance with state and federal laws.

Additional studies would be needed to fully assess the potential impacts to the built environment including:

- Detailed analysis of land uses near the corridor and a breakdown of land uses by type.
- Detailed evaluation of the location of minorities and other protected citizens.
- The exact locations of:
  - Potential historic sites and cultural resource areas, and
  - Utility crossing locations.
  - Stations and maintenance facilities.
  - Property acquisitions.

Additional mitigation measures would be developed at the project design and environmental analysis phase.
Eastside corridor commuter rail construction within the shoreline area may be permitted either through a Shoreline Substantial Development Permit or a Shoreline Conditional Use Permit. Compliance with the regulatory framework of each jurisdiction would require avoidance, minimization, and mitigation of all impacts to the shoreline environment.

**Transportation**
The existing rail line crosses a number of roadways at-grade. Many of these locations are already high traffic volume intersections. Construction along the corridor could potentially create significant impacts to roadway vehicular traffic. If roadway closures were needed during construction, re-routing traffic through neighborhoods could cause temporary localized increases in noise and decreases in air quality.

The *BNSF Corridor Preservation Study* completed a preliminary traffic analysis for a “trail with increased rail” scenario (among others) within the Eastside corridor at several high volume intersections. Operational impacts were evaluated and identified as:
- Train delays due to roadway traffic volumes and resulting signalization plans
- Train delays due to bicycle/pedestrian traffic
- Additional train operational costs due to train delays
- Delays to roadway traffic due to train and/or pedestrian/bicycle crossings

The addition of the assumed commuter rail stations would increase pedestrian traffic, resulting in the need to evaluate each pedestrian/track crossing on an individual basis to determine the appropriate type of pedestrian warning equipment. Impacts could include elevated noise levels along the tracks, at assumed station areas, and at the maintenance facility.

Potential mitigation options for roadway traffic delays caused by pedestrians and bicyclists using a potential trail were identified in the 2007 PSRC report. These included rerouting pedestrian and bicycle trail traffic to adjacent intersections or providing grade-separated trail crossings at key arterial streets.

The impacts from construction and operation of a commuter rail system and/or a bicycle/pedestrian trail could be similar to those identified in the *BNSF Corridor Preservation Study*.

**Water Resources**

**Surface Water**

Construction of a commuter rail system in the Eastside corridor has the potential to temporarily degrade water quality during construction. Several of the stream basins within the corridor could potentially suffer serious, short-term water quality degradation due to a combination of their sloping nature along with clearing and grading that would be required to reconstruct existing tracks, build passing tracks, and construct new stations and a maintenance base. These activities could result in increased sedimentation and turbidity. Construction of a rail could have similar impacts.
In-water work to stabilize or reconstruct existing over-water crossings could stir up bottom sediments and temporarily exceed allowed turbidity limits. Construction of new bridge footings would have similar impacts. Stream or creek rerouting during construction would result in temporary reductions in in-stream flows. The Cedar, Snohomish and Sammamish Rivers are known habitat for salmon species protected under the Endangered Species Act. Impacts to these waterbodies further analysis and consultation with the NOAA Fisheries and the U.S. Fish and Wildlife Service.

While substantial short-term impacts from construction could be minimized or avoided by implementing water quality protection Best Management Practices (BMPs), including construction during dry weather, project-specific mitigation measures would need to be developed as required by the Stormwater Management Manual for Western Washington or functionally equivalent stormwater guidance and in concert with local, state and federal permitting agencies.

Longer term impacts to surface water such as higher peak flows into receiving waters could result from increases in new impervious through the construction of a new trail, track, passing sidings, stations and/or a maintenance facility. Site clearing and grading could increase erosion, particularly on steep slopes. Increased erosion could lead to subsequent increases in sedimentation in the receiving water-body. Loss of ecological and hydro-geological functions could occur through the filling of wetlands and construction within flood basins.

Mitigation for impacts to surface water quality is detailed in the I-405 EIS. These BMPs could serve as a starting point for the development of project-level protective measures which would need to be discussed with the Washington Department of Ecology and local jurisdictions.

In addition to these BMPs, stormwater treatment would be required to be implemented during construction and to accommodate the addition of new impervious surfaces per requirements of local jurisdictions.

**Groundwater**

The use of hazardous materials during construction near areas where groundwater is close to the surface may result in direct impacts to groundwater. Potential sources of hazardous materials related to construction include: fuel used by construction vehicles; chemicals used during construction, such as cement curing aids, formcoats, and sealants; and fill material brought in from outside sources that may contain hazardous materials.

Similarly, hazardous materials present in soil that is newly exposed during construction, is another source of contamination through direct infiltration and surface runoff. Release of small amounts of hazardous materials over time via vehicle fuel, lubricant, or other fluid leaks could be picked up by runoff and, if not contained and treated, could reach the ground and infiltrate to groundwater. The assumed Renton/Port Quendall/NE 44th Street station is located at a site of known contamination.
Mitigation measures to decrease the potential for groundwater contamination in sensitive areas are based on minimizing the uses of hazardous materials, as described in the I-405 EIS. These BMPs could serve as a starting point for the development of project-level protective measures which would require discussions with the Washington Department of Ecology, the U.S. Environmental Protection Agency and local jurisdictions.

Activities that might remove substantial quantities of groundwater from aquifers during construction are pump tests and construction dewatering activities. These would be expected to occur in the areas where groundwater is near the surface, such as in Redmond and Renton. To mitigate the depletion of groundwater supplies via construction dewatering or pump testing, the groundwater that is removed could be re-infiltrated, provided programs are in place to test for and/or treat to the groundwater to remove hazardous materials that may have come in contact with the groundwater.

Placement of new impervious surface has the potential to reduce groundwater recharge areas. The total loss of acreage due to the replacement of pervious surfaces with cement, asphalt or compacted soils should be calculated at the project level. As an example, general mitigation measures for long-term loss of recharge to aquifers are described in the I-405 EIS. These BMPs could serve as a starting point for the development of project-level protective measures which would require discussions with the Washington Department of Ecology, the U.S. Environmental Protection Agency and local jurisdictions.

**Wetlands**

The wetlands along the Eastside corridor provide a number of ecological functions and values in the biological, hydrological, and societal landscape. For example, many of these wetlands provide essential habitat and habitat buffers for wildlife including threatened and endangered (T&E) plants and animals and for species with other special status. Other wetland functions provide perching, foraging, and/or buffer habitat for protected wildlife species such as the bald eagle, chinook salmon (Oncorhynchus tshawytscha), bull trout (Salvelinus confluentus), and Puget Sound/Strait of Georgia coho salmon (Oncorhynchus kisutch).

Wetlands remove sediments and contaminants from surface water, reduce peak flows, store flood waters and recharge groundwater. Wetland buffers are required in most jurisdictions to help maintain wetland functions and values by limiting many of the typical wetland alterations caused by construction projects.

Filling in wetlands or wetland buffers could cause the loss of wetland function; with a potential reduction in water quality of nearby streams, loss of ground water recharge and increased peak flows in nearby streams. Areas where impacts to wetland and wetland buffers could occur are where track or trail alignment deviate from existing right-of-way and where assumed stations and/or a maintenance facility would be built adjacent to or intrude upon existing wetland and wetland buffers.
Some general mitigation measures to counter potential impacts to wetlands could include:

- Design structures to avoid wetlands (e.g., lengthening bridges to cross streams and their associated riparian corridors and wetlands).
- Reducing impacts over the life of the project using preservation and maintenance operations.
- Utilize BMPs to avoid or minimize short-term sedimentation and contamination of wetlands.
- Compensating for adverse impacts by replacing the affected environment or providing substitute resources.
- Monitoring the impacted environment during construction and taking appropriate corrective measures as needed.

As an example, the I-405 SEIS identifies a number of mitigation measures and BMPs for mitigating potential impacts to wetlands. These BMPs could serve as a starting point for the development of project-level protective measures which would require discussions with the Washington Department of Ecology, the U.S. Army Corps of Engineers and local jurisdictions.

Wetland delineations would be required to determine the exact acreage of wetlands and wetland buffers that would be impacted and to identify mitigation.

**Wildlife**

Potential impacts to fish and their habitat from construction of a commuter rail line within the Eastside corridor could include encroachments to existing riparian areas (locations, including stream crossings, where clearing and grading within 300 feet of any stream would be needed and including wetlands and stream crossings), vegetation removal through clearing and grading, increased erosion and sedimentation during construction and through addition of new impervious surface. These activities could lead to increased water temperatures in nearby streams, increased pollution from road runoff, increased peak flows and rates of runoff, decreased base flows, increased erosion, decreased infiltration, and decreased evapo-transpiration.

These impacts are known to have adverse effects on aquatic habitat, including increased water temperature, displacement of gravel that forms spawning habitat, wash out or crushing of salmon eggs, degradation of salmon food sources, flushing of juvenile fish downstream, and increases in stream flow fluctuation during storms.

Along with increases in stream flow, there is typically a corresponding decrease in shallow groundwater recharge. This may cause water levels to decline much more quickly to levels inadequate for maintaining fish survival through the dry summer season. Salmonids are sensitive to all of the above potential environmental changes.

As an example, mitigation measures are described in the I-405 EIS. Specific BMPs would need to be determined in coordination with the federal, state and local jurisdictions.
Environmental Health (Noise and Hazardous Materials)

Hazardous Materials
Construction impacts could include releases of contaminants to the environment by spills, ground-disturbing, dewatering activities, underground storage tanks or leaking underground storage tanks. In addition, releases of hazardous materials could occur during building or structure demolition.

Potential types of hazardous materials that could be encountered during project construction include petroleum-contaminated soil, surface water, and groundwater; and USEPA priority pollutants, organic compounds (volatile and semi-volatile compounds and pesticides), metals, and PCBs in soil, groundwater, and surface water. Hazardous materials including asbestos, lead-based paint, and PCBs may be present in buildings and structures. The assumed Renton/Port Quendall/NE 44th Street station is located at a site of known contamination.

Typical impacts encountered from hazardous materials during construction could include:
- Releases of contaminated air emissions (dust and volatile organic compounds), contaminated soil, surface water, and groundwater
- Releases of hazardous materials from spills
- Alteration of contaminated groundwater plume(s) and generation of contaminated water during dewatering activities
- Alteration of contaminant migration pathways due to excavation and other construction activities
- Release of PCBs via transformer fluid during relocation of electrical transformers.
- Releases during cleanup of a contaminated site.

Mitigation measures that could be employed were developed in the I-405 EIS and could serve as a starting point for development of project-level measures.

There is also a potential for release to the environment of hazardous substances used or transported during routine operation and maintenance of the corridor. Shipping of hazardous material by motor vehicles are regulated under the authority of the USDOT through CFR 49.

It is recognized that new maintenance facilities could be needed for the commuter rail vehicles. These maintenance facilities could store petroleum or hazardous materials and generate hazardous waste. Potential impacts from these maintenance facilities, or expansion of existing facilities, have not been identified for this feasibility study. This analysis would need to be performed at the project level.

Noise
Additional noise could be generated in the Eastside corridor both during construction and operation of a commuter rail system and/or a trail. Construction activities could involve clearing, cut-and-fill activities, removing old and replacing old railroad ties, importing fill, placement of ballast, construction or repair of structures, laying new rail and trail
surfaces, etc. Engine-powered equipment used during construction such as earth-moving equipment, material-handling equipment, and stationary equipment, generators and compressors, could produce intermittent temporary increases in noise. Road construction could involve similar activities and generate similar levels of noise. Additional sources of noise could include demolition of old buildings and structures and construction of new ones.

Construction noise levels are regulated by local jurisdictions and would be restricted by the appropriate development regulations. Typically, allowed nighttime construction noise is less than that allowed for daytime work. Work at night would require a variance from the local jurisdiction.

Increases in noise due to operation of the representative commuter rail system could be related to vehicle type, increases in the number of trains in the corridor, increased traffic at at-grade crossings, increased auto and/or bus traffic at stations, and maintenance facility operations.

There are several sensitive receptors along the Eastside corridor, including public schools, residences and several parks. All could be impacted by construction and operations of this work. Additional project-level analyses would be required to identify the full range of impacts and mitigation.

Parks and Recreation
Both short-term impacts to parks and recreational facilities from construction and long-term operational impacts could result from development of a commuter rail system and/or a trail in the Eastside corridor. These are described in the following sections.

Construction impacts could occur at parks, recreational areas and facilities and trails that are in close proximity to the construction activities. Temporary impacts may include: trail detours, restrictions on park access, increases in erosion/sedimentation dust, and noise, view blockage, loss of parking, temporary restrictions on or change to facility access, street closures and traffic detours. Longer term impacts such as vegetation removal from clearing and grading could also result from construction of commuter rail system and/or a trail in this corridor.

Construction equipment and stockpiled materials, construction lighting, demolition, and general clutter could affect park access, public safety and use-ability. In some cases, replacement of track or construction of new stations could require use of parkland for staging areas or other construction activities.

Several parks are located within a few hundred feet of the Eastside corridor. Some lie in close proximity to assumed commuter rail stations. Actual construction impacts and the number of parks affected would be determined during future project-level planning and environmental review.
Long-term impacts to parks and recreational resources could occur from acquisition of all or part of the facility property or from proximity affects to the commuter rail system or trail such as increased noise, degradation of air quality, degradation of visual or aesthetic setting or access restrictions. Operational impacts and the number and type of impacts to parks would be determined during future project-level design and environmental analysis.

During construction, impacts could be mitigated by maintaining access during temporary road and trail closures, screening views of construction sites, and by providing signage explaining the nature and duration of construction. Implementation of BMPs could minimize dust control, erosion and sedimentation.

Operational mitigation measures could include: avoiding or minimizing potential adverse effects such as shifting improvements to one side of the right-of-way, restoring disturbed landscaping, screening the alignment with landscaped berms, fences and walls, screening or shielding lights on structures, providing trail improvements, and by replacing lost park or recreational facility land with comparable facilities in a new location.

(Note: If this project receives federal funds for design or construction, the project would be subject to Section 4(f) of the U.S. Department of Transportation Act of 1966. Under section 4(f), project proponents would be required to avoid the use of a significant public park, recreation area, wildlife and waterfowl refuge and historic sites or complete a detailed evaluation to prove there is no feasible and prudent alternative to the use of such land. The assumed Renton/Gene Coulon Park and Snohomish CBD station areas could be subject to a 4(f) analysis. Project-level mitigation measures would be determined as part of these studies.

**Historic, Archaeological and Cultural Resources**

Ground disturbing activities within the Eastside corridor have the potential to affect archaeological sites, TCPs, particularly along Lake Washington, and the Sammamish and Snohomish Rivers. Potential impacts and appropriate mitigation measures would be determined in consultation with the lead agency, Washington Office of Archaeology and Historic Preservation (OAHP), Native American tribes, affected local governments, and the public during project-level review.

Potential mitigation measures could include:

- Archaeological monitoring during construction (to mitigate potential impacts to unrecorded sites), subsurface testing, and data recovery excavations if sites are known or discovered.
- Subsurface testing in high probability areas such as near lakes, rivers, and shorelines.
- Significant (i.e., eligible for inclusion in the national, state, or local register) archaeological sites may be subject to full excavation to recover data from those portions of the site that have the potential to contribute important information.
- If impacts to Traditional Cultural Properties eligible for inclusion in the National Register of Historic Places are identified, all reasonable and feasible measures should be taken to avoid and/or minimize impacts to these properties.
Note: If federal funding would be received to design or construct a portion of the rail/trail line, the project is subject to Section 106 of the National Historic Preservation Act (36 CFR 800) and Section 4(f) of the U.S. Transportation Act of 1966. Analyses satisfying both these federal laws would be required and appropriate mitigation measures would be determined in consultation with the appropriate agencies and tribes. Mitigation measures would be developed in government-to-government consultation with Native American tribes.

If impacts to historic properties are identified at the project level, several mitigation measures could be required including:

- Ensuring design compatibility of facilities near historic districts or sites.
- Providing landscaping elements and/or walls to lessen noise and visual impacts (as long as these elements do not in and of themselves constitute visual impacts).
- Modifying construction methods to avoid or limit construction–related impacts (noise, dust, emissions, vibrations).
- Monitoring construction to ensure no significant impacts occur.

Impacts to historic properties would be most likely to take place during the removal and construction of tracks. Operation of commuter rail trains could cause visual and/or vibration impacts to historic properties. The presence of new stations could potentially alter access to a historic property, or isolate a property from its historic setting. These improvements could also have visual impacts. Commuter rail improvements could have the potential to adversely alter the setting of historic properties.

If relocation or demolition of historic properties is deemed necessary after extensive evaluation and documentation, historic properties should be fully documented to standards agreed upon by the lead agency, OAHP, relevant local governments, any consulting parties, and the public. All rehabilitation or relocation work should be done in a manner consistent with the Secretary of the Interior’s Standards for the Treatment of Historic Properties, or other agreed upon standards. Additional mitigation for property removal may include interpretive displays and photographs of the impacted properties or of the area’s history in general located in the new facility. If the Eastside corridor itself is identified as an historic railroad, then additional federal and state requirements would apply. Note: If federal funding is received to design or construct a portion of the rail/trail line, the project would be subject to Section 106 Section 4(f) requirements.

**POTENTIALLY REQUIRED PERMITS AND APPROVALS**

There are numerous permits and approvals that could be required for construction and operation of the representative commuter rail system and/or parallel trail. These could include federal, state and local permits as described in this section.
Table 4 identifies federal permits which could be required at select locations along the corridor.

**Table 4: Potential Federal Permits**

<table>
<thead>
<tr>
<th>Permit or Approval</th>
<th>Issuing Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEPA/SEPA Section 106 Section 4(f)</td>
<td>FTA</td>
</tr>
<tr>
<td>Clean Water Act Section 404 Permit</td>
<td>US Army Corps of Engineers (USACE)</td>
</tr>
<tr>
<td>Sole Source Aquifer (SSA) Protection Program</td>
<td>US Environmental Protection Agency (EPA)</td>
</tr>
<tr>
<td>National Historic Preservation Act Section 106</td>
<td>ACHP DHAP</td>
</tr>
<tr>
<td>Transportation Act Section 4(f)</td>
<td>FTA</td>
</tr>
<tr>
<td>Endangered Species Act</td>
<td>NOAA Fisheries &amp; USFWS</td>
</tr>
<tr>
<td>Approval of signal system type to be used and any new grade crossings to be added</td>
<td>FHWA</td>
</tr>
<tr>
<td>New/modified (rail and/or trail) crossings over or under state highways/National Highway System</td>
<td>FHWA</td>
</tr>
<tr>
<td>Approval for Track Abandonment Certification to operate railroad (Registration as an active Railroad) Rail Banking Agreements or Amendments</td>
<td>Surface Transportation Board (STB)</td>
</tr>
<tr>
<td>Certain submittals and approvals for construction of a commuter rail and trail along the Eastside corridor may be required from the FRA. These may include: Safety Implementation Plans, Grade Crossing Signal Failure Reports, and results of inspections and tests. In addition, if the rail alignment differs from FRA specifications, waivers from compliance or special approvals would be required. FHA has special reporting and notification requirements that may be applicable to this project. FRA regulations are listed in Title 49 of the Code of Federal Regulations.</td>
<td>Federal Railroad Administration (FRA)</td>
</tr>
<tr>
<td>Potential design/height restrictions for bridge(s) over Snohomish River (in vicinity of Harvey Airfield flight paths)</td>
<td>Federal Aviation Administration (FAA)</td>
</tr>
</tbody>
</table>
Table 5 identifies state permits which could be required at select locations along the corridor.

**Table 5: Potential State Permits**

<table>
<thead>
<tr>
<th>Permit or Approval</th>
<th>Issuing Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment of a DOT grade crossing number</td>
<td>Washington State Utilities and Transportation Commission</td>
</tr>
<tr>
<td>-Final approval of grade crossing layouts, detection type (CWTD or Motion) and warning equipment (gates, flashers/ cantilevers) -Easement or license for construction work in grade crossings -Certification of Project Completion -Updating the Federal Highway/Rail Crossing database</td>
<td>Washington State Utilities and Transportation Commission</td>
</tr>
<tr>
<td>New/modified (rail and/or trail) crossings over or under state highways/National Highway System</td>
<td>Washington State Department of Transportation</td>
</tr>
<tr>
<td>Hydraulic Permit Approval (HPA)</td>
<td>Washington State Department of Natural Resources</td>
</tr>
<tr>
<td>National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Permit</td>
<td>Washington State Department of Ecology</td>
</tr>
<tr>
<td>Underground Storage Tank Removal</td>
<td>Washington State Department of Ecology</td>
</tr>
<tr>
<td>Underground Injection Control Program</td>
<td>Washington State Department of Ecology</td>
</tr>
</tbody>
</table>

The following list includes local permits that would typically be required for a system such as that assumed in this report:
- Street Occupancy/Street Use
- Street Vacations
- Shoreline Permits
- Critical Areas Permits
- Clearing and Grading Permits
- Noise Variance
- Surface Water Discharge Approval
- Groundwater Discharge Approvals
- Building Permits
- Demolition Permits
Appendix I: Application of Performance Measures

The application of the performance measures provides background information about passenger/commuter rail on the Woodinville subdivision for consideration by decision-makers.

Draft performance measures were reviewed with the BNSF Ad Hoc Advisory Committee at their July 2008 meeting. As a result of their review, two performance measures were added: local/community impacts and safety/security. In addition, environmental impacts were added to the environmental benefits performance measure.

Ridership
Ridership forecasts were prepared by the Puget Sound Regional Council for the feasibility study.

Preliminary Ridership Results: Daily Trip Attractions

<table>
<thead>
<tr>
<th>Cumulative Segments</th>
<th>Trips in 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segment 2</td>
<td>Bellevue-to-Woodinville</td>
</tr>
<tr>
<td>13.5 miles</td>
<td>1,770</td>
</tr>
<tr>
<td>Segment 1+2</td>
<td>Coulon Park-to-Woodinville</td>
</tr>
<tr>
<td>21.7 miles</td>
<td>4,580* (2,810)</td>
</tr>
<tr>
<td>Segment 1+2+3</td>
<td>Coulon Park-to-Snohomish</td>
</tr>
<tr>
<td>34.1 miles</td>
<td>5,015 (435)</td>
</tr>
<tr>
<td>Segment 1+2+3+4</td>
<td>Coulon Park-to-Snohomish with South Woodinville-to-Redmond Spur</td>
</tr>
<tr>
<td>41.0 miles</td>
<td>6,070* (1,055)</td>
</tr>
</tbody>
</table>

The Puget Sound Regional Council used its Sketch Planning Tool, based on 2006 land use and transportation networks plus the 2006 Household Survey data, to prepare ridership information for the corridor. It was used as it allowed a more focused corridor-based approach. It is based on the Regional Travel Demand model. A possible commuter rail service on the BNSF corridor will be modeled using the Regional Travel Demand model as part of the Transportation 2040 update of Destination 2030’s transportation plan in 2009. Due to timing constraints, however, this data is not yet available to include in the report.

Costs
Capital and operating cost estimates were prepared for passenger/commuter rail on the corridor.
**Capital costs (2\textsuperscript{nd} Qtr 2008 Millions$)**

<table>
<thead>
<tr>
<th>Segment</th>
<th>Description</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>North Renton (Coulon Park) - Bellevue</td>
<td>$220</td>
<td>$286</td>
</tr>
<tr>
<td>2</td>
<td>Bellevue - Woodinville</td>
<td>$230</td>
<td>$299</td>
</tr>
<tr>
<td>3</td>
<td>Woodinville - Snohomish</td>
<td>$224</td>
<td>$291</td>
</tr>
<tr>
<td>4</td>
<td>Redmond - Woodinville</td>
<td>$116</td>
<td>$150</td>
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<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td>$789</td>
<td>$1,026</td>
</tr>
<tr>
<td><strong>Yard &amp; Shop</strong></td>
<td></td>
<td>$57</td>
<td>$74</td>
</tr>
<tr>
<td><strong>Vehicles (assumes DMU)</strong></td>
<td></td>
<td>$64</td>
<td>$74</td>
</tr>
<tr>
<td><strong>Corridor Acquisition(by the Port of Seattle)</strong></td>
<td></td>
<td>$107</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td>Low $1,017</td>
<td>High $1,280</td>
</tr>
</tbody>
</table>

**Operating costs**

Operating costs are estimated at $24 to $32 million per year (2008$) based on two-way service on the corridor with 30 minute headways for 16 hours per day (weekdays only). The costs include vehicle operations and maintenance, maintenance of way, and overhead and other costs.

**Travel time (by segment)**

<table>
<thead>
<tr>
<th>Segment</th>
<th>Description</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Renton (Gene Coulon Park) to Bellevue</td>
<td>21 minutes</td>
</tr>
<tr>
<td>2</td>
<td>Bellevue to North Woodinville</td>
<td>34 minutes</td>
</tr>
<tr>
<td>3</td>
<td>North Woodinville to Snohomish</td>
<td>31 minutes</td>
</tr>
<tr>
<td><strong>Segments 1+2+3 (34.1 miles)</strong></td>
<td>Renton to Snohomish</td>
<td>86 minutes</td>
</tr>
<tr>
<td>4</td>
<td>Redmond to South Woodinville via spur</td>
<td>17 minutes</td>
</tr>
</tbody>
</table>
System integration

- **Key Question:** Would passenger/commuter rail extend the reach of transit service or connect to Sound Transit and other service or facilities?
- **Conclusion:** passenger/commuter rail on the Eastside BNSF corridor could extend the reach of transit service and/or connect to Sound Transit and other service and facilities.

Access—see Connectivity and mobility measure below

**Connectivity and mobility**

Regional Centers served – The Regional Growth Strategy in VISION 2040 focuses the majority of the region’s employment and housing growth in both Metropolitan and Core Cities. The BNSF corridor connects the Metropolitan City of Bellevue to the Core Cities of Kirkland, Redmond and Renton, which could support the Regional Growth Strategy by providing both rail passenger service and a bicycle/pedestrian trail in areas targeted for significant growth.

**Land use and development based on adopted Vision 2040 regional plan.**

For more information, refer to Section 3.1.5 and Appendix F.

*Destination 2030*’s project list identifies “candidate” trail projects on all segments of the corridor (including the Redmond spur). Both the project descriptions and the plan text explicitly mention the possibility of dual freight/trail use on the Woodinville-to-Snohomish segment. The plan also explicitly designates the segments within King County as “candidate” High Capacity Transit corridors under state law and acknowledges that further study will examine HCT potential. And this directly from the plan:

- “...the BNSF Corridor Advisory Committee completed a planning process for a rail corridor from Renton to Woodinville (with a spur from Woodinville to Redmond) on the east side of Lake Washington. This process concluded that potential HCT investments on portions of this corridor merited further study and that the corridor segments in King County should be designated as “candidate” HCT corridors to assure corridor preservation consistent with Washington state law (RCW 81.104.080). The King County BNSF corridor segments are also proposed to be preserved for future rail options under federal rail banking provisions.” [*Destination 2030, p. 43*]

- “The same BNSF Corridor Advisory Committee process that recommended consideration of rail banking and HCT applications for an existing rail corridor now owned by BNSF running from Renton to Woodinville (with a spur from Woodinville to Redmond) on the east side of Lake Washington also recommended non-motorized trail uses in the short-term (next 10 years) on all segments of this corridor in both King and Snohomish counties. Between Woodinville and the city of Snohomish the corridor is proposed to consider the potential development of the regional trail as a dual use since the existing freight
rail operations are expected to continue as long as economically viable. Non-motorized trails in this corridor would be invaluable in connecting the four urban centers of Renton, Bellevue, Kirkland/Totem Lake, and Redmond.” [Destination 2030, p. 44]

Transit-supportive zoning and land use plans adjacent to the line or stations
Appendix F provides an evaluation of the potential for each station to support transit- and pedestrian-oriented development. Based on the analysis described in this report, the majority of the assumed station areas do not demonstrate the potential to support transit- and pedestrian-oriented development, based on their existing land uses, plan policies and regulations. In general, the BNSF Eastside corridor is not well oriented to serve the Eastside’s urban and activity centers and instead winds its way through low density residential and industrial areas. The corridor does not directly serve Downtown Bellevue, the Eastside’s largest activity center (and a designated regional growth center).

In addition, most of the Snohomish County portion of the corridor is outside the region’s designated urban growth area. However, some of the assumed station areas have existing or planned land uses and densities to potentially support TOD. The assumed stations that show the highest potential for TOD are the following (not in any order):
- Bellevue/NE 12th Street (included in Bellevue’s Bel-Red Corridor Study area)
- South Kirkland Park-and-Ride (TOD project by King County is in the planning stages)
- Kirkland/Totem Lake (designated regional growth center)
- Snohomish CBD
- Redmond CBD (designated regional growth center)

Population and employment within ½ mile of stations
Figure 1 shows existing population and employment with ½ mile of stations. This information is based on PSRC data.

Environmental benefits and impacts
Environmental benefits and impacts are not quantifiable at this stage of analysis. For more information on environmental evaluation completed for this study, see Section 6 and Appendix H.

Local/community impacts
Potential local/community impacts would be evaluated in the environmental review phase of a passenger/commuter rail proposal, if this occurs. Also, see Section 6 and Appendix H for a discussion of environmental evaluation completed for this study.
**Traffic**

For the feasibility analysis, all of the existing at-grade crossings in the corridor were identified. These crossings include public streets and private access roads and driveways. The impact of passenger/commuter rail operation on traffic (and potential mitigation) would need to be evaluated during the design phase.

The table below identifies the number and type (public or private) of at-grade crossings of the Woodinville Subdivision.

<table>
<thead>
<tr>
<th>Existing Grade Crossings</th>
<th>Length of Segment (miles)</th>
<th># of Existing Public Grade Crossings</th>
<th># of Existing Private Grade Crossings</th>
<th># of Existing Grade Crossings (total)</th>
<th># of Existing Grade Crossings (total) per Mile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segment 1</td>
<td>Renton-to-Bellevue</td>
<td>8.2</td>
<td>7</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>Segment 2</td>
<td>Bellevue-to-Woodinville</td>
<td>13.5</td>
<td>19</td>
<td>13</td>
<td>32</td>
</tr>
<tr>
<td>Segment 3</td>
<td>Woodinville-to-Snohomish</td>
<td>12.4</td>
<td>13</td>
<td>7</td>
<td>20</td>
</tr>
<tr>
<td>Segment 4 (Redmond spur)</td>
<td>Redmond-to-Woodinville</td>
<td>6.9</td>
<td>9</td>
<td>31</td>
<td>40</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>41.0</td>
<td>48</td>
<td>59</td>
<td>107</td>
</tr>
</tbody>
</table>

**Safety/security**

The feasibility analysis and cost estimate include a complete centralized train control system to manage all train movements and crossings. Full protection at each at-grade crossing was assumed in the analysis. In addition, a fence was included along the corridor to separate the representative pedestrian/bicycle path from the track.

**Public support/opposition**

See Appendix J for copies of letters and/or position statements from jurisdictions located along the Woodinville subdivision corridor. Other comment letters are included as Appendix K.

**Risk**

One of the performance measures of a potential commuter rail system and parallel trail along the Eastside corridor is an assessment of risk. For this analysis risk is defined in a broad sense and is assumed to be relevant to any potential operator of the representative commuter rail system (i.e. Sound Transit or any other operating organization).
For the feasibility study of the Eastside corridor, the risk assessment involved the following steps:

- Identifying and defining project hazards;
- Assessing the general probability of the hazard occurring and its potential impact; and
- Identifying the relative level of risk exposure

Because this analysis is being applied at the feasibility stage, all assessment of risk will be done at a conceptual level using qualitative measures only. Additional risk assessment would be completed during future planning and design phases.

Risk Categories
For this assessment, risks were generally divided into four (4) main categories:

- The existence of high risk components for the facility (i.e. tunnels, bridges, etc.)
- The level and quality of available information about key project elements. The existence of engineering-quality data regarding the location and/or condition of existing infrastructure, topography, environmental constraints, etc. could reduce risk. Lack of this information (or lower quality level of information) could increase risk.
- Partner risk – the degree to which other entities are involved in the project could affect risk. Examples of this could include: the need for funding by project partners, required agreements or approvals from other parties, etc.
- The need for unusual/special permits and environmental clearances could increase risk for projects

Risk Rating
Risk assessment methodology aims to define unmitigated risks that could potentially impact projects in terms of cost, schedule, life safety, quality of life, and media and political pressure. Each of the four categories described above was evaluated at a qualitative level based on available information and was given a rating of low, medium or high. An overall rating of **High Risk** was then identified based on the un-weighted summation of the individual categories. The risk assessment by category is shown in the table below.
<table>
<thead>
<tr>
<th>Category</th>
<th>Rating (High/ Medium/ Low Risk)</th>
<th>Discussion</th>
</tr>
</thead>
</table>
| Presence of High Risk Components (i.e., tunnels, bridges) | High Risk | The corridor has 24 existing rail bridges. For purposes of this study, it is assumed that rail bridges would be constructed/replaced at four of those locations, including the location of the Wilburton Trestle and Snohomish River bridges. The other 20 rail bridges were not inspected or evaluated in any detail, and the need for (and cost of) potential upgrades of those facilities is unknown at this time. A new rail/trail bridge would be constructed over the I-405 southbound lanes. The system also assumes construction of 16 new trail bridges.

The system assumes conversion of the existing Wilburton Trestle (historic) and Snohomish River bridges to trail use. Due to the complex environmental and/or historic nature of these significant structures, their modification and/or re-use may have additional risks.

The system assumes construction of a joint rail and trail bridge across the I-405 southbound lanes. Based on WSDOT plans for widening I-405 at that location and the alignment of the existing track approaches (skewed angle to I-405 alignment), the center span of this significant structure is assumed to be approximately 500' long. |
| Level/Quality of Available Information | High Risk | Because of its preliminary and conceptual nature, this feasibility study has been completed at a very low level (approximately 1%) of engineering design. Very limited engineering-quality data was available on existing terrain, track horizontal and vertical geometry, bridge/trestle designs and conditions, environmental conditions, limited field study, etc. |
| Partner Risks | High Risk | The corridor is currently owned by BNSF, except for the right-of-way north of the Snohomish River Bridge (tracks removed), which is currently owned by the City of Snohomish. The purchase and sale agreements (and associated easements) for the Eastside corridor involve BNSF, the Port of Seattle, King County, a Third Party Operator, and the federal Surface Transportation Board. The corridor runs through two counties and six cities. Regardless of the service provider, initiation of commuter rail operation in this corridor and/or construction of a trail could require several multi-party agreements between several public and/or private entities.

Potential commuter rail extensions to Everett and/or Tukwila would require negotiation with BNSF.

No new grade-separated crossings are assumed in the system. If new grade-separated crossings become part of the system at some future time, capital costs could increase. |
### Category | Rating (High/Medium/Low Risk) | Discussion
---|---|---
Special Permits and Environmental Clearance | High Risk | Permits could be required from a multitude of federal, state and local agencies. The corridor runs through two counties and six cities.

Environmental analysis, permits and/or mitigation could be required for potential impacts to the following: land use (including neighborhoods); transportation; water resources; wildlife; environmental health (noise and hazardous materials); parks and recreation; and historic, archaeological and cultural resources.

Overall | High Risk | See discussion of individual categories above.

**Customer experience**

Passenger/commuter rail in this corridor could provide a unique experience. The corridor travels through many cities and neighborhoods and provides views of Lake Washington in several segments.
Performance Measures for Eastside BNSF commuter rail feasibility analysis
(7/10/08 DRAFT; updated based on comments from Ad Hoc Advisory Committee)

Projected ridership for 2010, 2020 and 2040
- Daily transit volumes
- Projected boardings by station

Costs (in 2008$)
- Capital
- Operating

Travel time
- Travel time between stations and along corridor

System integration
- Extend the reach of transit service or connect to Sound Transit and other service or facilities
- Access

Connectivity and mobility
- Regional growth centers served

Land use and development based on adopted Vision 2040 regional plan
- Transit-supportive zoning and land use plans adjacent to the line or stations
- Population and employment within ½ mile of stations

Environmental benefits and impacts
- Air quality, greenhouse gas
- Noise
- Visual
- Aesthetics

Local/community impacts

Traffic
- Grade crossings

Safety/security

Public support/opposition

Risks

Customer experience
Appendix J: Comment Letters Received from Jurisdictions
Appendix K: Other Comment Letters Received