Central Link Light Rail Transit Project

VOLUME 1
FINAL ENVIRONMENTAL IMPACT STATEMENT

November 1999

SoundTransit

Central Puget Sound
Regional Transit Authority

U.S. Department of Transportation
Federal Transit Administration

SOUNDTRANSIT

November 5, 1999

Dear Recipient:

The U.S. Department of Transportation Federal Transit Administration (FTA) and Sound Transit (the Central Puget Sound Regional Transit Authority) have completed preparation of a Final Environmental Impact Statement (EIS) on the proposed Central Link light rail transit project. The project is part of *Sound Move*, a 10-year plan for regional high capacity transportation. Sound Transit is the project proponent.

The EIS was prepared pursuant to the National Environmental Policy Act (42 U.S.C. 4321 to 4370e) and the State Environmental Policy Act (Ch. 43.21C RCW). It was prepared to inform the public, agencies and decision makers about the environmental consequences of building and operating a light rail system within the cities of Seattle, Tukwila, and SeaTac. Mitigation measures to reduce or avoid impacts are also discussed. Overall, the Final EIS examines the environmental effects of 31 route and 67 station alternatives, including the route and stations of the preferred alternative. It also considers the impacts of seven alternatives for a maintenance base facility, and five alternatives for the system's length. Many of these alternatives have been modified and some new alternatives have been added since the Draft EIS to respond to agency and public comments, incoroporate and respond to new information, and to reduce or avoid impacts.

The Final EIS examines the preferred alternative for the light rail system, including route and station locations, as identified by the Sound Transit Board on February 25, 1999. The preferred alternative was identified following the 60-day public review and comment period for the Draft EIS released in December 1998. The preferred alternative is for a 20-mile light rail line that would begin at N.E 45th Street in the University District in Seattle, connecting to Capitol Hill, First Hill, downtown Seattle, Rainier Valley, Tukwila International Boulevard, and Sea-Tac Airport, ending at S. 200th Street in the City of SeaTac.

The major choices for the project involve the route and profile of the light rail line, station and maintenance base locations and design. Sound Transit will consider the Final EIS and other information before selecting the final route, station locations and maintenance bases to be built. The FTA will then issue a record of decision, which will state FTA's decision, identify the alternatives considered by FTA in making its decision, and list Sound Transit's mitigation commitments. The federal record of decision will allow the Central Link light rail transit project to start final engineering and compete for additional federal funding.

This is Volume 1 of a seven-volume Final EIS. Volumes 2 through 7 are appendices to the Final EIS. The contents of each volume include:

Central Puget Sound
Regional Transit Authority
Union Station
401 S. Jackson St.
Seattle, WA 98104-2826
Reception 206.398.5000
Facsimile 206.398.5499
www.soundtransit.org

Volume 1 – Final EIS
Volume 2 – Visual simulations and land use maps
Volume 3 – Comment letters and responses
Volume 4 – Comment letters and responses
Volume 5 – Comment letters and responses
Volume 6 – Route and station drawings, affected properties
Volume 7 – Rainier Valley Tunnel Report and update

Companion documents to the EIS include a separately bound executive summary and 20 technical back-up reports and environmental studies. All of these documents are available for review at Sound Transit (9:00 a.m. to 5:00 p.m.) or at local libraries. Volume 1 of the Final EIS and the executive summary are available from Sound Transit on request at no charge. Complete copies of Volumes 2 through 7 of the Final EIS are available for purchase at Sound Transit. The technical back-up reports and portions of the Final EIS volumes can be purchased at locations listed on the Fact Sheet. Please see the EIS Fact Sheet for more information on how to obtain copies of the Final EIS and other documents.

Please note that as of November 1, 1999, Sound Transit's offices will be located at::

Union Station
401 Jackson Street
Seattle, WA 98104

Sound Transit thanks all agencies, groups and individuals that commented on the Draft EIS, and those who participated in preparation of the EIS. We look forward to continuing this productive dialogue as we progress toward building the Central Link Light Rail Transit Project and fulfilling our commitments under Sound Move.

For further information about this EIS, please call James Irish, EIS project manager or Sound Transit reception at (206) 398-5000.

Sincerely,

Bob White

Bob White
Executive Director

CENTRAL LINK LIGHT RAIL TRANSIT PROJECT
SEATTLE, TUKWILA AND SEATAC, WASHINGTON

FINAL ENVIRONMENTAL IMPACT STATEMENT

Submitted pursuant to
the National Environmental Policy Act (42 U.S.C. 4322(2)(c))
and the State Environmental Policy Act (SEPA) (Ch. 43.21 C RCW)

by the

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL TRANSIT ADMINISTRATION

and

CENTRAL PUGET SOUND REGIONAL TRANSIT AUTHORITY
(Sound Transit)

In cooperation with

FEDERAL HIGHWAY ADMINISTRATION
U.S. COAST GUARD
WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
CITY OF SEATTLE
CITY OF TUKWILA
CITY OF SEATAC
KING COUNTY

Oct. 20, 1999
Date of Approval

Helen M. Knoll
Regional Administrator
For Federal Transit Administration

Oct 20, 1999
Date of Approval

Bob White
Executive Director
For Central Puget Sound
Regional Transit Authority

Oct. 20, 1999
Date of Approval

Perry Weinberg
SEPA Responsible Official
For Central Puget Sound
Regional Transit Authority

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Seattle, WA 98104

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Downtown and Southeast Seattle
(Westlake to Boeing Access Road)
(206) 398-5132

Jeff Munnoch
Tukwila and SeaTac
(206) 398-5131

Abstract

Sound Transit proposes to construct and operate a light rail system providing urban transportation improvements in the Central Puget Sound metropolitan region. Alternatives considered include the No-build Alternative, five light rail length alternatives, 28 light rail route alternatives, 83 station options (including park-and-ride lots) and seven alternative maintenance base sites. This Final EIS includes a preferred alternative identified by the Sound Transit Board after the Draft EIS was issued and public comments received. The analysis and impact assessment considers potential long-term and short-term effects on transit service, ridership, accessibility, roadways, freight movements, navigable waterways, land use, economics, neighborhoods, visual and aesthetic resources, air quality, noise and vibration, ecosystems, water quality and hydrology, energy, geology, hazardous materials, electromagnetic fields, public services, parklands, and historic and archaeological resources. The analysis also considers the financial feasibility and cost-effectiveness of the alternatives. Public and agency comments on the Draft EIS and Sound Transit's responses to those comments, including changes to the alternatives and additional analysis, are contained in this Final EIS.

Fact Sheet

PROPOSED ACTION

Sound Transit (the Central Puget Sound Regional Transit Authority) proposes to construct and operate an electric light rail transit system that would improve transportation in the Central Puget Sound region. The proposed light rail system, known as Central Link, would operate in an exclusive and semi-exclusive right-of-way between North Seattle and the City of SeaTac. This proposed project is a component of *Sound Move*, the 10-year program for regional high-capacity transportation. Alternatives considered include the No-build Alternative, five light rail length alternatives, 28 light rail route alternatives, 83 station options and seven alternative maintenance base sites.

With up to 29 miles of light rail line, the corridor has been divided into six geographic segments, including: Segment A (Northgate to University District), Segment B (University District to Westlake Station), Segment C (Westlake Station to S. McClellan Street), Segment D (S. McClellan Street to Boeing Access), Segment E (Tukwila), and Segment F (SeaTac). For each segment, three to eight route alternatives are studied. The segment alternatives would be linked to create a complete, operable light rail system. System length alternatives extend from the city of SeaTac (just south of Sea-Tac Airport) to N.E. 45th Street (the University District) or Northgate in Seattle, S. McClellan Street to N.E. 45th Street, Henderson Street to Capitol Hill Station, or Lander Street to N.E. 45th Street. Following issuance of the Final EIS, the Sound Transit Board will make a final decision on the routes, stations, and maintenance facilities to be built and the Federal Transit Administration (FTA) will issue a record of decision (ROD).

PROPONENT AND SEPA LEAD AGENCY

Sound Transit (Central Puget Sound Regional Transit Authority)
1100 Second Avenue, Suite 500
Seattle, Washington 98101-3423
www.soundtransit.org

After November 1, 1999, Sound Transit will be located at:
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Seattle, Washington 98104

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Federal Transit Administration
915 Second Avenue, Suite 3142
Seattle, WA 98174-1002

DATE OF CONSTRUCTION

2000—2006

SEPA Responsible Official

Desmond Brown, General Counsel
Sound Transit

CONTACT PERSON

James Irish, Central Link Environmental Manager (see page i)

ANTICIPATED PERMITS AND APPROVALS

Federal	
Section 106 and Section 4(f) Review (Programmatic Agreement)	Department of the Interior; Advisory Council for Historic Preservation
General Bridge Permit	United States Coast Guard
Rivers and Harbors Act, Section 10 Permit	US Army Corps of Engineers
Clean Water Act, Section 404	US Army Corps of Engineers
Federal Endangered Species Act Review	US Fish & Wildlife Service & National Marine Fisheries Service
Federal Highway Administration Approvals	Washington State Department of Transportation
Franchise for Use of Interstate right-of-way	Washington State Department of Transportation
Form 7460 Construction Notice	Federal Aviation Administration
Airport Layout Plan Revision	Federal Aviation Administration
State	
Hydraulic Project Approval	Washington Department of Fish and Wildlife
Aquatic Use Authorization (Aquatic Lease)	Washington Department of Natural Resources
Public Utility Commission Permits	Washington Public Utility Commission
Section 106 and Section 4(f) Review (Programmatic Agreement)	Washington State Department of Archaeology and Historic Preservation
National Pollutant Discharge Elimination System (NPDES) Stormwater Discharge Permit	Washington State Department of Ecology
Coastal Zone Management Consistency Certification	Washington State Department of Ecology
Temporary Modification of Water Quality Criteria	Washington State Department of Ecology
Underground Storage Tank Notification Requirement	Washington State Department of Ecology
Water Quality Certification (Section 401)	Washington State Department of Ecology
Air Space Lease (Interstate or State Routes)	Washington State Department of Transportation
Cities	
Conditional Use Permits	Cities of Seattle, SeaTac and Renton, and King County
Construction Permits (including clearing, grading, building, and demolition)	Cities of Seattle, Tukwila, SeaTac and Renton, and King County
Right-of-way Permit or Franchise for Use of City/County right-of-way	Cities of Seattle, Tukwila, SeaTac and Renton, and King County
ECA – Sensitive Areas Review	Cities of Seattle, Tukwila, SeaTac and Renton, and King County
Shoreline Substantial Development Permit	Cities of Seattle and Tukwila
Floodplain Development Permit	Cities of Tukwila and Renton
Hauling and Dumping Permits	Cities, King County
Master Use Permit(s)	City of Seattle
Noise Variance	City of Seattle
Street and alley vacations	City of Seattle
Certificates of Approval	City of Seattle Landmark Preservation Board
Design Review	City of Tukwila
Unclassified Use Permit	City of Tukwila
Other	
Applications for private crossings	Burlington Northern Santa Fe RR, Union Pacific RR
Various Approvals Planning, Design, and Arts Commissions	Cities of Seattle, Tukwila, SeaTac and Renton, King County, and the Port of Seattle
Possible modification of Major Institution Master Plan(s)	Port of Seattle, University of Washington, Seattle University, Swedish Hospital
Access Easements elevated and subterranean	Landowners
Notification of Intent to Perform Demolition or Asbestos Removal	Puget Sound Clean Air Agency
Pipeline and Utility Crossing (Permits)	Utility Providers
Utility Approvals (Easements and Use Agreements)	Utility Providers

PRINCIPAL CONTRIBUTORS

See List of Preparers in Appendix F.

DATE OF ISSUE OF FINAL EIS

November 5, 1999

COMMENT PERIOD

The Draft EIS comment period began December 4, 1998 and closed February 5, 1999.

The Rainier Valley Tunnel Environmental Technical Report comment period ran from February 1, 1999 until March 18, 1999.

The comment period on the Environmental Assessment for the N.E. 45th Station, Capitol Hill Station and North Duwamish Maintenance Base Alternatives ran from August 9 to September 8, 1999.

Public Hearings for the Draft EIS

Wednesday, January 13th, 6 to 9 p.m.
Tukwila Community Center, 12424 42nd Avenue S., Tukwila.
Thursday, January 14th, 6 to 9 p.m.
SeaTac City Council Chambers, 17900 International Boulevard, Suite 402 SeaTac.
Wednesday, January 20th, 6 to 9 p.m.
Lake Washington Public School District Board Room, 16259 N.E. 74th, Redmond.
Tuesday, January 26th, 6 to 9 p.m.
Kane Hall, University of Washington campus, Room 110, Seattle.
Thursday, January 28th, 6 to 9 p.m.
Filipino Community Center, 5740 MLK Jr. Way S., Seattle.

Public Hearings for the Rainier Valley Tunnel Report

Thursday, February 11th, 6 to 9 p.m.
Filipino Community Center, 5740 MLK Jr. Way S., Seattle.

Public Meetings for the Environmental Assessment

Thursday, August 24th, 11 a.m. to 1 p.m.
Seattle Public Utilities Operations Center, 2700 Airport Way S., Seattle.
Monday, August 30th, 6 to 8 p.m.
University Heights Community Center, 5031 University Way N.E., Seattle.
Tuesday, August 31st, 6 to 8 p.m.
Seattle Central Community College, Room 1110, 1701 Broadway, Seattle.

FINAL ACTION

The Sound Transit Board plans to make a final decision in November of 1999 on the routes, stations, and maintenance facilities to be built. The Federal Transit Administration is expected to issue a Record of Decision (ROD) by December 1999.

RELATED ENVIRONMENTAL DOCUMENTS

Regional Transit System Plan Environmental Impact Statement (March 1993)
Downtown Seattle Transit Project EIS (March 1995)
PSRC EIS on the Vision 2020 Update and Metropolitan Transportation Plan (EIS March 1995)

N.E. 45th Station, Capitol Hill Station and North Duwamish Maintenance Base Alternatives Draft EA (August 1999)

Central Link EIS Technical Back-up

The following technical back-ups and reports have been incorporated into the Final EIS by reference:

Central Link Electromagnetic Fields Technical Back-up
Central Link Energy Technical Back-up
Central Link Geology Technical Back-up
Central Link Neighborhoods Technical Back-up
Central Link Economics Technical Report
Central Link Land Use Technical Report
Central Link Transportation Technical Report
Central Link Visual Resources Technical Back-up
Central Link Noise and Vibration Technical Report
Central Link Air Quality Technical Back-up
Central Link Ecosystems Technical Back-up
Central Link Water Resources Technical Back-up
Central Link Hazardous Materials Technical Back-up
Central Link Public Services and Utilities Technical Back-up
Central Link Parklands Technical Back-up
Central Link Historic and Prehistoric Archaeological Sites, Historic Resources, Native American Traditional Cultural Properties, and Paleontological Sites
Central Link Transit Ridership Forecasting Technology
Downtown Seattle Surface Report Alternatives to Improve Transit Operations (April 1999)
N.E. 45th Station, Capitol Hill Station and North Duwamish Maintenance Base Alternatives Environmental Assessment (August 1999)

Copies of the documents listed above are available for review at the offices of Sound Transit, 1100 Second Avenue, Suite 500, Seattle. Please call Rebecca Withington, Librarian, at (206) 689-4977 during normal business hours (weekdays from 8:00 a.m. to 5:00 p.m.) to arrange an appointment. After November 1, 1999, Sound Transit will be relocating to Union Station 401 S. Jackson Street, Seattle, Washington 98104. Copies are also available at the following public libraries or can be purchased at the Kinko's listed below:

Libraries

County Libraries

Bellevue
Bothell
Federal Way
Foster
Kent
Redmond
Skyway
Tukwila
Valley View

Seattle Libraries

Central Library (Downtown)
Ballard

Beacon Hill
Broadview
Columbia
Douglass-Truth
Fremont
Green Lake
Greenwood
Henry
High Point
Holly Park
Lake City
Madrona Sally
Goldmark
Magnolia
Montlake
North East
Queen Anne
Rainier Beach
Southwest
University
Wallingford-Wilmot
West Seattle

Kinko's

1335 Second Avenue
Seattle, WA 98101
(206) 292-9255
Contact: Jack Foster
(206) 409-1791

COST

The Final EIS Volume 1 and Executive Summary are available at no cost. Complete copies of the Final EIS Volumes 2 through 7 (appendices) are available at Sound Transit for the cost listed below. Individual pages or portions of the Final EIS appendices and technical back-up documents are available for the cost of reproduction at Kinko's.

Volume 1	no charge
Volume 2	$20
Volume 3	$10
Volume 4	$10
Volume 5	$10
Volume 6	$30
Volume 7	$5

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APPENDICES – VOLUME 7

Project Nomenclature

The following provides summary definitions of project nomenclature, including the names of the light rail system components, and several key plans and organizations. The Glossary in Appendix D of this Final EIS provides definitions of other terms. Chapter 2 includes more complete descriptions of each alternative and option, including stations.

General Project-Related Terms

Central Link light rail. The proposed light rail system running from Northgate or N.E. 45th Street to SeaTac, Washington.

Environmental Impact Statement. A comprehensive study of likely environmental impacts resulting from major federally-assisted or local projects; statements are required by the National Environmental Policy Act and State Environmental Policy Act.

Federal Transit Administration (FTA). FTA is an agency of the U.S. Department of Transportation. The FTA administers the federal program of financial assistance to public transit, and is the lead NEPA agency for this EIS.

Light rail. A mode of mass transportation consisting of electric-powered rail vehicles traveling on steel tracks. Light rail may use shared or exclusive rights-of-way, high or low platform loading and multi-car trains or single cars. Sound Transit's light rail system will mostly operate in exclusive and semi-exclusive rights-of-way, at street level, on elevated structures and in subways.

Link Light Rail Corridor Study. The full collection of studies and processes associated with the proposed Link Light Rail Project.

Metropolitan Planning Organization (MPO). The organization designated by local elected officials as being responsible for carrying out the urban transportation and other planning processes for an area. The Puget Sound Regional Council is the MPO for the Puget Sound region.

Minimum Operable Segment (MOS). A shorter segment of the overall full-length light rail project that could function independently if the other segments of the project were not constructed. The MOS must therefore include a maintenance facility and the terminus points must have appropriate turnback capabilities for the light rail vehicles. A MOS is often considered to be an interim phase of the overall project.

National Environmental Policy Act of 1969. A comprehensive federal law requiring analysis of the environmental impacts of federal actions such as approval of grants; also requiring preparation of an environmental impact statement for every major federal action significantly affecting the quality of the environment.

No-Build Alternative. Represents current conditions and reasonably foreseeable changes in background conditions by year 2010. This includes committed transportation improvements and major new land uses expected by 2010.

Puget Sound Regional Council. Formerly the Puget Sound Council of Governments. PSRC is the region's Metropolitan Planning Organization.

Sound Move. The 10-year regional transit system plan for the Central Puget Sound Region, financing for which was approved by voters on November 6th, 1996. The plan includes a mix of light rail (Link), commuter rail (Sounder), Regional Express buses and high-occupancy-vehicle access improvements.

Sound Transit. Central Puget Sound Regional Transit Authority, a municipal corporation authorized by RCW81.104 and 81.112. The CPSRTA was generally referred to by the acronym RTA until 1997 when the Board chose to do business under the name of Sound Transit.

Station area. Generally, the area within a ¼ mile radius surrounding a light rail station. This encompasses the area typically considered to be within walking distance of the station.

State Environmental Policy Act (SEPA). A comprehensive Washington State law requiring analysis of the environmental impacts of public and private actions.

System terminal alternatives. The southern terminus will be near S. 200th Street in SeaTac. The northern terminus will be at either N.E. 45th Street or at Northgate.

Tacoma Link light rail. A proposed 1.5 mile light rail system running from downtown Tacoma to the Tacoma Dome. This action is evaluated in a separate EIS.

Alternative and Option Nomenclature

Central Link alternatives and options. Includes all actions being considered in the EIS.

Full Length (Northgate to SeaTac). An up to 29-mile, double-tracked light rail line from 103rd Avenue N.E. in Northgate to S. 200th Street in SeaTac; *Sound Move* contains funding from SeaTac to N.E. 45th Street in the University District. If additional funds are obtained, the line could be extended to Northgate.

Length Alternatives. Refers to the different "system" alternatives consisting of a light rail line from SeaTac in the south to either N.E. 45th Station in the University District or Northgate.

MOS (Minimum Operable Segment): A shorter segment of the N.E. 45th to SeaTac route that could be successfully operated on an interim or long-term basis if necessary, and could be extended at a later time. Three MOSs are discussed in the Final EIS (MOS A, B and C).

MOS A: Length Alternative from N.E. 45th Street to S. McClellan Street.

MOS B: Length Alternative from Capitol Hill to S. Henderson Street.

MOS C: Length Alternative from N.E. 45th Street to S. Lander Street.

Potential Station. Additional station options evaluated for some route alternatives in this EIS.

Preferred Alternative (N.E. 45th to SeaTac). 20-mile double-tracked light rail line from N.E. 45th Street in the University District to S. 200th Street in SeaTac. This "length alternative" could be successfully operated on an interim or long-term basis and could be extended to Northgate at a later time.

Route alternatives. Route alternatives specify the location and vertical profile (at-grade, elevated or underground) of light rail guideway within a given segment of the Link Corridor.

Route options. Route options specify design variations to the same approximate route location or profile.

Segment A (Northgate to University District). Refers to the segment from 103rd Avenue N.E. in Northgate to N.E. 45th Street in the University District in the city of Seattle.

Segment B (University District to Westlake Station). Refers to the segment from N.E. 45th Street in the University District to the existing Westlake Station in downtown Seattle.

Segment C (Westlake Station to S. McClellan Street). Refers to the segment from Westlake Station in downtown Seattle to S. McClellan Street in the city of Seattle.

Segment D (S. McClellan Street to Boeing Access Road). Refers to the segment from S. McClellan Street to Boeing Access Road in the city of Seattle.

Segment E (Tukwila). Refers to the segment from Boeing Access Road through the city of Tukwila to approximately SR 518. Although largely in the city of Tukwila, parts of the alternative routes pass through Seattle, Renton, and King County.

Segment F (SeaTac). Refers to the segment from SR 518 in Tukwila through the city of SeaTac to S. 204th Street.

Maintenance Base Alternative. Refers to the different sites where a maintenance facility would be located.

Preface

Sound Transit prepared this final environmental impact statement (Final EIS) for the Central Link Light Rail Project in compliance with the National Environmental Policy Act (NEPA), the Washington State Environmental Policy Act (SEPA), and the guidelines of the U.S. Department of Transportation, Federal Transit Administration (FTA).

The Final EIS serves a number of purposes. It: 1) describes alternatives and their potential impacts; 2) provides environmental information to assist decision-makers in selecting the preferred alternative to be built; 3) identifies measures to reduce or avoid impacts; 4) considers cumulative impacts as part of the planning process; and 5)provides information for other environmental processes including: permitting, Endangered Species Act consultation, Section 106, Section 4(f), and Environmental Justice.

The light rail project is an element of the *Sound Move* Ten Year Regional Transit Plan adopted by the Sound Transit Board in May 1996. Voters within the district authorized the local taxes required to implement the plan in November 1996. The proposed light rail project was defined through a regional systemwide planning process that compared a range of alternatives, including the No-build Alternative, rail investments, transportation system management measures, and exclusive bus transitways. The benefits that led to selection of the rail alternative were its capacity to meet the high end of projected transit demand, support transportation and land use plans, and contribute to reduced energy consumption and air pollutant emissions (Regional Transit System Plan Final EIS, March 1993). The current EIS builds on the 1993 Final EIS and is part of a phased review process. Conceptual engineering studies were conducted in 1993 and 1994, and a Major Investment Study in 1997 confirmed the choice of light rail technology within the Central study corridor.

The scope of environmental review and range of alternatives evaluated in this EIS responds to nearly 1,000 comments received from more than 400 groups and individuals during the public scoping process. After the scoping process, community participation was further extended through ten community workshops, over 50 stakeholder presentations, and over 75 agency coordination meetings. In May 1998, the Sound Transit Board identified the most promising alternatives to be included in the EIS. The Draft EIS was published in December 1998. A public comment period for the Draft EIS began on December 4, 1998 and closed on February 5, 1999. Five public hearings on the Draft EIS were held at locations throughout the corridor.

Sound Transit received 935 letters and oral testimonies during the comment period from individuals, community groups, businesses, private organizations, tribes, and federal, state and local agencies, containing more than 3,700 separate comments. The comments and responses are published in Volumes 3, 4, and 5 of this Final EIS.

The light rail alternatives are defined at the "conceptual engineering" level of design. Although conceptual engineering does not answer all of the design questions, it does provide enough information to identify potentially significant impacts and measures available to mitigate them.

In order to comply with NEPA and SEPA and to enhance readability, this Final EIS focuses on the most relevant information regarding project definition, significant impacts and trade-offs among alternatives. The study area for the EIS varies by topic and is described within each section of the document, as appropriate. The major project changes that have occurred since the Draft EIS was issued include the following:

1. The Sound Transit Board identified a preferred alternative on February 25, 1999. The Board's direction did not include Segment A nor a maintenance base preference.
2. Four additional maintenance base alternatives and light rail routes to serve them have been added in the North Duwamish industrial area, and are included in this Final EIS.

3. The Sound Transit Board proposed a $50 million fund as part of the preferred alternative to support light rail-related community development in the Rainier Valley. This fund would need appropriations by the Board.
4. In response to community and agency requests, a full tunnel alternative was developed for the Rainier Valley and it was evaluated in a separate technical report issued on February 1, 1999. Responses to comments received during the 45-day comment period on that separate report are included in the Final EIS Comments and Responses volume.
5. Two new 93 ft wide at-grade route alternatives were prepared to reduce impacts along MLK Jr. Way, a 4-lane section (D1.1e) and a 2-lane section (D1.1f). New signalized intersections and additional pedestrian crossings were added to these two route alternatives in response to community concerns about safety, vehicle circulation, and pedestrian access.
6. Thirty-seven new station options were added and evaluated throughout the corridor since the Draft EIS in response to comments, an increase of 61 percent.
7. A separate Draft Environmental Assessment was issued on August 9, 1999 for N.E. 45th and Capitol Hill station alternatives and the four new maintenance base alternatives in the North Duwamish industrial area. Responses to the comments received during the 30-day comment period on that report are included in the Draft EIS Comments and Responses volume.
8. Alternative E1.1 on Tukwila International Boulevard in Tukwila was changed to include a 102' section with four lanes and three new signalized pedestrian crossings, and most elements of the city's Pacific Highway Revitalization Plan.
9. Alternative F2.3 in SeaTac was developed in the configuration selected for a preferred alternative (a combination of alternatives in the Draft EIS). Two station options were proposed to serve the proposed North End Airport Terminal (NEAT) or Intermodal Center. Sound Transit also developed an option for a a potential South SeaTac Station at S. 184th Street, serving SeaTac's city center. New station options were added at S. 154th and S. 200th streets.
10. Responses to commonly asked questions are included in Chapter 7, and specific responses to comments submitted on the Draft EIS are provided in Volumes 3, 4, and 5, Comments and Responses.

This Final EIS responds to public and agency comments on the Draft EIS and EA, and it refines the impact analysis based on information developed after the Draft EIS was issued. This Final EIS provides the review and documentation necessary for the Sound Transit Board to adopt the alternative to be carried into final design, construction and operation and for the Federal Transit Administration to issue a record of decision (ROD).

This Final EIS is organized as follows:

The **Summary** is a condensed version of the overall document. It briefly presents the project setting objectives, purpose and need, and the alternatives being considered. It reviews the major impacts for each alternative, presents the project's financial characteristics, and provides a brief evaluative comparison of the different alternatives. The summary concludes by identifying the major conclusions, areas of controversy, uncertainty, and the project's next steps.

Chapter 1, **Purpose And Need,** describes the project's purpose and need, and defines the study area. It briefly discusses the area's transportation system, and reviews regional and local land use and transportation needs and goals. It concludes with the proposed action's goals and objectives.

Chapter 2, **Alternatives Considered** describes the preferred and other alternatives that are studied in this Final EIS. It also presents the process that was used to define the range of potential project alternatives and to screen them to the set studied in the EIS. It concludes by explaining the project's planning and decision making context, including the major steps in the environmental evaluation and project development process.

Chapter 3, **Transportation Impacts And Mitigation,** describes the potentially affected existing and future regional and local transportation system, and identifies how the project alternatives could impact that system. It then describes potential mitigation strategies to reduce or eliminate transportation impacts. The transportation system elements include transit, highways, local streets, parking, freight movement, and walking/bicycling.

Chapter 4, **Environmental Impacts And Mitigation,** describes the potentially affected environmental (built and natural) conditions in the study area, and explains the impacts the project alternatives may cause. It then describes potential actions that could or would be taken to mitigate (reduce or avoid) impacts. It also lists those significant impacts that cannot be avoided. This chapter includes the following environmental elements:

- Land Use and Economic Activity
- Displacement and Relocation
- Neighborhoods and Environmental Justice
- Visual and Aesthetic Resources
- Air Quality
- Noise and Vibration
- Ecosystems
- Water Resources
- Energy
- Geology and Soils
- Hazardous Materials
- Electromagnetic Fields
- Public Services
- Utilities
- Historic and Archaeological Resources
- Parklands
- Construction Impacts
- Cumulative Impacts

Chapter 5, **Financial Analysis,** provides information on the projected cost and financial feasibility of the project alternatives, and outlines project costs in the project subareas.

Chapter 6, **Evaluation Of Alternatives,** compares the alternatives in terms of how effectively they meet the project's goals and objectives, and how cost-effective and equitable they are. The chapter concludes by comparing the unique benefits and limitations of the different alternatives.

Chapter 7, **Responses to Comments,** identifies the most frequently asked questions about the light rail project from the Draft EIS comment period and provides brief answers.

The **Appendices** provide additional details on the project and the EIS process, including agency coordination and community participation. They include federally-required reports on Environmental Justice, Section 4(f) resources (park and recreation areas, wildlife refuges, and historic sites), and a draft Programmatic Agreement for Historic and Cultural Resources. They define project terms, list references, describe plans for mitigation associated with the project, and identify project staff. There are also sections with additional graphics depicting the project's design, setting, land use, and visual simulations of various alternatives. Comment letters and responses are in separately bound volumes.

The Final EIS and appendices are presented in seven volumes as follows:

Volume 1 – Final EIS

Volume 2 – Visual simulations and land use maps

Volume 3 – Comment letters and responses

Volume 4 – Comment letters and responses

Volume 5 – Comment letters and responses

Volume 6 – Route and station drawings and property acquisitions

Volume 7 – Rainier Valley Tunnel Report

Additional information can be found in the technical back-up reports, which are listed in the Fact Sheet of this Final EIS and incorporated by reference.

EXECUTIVE SUMMARY

Executive Summary

The following summary of the Final EIS for the Central Link Light Rail Project presents the preferred alternative, including the project setting, purpose, and goals, and describes the other alternatives being considered. The major impacts for each alternative are also reviewed. The summary likewise provides the project's financial characteristics, and compares the effectiveness and tradeoffs among the different alternatives. This summary concludes by outlining the project's next steps.

S.1 PROPOSED ACTION

Sound Transit (the Central Puget Sound Regional Transit Authority) is proposing to construct and operate a light rail system known as the Central Link Light Rail Project. The preferred alternative for the project would be a 20-mile light rail line connecting the University District, downtown Seattle, southeast Seattle, and the cities of Tukwila and SeaTac. An extension to Northgate is proposed if additional funding is available. With the Northgate extension, and with the other alternative routes, the system length could range from 24 to 29 miles.

Sections S.3 and S.4 describe the preferred alternative and the other light rail and No-build alternatives considered in this Final EIS.

The light rail project is a component of *Sound Move*, Sound Transit's 10-year program for regional high-capacity transportation. The region's voters approved local funding to implement *Sound Move* on November 5, 1996. The *Sound Move* plan represents the region's preferred transportation strategy and is consistent with and implements applicable federal, state, and local requirements for transportation and land use/growth management planning.

The *Sound Move* plan includes three types of regional transportation facilities and services:

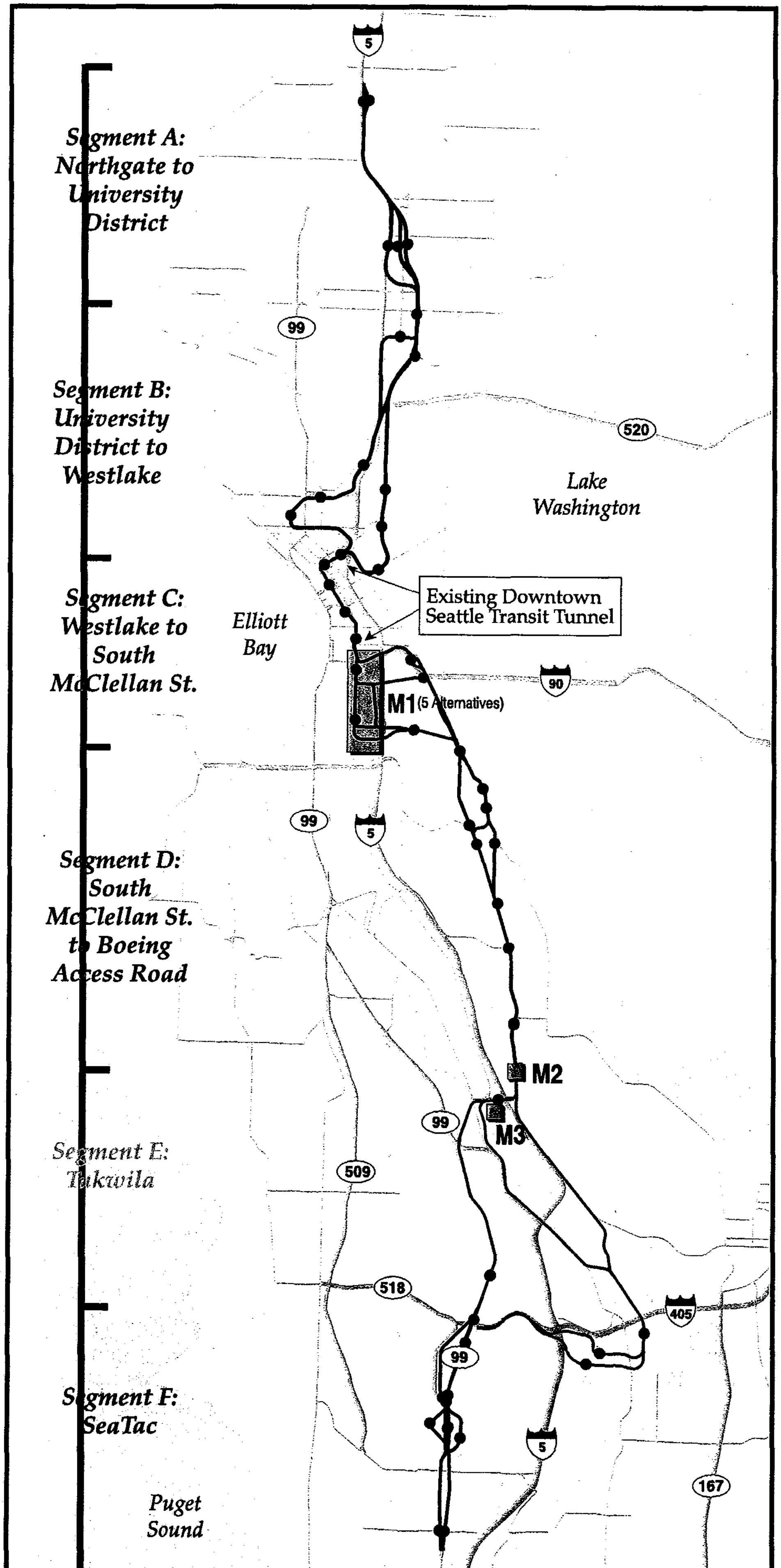
- Regional Express bus/HOV System – new regional bus routes operating primarily on highway HOV lanes
- Sounder commuter rail – rush hour passenger service on 82 miles of an existing rail corridor, serving 14 stations in Lakewood, Tacoma, the Green River Valley, Seattle, and Everett
- Light rail – up to 29 miles of new light rail track (depending on route selection) with approximately 25 stations between SeaTac and North Seattle (Central Link), and a 1.6-mile light rail line with five stations between downtown Tacoma and the Tacoma Dome regional transportation terminal (Tacoma Link)

The light rail system is analyzed in this EIS. The other components of *Sound Move* are analyzed in additional environmental documents, although their cumulative impacts are considered in this EIS.

S.2 STUDY AREA

The light rail corridor is located in west central Washington, in the cities of Seattle, SeaTac, Tukwila, and Renton, and in unincorporated King County (Figure S-1).

The light rail corridor topography consists of alternating north/south ridges, hills, and valleys. Puget Sound to the west and Lake Washington to the east give the area a distinctive hourglass shape. The Seattle central business district lies near the center of the hourglass. The region's geography creates natural barriers to travel which have necessitated innovative and expensive solutions such as massive hill re-grading, the construction of railroad and transit tunnels, floating bridges, and many miles of elevated highway.



SOUNDTRANSIT

Figure S-1
Central Link Corridor Study Area

Proposed Light Rail Stations

Name	Segment
Northgate[2]	A
Roosevelt	A
NE 45th	B
Pacific	B
Campus Parkway	B
Roy / Aloha[1]	B
Capitol Hill	B
First Hill	B
Eastlake	B
South Lake Union	B
Seattle Center	B
Convention Place[1A]	B
Westlake	C
University Street	C
Pioneer Square	C
International District[3]	C
Royal Brougham	C
Lander	C
Beacon Hill[1]	C
Poplar Place	C
I-90	C
McClellan	D
Charlestown[1]	D
Genesee	D
Edmunds[1B]	D
Columbia City	D
Alaska	D
Graham[1B]	D
Othello	D
Henderson	D
Boeing Access Road[2,3]	E
South 144th	E
Longacres[2,3]	E
Southcenter	E
North SeaTac[1B,2]	F
North Central SeaTac	F
South Central SeaTac[1]	F
South SeaTac[2]	F

1 Potential Station

1A Not Included in Preferred Alternative, Potential Station in Other Alternatives

1B Included in Preferred Alternative, Potential Station in Other Alternatives

2 Includes New Park-and-Ride

3 Potential Light Rail/ Commuter Rail Transfer

M2 Maintenance Base Alternatives

Route Alternative

Station

0 1 2

MILES

The light rail project would connect Washington State's largest employment centers, highest density residential areas, and highest regional transit ridership areas.

The population in the light rail corridor is part of the rapidly expanding Central Puget Sound region, which has the third highest growth rate in the nation for metropolitan areas with over two million people. Between 1990 and 2020, the central Puget Sound region's population is projected to grow by 52 percent (PSRC 1995).

The light rail alternatives are being planned and evaluated in six geographic segments to facilitate environmental analysis and community participation:

- Segment A: Northgate to the University District
- Segment B: University District to Westlake Station
- Segment C: Westlake Station to S. McClellan Street
- Segment D: S. McClellan Street to Boeing Access Road
- Segment E: Tukwila
- Segment F: SeaTac

S.3 THE PREFERRED ALTERNATIVE

On February 25, 1999, following issuance of the Draft EIS and the receipt of public comments, the Sound Transit Board passed Motion 99-14, identifying preferred route and station locations for the light rail line from the University District to SeaTac. The preferred alternative (Figure S-2) includes route and station alternatives developed in response to public and agency comments, or in response to recently available information. The Final EIS evaluates the preferred alternative along with all of the alternatives included in the Draft EIS. In keeping with the *Sound Move* transit system plan, the alternatives evaluated include an extension of the line north to the Roosevelt and Northgate neighborhoods (Segment A). The extension to Northgate was not included in the preferred alternative. The preferred route and station locations by segment are:

Segment A (Northgate to University District)

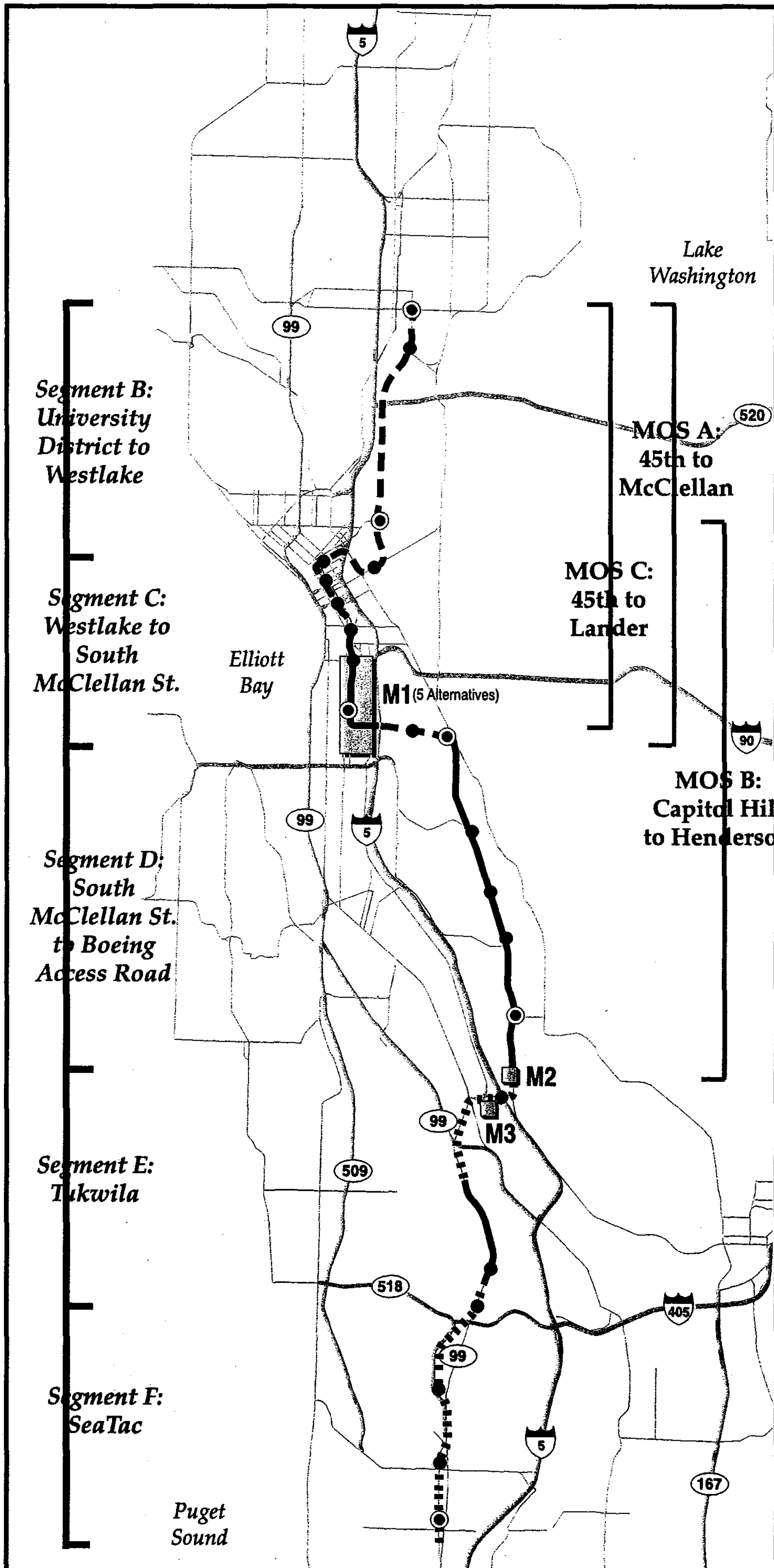
No preferred alternative was identified for Segment A by the Sound Transit Board.

Segment B (University District to Westlake Station)

Alternative B1a (Capitol Hill Tunnel) would begin with an underground N.E. 45th Street/15th Avenue N.E. terminus, then would tunnel under Portage Bay, Capitol Hill, and First Hill to the Downtown Seattle Transit Tunnel (DSTT). In the University District, there would be underground stations south of N.E. 45th Street at 15th Avenue N.E. (with options for siting the station east or west of 15th), and at N.E. Pacific Street to the west side of 15th Avenue N.E. (Option B). On Capitol Hill, the underground station would be at Broadway south of E. John Street (with several options involving construction and siting). On First Hill, there are two options for an underground station near E. Madison Street and Summit Avenue E. There would not be a station at Convention Place.

Segment C (Westlake Station to S. McClellan Street)

Alternative C1.2 (at-grade north of Lander Street), a modification of Alternative C1 studied in the Draft EIS, was developed to minimize or avoid Alternative C1 impacts in the Duwamish Industrial and Manufacturing area, particularly to freight movement and business access. The C1.2 route would use the DSTT from Westlake Station to the International District Station. The DSTT would be reserved for rail use only.



SOUNDTRANSIT

Figure S-2
Preferred Alternative for Central Link Light Rail (With Minimum Operable Segment Alternatives)

Proposed Light Rail Stations

Name	Segment
NE 45th	B
Pacific	B
Capitol Hill	B
First Hill	B
Westlake	C
University Street	C
Pioneer Square	C
International District[3]	C
Royal Brougham	C
Lander	C
Beacon Hill[1](Shell only)	C
McClellan	D
Edmunds	D
Graham	D
Othello	D
Henderson	D
Boeing Access Road[2, 3]	E
South 144th	E
North SeaTac[2]	F
North Central SeaTac	F
South Central SeaTac[1]	F
South SeaTac[2]	F

1 Potential Station

2 Includes New Park-and-Ride

3 Light Rail/Commuter Rail Transfer

MOS Minimum Operable Segment

M2 Maintenance Base Alternatives

Tunnel

Elevated

At Grade

Station

Potential Terminal Station

0 1

MILES

After leaving the DSTT, the route would be at-grade along the east side of the E3 Busway (also known as the Metro busway) to the north side of S. Lander Street. There it would turn east, cross Airport Way S. at-grade, and tunnel under I-5 and Beacon Hill. It would transition to an elevated profile approaching the McClellan Station. Stations in the DSTT would be at Westlake, University Street, Pioneer Square, and the International District. At Westlake Station, there are station options involving new entrances on Pine Street at 5th Avenue. Stations south of the DSTT would be located at S. Royal Brougham Way, S. Lander Street, and the shell of a tunnel station would be provided at Beacon Hill.

Segment D (S. McClellan Street to Boeing Access Road)

Alternative D1.1e (at-grade, in 93-ft right-of-way with 4 traffic lanes) modifies Alternative D1.1c studied in the Draft EIS. The route is elevated at the McClellan Station, continues elevated over the southbound lanes of MLK Jr. Way S., before descending to the median of that roadway, north of S. Walden Street. MLK Jr. Way S. would be modified to provide four lanes of traffic within a 93-ft right-of-way. In response to public and agency comments, this alternative includes seven new signalized intersections on MLK Jr. Way S., and nine pedestrian-only signals. There would also be two new signals on Rainier Avenue S., and one new signal on S. Henderson for bikes, pedestrians, and buses. These changes considerably reduce the distance between controlled pedestrian crossings, and improve access and circulation over earlier proposals. Sidewalk and landscaping improvements would be provided along the route, including new sidewalks, street trees, and street lighting. Parallel bike facilities would be provided. Stations would be at S. McClellan (elevated), Edmunds, Graham, Othello, and Henderson streets. Modified station designs were developed for the McClellan, Edmunds, and Henderson stations in response to comments received. The Edmunds Station area improvements include pedestrian-oriented streetscape features along Edmunds Street and connects to the Columbia City business district, and similar improvements would be provided from the Henderson Station along Henderson Street and connecting to Rainier Beach at Rainier Avenue S. The preferred alternative also proposes a $50 million local fund to support light rail-related community development, ridership and appropriate mitigation activities in the Rainier Valley area.

Segment E (Tukwila)

Alternative E1.1 is elevated at Boeing Access Road, crossing over I-5 and E. Marginal Way, before turning south along Tukwila International Boulevard (SR 99). The trackway would continue elevated over the Duwamish River, Riverton Creek, and SR 599. Light rail would descend to the median of Tukwila International Boulevard near S. 126th Street, continuing at-grade to near SR 518. In response to comments, Alternative E1.1 has been modified to provide a 102-ft right-of-way with four through lanes and other design features. The modified design incorporates most of the City of Tukwila's planned improvements for the roadway, including new sidewalks, landscaping, new signalized pedestrian crossings, and two additional signalized intersections at S. 140th and S. 148th Streets. Stations at Boeing Access Road (including a 300-stall park-and-ride serving both the light rail and a separately proposed commuter rail station) and S. 144th Street are proposed.

Segment F (SeaTac)

Alternative F2.3 (Washington Memorial Park, elevated east of 28th Avenue S.) is a modified alternative derived from elements of the alternatives considered in the Draft EIS. It would be elevated along Tukwila International Boulevard from 152nd Street, continuing southwest to cross over SR 518, travel west of Washington Memorial Park, and connect to the Airport's proposed North End Airport Terminal (NEAT) or Intermodal Center (IMC). It would then continue elevated along the west side of International Boulevard, turn southwest to cross S. 188th Street, and continue elevated south along the east side of 28th Avenue S. to S. 200th Street. Three stations are proposed: North SeaTac (at S. 154th Street, with three options involving a 260-, 454-, or 670-stall park-and-ride), North

Central SeaTac (at IMC), and South SeaTac (Options E or F at S. 200th Street with a 630-stall park-and-ride). The design also provides for a potential South Central SeaTac Station at S. 184th Street.

Maintenance Base

The Sound Transit Board has not yet identified a preferred maintenance base alternative.

S.4 ALTERNATIVES CONSIDERED

Electric light rail technology was chosen for the Central Link Light Rail Project because of its versatility to operate at-grade (on the surface), on elevated tracks, or in tunnels. Because of the varied conditions along the proposed corridor, the light rail project combines all three profiles. At-grade operation is preferred, although each profile type has benefits and disadvantages.

- At-grade: Light rail operating at-grade is best suited in areas where the grade is 5 to 6 percent or less and there is adequate room within reserved street right-of-way or off-street corridors. It works well with a moderate number of riders and low-to-moderate train frequencies.
- Elevated: Light rail on elevated structures works well where the system must be grade-separated to cross over geographic or physical barriers, accommodate higher train frequencies, and where surface corridors are inadequate to fit at-grade trackway. Maximum allowable grades are 5 to 6 percent.
- Tunnels: Tunnels may be used where slopes are steep (more than 5 to 6 percent), physical barriers must be crossed, right-of-way is inadequate for at-grade or elevated profiles, the density of homes and businesses is high, and/or where ridership and resulting train frequencies would be so high as to make street-level operations impractical.

In response to public and agency comments and new information, several new or modified alternatives/options have been added since the issuance of the Draft EIS. Many of the new or modified alternatives were developed specifically to reduce potential impacts, such as Alternatives D1.1e and D1.1f. Others, such as the deeper station options in Segment B, respond to new design information. New maintenance base alternatives and Capitol Hill and N.E. 45th Station options are different enough from those in the Draft EIS that Sound Transit and the FTA desired public and agency comments before the release of the Final EIS. Sound Transit issued an Environmental Assessment (EA) in August 1999. Each of the alternatives in the EA is also included in this EIS. Public and agency comments just prior to and after the release of the Draft EIS led to development of an all tunnel option the entire length of the Rainier Valley. This option was studied in the Rainier Valley Tunnel Environmental Technical Report issued February 1, 1999 for public and agency review. The report is also included in this EIS in Appendix Q. Evaluation of the Rainier Valley Tunnel alternative indicates that it is not a reasonable alternative.

S.4.1 Route and Station Alternatives

Light rail alternative routes and station plans are provided in Appendix H of the EIS. Standard features of the stations include boarding platforms that would be approximately 400 ft long to accommodate four-car trains. Platforms may be on either side of the track or in the center with tracks on both sides. Where stations are elevated or in tunnels, escalators, elevators, and stairs would be provided as appropriate.

Bus transfer facilities would be provided at most light rail stations, and existing on-street transfer locations would continue in downtown Seattle. Transfers to Sounder commuter rail service are proposed at the International District Station and either the Boeing Access Road Station or the Longacres Station in Tukwila (depending on the route). Transfers to Amtrak could occur at the International District Station or at a Longacres Station. Park-and-ride facilities would be provided at Northgate, Boeing Access Road, Longacres, and the North and South SeaTac stations.

Table S.8-1 summarizes track length, segment travel time, and the number of proposed stations for each route alternative. Figures S-3 through S-8 show routes and station locations by segment. Each route alternative is defined according to its horizontal route and vertical profile—that is, whether the tracks are at street level, elevated, or in a tunnel.

Table S.8-1
Characteristics of Light Rail Route Alternatives

Route Alternatives and Options *(preferred alternative in italics)*	**One-way light rail track (mi.)**	**Segment travel time (min.)**	**Number of stations**
Segment A (Northgate to University District)			
A1.1—12th Avenue N.E. Tunnel	3.12	5.3	2
A1.2—Roosevelt Way N.E. Tunnel	3.12	5.3	2
A2.1—8th Avenue N.E. Short Elevated	3.29	5.6	2
A2.2—8th Avenue N.E. Elevated	3.29	5.6	2
Segment B (University District to Westlake Station)			
B1a—Capitol Hill Tunnel	4.47	9.4	4
B1b—Capitol Hill Tunnel (with Roy/Aloha Station)	4.47	10.2-10.8	4-6[1]
B2.1—Seattle Center High-level Bridge	5.28	12.2-12.8	5-6[1]
B2.2—Seattle Center Portage Bay Tunnel	5.01	11.6-12.2	5-6[1]
Segment C (Westlake Station to S. McClellan Street)			
C1.1—At-grade center of Lander Street	3.76	11.4-12.2	6-7[2]
C1.2—At-grade north of Lander Street	3.75	11.5	7
C1.3—Elevated north of Lander Street	3.75	10.6-11.4	6-7[2]
C1.4—Forest Street/S. Lander Street Tunnel	3.96	11.1-11.9	6-7[2]
C1.5—Massachusetts Street and I-5 right-of-way	3.71	11.0-11.8	5-6[2]
C2.3—West of Rainier Avenue S. Elevated	3.58	10.5	5
C2.4—Rainier Avenue S. Tunnel	3.6	10.6	5
C3—S. Massachusetts Street Tunnel	3.66	11.0	5
Segment D (S. McClellan Street to Boeing Access Road)			
D1.1c—MLK Jr. Way S. At-grade, 4-lane (104' cross section)	4.59	9.8-10.5	4-5[3]
D1.1d—MLK Jr. Way S. At-grade, 2-lane (90' cross section)	4.59	9.8-10.5	4-5[3]
D1.1e—MLK Jr. Way S. At-grade 4-lane (93' cross section)	4.59	10.5	5
D1.1f—MLK Jr. Way S. At-grade, 2-lane (93' cross section)	4.59	10.5	5
D1.3—MLK Jr. Way S. Combined Profile	4.59	8.9-9.6	5
D3.3—S. Alaska Street Crossover	4.59	10.1-10.8	4-5[3]
D3.3—S. Alaska Street Crossover (with alternative stations)	4.80	10.6-11.3	4-6[3]
D3.4—37th Avenue S. Tunnel	4.63	10.2-11.4	5-6[3]
Segment E (Tukwila)			
E1.1—Tukwila International Blvd. At-grade	4.37	7.6	2[4]
E1.2—Tukwila International Blvd. Elevated	4.37	6.9	2[4]
E2—Interurban Avenue S.	7.92	14.6	2[4]
E3—MLK Jr. Way S.	7.28	11.0	2[4]
Segment F (SeaTac)			
F1—International Boulevard At-grade	2.67	6.0-6.7	3-4
F2.1—Washington Memorial Park, City Center West	2.85	6.2	3
F2.2—Washington Memorial Park, City Center East	3.04	6.7	3
F2.3—Washington Memorial Park, Elevated east of 28th Ave. S.	2.77	5.1-5.9	3-4[5]
F3.1—West of International Blvd. Grassy Knoll	2.68	5.7	3
F3.2—West of International Blvd. Main terminal	2.82	6.5-7.2	3-4[6]
F3.3—West side of International Blvd.	2.63	4.8	3
F4—International Blvd. to 28th/24th	2.63	5.1	3

Source: Sound Transit, October 8, 1998, March 5, 1999, and July 8, 1999
Notes: Travel times prepared by PSTC are based on an incremental planning model.
[1] Convention Place Station may or may not be rebuilt for light rail operations.
[2] Potential station at Beacon Hill.
[3] Includes a potential station at S. Graham Street. D3.3 and D3.4 include a potential Charlestown station.
[4] The match point between Segments E and F at S. 160th Street was used to provide common distance and travel time comparisons. The actual match point will vary by 2,000 ft depending on the routes selected.
[5] Potential future station at S. 184th Street.
[6] Potential North SeaTac Station depending on Segment F route combination.

The preferred routes and stations are described in Section S.3. The other alternatives considered are summarized here, and their characteristics are provided in Table S.8-1.

Segment A (Northgate to University District)

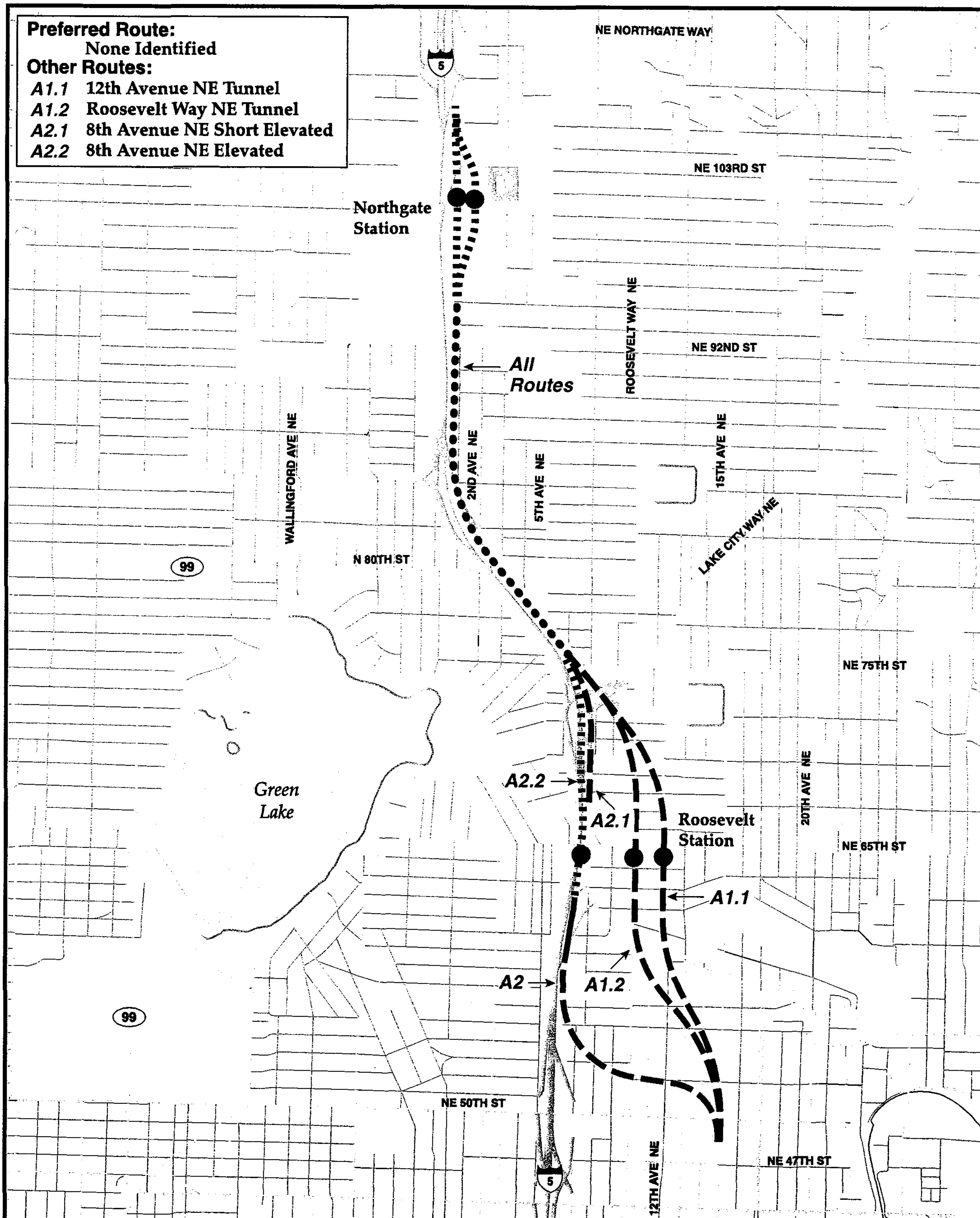
None of the Segment A alternatives were included in the preferred alternative. Segment A alternatives (Figure S-3) would all start on an elevated guideway near Northgate Mall and transition to a retained cut (a terrace cut into the hillside) along the east side of I-5 within the freeway right-of-way. The four alternatives take different routes just north of Lake City Way, to continue south through the Maple Leaf and Roosevelt neighborhoods to the northwest corner of the University of Washington campus; all routes would finish in a tunnel at N.E. 45th Street and 15th Avenue N.E. Each route would have a station on the Northgate park-and-ride lot (three station options) and one in the Roosevelt area. The four alternatives considered include:

- A1.1 (12th Avenue N.E. Tunnel), which would enter a tunnel just north of Lake City Way near N.E. 76th Street and continue to a tunnel station under 12th Avenue N.E. at N.E. 65th Street.
- A1.2 (Roosevelt Avenue N.E. Tunnel), which would be similar to A1.1, but the tunnel station would be primarily under Roosevelt Avenue N.E. at N.E. 65th Street.
- A2.1 (Eighth Avenue N.E. short elevated), which would emerge from a tunnel under the Lake City Way ramps and parallel I-5 on the east to an elevated station at N.E. 65th Street; next, it would cross over Ravenna Boulevard, then tunnel southeast to 15th Avenue N.E.
- A2.2 (Eighth Avenue N.E. elevated), which would have the same route and station as A2.1, except it would be elevated over (instead of tunneling under) the I-5/Lake City Way ramps.

Segment B (University District to Westlake Station)

Segment B routes (Figure S-4) would all start under N.E. 45th Street and 15th Avenue N.E. in the University District and cross under Portage Bay or over the Ship Canal, connecting to the DSTT. The alternatives below are being considered in addition to the preferred alternative (B1a):

- B1b (Capitol Hill Tunnel with potential Roy/Aloha Station) would follow the same route as the preferred alternative, but have a deeper profile under Capitol Hill and different design options for the N.E. 45th, Pacific, and Capitol Hill stations. It also includes a potential station at Roy and Aloha, and has options for the Convention Place Station to be relocated and used by rail and bus, or rail only.
- B2.1 (Seattle Center via high-level bridge) would follow under 15th Avenue N.E., turn west under Campus Parkway, climb to a high-level bridge turning south over the Ship Canal next to I-5, and enter a tunnel parallel to I-5 and Harvard Avenue E. Emerging from the tunnel near E. Yale Street, the route would turn west elevated along Mercer Street, enter a tunnel near Seattle Center, turn east along Denny Way, then turn south to connect with the DSTT. Stations would be at N.E. 45th Street, Campus Parkway, Eastlake, S. Lake Union, and Seattle Center, with an option to rebuild the Convention Place Station or close it.
- B2.2 (Seattle Center via Portage Bay Tunnel) would begin like B1, tunneling under 15th Avenue N.E. to Pacific, and under Portage Bay. Crossing under I-5 near SR 520, the route would be the same as Alternative B2.1 along the south end of Lake Union. Stations would be at N.E. 45th Street, Pacific Street, Eastlake, S. Lake Union, Seattle Center, with an option to rebuild or close the station at Convention Place.

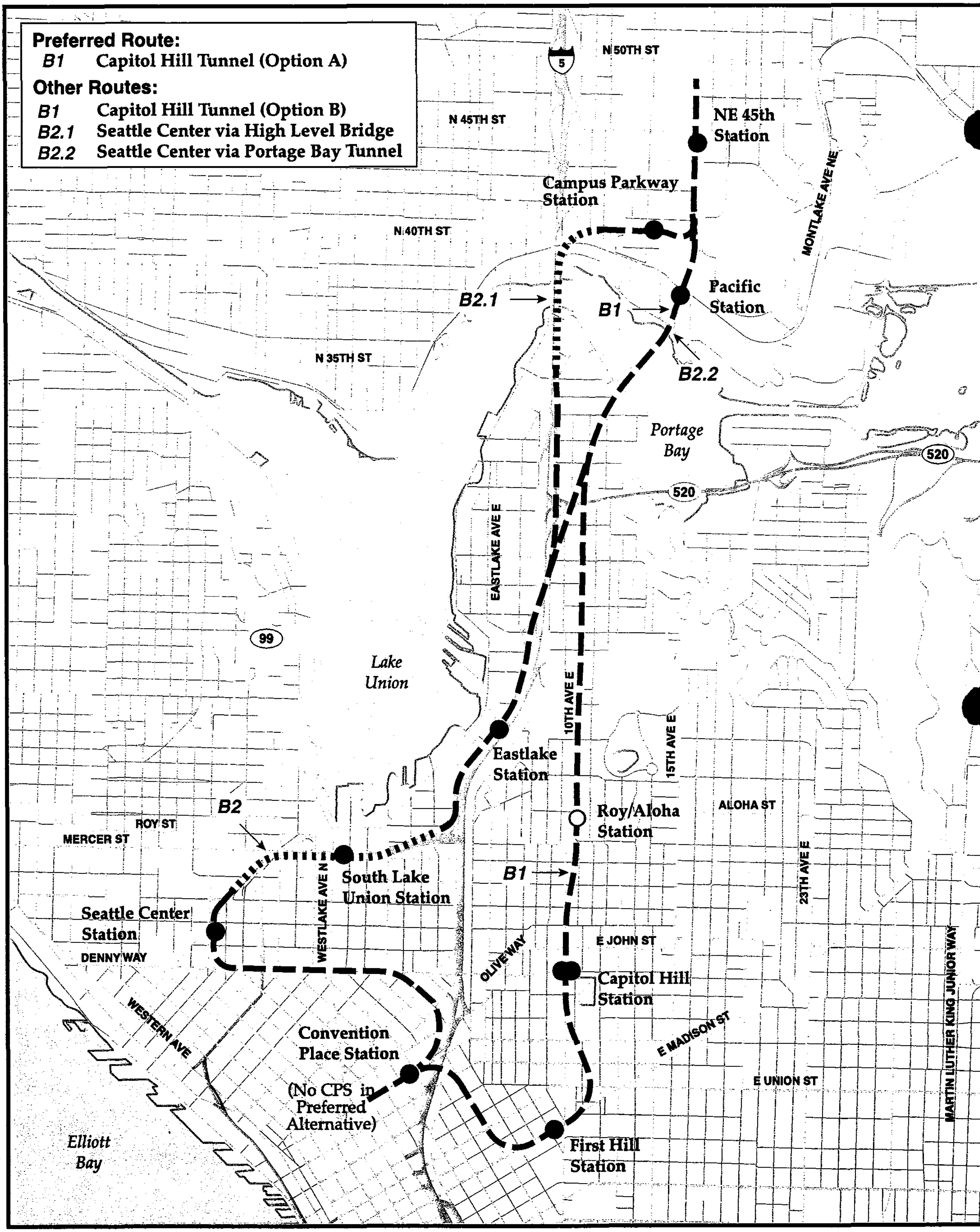


SOUNDTRANSIT

0 1,000 2,000
FEET

Tunnel
Elevated
At Grade
Retained Cut-Fill
Station
Potential Station
Park & Ride

Figure S-3 Segment A: Northgate to University District



SOUNDTRANSIT

0 1,000 2,000
FEET

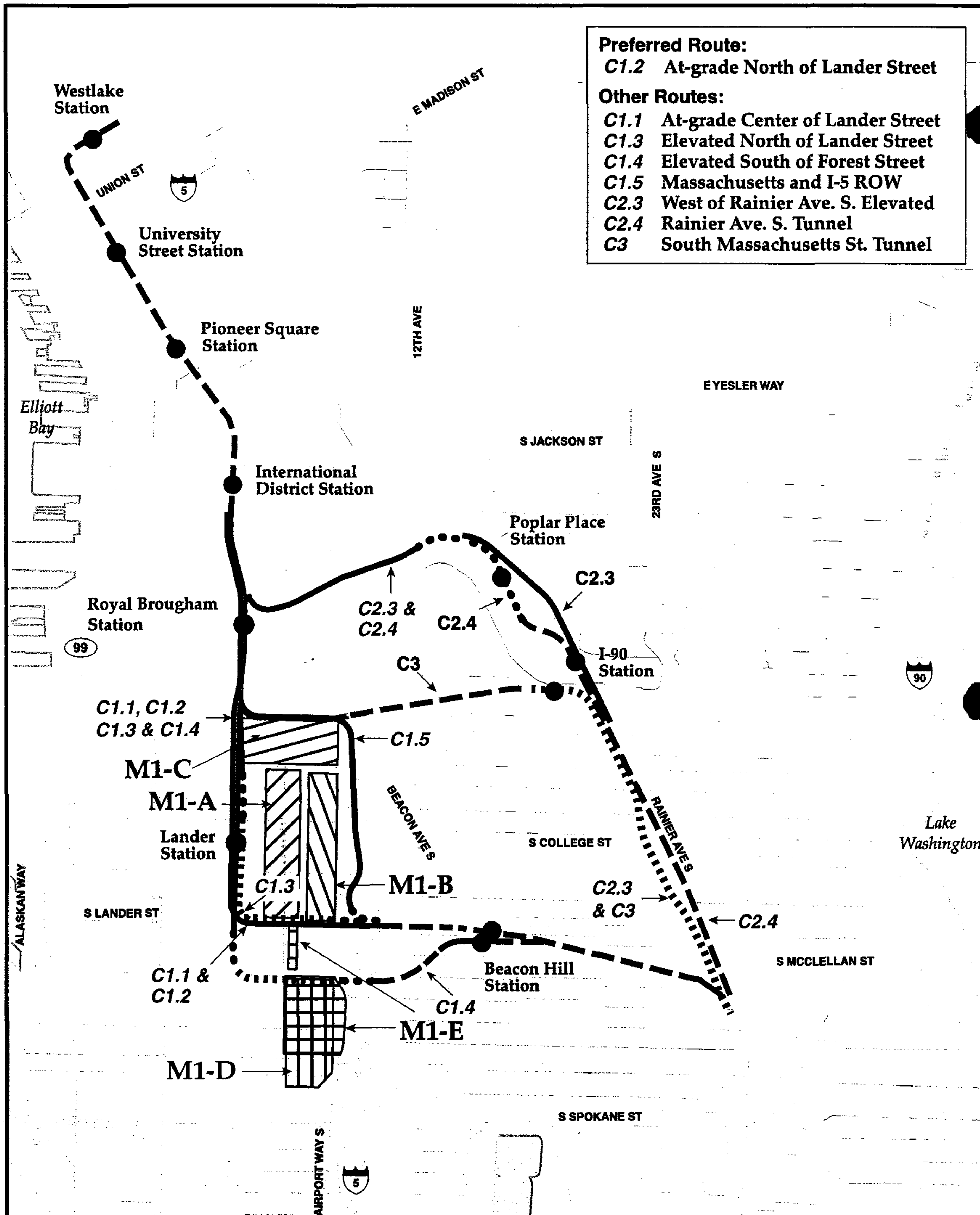
Tunnel
Elevated
At Grade
Retained Cut-Fill
Station
Potential Station
Park & Ride
Preferred Alternative

Figure S-4 Segment B University District to Westlake Station

Segment C (Westlake Station to S. McClellan Street)

Segment C route alternatives (Figure S-5) would use the DSTT from Westlake Station to the International District. Light rail vehicles would operate in the DSTT either exclusively or jointly with buses. (The preferred alternative is for rail-only operations in the DSTT). Tunnel stations would be at Westlake, University Street, Pioneer Square, and the International District. From the International District station, the alternatives would take different routes to a common endpoint at S. McClellan Street in the north end of Rainier Valley. The Segment C alternatives being evaluated in addition to the preferred alternative (C1.2) include:

- C1.1 (At-grade center of Lander Street), which would be on the same route as the preferred alternative along the existing E3 Busway, turning east at S. Lander Street, and tunneling under I-5 and Beacon Hill to S. McClellan Street. The alternative would be at-grade in the median of S. Lander Street. Stations south of the DSTT would be at Royal Brougham and at S. Lander Street, with a potential Beacon Hill Station.
- C1.3 (Elevated north of Lander), which would have the same route and stations as the preferred alternative but would elevate light rail on a structure on the north side of S. Lander Street. The Lander Station would also be elevated.
- C1.4 (Forest Street), which would have the same route as the preferred alternative to S. Lander Street and would then become elevated south of S. Lander Street before turning east at S. Forest Street, running on the south side of the street to the Beacon Hill Tunnel. It would have the same stations as in C1.1, C1.2, and C1.3, except for the Beacon Hill Station, which would be sited slightly south.
- C1.5 (Massachusetts and I-5 right-of-way), which would head south on the E3 Busway to S. Massachusetts Street, then head east on the south side of the street to a railroad right-of-way adjacent to I-5. There it would turn south along the west side of I-5 before turning east to the Beacon Hill Tunnel, located in the same area as the other C1 alternatives and Lander Street. It would have all the same stations as the preferred alternative, except it would not have a Lander Station.
- C2.3 (West of Rainier Avenue S. Elevated), which would travel east at-grade on the D2 roadway (HOV lanes parallel to I-90), turn southeast at street level in the median of Rainier Avenue S., and then travel elevated from S. Massachusetts Street south with the route one-half block west of Rainier Avenue S. The only station beyond the DSTT would be under I-90.
- C2.4 (Rainier Avenue S. Tunnel), which would also follow the D2 roadway, entering a tunnel before I-90 and running under Rainier Avenue S. to S. McClellan Street. The only station south of the DSST would be located at Poplar Place.
- C3 (S. Massachusetts Street Tunnel), which would travel south at-grade on the E3 Busway, east at S. Massachusetts Street, and tunnel under I-5 and Beacon Hill. It would emerge and become elevated approaching I-90 and S. Atlantic Street, then turn southeast on the same route as C2.3. Stations outside the DSTT would be at Royal Brougham and I-90 at S. Massachusetts Street.



SOUNDTRANSIT

0 1,000 2,000
FEET

Tunnel
Elevated
At Grade
Retained Cut-Fill
Station
Potential Station
Preferred Alternative
Potential Maintenance Base

Figure S-5 Segment C Westlake to S. McClellan Street

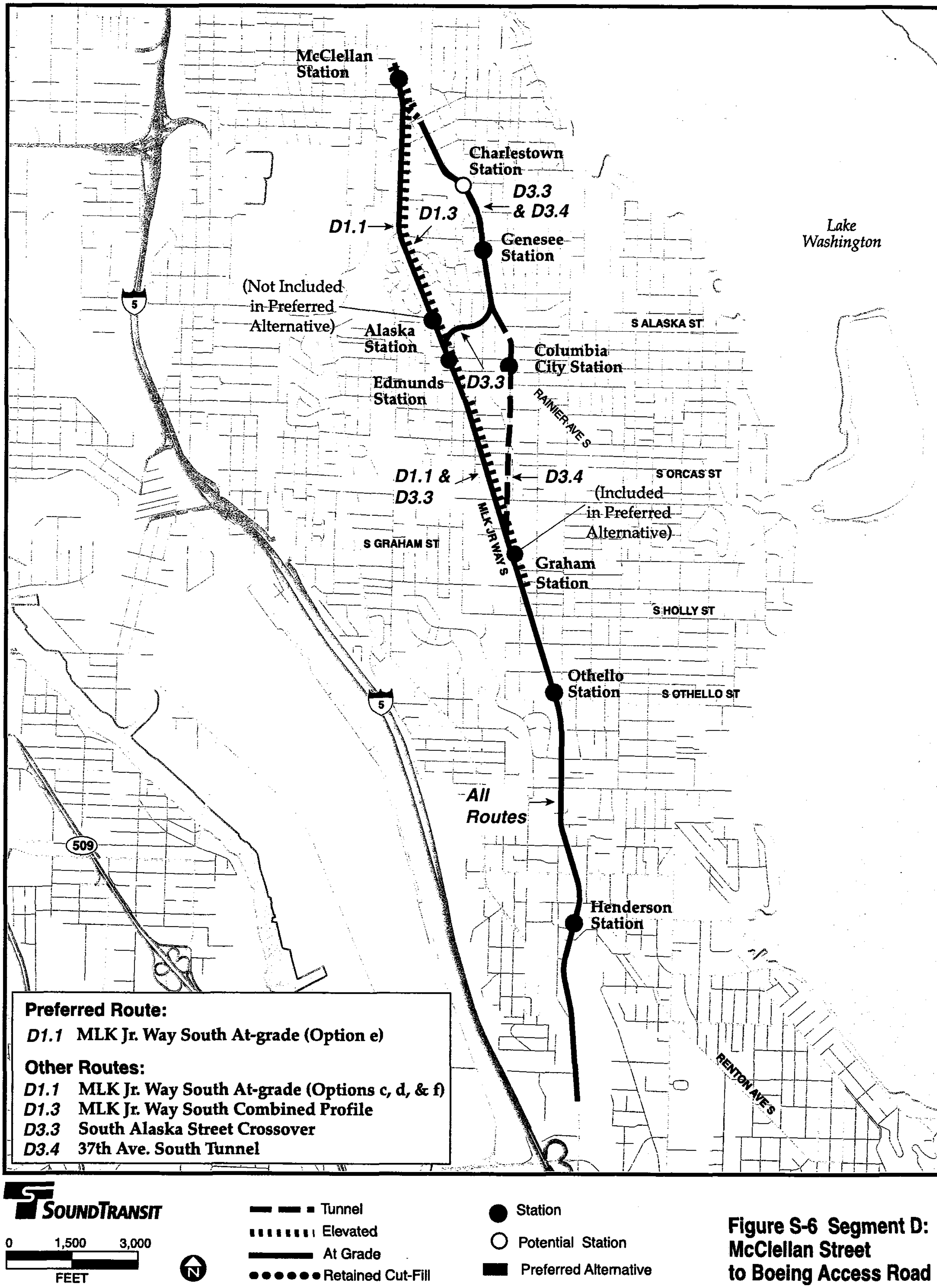


Figure S-6 Segment D: McClellan Street to Boeing Access Road

Segment D (S. McClellan Street to Boeing Access Road)

Segment D routes (Figure S-6) would all begin at S. McClellan Street, and either follow Rainier Avenue S. or MLK Jr. Way S. until south of S. Graham Street. From there they all share the same at-grade route in the median of MLK Jr. Way S. to just north of Boeing Access Road. The route alternatives evaluated in addition to the preferred alternative (D1.1e) include the following:

- D1.1c (MLK Jr. Way S., At-grade 4-lane, 104-ft cross section) would be located at-grade in the median of MLK Jr. Way S., with four traffic lanes throughout the segment. Stations would include McClellan, Alaska, Othello, and Henderson, with a potential station at Graham.
- D1.1d (MLK Jr. Way S. At-grade, 2-lane) would be at-grade in the median of MLK Jr. Way S., but the street would be narrowed to two traffic lanes (one in each direction in a 90-ft right-of-way). It would have the same stations at D1.1c.
- D1.1f (MLK Jr. Way S. At-grade 2-lane with 93-ft cross section) would provide for rail, 2 lanes of traffic, a parking lane, and additional room that could accommodate room for bicycles within a 93-ft right-of-way. It would have the same stations as the preferred alternative.
- D1.3 (MLK Jr. Way S. Combined Profile) would be elevated in the median of MLK Jr. Way S. from S. McClellan Street to S. Holly Street. Stations would be elevated at McClellan, Alaska, and Graham (a potential station), and at-grade at Othello and Henderson.
- D3.3 (Alaska Street Crossover) would follow an at-grade route one-half block west of Rainier Avenue S. before turning west on S. Alaska Street, then south on to MLK Jr. Way S. It would then have the same route as the preferred alternative. Stations would be at McClellan, Genesee, Othello, and Henderson. Potential stations at Charlestown and Edmunds could be used instead of a Genesee Station. A potential Graham Station could also be added.
- D3.4 (37th Avenue S. Tunnel) would start the same as D3.3, but rather than turning on S. Alaska Street, it would continue south in a tunnel through Columbia City until reaching MLK Jr. Way S. just south of S. Graham Street. Stations would be at McClellan (elevated), Edmunds (underground), Othello, and Henderson, with potential Charlestown and Graham stations.

Segment E (Tukwila)

The Segment E routes (Figure S-7) would begin with an elevated guideway along MLK Jr. Way S. at Boeing Access Road and end near SR 518 and Tukwila International Boulevard. The following alternatives were evaluated in addition to the preferred alternative (E1.1):

- E1.2 (Tukwila International Boulevard elevated) would follow the same route as the preferred alternative, except that it would remain elevated along the median of Tukwila International Boulevard. Stations would be built at Boeing Access Road and at S. 144th Street.
- E2 (Interurban Avenue S.) would begin elevated, like E1.1 and E1.2, but would turn south just east of E. Marginal Way S. It would have elevated and at-grade sections along SR 599/Interurban Avenue S. It would turn east across the Duwamish River and follow the BNSF and UPSP mainlines south to I-405. Crossing under I-405 to Longacres, the route would travel elevated over the railroad and Green River, continue elevated through Southcenter adjacent to Baker Boulevard and I-405, over the I-5/I-405 interchange, and along the south side of SR 518 to Tukwila International Boulevard. Stations would be at Longacres and Baker Boulevard (Southcenter).
- E3 (MLK Jr. Way S.) would follow alongside MLK Jr. Way S. to about S. 129th Street, then the route would be a combination of tunnel, elevated, and at-grade, traveling south to the existing railroad tracks, crossing under I-405 to Longacres like E2. The route would cross

over the railroad and the Green River similar to E2, but it would follow Strander Boulevard through Southcenter to the I-5/I-405 interchange, then rejoin E2 along the south side of SR 518. Stations would be at Longacres and Strander Boulevard (Southcenter).

Segment F (SeaTac)

Segment F routes (Figure S-8) would begin near SR 518 and extend south to S. 200th Street, with a tail track extending to S. 204th Street. The alternatives differ in their location, profile, and stations, but all routes are along or generally parallel to International Boulevard. In all alternatives, the North SeaTac and South SeaTac stations include park-and-ride facilities. The North SeaTac Station would be at S. 160th or S. 154th Street, depending on the Segment E alternative chosen. In addition to the preferred alternative (F2.3), the following alternatives were evaluated:

- F1 (International Boulevard in median) would travel at-grade in the median of International Boulevard to S. 200th Street. All stations would be on International Boulevard with a North SeaTac Station and park-and-ride lot at S. 154th or 160th Street, an at-grade North Central Station at S. 170th Street, and an at-grade South SeaTac Station and park-and-ride lot at S. 200th Street.
- F2.1 (Washington Memorial Park, City Center West) would follow the west edge of the cemetery to a North Central Station located at S. 170th Street. It would cross elevated over International Boulevard, then follow the east side of the boulevard to a South Central Station. It would continue south of the main airport terminal, cross back over International Boulevard, then follow Air Cargo Road/28th Avenue S. to S. 193rd Street before returning to grade.
- F2.2 (Washington Memorial Park, City Center East) would be similar to F2.1 except that after crossing International Boulevard, it would continue southeast for approximately one-fourth mile before turning south to a South Central Station along 32nd Avenue S. As the elevated trackway continues south, it would cross the north end of Bow Lake before traveling elevated over International Boulevard on its way east to join the F2.1 route along 28th Avenue S. to S. 200th Street. A North Central Station would be located at S. 170th Street.
- F3.1 (West Side of International Boulevard, Grassy Knoll) and F3.2 (West Side of International Boulevard, Main Terminal) both would be elevated along the west side of International Boulevard to a North Central Station at S. 170th Street. F3.1 would connect to a South Central station east of the main airport terminal parking garage, then follow 28th Avenue S. to S. 200th Street. F3.2 would swing into a South Central station in the main terminal area, elevated over the airport drives, then continue south along 28th Avenue S. to S. 200th Street.
- F3.3 (West Side of International Boulevard, Intermodal Center) is at-grade in the median of International Boulevard, becomes elevated approaching S. 152nd Street, and moves to the west side of International Boulevard at S. 154th Street. Near the 18000 block of International Boulevard, the route turns southwest toward Airport Cargo Road and follows the same route to S. 200th Street as Alternative F2.3.
- F4 (International Boulevard to 28th/24th) is at-grade in the median of International Boulevard, is elevated approaching S. 160th Street and elevated on the west side of International Boulevard to approximately the 18000 block, where it turns southwest to Airport Cargo Road and then along the same route to S. 200th Street as Alternative F2.3.

S.4.2 No-build Alternative, and Length Alternatives

The Final EIS evaluates the No-build Alternative and different length alternatives for the proposed light rail line. The No-build Alternative represents the current transportation system plus projects in the region's 20-year Metropolitan Transportation Plan. The Northgate to SeaTac (full-length) light rail alternative extends approximately 24 to 29 miles (covering Segments A through F) from 103rd Avenue N.E. in Northgate to S. 200th Street in SeaTac and include all the potential route alternatives and station options in the segments. The 45th to SeaTac alternatives would be 3.4 miles shorter, extending from N.E. 45th Street to S. 200th Street and includes all the route alternatives and station option in Segments B through F. The preferred alternatives also extends from N.E. 45th Street to S. 200th Street in SeaTac, but include only the routes and station options identified as prepared by the Sound Transit Board. Three minimum operable segments are also evaluated: MOS A, from N.E. 45th Street to S. McClellan Street (Segments B and C); MOS B from Capitol Hill to S. Henderson Street (part of Segments B and D, and all of Segment C); and MOS C from N.E. 45th Street to S. Lander Street (Segment B and part of Segment C). The MOSs consist of the same routes station options that are part of the preferred alternative.

Terminus Station Options

Each of the length alternatives would involve different selections of one or both terminus stations, although all stations would be designed to allow future extensions. The potential terminus stations would be at Northgate, N.E. 45th Street, Capitol Hill, S. Lander Street, S. McClellan Street, S. Henderson Street, or S. 200th Street. Park-and-rides or significantly increased bus activity would not occur with any of the terminus stations except Northgate and S. 200th Street.

S.4.3 Maintenance Base Site Alternatives

The maintenance base would provide for heavy maintenance and storage of light rail vehicles. The Draft EIS considered three alternative maintenance base locations. Additional alternative base sites were then developed and evaluated in response to comments on the Draft EIS and an FTA request that each MOS be fully operational and include a maintenance base facility. These additional maintenance bases also allow the consideration of additional minimum operating segments (MOS). Maintenance base alternatives (see Figures S-4 – S-7) include:

- M1-A – S. Lander Street, bounded by S. Lander and S. Holgate streets, and Sixth and Eighth Avenues S.
- M1-B – S. Lander Street, bounded by S. Lander and S. Holgate streets, and Eighth Avenue and Airport Way S.
- M1-C – Atlantic/Central, bounded by the E3 Busway and Airport Way S., and Massachusetts and Holgate streets.
- M1-D – Rainier Brewery/Roadway Express, bounded by Seventh Avenue S., S. Airport Way and S. Forest Street, and south of S. Hinds Street.
- M1-E – Rainier Brewery/Airport Way, on a portion of the M1-D site above, but shifted to the east, realigning Airport Way S. eastbound. The southern boundary would be Horton Street. This site would also require 1 to 8 acres between S. Lander and S. Forest streets.
- M2 – Northeast of the Boeing Access Road, in a site bounded by Boeing Access Road, I-5/ 40th Avenue S., Norfolk Street, and MLK Jr. Way S.
- M3 – Southwest of the Boeing Access Road, in a site bounded by Boeing Access Road, E. Marginal Way, Duwamish power transmission line right-of-way, and the BNSF railroad.

S.4.4 Light Rail Vehicles, Operations, and Access

Light rail would provide frequent, convenient, and reliable service, running 18 to 20 hours daily. The light rail fleet would include 64 to 76 vehicles for light rail operations in 2010 and 83 to 106 vehicles in 2020, depending on the alternatives selected and whether the system is extended to Northgate. Cars are typically 70 to 95 ft long by 8 to 9 ft wide. They are able to seat from 60 to 80 riders while accommodating 200 or more at peak periods. Conventional low-floor light rail vehicles would likely be used to provide level boarding for all passengers, offering easy access to bicycles and people with disabilities. Trains would operate with up to four light rail cars/vehicles during peak periods and fewer cars during off-peak times. Light rail speed limits would range from the posted roadway speed limit (where operating in streets) to a maximum of about 55 mph on exclusive right-of-way segments. With station stops, the light rail trains are expected to average 28 mph if operating with full traffic signal preemption.

Sound Transit would work with other entities to implement pedestrian and bicycle improvements within a one-half-mile radius of stations. Streets reconstructed as part of building the light rail system would include pedestrian and bicycle facilities consistent with the adopted policies of the local jurisdictions. A mix of bicycle storage lockers and locking racks would be provided at most stations. Bicycles would be accommodated on light rail vehicles.

S.5 PURPOSE AND NEED

The purpose of the proposed light rail project is to construct and operate an electric light rail system connecting the region's major activity centers. Implementing the light rail element of *Sound Move* would expand transit capacity within the region's most dense and congested corridor, provide a practical alternative to driving a car on increasingly congested roadways, support comprehensive land use and transportation planning, provide environmental benefits, and improve mobility for travel-disadvantaged residents in the corridor. The light rail line is envisioned as the initial phase of a long-range regional transit system with future phases extending to the north, east, and south.

S.6 GOALS AND OBJECTIVES OF THE PROPOSED ACTION

The goals and objectives of the light rail project are consistent with the *Sound Move* plan and with Sound Transit's Long-Range Vision, adopted May 1996. These policy elements have guided actions of the Sound Transit Board in designing the regional transit system, including the development and selection of route, station, and maintenance base alternatives for evaluation in the EIS.

1) Transportation Goal: Enhance Mobility

- Provide an effective, high quality transit system;
- Design a system to accommodate future extensions and expansion;
- Support the region's transportation goals;
- Integrate services and fare policies with local transit providers and provide convenient connections; and
- Enhance transportation equity.

2) Environment Goal: Preserve Environmental Quality

- Minimize potential adverse impacts to the natural and built environment.

3) Land Use Goal: Support Regional and Local Land Use Goals and Objectives

- Support adopted land use and transportation plans;
- Support pedestrian-friendly and transit-oriented community development; and
- Enhance neighborhoods.

4) Financial Goal: Achieve Financial Feasibility

- Build a system within *Sound Move*'s budget;
- Build a system that can be operated and maintained within available revenues; and
- Build a system that is cost-effective.

5) Community Support Goal: Maximize Community Support

- Involve the community in the project development and design process; and
- Enhance community support.

Section S.13 summarizes the effectiveness of the alternatives (in terms of their ability to meet the goals and objective S.14.1).

S.7 LOCAL, STATE, AND FEDERAL PLANNING FRAMEWORK

The following laws, mandates, and plans define the regulatory framework in which the light rail project has been initiated and planned.

S.7.1 State and Federal Laws

Washington State High-Capacity Transit Act

In 1990, the Washington State Legislature passed the High-Capacity Transit Act, which established a high-capacity transit (HCT) program, funded planning by local jurisdictions, and enacted tax mechanisms to pay for building a regional transit system.

Washington State Growth Management Act

The Washington State Growth Management Act (GMA) of 1990 requires the designation of urban-growth boundaries (UGBs) and adoption of comprehensive plans by the region's counties and cities. Within the UGBs, adequate infrastructure (transportation, water, sewer, and other urban services) must be provided to achieve population and employment targets established by the region.

Washington State Commute Trip Reduction Act

In 1991, the state legislature passed the Commute Trip Reduction Act (HB 1671) requiring that counties, cities, and towns implement a commute trip reduction plan for major employers. Providing commute alternatives is essential to achieving the law's goals.

ISTEA and TEA-21

The federal Intermodal Surface Transportation Efficiency Act (ISTEA of 1991) strengthened the role of local governments in coordinating transportation and growth management through regional metropolitan planning organizations (MPOs). The Puget Sound Regional Council is the Puget Sound region's MPO. The Transportation Equity Act for the 21st Century (TEA-21 of 1998) essentially extended the initiatives of ISTEA for six years, through 2004.

Clean Air Act of 1970 and Amendments

Transportation plans and projects must conform to the State Implementation Plan for air quality. The criteria for conformity specify that a transportation activity cannot: (1) Cause or contribute to any violation of the federal air quality standards; (2) Increase the frequency or severity of any existing violation of the standards; or (3) Delay timely attainment of the standards. The region's Metropolitan Transportation Plan, as adopted by PSRC in 1995, has been found to meet the conformity tests as identified by the federal and state conformity regulations. The light rail project and other *Sound Move* plan components are assumed in the MTP.

S.7.2 Regional and Local Plans and Programs

Vision 2020 and the Metropolitan Transportation Plan

Vision 2020 is the region's primary planning document. First adopted in 1990, Vision 2020 is an integrated land use, economic, transportation, and growth management strategy that includes a Metropolitan Transportation Plan (MTP) to respond to ISTEA requirements. Vision 2020 proposes a regional growth management strategy that includes identifying and maintaining urban growth areas, supporting compact communities, focusing growth in designated urban centers, and redeveloping urban transportation corridors. The MTP calls for a regional rapid transit system to support higher urban population densities, as well as policies and facilities to promote HOV use and discourage the use of single-occupant vehicles. *Sound Move* is a central element of the MTP.

Sound Move: The Ten-Year Regional Transit System Plan

Sound Move was designed to provide a balanced approach to increasing the capacity, utility, and convenience of the existing transit system by offering an integrated package of transit options. It is also the first phase of Sound Transit's Long Range Vision to link the region's urban centers by high-capacity transit. Collectively, this system of transit options will provide reliable, efficient, and congestion-free travel alternatives by adding new high-capacity services and facilities in existing transportation corridors. Sound Transit will provide light rail, commuter rail (Sounder), and regional express bus services within a three-county area.

S.8 PREVIOUS HIGH CAPACITY TRANSIT STUDIES

The alternatives evaluated in this EIS are consistent with the Major Investment Study completed for the *Sound Move* plan in May 1997, the 1993 Regional Transit System Plan, and the 1993 Regional Transit System Plan Environmental Impact Statement.

Voters approved local financing for *Sound Move* in November 1996—including increases of 0.4 percent sales tax and 0.3 percent motor vehicle excise tax.

In May 1997, RTA completed a Major Investment Study (MIS) for *Sound Move*, as required by the Intermodal Surface Transportation Efficiency Act (ISTEA). The choice to implement electric light rail as the most appropriate rail technology was based on a comprehensive analysis of alternative technologies conducted during the early 1990s. Criteria such as transit capacity, operating speeds, cost-effectiveness, compatibility with existing highway and transit facilities, technical feasibility, and operational reliability were considered. In addition, the system needed to optimize safety, comfort, and environmental benefits, preserve rights-of-way, and minimize adverse impacts to communities. The analysis concluded that conventional-tracked rail (light or heavy) would be best suited to the Seattle area. Heavy rail was screened from further consideration in 1994, primarily because of the inability to operate in non-exclusive rights-of-way, which would be necessary for cost-effective service in some portions of the corridor. Light rail was chosen as the preferred technology based on its ability to meet criteria. Light rail has the versatility to fit with our region's unique geography as it can operate within roadways, in tunnels, and on elevated tracks. It has proven to be a rapid, reliable, cost-effective system that will satisfy commuter needs and enhance the communities it serves.

S.9 ENVIRONMENTAL IMPACT STATEMENT PROCESS

S.9.1 Scoping Process and Draft EIS

With the overall *Sound Move* system plan approved, Sound Transit began to refine light rail route and station alternatives. A formal scoping process was initiated in November 1997 when the Federal Transit Administration (FTA) issued notice of its intent to prepare an EIS for the central corridor under the National Environmental Policy Act (NEPA). Concurrently, Sound Transit issued a determination of significance and scoping notice to prepare an EIS under the Washington State Environmental Policy Act (SEPA). FTA and Sound Transit combined their environmental reviews in the Draft EIS.

From November 1997 to February 1998, Sound Transit distributed a Scoping Information Report to approximately 4,500 households, held seven public open houses, and collected over 400 written comments on the environmental analysis and alternatives proposed. In March 1998, comments were described in a Scoping Summary Report. Sound Transit applied two levels of evaluation criteria to further identify and develop alternatives for the EIS. Level One criteria were designed to ensure that route and station locations proposed for the light rail system would fit with the whole system and with any future extensions. Level Two criteria were developed to compare the advantages and disadvantages of the route alternatives in each segment and to highlight the differences between them. These criteria included community compatibility, cost, environmental impacts, political and community acceptance, ridership, and transportation impacts. Since each segment has unique characteristics, different criteria were important in different segments to identify the most promising alternatives for continued study. On May 14, 1998, the Sound Transit Board approved the route and station location alternatives for study in the Draft EIS.

Draft EIS Review and Comment Process

Sound Transit and FTA widely circulated the Draft EIS to affected local jurisdictions; regional, state, and federal agencies; community organizations; environmental and other interest groups; and interested individuals. The Draft EIS was issued on December 4, 1998. Over 1,500 Draft EISs were distributed. A 60-day comment period (45 days is the minimum required under NEPA and 30 days minimum under SEPA) was provided to the public, agencies, and jurisdictions to allow the opportunity to comment on the Draft EIS to Sound Transit and the FTA. Five public hearings were held during the comment period at various locations along the project corridor to take oral testimony. Sound Transit received more than 900 comment letters or public hearing testimonies. These comments, and Sound Transit's responses, are included in the Final EIS, Volumes 3, 4, and 5.

Identify a Preferred Alternative

The identification of a preferred alternative by the Sound Transit Board is a specific step in the project development process following the public review and comment on the Draft EIS. The preferred alternative is based on balancing design and environmental information, goals and objectives, community comments, and technical data (such as ridership, integration with other transit systems, cost-effectiveness, and financial feasibility). This step identifies which route, station locations, and maintenance facility alternative will likely move forward into preliminary engineering (30 percent design). The Sound Transit Board identified a preferred alternative on February 25, 1999.

Additional Environmental Studies

In response to public and agency requests, and to provide additional public and agency review of design modifications, Sound Transit conducted additional analyses and published additional reports following the Draft EIS. These additional studies included the Rainier Valley Tunnel Environmental Technical Report, and the N.E. 45th, Capitol Hill stations and Maintenance Base Alternatives Environmental Assessment (EA).

The Rainier Valley Tunnel Environmental Technical Report responded to requests from citizens for additional analysis of a tunnel option the full length of Segment D. Sound Transit developed and evaluated an all-tunnel option and issued a report on February 1, 1999. Sound Transit held a public hearing and accepted comments from February 1 to March 18, 1999. The Sound Transit Board considered the report and public comments received at the time, prior to identifying a preferred alternative. The Rainier Valley Tunnel Environmental Technical Report analysis confirmed conclusions from previous analyses that a tunnel the full length of Segment D is not a reasonable alternative.

In August 1999, Sound Transit issued an EA on new maintenance base alternatives in the North Duwamish area, and on new station options in the University District and Capitol Hill areas. These modifications were developed in response to public and agency comments on the Draft EIS and in light of new geotechnical information. The EA was prepared to provide information and to allow public and agency review of these project modifications. Sound Transit held three public meetings on the EA in late August 1999 and accepted comments from August 9 to September 8, 1999. The alternatives evaluated in the EA have also been added to the Final EIS.

Prepare Final EIS and Mitigation Plans

The Final EIS analyzes the preferred alternative along with all of the alternatives considered in the Draft EIS. The Final EIS also includes new or modified alternatives developed in response to public and agency comments, newly available design information, and to reduce environmental impacts.

The Final EIS was prepared concurrently with preliminary engineering. Preliminary engineering advances the level of design detail to incorporate committed mitigation measures into the project design and to more closely estimate project costs. The Final EIS documents and responds to comments received on the Draft EIS, the Rainier Valley Tunnel Environmental Technical Report, and the Environmental Assessment for the N.E. 45th Street Station Options, Capitol Hill Station Options, and North Duwamish Maintenance Base Alternatives.

S.10 SUMMARY OF ENVIRONMENTAL CONSEQUENCES

This section summarizes the potential environmental impacts associated with the light rail alternatives evaluated in the Final EIS, focusing on the significant or most notable impacts that differentiate the alternatives. Section S.10.1 discusses the impacts of the preferred route and station alternatives by segment, compared with the impacts of the other alternatives considered; the impacts of the maintenance base sites are also discussed. Section S.10.2 highlights the overall impacts associated with the system's six length alternatives and the No-build Alternative. Tables S.10-1 through S.10-7, at the end of Section S.10, offer a tabular comparison of environmental impacts and tradeoffs of the route and maintenance base alternatives. Chapters 3 and 4 of the Final EIS discuss impacts in more detail.

S.10.1 Environmental Effects of Route Alternatives and Maintenance Base Sites

Segment A (Northgate to University District)

The major differences in environmental impacts between the various alternatives in Segment A are associated with the choice of a tunnel or elevated route through the Roosevelt District. Most impacts can be at least partially mitigated.

Of the seven major intersections in the study area, all the light rail alternatives would potentially cause one intersection on First Avenue N.E. to operate at an unacceptable level (Level of Service [LOS] F) in 2010, and another to operate unacceptably in 2020 (LOS E). These intersections would operate acceptably in 2010 with the No-build Alternative. However, one of the intersections would degrade to LOS F with the No-build Alternative in 2020. The impacts of the light rail alternatives can be mitigated. From 10 to 18 on-street parking spaces and 140 and 196 off-street spaces would be displaced in all alternatives. Near the Roosevelt Station, all alternatives would have the potential for hide-and-ride parking by rail commuters parking on neighborhood streets.

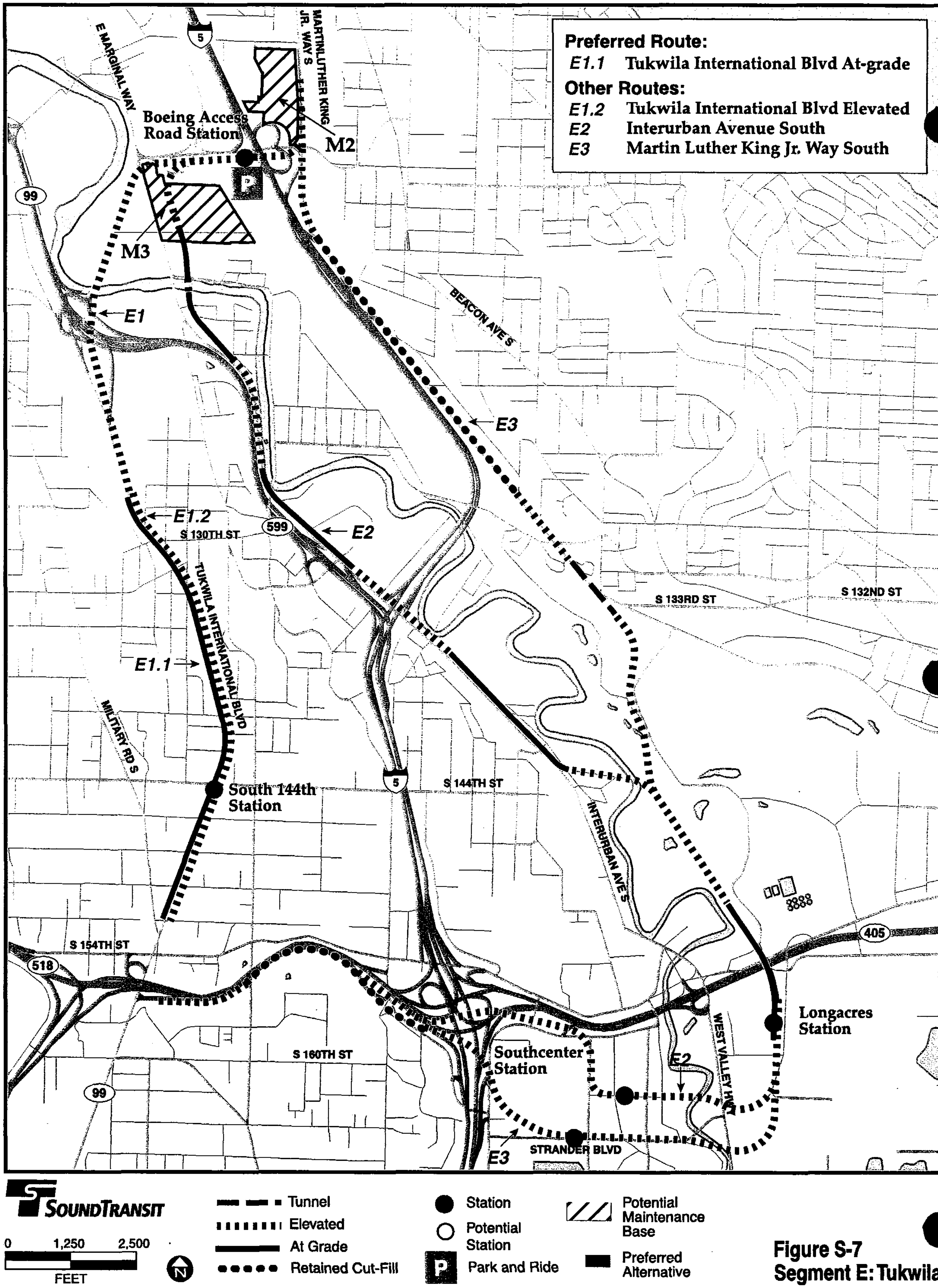


Figure S-7
Segment E: Tukwila

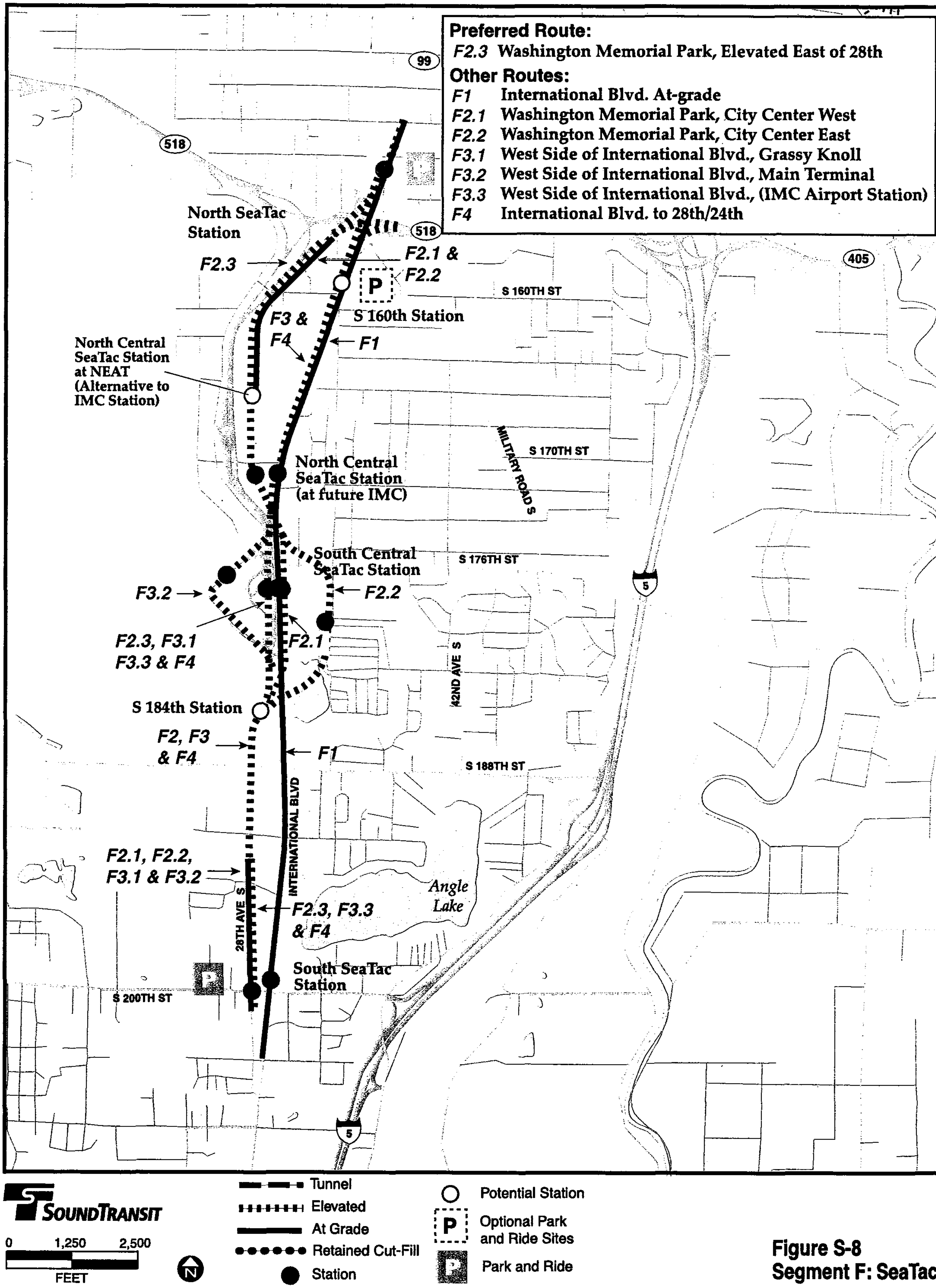


Figure S-8
Segment F: SeaTac

The relatively few displacements that would occur would not change land use patterns in the area. Substantial redevelopment and increased density could occur around any of the Roosevelt station alternatives. Alternative A2.1 would acquire 10 parcels, including eight housing units; the other alternatives would acquire two to six parcels and no housing.

Northgate station Option A would shade more areas of the wetlands along Thornton Creek than station options B and C.

The elevated guideway and overhead catenary system (OCS) in Alternative A2.2 could partially obstruct views of the Olympic Mountains and Green Lake from Rainbow Point Park, a designated scenic viewpoint, and from some residences along I-5. Alternative A2.1 would introduce new visual elements in the Roosevelt neighborhood. Both A2.1 and A2.2 would cross over Ravenna Boulevard, a designated parkland and historic resource, and would remove trees. The elevated structure would also contribute to visual impacts, shading, and lend a "tunnel effect" to the boulevard.

After implementing standard mitigation, there would be residual vibration impacts at four structures for Alternative A1.1, nine structures for A1.2, and one structure for A2.1.

The possible use of cut-and-cover tunneling techniques, compared to mining techniques, for construction of the Roosevelt Way or 12th Avenue stations in Alternatives A1.1 and A1.2 would create greater disruption during construction in the station areas.

Segment B (University District to Westlake Station)

The impacts of the preferred alternative (B1a) would be lower or the same as other alternatives in Segment B. The most significant environmental impacts in Segment B are associated with Alternative B2.1 and the construction of the high-level bridge over Portage Bay, which would result in parkland, visual, noise, and displacement impacts.

All alternatives would have direct parking loss at portals and at station areas due to bus layover and stop zones. Alternative B1a (preferred alternative) would have the lowest parking impacts (31-37) followed by B1b (47-53), B2.2 (59-65), and B2.1 (99-105). Pedestrian activity for the Pacific Station options could conflict with users of the Burke-Gilman trail, although the preferred alternative station option access plans have been revised to minimize this impact. By the year 2020, pedestrian volumes could cause the intersection of Broadway Avenue/E. John Street to operate unacceptably under the preferred alternative, but this can be mitigated by the addition of turn lanes. Under all alternatives, the intersection of N.E. 45th Street/15th Avenue N.E. would operate acceptably, but increased bus traffic may require additional intersection and signal treatments. Several other intersections in the Segment B study area would have increased congestion under No-build and light rail alternatives, with light rail not significantly worsening conditions.

The preferred alternative would have the fewest full property acquisitions (4), with properties clustered around station entrances. Alternatives B2.1 and B2.2 would acquire 8 and 22 properties respectively, including 40 affordable housing units for B2.1. None of the alternatives would cause significantly direct affects on affect land use patterns. All Segment B stations would also have construction impacts, including property displacements and traffic detours or lane closures. The N.E. 45th Street Station Option C would have construction impacts on one side of nearly one block of businesses and residences, including displacement of more than 100 apartment units, and it would also cause traffic disruption. The impacts of Option C would be greater than for than Options A or B, which would be largely confined to University property, but which also could conflict with U.W. law school and Burke museum expansion projects. Substantial redevelopment and increased density could occur as an indirect affect around stations at N.E. 45th Street, Pacific Street, and Campus Parkway.

Alternative B2.1 would impose potentially significant visual quality impacts along Campus Parkway. Alternatives B2.1 and B2.2 would obstruct views along Westlake and Fairview avenues. The University Friends Meeting Hall would be demolished, constituting a significant and unavoidable effect on a structure eligible for listing as a historic landmark.

For the preferred alternative, the Capitol Hill Station Option D (Nagle Place) would require removing mature trees (with potential historic significance) on a corner of the Lincoln Park reservoir.

Alternative B2.1 would require placing piers on portions of the North and South Passage Point parks, and would cause additional shading to the remaining portions. Although local ordinance would require the purchase of replacement parklands, this would not fully mitigate the loss of parkland resources at these two parks.

Sensitive research at the UW Physics and Astronomy building could potentially be affected by vibration and electromagnetic interference from Alternatives B1a or b, B2.2 and to a lesser degree, B2.1. Mitigation would be provided. Alternative B2.1 would cause vibration impacts at two sites after mitigation; the impacted sites are near the Harvard Street tunnel portal, and impacts could be eliminated by additional vibration control.

The preferred alternative would close the Convention Place Station. Alternatives B2.1 and B2.2 and B1b could potentially close or rebuild the station. Redevelopment plans have been proposed at the site, with closure offering more opportunities for redevelopment than other alternatives. Reconstruction of this station would temporarily close Pine Street, affecting transit and traffic circulation in this area. Construction impacts associated with tunneling (B1 or B2.2) and with high-level bridge construction (B2.1) would be potentially disruptive to nearby land uses. Spoils removal for Alternatives B1 and B2.2 at Portage Bay could be accomplished with barge or truck transport. Cut-and-cover construction for Capitol Hill Station Options B and C would have impacts to the Broadway commercial district. Nagle Place (Option D), also cut-and-cover, would displace more businesses and residences during its construction.

Segment C (Westlake Station to S. McClellan Street)

The preferred alternative would have potential impacts involving transportation, property acquisitions, ecosystems, and parklands. Most of these impacts would be mitigated.

The preferred alternative would operate light rail only in the DSTT, with buses operating on surface streets. The Final EIS also considers the other scenario that would allow bus and rail operations in the tunnel. In all cases, the DSTT would be closed for 24 to 27 months for construction of light rail improvements, and all buses that would normally operate in the tunnel would need to be accommodated on downtown streets. Impacts would be most significant during construction.

Sound Transit analyzed options for addressing the effects of construction closure and subsequent light-rail-only operations in the DSTT. All scenarios showed that downtown intersections would operate acceptably (LOS D or better) under the light rail alternatives, with performances similar to the No-build Alternative. Rail-only use of the DSTT could increase the number of buses using surface streets, but auto vehicle trips to downtown would be reduced. Surface changes such as increased capacity on downtown streets, on-street parking restrictions, a transit shuttle system, or transit-priority treatments for buses would be needed for all scenarios during construction and possibly during operations.

All C1 alternatives, including the preferred alternative (C1.2) would not significantly impact traffic operations in the study area, with all intersections operating at LOS D or better in 2020. Circulation and access impacts are found along at-grade and elevated sections on S. Lander Street (C1 alternatives), Rainier Avenue S. (C2.3 and C3), and S. Massachusetts Street (C3), with left-turn prohibitions to and from unsignalized driveways and side streets. Alternative C1.1 would have impacts to both sides of S. Lander Street, which is an important east-west route in the area. The preferred alternative would minimize the access impacts along S. Lander Street by locating the track on the north side of the street, affecting streets and properties on one rather than both sides of S. Lander Street. Alternatives C1.4 and C1.5 would completely avoid access impacts to S. Lander Street. For the preferred alternative and other at-grade alternatives, traffic signal preemption for at-grade light rail vehicles would increase vehicle delays for minor cross street approaches and major street left turn movements at all signalized intersections; these congestion impacts can be minimized with mitigation. Some trucks and other vehicles would be required to make U-turns at signalized intersections to reach their destinations. Overall, Alternative C2.3 would cause the greatest overall impact to traffic access and circulation, followed by Alternatives C2.4, C3, and then the preferred alternative (C1.2) and other C1 alternatives along S. Lander Street (lowest access and circulation impact). The least impacts would occur with Alternatives C1.4 and C1.5.

All of the segment C alternatives have similar parking impacts, ranging from 200 to 250 total spaces, except for C1.5, C2.3, and C1.3, which would each have fewer than 50.

The preferred alternative would acquire 15 properties, which is within the same range as other C1 alternatives. Alternatives C2.3 and C3 would each acquire more than 30 properties. Alternative C1.1 would acquire 12 properties.

Alternatives C2.3 and C3 would unavoidably obstruct views toward Mount Rainier from Rainier Avenue S., a designated scenic route. Both alternatives would also obstruct views and substantially alter the setting of the Stewart Lumber Company, a structure eligible for local and federal historic listing. Alternative C2.3 would also require partial demolition of the structure.

Alternative C3 would locate the I-90 Station within the boundaries of the future Sister City Park, and the elevated guideway would pass over the park. Station design approaches, acquisition of replacement parkland, or implementing one of the other alternatives would reduce or eliminate this impact. All C1 alternatives, including the preferred alternative, would locate the Beacon Hill tunnel in the East Duwamish and Cheasty greenbelts, although the portals are outside the greenbelts; the removal of trees and other disruptions due to the tunnel construction would temporarily impact ecosystems, parklands, and visual resources.

Segment D (S. McClellan Street to Boeing Access Road)

The preferred alternative (D1.1e) would have potential impacts to transportation, property acquisition, noise, historic resources, and parklands. Most of these impacts can be mitigated. The impacts of the other alternatives in these areas would be similar or greater.

Transportation effects for the preferred alternative involve congestion at intersections, access and circulation, changes to bicycle and pedestrian movements, and parking. All of the congestion impacts can be mitigated. Of the 28 major intersections analyzed, a "worst-case" analysis found that most signalized intersections in the project area would operate at acceptable levels in 2010 and 2020 with or without the preferred alternative or the other light rail alternatives. The "worst-case" analysis assumed a "signal preemption" system that would trigger signal changes as trains approach. The recommended strategy for light rail is for "signal progression" timed to scheduled train arrivals: this scenario would be least disruptive to traffic flows. In the "worst-case" in 2020, the preferred alternative would reduce overall conditions to unacceptable levels at only one intersection (S. Alaska Street/MLK Jr. Way S.); all the other light rail alternatives would also impact this intersection, and would further impact from two to four other intersections. Light rail vehicles would increase average vehicle delays for east-west street approaches and major street left-turn movements at signalized intersections. With the recommended system (signal progression) and other improvements, the LOS impacts and intersection delays would be minimized.

Access and circulation impacts for the preferred alternative and other alternatives in the median of MLK Jr. Way S. are caused by street closures, and by restricting driveways and unsignalized intersections to right turns in and out only. The preferred alternative and D1.1f would restrict movements on 34 signalized intersections and would close one sidestreet. Alternatives D1.1c, D1.1d, and D1.3 would restrict movements at 39 unsignalized intersections. Alternatives D3.3 and D3.4 would affect 16 unsignalized intersections along MLK Jr. Way S. An additional three sidestreet intersections for Alternative D3.3 and four sidestreet intersections for Alternative D3.4 would be closed along Rainier Avenue S. For Alternatives D1.1e (preferred alternative) and D 1.1f, mitigation features have been added after the Draft EIS was issued to minimize traffic access and circulation impacts. This includes the seven new traffic signals on MLK Jr. Way S. and two new signals on Rainier Avenue S. All of these new signalized intersections would provide full cross street access to MLK Jr. Way S., and four of the intersections would also provide northbound and/or southbound access from MLK Jr. Way S. to the cross street. U-turn movements for passenger vehicles would also be allowed at these new signalized intersections. In addition, the number of unsignalized intersections limited to right-in, right-out access only decreases from 40 in the Draft EIS to 34 with the preferred alternative. (Some or all of these mitigation features could also be included with other Segment D alternatives).

With the access changes for the preferred alternative, and mitigation features travel times for passenger vehicles would increase by an average of about one-minute. These travel time increases would be slightly higher for other alternatives. With or without the added mitigation features included with the preferred alternative, this impact is not considered to be significant. For larger trucks unable to make a U-turn on MLK Jr.

Way S., the maximum travel time increase for rerouting to other nearby arterial streets could be as high as 4 minutes. Since most businesses requiring large truck deliveries are already located at intersections with traffic signals, this impact is also not considered to be significant.

Alternatives D1.1d and D1.1f, which would change MLK Jr. Way S. to a two-lane street, would have the highest impact on access and circulation; they would also have the potential to increase response times for emergency vehicles that may have limited room to maneuver around other vehicles. Emergency vehicles could be subject to delays crossing MLK Jr. Way S. for the preferred alternative and other D1.1 alternatives, although emergency vehicles would be able to make left-hand turns, at their discretion. Trackway curbing would allow emergency vehicles to cross at mid-block locations. Emergency vehicles would also have signal priority over light rail train signal requests.

The elevated McClellan Station of the preferred and other alternatives would avoid the requirement for traffic to stop on MLK Jr. Way S. when trains pass.

Currently, pedestrian crossings are allowed at all unsignalized intersections along MLK Jr. Way S. The preferred alternative and other light rail alternatives would allow crossings only where signal protection would be provided. While this potentially increases distances pedestrians must walk, it would improve crossing safety. Impacts to pedestrian movements have been minimized with the preferred alternative and Alternative D1.1f, because new signalized intersections or crossings have been added, reducing distances between crossings. Pedestrian improvements would be provided along Edmunds and Henderson streets to the Columbia City and Rainier Beach areas, respectively. Bicycle improvements would be provided on a parallel route to the preferred alternative. Parking impacts for the preferred alternative and other MLK Jr. Way S. alternatives involve few on-street losses, but off-street spaces would be displaced; overall parking displacements would be highest for Alternatives D3.3 and D3.4.

All of the alternatives in this segment would result in residential and business displacements. The preferred alternative would acquire 84 properties, D1.1d would acquire 63, D1.1f would acquire 77, and D1.1c would acquire 110. The most acquisitions in Segment D are 191 for D3.3 and 143 for D3.4, because a new light rail right-of-way west of Rainier Avenue S. would displace all the businesses and residences along the west side of the street. Overall, land use and economic impacts would be lower for the D1.1 alternatives and for Alternative D1.3, compared to D3.3 or D3.4. In all alternatives, displaced single-family residences would likely be replaced by multi-family and retail/commercial uses, increasing the density of development in the corridor. Each of the station areas in this segment may be developed or redeveloped into denser, more intensive, transit-supportive land uses, as proposed in the Draft Southeast Seattle Neighborhood Plans. For all Segment D alternatives, some businesses may incur economic losses as an indirect effect along MLK Jr. Way S. and Rainier Avenue S. These potential impacts could be countered by redevelopment in the vicinity of displacements and increased activity in station areas.

The preferred and other alternatives would have an elevated route across Cheasty Boulevard, which would obstruct views between Cheasty Boulevard and Mt. Baker Boulevard. However, other MLK Jr. Way S. alternatives with an at-grade station for McClellan would cross Cheasty, which could preclude the possible connection of Cheasty and Mt. Baker boulevards as historically planned. Alternatives D3.3 and D3.4 would require the removal of buildings on Rainier Avenue S. that are eligible for historic listing or are important community resources. The elevated structure and overhead wires of Alternative D1.3 would impose high visual contrast at the designated scenic routes of S. Columbia Way and S. Alaska Street, along the east frontage of the Rainier Vista housing development, and along MLK Jr. Way S.

All alternatives include a bus layover facility located at S. Henderson Street and MLK Jr. Way S., which will include approximately 10 bus bays and associated overhead catenary system (OCS). The OCS will begin at Rainier Avenue S. and run down S. Henderson Street to the new bus facility.

Without mitigation, several hundred traffic noise and light rail noise impacts would occur for all alternatives except D1.1d and D1.1f, but all impacts can be eliminated with mitigation. Vibration impacts would occur after mitigation for alternatives D1.1d (six structures), D1.3 (seven structures), D3.3 (seventeen structures), and D3.4 (eight structures). Alternative D1.1e, the preferred alternative, would avoid these impacts.

Construction of the cut-and-cover tunnel in Alternative D3.4 would cause substantial disruption of business and traffic in Columbia City and along 37th Avenue S.

High numbers of minority and low-income populations reside in this segment. See Section S.12 for a more detailed of impacts and benefits to low-income and minority populations.

Segment E (Tukwila)

Alternative E1.1 (preferred alternative) and Alternative E1.2 would cause more potential transportation impacts than alternatives E2 and E3, but conditions overall in Segment E are generally similar between the No-build and the light rail alternatives. Most study area intersections would operate acceptably with Alternatives E1.1 (preferred), E1.2, E2, and E3. With the No-build Alternative and E1.1 and E1.2, three study area intersections would operate unacceptably in 2010 or 2020, including the S. 144th/Tukwila International Boulevard intersection, where a station is proposed. At that intersection, the preferred alternative and E1.2 would significantly worsen conditions, but, the impact can be mitigated. Alternatives E2 and E3 would have minimal effects on most study area intersections. All alternatives would increase average delays for movements to or from east-west streets along the light rail routes. Without mitigation, the impacts would be significant at two locations for the preferred alternative (MLK Jr. Way S./Boeing Access Road and S. 144th Street/Tukwila International Boulevard), but these impacts can be mitigated. Similarly, the impacts of Alternative E2 on two Interurban Avenue intersections can be mitigated, as can the impacts of Alternatives E2 and E3 on the West Valley Highway/S. 156th Street intersection.

Alternatives E1.1 and E1.2 would restrict driveways and nine unsignalized intersections to right turn in and right turn out only on Tukwila International Boulevard from S. 122nd Street to S. 150th Street. For Alternative E1.1 (preferred alternative), new traffic signals were included on Tukwila International Boulevard at S. 140th and S. 148th streets to minimize impacts from eliminating left-turn access at other unsignalized intersections. Passenger vehicles would be allowed to make U-turns at these intersections. With these added traffic signals, travel time impacts from the preferred alternative would be minimized. Travel times would increase by up to two minutes per trip or an average increase of about one-minute. This is not considered a significant impact. Alternative E2 would relocate access to the Foster Golf Course from Interurban Avenue S., and Alternative E3 would close 57th Avenue S. from MLK Jr. Way S. Alternatives E1.1 and E1.2 would increase the walking distances for some pedestrians crossing Tukwila International Boulevard, because crossings would be allowed only at signal-controlled locations. However, three additional signalized pedestrian-only crossings and two new signalized intersections were added since the Draft EIS was issued, minimizing the impact to pedestrians. Signal-protected crossings would also reduce risks for pedestrians who might otherwise cross Tukwila International Boulevard at unsignalized intersections or mid-block locations. Alternatives E1.1 and E1.2 would displace 124 to 112 on-street and off-street parking spaces, respectively, along Tukwila International Boulevard; Alternative E2 would displace 314, and E3 would displace up to 460 off-street parking spaces; new station options for the Strander station have been developed to reduce the parking loss for E3 to 260 spaces.

Emergency vehicles could be subject to delays in crossing Tukwila International Boulevard under Alternatives E1.1 and E1.2, although these delays can be minimized by allowing emergency vehicles to cross the tracks at their discretion, and allowing them to have priority control of the light rail traffic signals system. The right-turn-in/right-turn-out restrictions at unsignalized cross streets and private driveways would create the need for trucks to make U-turns at signalized intersections, travel out-of-direction, or adjust their existing route before reaching a destination.

Stations in Alternatives E2 and E3 would support the City's designated urban center in the Southcenter area. The Tukwila International Boulevard alternatives would not serve Southcenter (Tukwila's Urban Center), but could serve the commercial centers in the S. 144th and S. 154th Street areas. The potential for rail stations to directly induce new development is relatively low for all alternatives.

The preferred alternative would have 16 property acquisitions, the same as Alternative E3, but some of the properties are vacant for each alternative. Alternatives E1.1 (preferred alternative) and E1.2 both displace a five-unit apartment building. Alternatives E2 and E1.2 would acquire 5 and 7 properties, respectively.

For Alternative E1.2, the elevated guideway and overhead catenary system (OCS) would obstruct scenic skyline views from Tukwila International Boulevard. Alternative E1.2 would impose high visual contrast within the Riverton Heights neighborhood. With implementation of Alternative E2, the I-5 flyover and transition segment would obstruct views, cast shadows, and impose high visual contrast along the Green River Trail, Lookout Park, and Foster Golf Links. For Alternative E3, the transition section from at-grade to an elevated profile would impose high visual contrast within the Skyway neighborhood. Alternative E2 would result in unavoidable impacts to Lookout Park where elevated guideways cross the park. The proximity of Alternative E2 to the Duwamish/Green River Trail would result in adverse proximity impacts to this recreation resource. Right-of-way needed for Alternative E2 would result in the loss of needed parking at the Foster Golf Course, but parking could be replaced.

Alternatives E1.1 and E1.2 would have the highest number of traffic and light rail noise impacts before mitigation, but all significant noise impacts in all alternatives would be avoided with mitigation. After mitigation, Alternative E2 would have two residual vibration impacts.

Alternatives E1.1 and E1.2 would require filling approximately 2.02 acres of wetlands, largely for the park-and-ride lot at Boeing Access Road Station, and Alternatives E2 and E3 would require filling just over 1 acre of wetland each. Alternative E3 would remove 12.4 acres of forest, E2 would remove 6.1 acres, and E1.1 and E1.2 would remove about 1.5 acres. Alternative E2 would cause greater fish habitat loss than other alternatives due to riparian vegetation removal and three new bridge crossings of the Duwamish/Green rivers. Alternatives E1.1 and E1.2 would potentially affect the Riverton Side Channel Project. Alternative E2 (and to a lesser degree E3) would remove potential bald eagle winter perch sites. Alternative E2 would adversely affect Gilliam Creek and the adjacent floodplain due to removal of vegetation and possible installation of piers in the floodway. Alternatives E1.1 (preferred alternative), E1.2, and E2 would pass near a hill south of Boeing Access Road that is a potential property of cultural interest for the Muckleshoot and Duwamish Tribes.

Segment F (SeaTac)

The preferred alternative (F2.3) would have fewer transportation impacts than the other alternatives, but with mitigation all transportation impacts can be avoided or reduced below a level of significance. With the preferred alternative (F2.3), most intersections would operate at acceptable levels in the year 2020, when compared to No-build. The only exceptions include the International Boulevard/S. 154th Street, International Boulevard/160th Street, International Boulevard/170th Street, 32nd Avenue S./S. 176th Street, and International Boulevard/S. 200th Street intersections. Although these are all major intersections in SeaTac, additional signal or intersection improvements would mitigate the impacts of the preferred alternative. Depending on the station options, light rail could add delays to minor approaches of east-west cross-streets to International Boulevard, 32nd Avenue S., and 28th Avenue S., but these effects can also be mitigated. Other alternatives would have similar or greater impacts, particularly Alternative F1 which is at-grade on International Boulevard.

The preferred alternative would acquire 12 properties, similar to F2.1 and F4 (13 and 15). Alternative F1 would acquire the most properties (53), mostly businesses. Direct and indirect impacts to land use and economics would be lowest for the preferred alternative and other F2, F3, and F4 alternatives. They would be greatest for Alternative F1. The land use impacts of the preferred alternative and Alternatives F2.1, F2.2, F3.1, and F3.2 would be similar, with the most differences in impacts appearing in the station areas. The North SeaTac Station of the preferred alternative (at S. 154th Street) could help support increased pedestrian and commercial activities in that area. Station Option A offers the most opportunities for area redevelopment, and all the S. 154th Station options would have more redevelopment potential than a S. 160th Station. The preferred alternative currently includes a North Central SeaTac Station at the airport's proposed Intermodal Center (IMC) with a people-mover connected to the existing airport terminal. Alternately, the station could be located at the airport's proposed North End Airport Terminal (NEAT), with a direct pedestrian connection to the new terminal and people-mover access to the existing terminal and IMC. The preferred alternative's potential station at South Central SeaTac (S. 184th Street) would serve the City of SeaTac's designated City Center and could support increased density and redevelopment, but Alternative F2.1 with a City Center Station would most directly serve the area and would have a higher potential to support increased density and redevelopment; the station in the main airport terminal for Alternative F3.2 would not serve the City Center area. The South SeaTac Station options for the preferred alternative and the other alternatives impact different properties around 28th Avenue S./S. 200th Street, but all options would impact fewer developed properties than the station on International Boulevard for Alternative F1.

The preferred alternative and most other alternatives with elevated sections would have minor visual impacts. Alternative F2.2 would obstruct views from the northeast shore of Bow Lake and impose high visual contrast. Alternative F1 would remove trees and vegetation at Angle Lake Park and relocate the park entry.

Maintenance Base Sites

All of the proposed M1 maintenance base alternatives in the North Duwamish area would displace existing businesses and their employees, and could affect property access and circulation. Any of the M1 base options would be consistent with the industrial land use in the North Duwamish area, although there is limited land available for displaced businesses to relocate. Most of the Duwamish area sites acquire similar amounts of land and displace 6 to 18 properties. The impacts in terms of businesses and employees affected are more varied, and the related number of jobs affected provides a basis for comparison. Sites M1-D and M1-E (with Alternative C1.4) would displace the fewest employees, cause the least property access disruption, and the fewest traffic impacts. Sites M1-A, M1-B, and M1-C could have the highest impacts, depending on the route alternative and access route chosen. Site M1-B would also affect 1,026 employees, and it would have comparatively high impacts to property access, circulation, rail freight, and safety. Site M1-C would affect 581 jobs, and would also impact traffic operations in its immediate vicinity the most since it would divert traffic from Sixth Avenue S. Site M1-A would affect 621 jobs, and remove 3,500 ft of rail storage track, but the track could be replaced in other locations. Hazardous materials releases are known on all sites, with M1-A having the lowest potential for long-term impacts. The other sites have similar potential, although sites M1-D and M1-E include an historic landfill with unknown releases to groundwater.

The Boeing Access Road sites have fewer impacts overall, including lower impacts to transportation, property, or employment. Site M2 would acquire 14 properties and M3 would acquire 13. Most would be industrial or commercial parcels, although a large portion of the M3 site is a Seattle Police Athletic Association training facility. Each site includes known hazardous material releases (two on M2, and three on M3).

Construction of Site M3, S.W. Boeing Access Road, could affect a wetland, disturb an area with a high probability for archaeological resources, and affect a potential property of cultural interest to Indian Tribes.

S.10.2 System-Wide Impacts

This section summarizes the system totals for those impacts that can be quantified (such as acres of wetlands filled), and discusses other impacts that are measured on a system-wide scale (such as regional travel impacts).

Regional Transportation

Compared to the No-build conditions, the light rail system would slightly reduce daily vehicle trip volumes, as well as the number of miles traveled by vehicles and the number of hours they spend in travel. The transit transfer rate would increase slightly with implementation of any of the light rail alternatives. The light rail alternatives would substantially increase transit capacity in the central corridor and King County, decrease travel times, increase overall transit system speed and reliability, increase comfort, and potentially result in increased transit coverage for the metropolitan area. Average door-to-door transit travel time savings, for example, would be 10 to 17 percent over the No-build Alternative. Year 2010 light rail daily boardings for the preferred alternative are projected to total about 110,000, and 133,000 in 2020. The N.E. 45th Street to SeaTac system alternative would be similar to the preferred alternative (it involves different route choices), and the Northgate to SeaTac alternative would have 124,000 in 2010 and 149,000 in 2020. The MOS alternatives would have between 60 to 80 percent of the preferred alternative's daily ridership. MOS A (N.E. 45th Street to S. McClellan) would have 86,700 daily boardings in 2010 and 106,100 in 2020. MOS B (Capitol Hill to S. Henderson) would have 62,600 daily boardings in 2010, and 76,900 in 2020. MOS C (N.E. 45th to S. Lander

Street) would have 70,000 daily boardings in 2010 and 87,300 in 2020. If the preferred alternative were extended to Northgate, it would carry 156,400 daily riders by 2020.

The travel capacity in the project corridor would be substantially increased with the preferred alternative. Measured as "equivalent lane capacity," the person-carrying capacity of the north-south corridor would nearly double compared to the No-build Alternative.

Regional Land Use and Economic Activity

The light rail system is consistent with and supports the policies of relevant state and regional planning documents. Urban centers identified in Vision 2020 are located along the route alternatives of the proposed light rail system. The No-build Alternative, by not providing alternative transportation modes and lessening the ability of local jurisdictions to intensify land uses in urbanized areas, would not support adopted regional and local policies.

Net direct project expenditures (inflows of funds to the regional economy) would be about $298 million for the preferred alternative, $350 million for the Northgate to SeaTac alternative, and $270 million for MOS C, the least costly alternative. Total beneficial effects to the regional economy from project expenditures would be $492 million for the preferred alternative, $576 million for the Northgate to SeaTac alternative, and $446 million for MOS C. These effects would occur over the 8-year period of project planning, design, and construction.

Nearly 14,500 employees (direct total person-jobs) would be expected to be hired to design and construct the preferred alternative. These projections constitute 6,000 "net" new jobs for the preferred alternative, 7,100 new jobs for the Northgate to SeaTac alternative, and 5,200 new jobs for MOS C. The No-build Alternative would not create the new economic activity and jobs.

Property Acquisitions

As designed, the preferred alternative would acquire 145 properties, MOS A would acquire 117, MOS B would acquire 6, and MOS C would acquire 33. Property acquisitions would range from 103 to 348 for the Northgate to SeaTac alternative and 101 to 338 for the N.E. 45th Street to SeaTac alternative. In terms of full displacements, the low end of the range light rail "system" would consist of Alternatives A2.2, B1, C1.1, D1.3, E2, F2.1, and M1-C. Alternatives A2.1, B2.2, C2.3, D3.3, E3/E1.1, F1, and M1-E define the high end of the range.

Air Quality

Implementation of any other length alternative would result in lower mobile source pollutant emissions compared to the No-build Alternative and would support regional plans for air quality maintenance and conformance. All length alternatives are anticipated to conform to the State Implementation Plan for ozone.

Noise and Vibration

Before mitigation, the preferred alternative would create 334 noise and vibration impacts, but all impacts can be mitigated. The total receivers projected to have noise and/or vibration impacts is 87 to 456 with the N.E. 45th to SeaTac alternatives, before any mitigation is considered. Proposed mitigation measures would reduce the impacts to between 0 and 19 receivers. The Northgate to SeaTac alternatives would affect 99 to 556 receivers before mitigation, and 0 to 32 after. Under the No-build Alternative, noise and vibration levels in the proposed corridor would continue to be dominated by traffic, aircraft, and commercial and industrial activities. Traffic noise levels are expected to continue to exceed state criteria at several locations in the corridor, including along I-5, Rainier Avenue S., MLK Jr. Way S., Interurban Avenue, Tukwila International Boulevard, and International Boulevard. However, with mitigation proposed as part of the preferred alternative, noise levels inside affected residences would likely be lower with the light rail project than they are today.

Ecosystems

The preferred alternative would fill 2.13 acres of wetland and 1.60 acres of wetland buffer, remove 2.0 acres of other wildlife habitat, and potentially impact fisheries at four locations. Total ecosystem impacts would be similar for the Northgate to SeaTac or N.E. 45th to SeaTac alternatives. The only additional impacts would be minor effects to Thornton Creek and associated wetlands, if the system extends to Northgate. MOS A and MOS

C would have no wetland or fish habitat impacts. MOS A and MOS B would remove 0.34 acre of wildlife habitat from the base of Beacon Hill, and MOS B would fill up to 0.15 acre of wetland. The No-build Alternative would avoid the impacts associated with light rail construction and operation. Although, because the regional and local land use and transportation plans are dependent on increased high-capacity transit, implementation of the No-build Alternative could require that those plans be revised, and this could result in ecosystem impacts in other locations.

Water Quality and Hydrology

Implementation of either the Northgate to SeaTac or N.E. 45th to SeaTac alternatives (including the preferred alternative) would result in very low (24 yd^3) to moderate amounts of fill in local floodplains. New impervious surface (1,200,000 ft^2) would be created with implementation of the preferred alternative. Of the MOS alternatives, MOS C would create the least new impervious surface. Indirect water quality improvements from anticipated reductions in automobile use, emissions, and pollutants resulting from the project would not occur under the No-build Alternative.

Energy

The preferred alternative would consume 0.483 x 10^9 Btu daily, contributing to an overall regional energy demand of 567.618 x 10^9 Btu. The alternative would save 0.934 x 10^9 Btu over the No-build Alternative. The full-length alternative (Northgate to SeaTac) consumes slightly more energy, and results in a system savings of 0.859 x 10^9 Btu. The three MOS alternatives consume less energy than the preferred alternative, but also reduce regional system energy demand less than the preferred alternative because they carry fewer riders. System savings range from 0.901 x 10^9 Btu (MOS A) to 0.719 x 10^9 Btu (MOS C).

Hazardous Materials

Overall, the hazardous materials impacts from the light rail alternatives would be beneficial. Existing contamination on the sites that would be acquired for the light rail project might otherwise remain in place and potentially migrate. With the light rail alternatives, existing contamination (such as spill sites) or contamination sources (such as underground storage tanks) would be discovered and remediated sooner than would otherwise occur. There are risks associated with potential public exposure while uncovering and handling existing contaminated soils or groundwater. The preferred alternative would affect 29 known release sites and 84 potential sites. The N.E. 45th Street to SeaTac Alternative would affect from 24 to 43 known sites and up to 121 potential sites. The Northgate to SeaTac Alternative would directly impact 23 to 45 known sites and up to 123 potential sites. MOS A would affect 8 known and 30 potential sites, MOS B would affect 13 known and 55 potential sites, and MOS C would affect 7 known and 29 potential sites.

Historic and Archaeological Resources

The preferred alternative could adversely affect one potential property of cultural interest and one historic resource but these would be mitigated. It would cross three areas with high potential for archaeological resources and areas with potential resource. The impacts of the Northgate to SeaTac or N.E. 45th to SeaTac alternatives would be greater, MOS A, B and C each cross one area with high probability for archaeological resource. MOS B would also affect a historic resource, but with mitigation would avoid adverse affects to that resource. No adverse effects would occur with implementation of the No-build Alternative.

Parklands

The preferred alternative and the MOS alternatives would affect no park resources, after mitigation. The N.E. 45th Street to SeaTac alternative would result in the acquisition of property or proximity impacts for 9 to 19 parks and other recreation facilities and 0 to 7 after mitigation. The Northgate to SeaTac alternative could affect 10 to 21 parks and other recreation facilities and 0 to 7 after mitigation. No adverse effects to parklands would occur under the No-build Alternative.

S.10.3 Summary of Significant Unavoidable Adverse Impacts

The following summarizes the significant unavoidable adverse impacts in each segment.

Segment A

- Between two and ten residences, businesses and/or organizations would be displaced by the alternatives in Segment A. Although compensation for property and relocation assistance would be provided, relocation could still represent an inconvenience or hardship.
- After standard mitigation, Alternatives A1.1, A1.2 and A2.1 would have vibration impacts at four, nine and one residence(s), respectively.
- During construction, temporary lane or roadway closures, truck traffic, parking loss and displacements could cause significant impacts. Disruption during construction could create economic hardship for some businesses.

Segment B

- Between four and 20 residences, businesses and/or organizations would be displaced by the alternatives in Segment B. Although compensation for property and relocation assistance would be provided, relocation could still represent an inconvenience or hardship.
- Alternative B2.1 would cause significant visual impacts just west of the University of Washington.
- After standard mitigation, Alternative B2.1 would have vibration impacts at two residences.
- Alternative B2.1 would demolish the University Friends Meeting Hall – a property that appears to meet the criteria for City of Seattle Landmark status.
- Alternative B2.1 would acquire and shade parts of North and South Passage Point Parks adjacent to Portage Bay.
- During construction, temporary lane or roadway closures, truck traffic and parking loss could cause significant impacts. Disruption during construction could create economic hardship for some businesses.

Segment C

- Between four and 20 businesses, residences and/or organizations would be displaced by the alternatives in Segment C. Although compensation for property and relocation assistance would be provided, relocation could still represent an inconvenience or hardship.
- Alternatives C2.3 and C3 would have significant adverse effects on views toward Mt. Rainier from Rainier Avenue S. – a designated scenic route.
- Alternative C2.3 would demolish a portion of the Stewart Lumber Company building – a property eligible for listing in the National Register of Historic Places and likely eligible for City of Seattle Landmark status.
- Alternative C3 would acquire and cover part of the Future Sister City Park near I-90.
- During construction, temporary lane or roadway closures, truck traffic, parking loss and displacements could cause significant impacts. Disruption during construction could create economic hardship for some businesses.

Segment D

- Between 62 and 191 businesses, residences and/or organizations would be displaced by the alternatives in Segment D. Although compensation for property and relocation assistance would be provided, relocation could still represent an inconvenience or hardship.
- Alternative D1.3 would cause significant adverse visual impacts by creating high visual contrast along MLK Jr. Way S.

- After standard mitigation, Alternatives D1.1d, D1.3, D3.3, and D3.4 would have vibration impacts at six, seven, seventeen and eight residences, respectively.
- In Segment D, the at-grade McClellan Station Option (Option A) would preclude the reconnection of the historic Cheasty Boulevard and Mt. Baker Boulevard. These two boulevards are eligible for listing in the National Register of Historic Places. They are also considered public parkland resources.
- During construction, temporary lane or roadway closures, truck traffic and parking loss could cause significant impacts. Disruption during construction could create economic hardship for some businesses.

Segment E

- Between five and 16 businesses, residences and/or organizations would be displaced by the alternatives in Segment E. Although compensation for property and relocation assistance would be provided, relocation could still represent an inconvenience or hardship.
- Significant adverse visual impacts would occur in the Riverton Heights and Cascade View neighborhoods (E1.2), at the Green River Trail, Lookout Mini-Park and Foster Golf Links (E2), and in the Skyway neighborhood (E3).
- After standard mitigation, Alternative E2 would have vibration impacts at two residences.
- All the alternatives in Segment E would fill wetlands (1.54 to 2.02 acres). Identified mitigation measures could replace, and possibly increase, the functional values of these wetlands, but none of the alternatives could avoid wetland fill.
- Alternatives E2 and E3 would remove mature trees within riparian habitat along the Duwamish. This significant impact would likely be avoided only by using a different route.
- Alternative E2 would significantly impact Gilliam Creek and the adjacent flood plain if piers are placed in the creek channel or floodplain.
- With visual and proximity impacts, Alternative E2 would affect the recreational experience of Duwamish/Green River Trail users.
- During construction, temporary lane or roadway closures, truck traffic and parking loss could cause significant impacts. Disruption during construction could create economic hardship for some businesses.
- Because impacts in forested wetlands are difficult to mitigate, the construction related activities in forested wetlands could be a significant, unavoidable adverse impact associated with all of the alternatives in Segment E.

Segment F

- Between 14 and 53 residences, businesses and/or organizations would be displaced by the alternatives in Segment F. Although compensation for property and relocation assistance would be provided, relocation could still represent an inconvenience or hardship.
- Alternative F2.2 and F1 would cause significant adverse visual impacts at Bow Lake and Angle Lake Park, respectively.
- Alternative F1 would acquire a portion of Angle Lake Park. This significant impact could only be avoided by selecting one of the other Segment F routes.
- During construction, temporary lane or roadway closures, truck traffic and parking loss could cause significant impacts. Disruption during construction could create economic hardship for some businesses.

Table S.10-1
Segment A (Northgate to University District) Summary of Impacts and Trade-offs

Criteria		Alternative: A1.1 12th Ave. Tunnel	A1.2 Roosevelt Way Tunnel	A2.1 8th Ave. Short Elevated	A2.2 8th Ave. Elevated
Service Level					
Transit	Segment Travel Time	5.3 minutes	5.3 minutes	5.6 minutes	5.6 minutes
	Schedule Reliability (Operating)	Good	Good	Good	Good
	Daily Segment Boardings (2010/2020)	13,200/15,800	13,200/15,800	13,300/15,900	13,300/15,900
	Total Daily System Boardings (2010/2020)	124,000/149,000	124,000/149,000	125,000/150,100	125,000/150,100
	Average Transit Travel Time Savings in Segment[1]	10-12 minutes	10-12 minutes	10-12 minutes	10-12 minutes
	Total New Transit Riders (Regionwide, in 2020)	36,000	36,000	36,000	36,000
Roadway	No. Intersections with Degraded Operations (overall)[2]	2	2	2	2
	No. Intersection with Degraded Operations (minor approaches)	0	0	0	0
	No. Intersections with Right-In/Right-Out only	0	0	0	0
	No. Street Closures	0	0	0	0
	No. Lanes Removed	0	0	0	0
	Safety Impact	None	None	None	None
	On-street/Off-street Parking Spaces Removed[3]	18/140-196	10/140-196	18/140-196	8/140-196
	Potential for Spillover Parking	Medium	Medium	Medium	Medium
Non-motorized	Pedestrian/Bicycle Impact	Low	Low	Low	Low
Freight	Truck Delivery Impact	None	None	None	None
	Rail Delivery Impact	None	None	None	None
Navigable Waterways	No. of Bridge Crossings	0	0	0	0
Environmental Consequences					
Land Use	State, Regional and Local Plan Consistency	High	High	Medium-High	Medium-High
	Direct Land Use Impacts	Low	Low	Low	Low
Economic Development	Indirect Development Impacts	Low-Medium	Medium	Low-Medium	Low-Medium
	Short-term Property Tax Impacts	$57,500	$66,400	$63,700	$50,500
Acquisitions and Relocations	No. of Full Acquisitions (& Partial Acquisitions)	4 (3)	6 (3)	10 (3)	2 (4)
	No. of Housing Units Acquired	0	0	8	0
Neighborhoods	Impact to Neighborhood Quality	Low	Low	Low-Medium	Low
	Social Barrier	Low	Low	Low	Low

Notes: [1] Estimated work-to-home transit travel time savings for people living in Segment A when compared to the No-build scenario.

[2] This reflects the number of intersections degrading from No-build Alternative LOS A-D to LOS E or LOS F with light rail, or an increase in average delay or volume-to-capacity ratio within the LOS E or LOS F range.

[3] The proposed 1,300 space park-and-ride facility for the Northgate Station would meet the highest estimated parking demand from light rail after accounting for existing park-and-ride spaces displaced by the Station and parking structure.

The preferred alternative is identified in italics.

Table S.10-1 continued

Criteria		Alternative			
		A1.1 12th Ave. Tunnel	A1.2 Roosevelt Way Tunnel	A2.1 8th Ave. Short Elevated	A2.2 8th Ave. Elevated
Environmental Consequences continued					
Visual and Aesthetic	Adverse Impacts	Low	Low	Low-Medium	Low
Air Quality	Local Impact[5]	No Change	No Change	No Change	No Change
Noise and Vibration[6,7]	No. Buildings Impacted by Light Rail Noise	8 (0)	8 (0)	12 (0)	22 (0)
	No. Buildings Impacted by Traffic Noise	0 (0)	0 (0)	3 (0)	3 (0)
	No. Buildings Impacted by Vibration	95 (4)	100 (9)	11 (1)	21 (0)
Ecosystems	Acres of Filled Wetlands	(shading only)	(shading only)	(shading only)	(shading only)
	Wildlife or Vegetation Impact	No Impact	No Impact	No Impact	No Impact
	Fisheries Impact	Low	Low	Low	Low
Water Quality & Hydrology	Overall Impact	Low	Low	Low	Low
Geology	Long-term Impact Potential	Low-None	Low-None	Low-None	Low-None
Hazardous Materials	No. of Sites of Highest Concern	2	5	2	2
EMF		None	None	None	None
Public Services	Potential Service Delays	No Difference	No Difference	No Difference	No Difference
Utilities	Short-term Service Disruption	Moderate	Moderate	Low	Low
Archaeological	No. of Known Sites Potentially Affected	0	0	0	0
	No. of High-Probability Areas	0	0	0	0
Historic[7]	No. of Sites Adversely Affected	0	0	2 (0)	2 (0)
Parklands	No. Significantly Impacted	0	0	1	2
Construction	Overall Temporary Impacts	Medium	Medium	Medium-Low	Medium-Low
Financial Analysis					
Costs (1995$)	Capital	$364 M	$391 M	$335 M	$303 M
	Vehicles	$0 M	$0 M	$0 M	$0 M
	Additional Annual O & M	$0	$0	–$0.1 M	–$0.1M

Notes: [5] Based on evaluation of highest volume intersections with worst predicted level of service in each segment, pollutant concentrations are expected to decrease with any alternative.
[6] Both moderate and severe impacts over the FTA thresholds are reported. (Sound barrier mitigation is not appropriate in every location and is particularly difficult with some at-grade light rail alternatives due to roadway widening).
[7] Numbers in parentheses indicate impacts remaining after mitigation.
The preferred alternative is identified in italics.

Table S.10-2
Segment B (University District to Westlake Station) Summary of Impacts and Trade-offs

Criteria		*B1a,b Capitol Hill Tunnel*[6]	B2.1 Seattle Center High-level Bridge	B2.2 Seattle Center Tunnel
Service Level				
Transit	Segment Travel Time[1]	9.4-10.0 minutes	12.2-12.8 minutes	11.6-12.2 minutes
	Schedule Reliability (Operating)	Very good	Very good	Very good
	Daily Segment Boardings[2] (2010/2020)	40,400/47,200	25,200/32,000	27,800/36,000
	Total Daily System Boardings[2] (2010/2020)	124,000/149,100	95,100/119,000	99,500/125,100
	Average Transit Travel Time Savings in Segment[3]	7 minutes	6 minutes	6 minutes
	Total New Transit Riders (Regionwide, in 2010)	36,000	27,000	29,000
Roadway	No. Intersections with Degraded Operations (overall)[4]	1	0	0
	No. Intersection with Degraded Operations (minor approaches)	0	0	0
	No. Intersections with Right-In/Right-Out only	0	0	0
	No. Street Closures	0-1	1	0
	No. Lanes Removed	0	2	0
	Safety Impact	No Impact	No Impact	No Impact
	On-street/Off-street Parking Spaces Removed[5]	27-31/0-10	55-59/40-50	19-23/40-50
	Potential for Spillover Parking	Medium-Low	Medium	Medium
Non-motorized	Pedestrian/Bicycle Impact	Medium	Low	Medium
Freight	Truck Delivery Impact	None	None	None
	Rail Delivery Impact	None	None	None
Navigable Waterways	No. of Bridge Crossings	0	1	0
Environmental Consequences				
Land Use	State, Regional and Local Plan Consistency	High	High	High
	Direct Land Use Impacts	Low	Medium-Low	Low
Economic Development	Indirect Development Impacts	Low-Moderate	Low-Moderate	Low
	Short-term Property Tax Impacts	$40,000	$138,200	$117,700
Acquisitions and Relocations	No. of Full Acquisitions (& Partial Acquisitions)	4 (4)	18 (17)	20 (12)
	No. of Housing Units Acquired	0	40	0
Neighborhoods	Impact to Neighborhood Quality	Low	Low-Medium	Low
	Social Barrier	Low	Low	Low

Notes: [1] Totals depend on whether the potential Roy/Aloha station is built and also whether Convention Place station is rebuilt.
[2] Ridership under a Northgate-SeaTac baseline system.
[3] Estimated work-to-home transit travel time savings for people living in Segment B when compared to the No-build scenario.
[4] This reflects the number of intersections degraded from No-build Alternative LOS A-D to LOS E or LOS F with light rail, or an increase in average delay or volume-to-capacity ratio within the LOS E or LOS F range.
[5] Maximum displacement in the Seattle Center Surface parking lot.
[6] Alternative B1a is the preferred alternative. Alternative B1b would include a Convention Place Station and a potential Roy/Aloha Station. The potential Roy/Aloha Station would have the same impacts, except the segment travel time would be 10.2 to 10.8 minutes. Ridership is shown for alternative B1a.
The preferred alternative is identified in italics.

Table S.10-2 continued

Criteria		B1a,b *Capitol Hill Tunnel*[6]	B2.1 Seattle Center High-level Bridge	B2.2 Seattle Center Tunnel
		Alternative		
Environmental Consequences continued				
Visual and Aesthetic	Adverse Impacts	Low	Medium	Low-Medium
Air Quality	Local Impact[8]	No Change	No Change	No Change
Noise and Vibration[9,12]	No. Buildings Impacted by Light Rail Noise	0	23(0)	0
	No. Buildings Impacted by Traffic Noise	0	0	0
	No. Buildings Impacted by Vibration	4(0)	25 (2)	7 (0)
Ecosystems	Acres of Filled Wetlands	No Impact	No Impact	No Impact
	Wildlife or Vegetation Impact	Low	Low-Medium	Low
	Fisheries Impact	Low/Medium	Low	Low
Water Quality & Hydrology	Overall Impact	Low	Low	Low
Geology	Long-term Impact Potential	Slight-None	High-None	Medium-None
Hazardous Materials	No. of Sites of Highest Concern	27	38	47
EMF		Medium	Low	Medium
Public Services	Potential Service Delays	No difference	No difference	No difference
Utilities	Short-term Service Disruption	Low	Medium	Low
Archaeological	No. of Known Sites Potentially Affected	0	0	0
	No. of High-Probability Areas	0	2 (0)	1 (0)
Historic[12]	No. of Sites Adversely Affected[10]	1 (0)	3-5 (1)	2-4 (0)
Parklands	No. Significantly Impacted	0	2	0
Construction	Overall Temporary Impacts	Medium	Medium	Medium
Financial Analysis				
Costs (1995$)	Capital[11]	$862 M / $975 M	$794 M / $889M	$794 M / $889 M
	Additional Vehicles	$0 M	$17 M	$13 M
	Total Additional Annual O & M	$0 M	$2.3 M	$1.6 M

Notes: [8] Based on evaluation of highest volume intersection with worst predicted level of service in each segment, pollutant concentrations are expected to decrease with any alternative.

[9] Both moderate and severe impacts over the FTA thresholds are reported. (Sound barrier mitigation is not appropriate in every location and is particularly difficult with some at-grade light rail alternatives due to roadway widening.) Low-frequency vibration could affect research at the University of Washington Physics and Astronomy Building.

[10] Numbers reflect the impacts of rebuilding Convention Place Station for each alternative.

[11] Higher capital cost includes new Convention Place Station and construction of mezzanines in new deep tunnel stations.

[12] Numbers in parentheses indicate impacts remaining after mitigation.

The preferred alternative is identified in italics.

Table S.10-3
Segment C (Westlake Station to S. McClellan Street) Summary of Impacts and Trade-offs

	Criteria	Alternative							
		C1.1 At-grade center of Lander St.	***C1.2 At-grade north of Lander St.***	**C1.3 Elevated north of Lander Street**	**C1.4 Elevated south of Forest Street**	**C1.5 Massachusetts Street and I-5 right-of-way**	**C2.3 West of Rainier Ave. S. Elevated**	**C2.4 Rainier Ave. S. Tunnel**	**C3 S. Massachusetts St. Tunnel**
Service Level									
Transit	Segment Travel Time[1]	11.4-12.2 min.	11.5 min.	10.6-11.4 min.	11.1-11.9 min.	11.0-11.8 min.	10.5 min.	10.6 min.	11.0 min.
	Schedule Reliability (Operating)	Very Good	Very Good	Very Good	Very Good	Very Good	Good	Good	Very Good
	Daily Segment Boardings[2] (2010/2020)	48,400-53,200/ 61,200–67,000	48,400-53,200/ 61,200–67,000	48,400-53,200/ 61,200–67,000	48,400-53,200/ 61,200–67,000	46,700/59,100	47,900/ 60,200	46,900/59,100	48,600/61,800
	Total Daily System Boardings[2] (2010/2020)	124,700-127,900/ 151,700–156,200	124,700-127,900/ 151,700–156,200	124,700-127,900/ 151,700–156,200	124,700-127,900/ 151,700–156,200	122,800/147,400	124,000/ 149,000	122,800/ 147,400	124,300/149,800
	Average Transit Travel Time Savings in Segment[3]	6 min.	6 min.	6 min.	6 min.	5 min.	5 min.	5 min.	5 min.
	Total New Transit Riders (Regionwide, in 2010)	37,000-38,000	37,000-38,000	37,000-38,000	37,000-38,000	36,000	36,000	36,000	36,000
Roadway	No. Intersections with Degraded Operations (overall)[4]	0	0	0	0	0	0	0	0
	No. Intersection with Degraded **Operations (minor approaches)	0	0	0	0	0	0	0	0
	No. Intersections with Right-in/Right-out only	4	4	4	4	1	5	0	1
	No. Street Closures	0	0	0	0	1	4	3	1
	No. Lanes Removed	0	0	0	0	0	0	0	0
	Safety Impact	Low	Low	Low	Low	Low	Low	Low	Low
	On-street/Off-street Parking Spaces Removed[5]	27/235	11/235	0-5/235	0-5/235	15-25/15	38/0	0/200	15-25/0
	Potential for Spillover Parking	Medium	Medium	Medium	Medium	Medium	Medium	Low	Medium
Non-motorized	Pedestrian/Bicycle Impact	Medium	Medium	Medium	Medium	Medium	Medium	Low	Medium
Freight	Truck Delivery Impact	Medium	Medium	Medium	Medium	Medium	Medium	Low	Medium
	Rail Delivery Impact	High	High	High	High	Low	Low	Low	Low
Navigable Waterways	No. of Bridge Crossings	0	0	0	0	0	0	0	0
Environmental Consequences									
Land Use	State, Regional and Local Plan Consistency	Medium	Medium	Medium	Medium	Medium	High	Medium	Medium
	Direct Land Use Impacts	Low	Low	Low	Low	Low	Low	Low	Low
Econ. Development	Indirect Development Impacts	Low	Low	Low	Low	Low	Medium-Low	Low	Low
	Short-term Property Tax Impacts	$38,600	$86,400	$38,600	$39,400	$161,100	$147,300	$85,900	$92,200
Acquisitions	No. of Full Acquisitions (& Partial Acquisitions)	12 (3)	15 (9)	14 (2)	14 (5)	27 (10)	40 (21)	15 (1)	33 (20)
	No. of Housing Units Acquired	2	2	2	2	2	12	1	21
Neighborhoods	Impact to Neighborhood Quality	Low	Low	Low	Low	Low	Low-Medium	Low	Low-Medium
	Social Barrier	Low	Low	Low	Low	Low	Low	Low	Low

Notes: [1] Total depends on which station options are selected. In particular, as it relates to the potential Beacon Hill station.

[2] Variations in ridership of 2000 boardings or more in 2010 are considered significant. Ridership shown is system maximum under Northgate-SeaTac. For the C1 alternatives, the range reflects a potential Beacon Hill station. All forecasts are for a Northgate-SeaTac baseline system.

[3] Estimated work-to-home transit travel time savings for people living in Segment C when compared to the No-build scenario.

[4] This reflects the number of intersections degraded from No-build Alternative LOS A-D to LOS E or LOS F with light rail, or an increase in average delay or volume-to-capacity ration within the LOS E or LOS F range.

[5] C1 off-street parking lot near the Beacon Hill Station. C2.4 parking displacement is for an off-street lot on S. Poplar St.

The preferred alternative is identified in italics.

Table S.10-3 continued

Criteria		C1.1 At-grade center of Lander St.	*C1.2 At-grade north of Lander St.*	C1.3 Elevated north of Lander Street	C1.4 Elevated south of Forest Street	C1.5 Massachusetts Street and I-5 right-of-way	C2.3 West of Rainier Ave. S. Elevated	C2.4 Rainier Ave. S. Tunnel	C3 S. Massachusetts St. Tunnel
		Alternative							
Environmental Consequences continued									
Visual and Aesthetic	Adverse Impacts	Low	Low	Low	Low	Low	High	Low	High
Air Quality	Local Impact[7]	No difference	No difference	No difference	No difference	No difference	No difference	No difference	No difference
Noise and Vibration[8,9]	No. Buildings Impacted by Light Rail Noise	0	0	0	0	0	15 (0)	0	16 (0)
	No. Buildings Impacted by Traffic Noise	0	0	0	0	0	0	0	0
	No. Buildings Impacted by Vibration	0	0	0	0	0	1 (0)	0	13 (0)
Ecosystems	Acres of Filled Wetlands	None	None	None	None	None	None	None	None
	Wildlife or Vegetation Impact	Medium-Low	Medium-Low	Medium-Low	Medium-Low	Medium-Low	None	None	Medium-Low
	Fisheries Impact	None	None	None	None	None	None	None	None
Water Quality & Hydrology	Overall Impact	None	None	None	None	None	None	None	None
Geology	Long-term Impact Potential	Medium-None	Medium-None	Medium-None	Medium-None	Medium-None	High-None	High-None	High-None
Hazardous Materials	No. of Sites of Highest Concern	13	10	16	10	17	29	20	23
EMF		None	None	None	None	None	None	None	None
Public Services	Potential Service Delays	No difference	No difference	No difference	No difference	No difference	No difference	No difference	No difference
Utilities	Short-term Service Disruption	Low-Moderate	Low-Moderate	Low-Moderate	Low-Moderate	Low-Moderate	Moderate	Moderate	Low
Archaeological	No. of Known Sites Potentially Affected	0	0	0	0	0	0	0	0
	No. of High-Probability Areas	0	0	0	0	0	0	0	0
Historic[9]	No. of Sites Adversely Affected	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	2 (1)	0 (0)	1 (0)
Parklands	No. Significantly Impacted	0	0	0	0	0	0	0	2
Construction	Overall Temporary Impacts	Medium-Low	Medium-Low	Medium-Low	Medium-Low	Medium-Low	Medium	Medium	Medium
Financial Analysis									
Costs (1995$)	Capital	$227 M	$228 M	$237 M	$235 M	$224 M	$149 M	$241 M	$207 M
	Vehicles	$0 M	$0 M	$0 M	$0 M	$0 M	$0 M	$0 M	$0 M
	Total Additional Annual O & M	$0.3	$0.3 M	$0.4 M	$0.5 M	$-0.1 M	$0 M	$0.1 M	$0 M

Notes: [7] Based on evaluation of highest volume intersections with worst predicted level of service in each segment, pollutant concentrations are expected to decrease with an alternative.

[8] Both moderate and severe impacts over the FTA thresholds are reported. (note: sound barrier mitigation is not appropriate in every location and is particularly difficult with some at-grade light rail alternatives due to roadway widening).

[9] Numbers in parentheses indicate impacts remaining after mitigation.

The preferred alternative is identified in italics.

Table S.10-4
Segment D (S. McClellan Street to Boeing Access Road) Summary of Impacts and Trade-offs

Criteria		D1.1c MLK Jr. Way S. 4-lane At-grade	D1.1d MLK Jr. Way S. 2-lane At-grade	*D1.1e MLK Jr. Way S. At-grade 4-lane*	D1.1f MLK Jr. Way S. At-grade 2-lane	D1.3 MLK Jr. Way S. Combined Profile	D3.3 Alaska St. Crossover	D3.4 37th Ave. S. Tunnel
		Alternative						
Service Level								
Transit	Segment Travel Time	9.8-10.5 min.	9.8-10.5 min.	10.5 min.	10.5 min.	8.9-9.6 min.	10.1-11.3 min	10.2-11.4 min
	Schedule Reliability (Operating)	Fair	Fair	Fair	Fair	Good	Fair	Good
	Daily Segment Boardings (2010/2020)	12,100/15,300	12,100/15,300	12,100/15,300	12,100/15,300	12,400/15,000	12,800/16,000	12,300/15,500
	Total Daily System Boardings[1] (2010/2020)	123,300/148,200	123,300/148,200	123,300/ 148,200	123,300/ 148,200	124,300/149,400	124,100/149,200	124,000/ 149,100
	Average Transit Travel Time Savings in Segment[2]	18 to 19 min.	18 to 19 min.	18 to 19 min.	18 to 19 min.	18 to 19 min.	18 to 19 min.	18 to 19 min.
	Total New Transit Riders (Regionwide, in 2010)	36,000	36,000	36,000	36,000	36,000	36,000	36,000
Roadway	No. Intersections with Degraded Operations (overall)[3]	1	4	1	5	1	2	1
	No. Intersection with Degraded Operations (minor approaches)	3	7	5	6	2	9	8
	No. Intersections with Right-In/Right-Out only	39	39	34	34	39	16	16
	No. Street Closures	0	0	1	1	0	3	1
	No. Lanes Removed	0	2	0	2	0	0	0
	Safety Impact	Medium	Medium	Low-Medium	Low-Medium	Medium	Medium	Medium
	On-street/Off-street Parking Spaces Removed[4]	3/284	3/163	3/232	3/232	3/129	68-71/247	46-53/177
	Potential for Spillover Parking	High	High	High	High	High	High	High
Non-motorized	Pedestrian/Bicycle Impact	Medium	Medium	Low	Low	Low	Low	Low
Freight	Truck Delivery Impact	Medium	Medium	Medium	Medium	Medium	Medium	Medium
	Rail Delivery Impact	Low	Low	Low	Low	Low	Low	Low
Navigable Waterways	No. of Bridge Crossings	0	0			0	0	0
Environmental Consequences								
Land Use	State, Regional and Local Plan Consistency	High	High	High	High	Medium	Medium-High	Medium-High
	Direct Land Use Impacts	High	Medium-High	Medium-High	Medium-High	Medium-High	High	High
Economic Development	Indirect Development Impacts	Low	Low	Low	Low	Low	Low	Low
	Short-term Property Tax Impacts	$174,700	$116,100	$141,700	$117,800	$174,600	$281,600	$259,800
Acquisitions & Relocations	No. of Full Acquisitions (& Partial Acquisitions)	110 (192)	63 (103)	84 (156)	77 (139)	62 (120)	191 (158)	143 (116)
	No. of Housing Units Acquired	69	23	46	41	35	114	71
Neighborhoods	Impact to Neighborhood Quality	Medium	Low-Medium	Low-Medium	Low-Medium	Medium	Medium	Medium
	Social Barrier	Medium	Medium	Medium	Medium	Medium	High	High

Notes:
1 Maximum ridership forecasts with a Northgate-SeaTac baseline system.
2 Estimated work-to-home transit travel time savings for people living in Segment D when compared to the No-build scenario.
3 This reflects the number of intersections degraded from No-build Alternative LOS A-D to LOS E or LOS F with light rail, or an increase in average delay or volume-to-capacity ratio within the LOS E or LOS F range.
4 Off-street parking displacements are for partial commercial property displacements only.
The preferred alternative is identified in italics.

Table S.10-4 continued

Criteria		Alternative: D1.1c MLK Jr. Way S. 4-lane At-grade	D1.1d MLK Jr. Way S. 2-lane At-grade	*D1.1e MLK Jr. Way S. At-grade 4-lane*	D1.1f MLK Jr. Way S. At-grade 2-lane	D1.3 MLK Jr. Way S. Combined Profile	D3.3 Alaska St. Crossover	D3.4 37th Ave. S. Tunnel
Environmental Consequences continued								
Visual and Aesthetic	Adverse Impacts	Medium	Low	Low	Low	High	Medium	Medium
Air Quality	Local Impact[6]	No Change	No Change	No Change	No Change	Beneficial	Beneficial	Beneficial
Noise and Vibration[7,9]	No. Buildings Impacted by Light Rail Noise	52 (0)	58 (0)	52 (0)	52 (0)	241 (0)	129 (4)	124 (0)
	No. Buildings Impacted by Traffic Noise	299 (0)	14 (0)	231 (0)	14 (0)	273 (0)	205 (0)	139 (0)
	No. Buildings Impacted by Vibration	0 (0)	6 (6)	0 (0)	0 (0)	7 (7)	58 (17)	79 (8)
Ecosystems	Acres of Filled Wetlands	0.15 acres	0.11 acres	0.11 acres	0.11 acres	0.11 acres	0.11 acres	0.11 acres
	Wildlife or Vegetation Impact	Low	Low	Low	Low	Low	Low	Low
	Fisheries Impact	None	None	None	None	None	None	None
Water Quality & Hydrology	Overall Impact	Low	Low	Low	Low	Low	Low	Low
Energy		No difference	No difference	No difference	No difference	No difference	No difference	No difference
Geology	Long-term Impact Potential	Low-None	Low-None	Low-None	Low-None	Low-None	Medium-None	Medium-None
Hazardous Materials	No. of Sites of Highest Concern	50	11	50	50	36	56	41
EMF		None	None	None	None	None	None	None
Public Services	Potential Service Delays	Medium	Medium	Medium-Low	Medium-Low	Low	Medium	Low
Utilities	Short-term Service Disruption	High	High	High	High	Moderate	Moderate	Moderate
Archaeological	No. of Known Sites Potentially Affected	0	0	0	0	0	0	0
	No. of High-Probability Areas/Sites	1 (0-1)	1 (0-1)	1 (0)	1 (0-1)	1 (0)	1 (0)	1 (0)
Historic	No. of Sites Adversely Affected	1 (0-1)	1 (0-1)	1	1 (0-1)	2 (0-1)	9 (0-1)	10 (0-1)
Parklands	No. Significantly Impacted	0-1	0-1	0	0	0	1	0
Construction	Overall Temporary Impacts	Medium-High	Medium	Medium	Medium	Medium	Medium	High
Financial Analysis								
Costs (1995$)	Capital[8]	$195/$206 M	$174/$185 M	$201 M	$197 M	$254 M	$222 M	$356 M
	Vehicles	$0 M	$0 M	$0 M	$0 M	$0 M	$0 M	$0 M
	Total Additional Annual O & M	–$0.7 M	–$0.7 M	–$0.7 M	–$0.7 M	–$1.1 M	$0 M	–$0.1 M

Notes: [6] Based on evaluation of highest volume intersections with worst predicted level of service in each segment, pollutant concentrations are expected to decrease with any alternative.
[7] Both moderate and severe impacts over the FTA thresholds are reported. (Sound barrier mitigation is not appropriate in every location and is particularly difficult with some at-grade light rail alternatives due to roadway widening).
[8] Capital cost depends on whether McClellan Station is at-grade or elevated.
[9] Numbers in parentheses indicate impacts remaining after mitigation.
The preferred alternative is identified in italics.

Table S.10-5
Segment E (Tukwila) Summary of Impacts and Trade-offs

		Alternative			
Criteria		***E1.1 Tukwila International Blvd. Combined Profile***	**E1.2 Tukwila International Blvd. Elevated**	**E2 Interurban Ave.**	**E3 MLK Jr. Way S.**
Service Level					
Transit	Segment Travel Time	7.6 min.	6.9 min.	14.6 min.	11.0 min.
	Schedule Reliability (Operating)	Fair	Good	Good	Good
	Daily Segment Boardings (2010/2020)	2,100/2,300	2,200/2,400	4,000/3,700	4,500/4,800
	Total Daily System Boardings[1] (2010/2020)	124,000/149,000	124,800/149,800	123,700/149,300	125,300/151,900
	Average Transit Travel Time Savings in Segment[2]	5 min.	5 min.	5 min.	6 min.
	Total New Transit Riders (Regionwide, 2010)	36,000	37,000	36,000	37,000
Roadway	No. Intersections with Degraded Operations (overall)[3]	3	2	3	3
	No. Intersection with Degraded Operations (minor approaches)	2	2	3	1
	No. Intersections with right-in/right-out only	9	9	0	0
	No. Street Closures	0	0	1	1
	No. Lanes Removed	0	0	0	0
	Safety Impact	Medium	Medium	Low	Low
	On-street/Off-street Parking Spaces Removed[4]	0/124	0/112	0/314	0/260-460
	Potential for Spillover Parking	Medium	Medium	Low	Low
Non-motorized	Pedestrian/Bicycle Impact	Medium	Low	Low	Low
Freight	Truck Delivery Impact	Medium	Medium	Medium	Low
	Rail Delivery Impact	Medium	Medium	Medium	Low
Navigable Waterways	No. of Bridge Crossings	1	1	3	1
Environmental Consequences					
Land Use	State, Regional and Local Plan Consistency	Medium	Medium	High	High
	Direct Land Use Impacts	Medium-Low	Medium-Low	Medium-Low	Medium
Economic Development	Indirect Development Impacts	Low	Low	Low	Low
	Short-term Property Tax Impacts	$51,000	$27,100	$2,100	$31,900
Acquisitions and Relocations	No. of Full Acquisitions (& Partial Acquisitions)	16 (74)	7 (63)	5 (62)	16 (94)
	No. of Housing Units Acquired	8	5	2	7
Neighborhoods	Impact to Neighborhood Quality	Low-Medium	Low-Medium	Low	Low
	Social Barrier	Medium	Medium	Medium	Low-Medium

Notes: [1] Ridership forecasts with a Northgate-SeaTac baseline system. Variations in systemwide ridership of 2,000 or more are considered significant (in this case for E3 in 2020 as compared to E1).
[2] Estimated work-to-home transit travel time savings for people living in Segment E when compared to the No-build scenario.
[3] This reflects the number of intersections degraded from No-build Alternative LOS A-D to LOS E or LOS F with light rail, or an increase in average delay or volume-to-capacity ratio within the LOS E or LOS F range.
[4] Off-street parking displacements are for partial commercial property displacements only.
The preferred alternative is identified in italics.

Table S.10-5 continued

Criteria		*E1.1 Tukwila International Blvd. Combined Profile* (Alternative)	E1.2 Tukwila International Blvd. Elevated (Alternative)	E2 Interurban Ave. (Alternative)	E3 MLK Jr. Way S. (Alternative)
Environmental Consequences continued					
Visual and Aesthetic	Adverse Impacts	Medium	High	High	Medium-High
Air Quality	Local Impact[7]	No Impact	No Impact	No Impact	No Impact
Noise and Vibration[8,9]	No. Buildings Impacted by Light Rail Noise	56 (0)	109 (0)	26 (0)	25 (0)
	No. Buildings Impacted by Traffic Noise	99 (0)	110 (0)	25 (0)	0
	No. Buildings Impacted by Vibration	23 (0)	0 (0)	2 (2)	17 (0)
Ecosystems	Acres of Filled Wetlands	2.02 acres	2.02 acres	1.54 acres	1.61 acres
	Wildlife or Vegetation Impact	High	High	Very High	Very High
	Fisheries Impact	Low	Low	High	Medium-High
Water Quality & Hydrology	Overall Impact	Low-Medium	Low-Medium	High	Medium-High
Energy		No difference	No difference	No difference	No difference
Geology	Long-term Impact Potential	Medium-None	Medium-None	High-Low	High-Low
Hazardous Materials	No. of Sites of Highest Concern	12	13	13	6
EMF		None	None	None	None
Public Services	Potential Service Delays	Medium	Low	Low	None
Utilities	Short-term Service Disruption	Medium-High	Medium-High	High	Low
Archaeological	No. of Known Sites Potentially Affected	0	0	2 (0)	1 (0)
	No. of High-Probability Areas	1 (0)	1 (0)	1 (0)	2 (0)
Historic[9]	No. of Sites Adversely Affected	0	0	2 (0)	1 (0)
Parklands	No. Significantly Impacted	0	0	3	0
Construction	Overall Temporary Impacts	Medium	Medium	Medium	Medium
Financial Analysis					
Costs (1995$)	Capital	$174 M	$213 M	$299 M	$329 M
	Vehicles	$0 M	$0 M	$17 M	$10 M
	Total Additional Annual O & M	$0 M	$0 M	$4.9 M	$3.5 M

Notes: [7] Based on evaluation of highest volume intersection with worst predicted level of service in each segment, pollutant concentrations are expected to decrease with any alternative.
[8] Both moderate and severe impacts over the FTA thresholds are reported. (Sound barrier mitigation is not appropriate in every location and is particularly difficult with some at-grade light rail alternatives due to roadway widening).
[9] Numbers in parentheses indicate impacts remaining after mitigation.
The preferred alternative is identified in italics.

Table S.10-6
Segment F (SeaTac) Summary of Impacts and Trade-offs

Criteria		Alternative							
		F1 Int. Blvd. At-grade	**F2.1 Wa. Mem. Park Cty. Ctr. West**	**F2.2 Wa. Mem. Park Cty. Ctr. East**	***F2.3 Washington Memorial Park, Elevated east of 28th Ave. S.***	**F3.1 W. of Int. Blvd. Gr. Knoll**	**F3.2 W. of Int. Blvd. Main Term.**	**F3.3 West of Int'l Blvd./IMC**	**F4 Int'l Blvd. to 28th/24th**
Service Level									
Transit	Segment Travel Time[1]	6.0-6.7 min.	6.2 min.	6.7 min.	5.1-5.9 min.	5.7 min.	6.5-7.2 min.	4.8 min.	5.1 min.
	Schedule Reliability (Operating)	Fair	Good	Good	Good	Good	Good	Good	Good
	Daily Segment Boardings[2] (2010/2020)	6,400/6,400	6,400/6,400	6,400/6,400	7,500/7,900	6,600/6,600	8,200/8,200	7,500/7,900	7,500/7,700
	Total Daily System Boardings[2] (2010/2020)	122,700 /147,900	122,700/147,900	122,700/ 147,900	123,100/ 148,900	123,100/ 148,300	124,000/ 149,000	122,700/ 149,000	123,100/ 148,900
	Average Transit Travel Time Savings in Segment[3]	7-8 min.	7-8 min.	7-8 min.	7-8 min.	7-8 min.	7-8 min.	7-8 min.	7-8 min.
	Total New Transit Riders ((Regionwide, in 2010))	36,000	36,000	36,000	36,000	36,000	36,000	36,000	36,000
Roadway	No. Intersections with Degraded Operations (overall)[4]	2	4	4	4-7	4	7	7	4
	No. Intersection with Degraded Operations (minor approaches)	2-4	1	1	3-5	2	2	1-2	4
	No. Intersections with Right-In/Right-Out only	3	1	1	3	1	1	1	2
	No. Street Closures	0	0	0	0	0	0	0	0
	No. Lanes Removed	0	0	0	0	0	0	0	0
	Safety Impact	Medium	Low	Low	Low	Low	Low	Low	Low
	On-street/Off-street Parking Spaces Removed[5]	40/711	40/519	40/552	40/226	40/334	40/328	40/258	40/206
	Potential for Spillover Parking	Low	Low	Low	Low	Low	Low	Low	Low
Non-motorized	Pedestrian/Bicycle Impact	Medium	Low	Low	Low	Low	Low	Low	Low
Freight	Truck Delivery Impact	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
	Rail Delivery Impact	Low	Low	Low	Low	Low	Low	Low	Low
Navigable Waterways	No. of Bridge Crossings	0	0	0	0	0	0	0	0
Environmental Consequences									
Land Use	State, Regional and Local Plan Consistency	Medium-High	High	High	Medium-High	Medium-High	Medium-High	Medium-High	Medium-High
	Direct Land Use Impacts	Medium-High	Low	Medium-Low	Medium-Low	Medium-Low	Medium-Low	Medium-Low	Medium-Low
Economic Development	Indirect Development Impacts	Low	Low	Medium	Low	Low	Low	Low	Low
	Short-term Property Tax Impacts	$311,900	$89,500	$313,100	$39,500	$156,900	$158,200	$104,400	$87,200
Acquisitions and Relocations	No. of Full Acquisitions (& Partial Acquisitions)	53 (86)	13 (68)	19 (62)	12 (47)	26 (94)	30 (89)	22 (86)	15 (82)
	No. of Housing Units Acquired	3	2	2	2	2	2	2	2
Neighborhoods	Impact to Neighborhood Quality	Low-Medium	Low	Low	Low	Low	Low	Low	Low
	Social Barrier	Low	Low	Low	Low	Low	Low	Low	Low

Notes: [1] This range reflects the impact of adding the potential North SeaTac station. For the purposes of analysis it was only associated with 2 of the 5 alternatives though it could be built with any.
[2] Variation in systemwide ridership is within the margin of error in the model and therefore not significant. Ridership shown is with a Northgate-SeaTac baseline +system.
[3] Estimated work-to-home transit travel time savings for people living in Segment F when compared to the No-build scenario.
[4] Reflects the number of intersections degraded from No-build Alternative LOS A-D to LOS E or F with light rail, or an increase in average delay or volume-to-capacity ratio within the LOS E or LOS F range. Where range is shown, impacts may vary due to station options.
[5] Off-street parking displacements are for partial commercial property displacements only.
The preferred alternative is identified in italics.

Table S.10-6 continued

	Criteria	Alternative: F1 Int. Blvd. At-grade	F2.1 Wa. Mem. Park Cty. Ctr. West	F2.2 Wa. Mem. Park Cty. Ctr. East	*F2.3 Washington Memorial Park, Elevated east of 28th Ave. S.*	F3.1 W. of Int. Blvd. Gr. Knoll	F3.2 W. of Int. Blvd. Main Term.	F3.3 West of Int'l Blvd./IMC	F4 Int'l Blvd. to 28th/24th
Environmental Consequences continued									
Visual and Aesthetic	Adverse Impacts	Medium	Low-Med.	Medium	Low	Low	Low	Low-Med.	Low-Med.
Air Quality	Local Impact[6]	Mitigable violation	Beneficial	No Change	No Change	No Change	No Change	No Change	No Change
Noise and Vibration[7]	No. Buildings Impacted by Light Rail Noise	0 (0)	0 (0)	6 (0)	0 (0)	4 (0)	4 (0)	0 (0)	2 (0)
	No. Buildings Impacted by Traffic Noise	0	0	0	0	0	0	0	0
	No. Buildings Impacted by Vibration	0	0	0	0	0	0	0	0
Ecosystems	Acres of Filled Wetlands	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
	Wildlife or Vegetation Impact	Medium	Medium	Medium	Medium	Medium-High	Medium-High	Medium	Medium
	Fisheries Impact	None	None	Low-Medium	None	None	None	None	None
Water Quality & Hydrology	Overall Impact	Low	Low	Low-Medium	Low	Low	Low	Low	Low
Energy		No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Geology	Long-term Impact Potential	Low-None	Medium-None	High-None	Low-None	Low-None	Low-None	Low-None	Low-None
Hazardous Materials	No. of Sites of Highest Concern	30	24	21	19	25	26	29	30
EMF		None	None	None	None	None	None	None	None
Public Services	Potential Service Delays	Moderate	Low	Low	Low	Low	Low	Low	Low
Utilities	Short-term Service Disruption	High	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Archaeological	No. of Known Sites Potentially Affected	0	0	0	0	0	0	0	0
	No. of High-Probability Areas	0	0	2 (0)	0	0	0	0	0
Historic	No. of Sites Adversely Affected	0 (0)	1 (0)	1 (0)	0	1 (0)	1 (0)	0	0
Parklands	No. Significantly Impacted	1	0	0	0	0	0	0	0
Construction	Overall Temporary Impacts	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Financial Analysis									
Costs (1995$)	Capital[8]	$172/$181 M	$172/187 M	$197/211 M	$223 M	$179/$190 M	$188/$198 M	$208 M	$210 M
	Total Additional Annual O & M	–$0.4 M	–$0.1 M	–$0.1 M	$0 M	–$0.4 M	$0 M	–$0.4 M	$0 M

Notes: [6] Based on the evaluation of highest volume intersections with worst predicted level of service in each segment, pollutant concentrations are expected to decrease with any alternative.

[7] Both moderate and severe impacts over the FTA thresholds are reported. The number inside parentheses is after mitigation. (Sound barrier mitigation is not appropriate in every location and is particularly difficult with some at-grade light rail alternatives due to roadway widening).

[9] Capital costs vary depending on whether the alternative connects to a Segment E alternative on either Pacific Highway or SR 518.

Numbers in parentheses indicate impacts remaining after mitigation.

The preferred alternative is identified in italics.

Table S.10-7
Maintenance Base Sites Summary of Impacts and Trade-offs

	Criteria	M1-A S. Lander St.	M1-B S. Lander St.	M1-C Atlantic/ Central A	M1-D Rainier Brewery/ Roadway Express	M1-E Rainier Brewery/ Airport Way	M2 N.E. Boeing Access Rd.	M3 S.W. Boeing Access Rd.
		Alternative						
Service Level								
Transit	Incremental Access Travel Time	Low	Low	Low	Low	Low	Medium	Medium
	No. of Access Points	2					2	1
	Non-Revenue Service Hours	Low	Low	Low	Low	Low	Medium	Medium
Roadway	No. Intersections with Degraded Operations (overall)	0	0	0	0	0	0	0
	No. Intersection with Degraded Operations (minor approaches)	0	0	0	0	0	0	0
	No. Street Closures	2	2	2	3	1	0	0
	No. Lanes Removed	0	0	0	0	0	0	0
	Safety Impact	Low	Low	Low	Low	Low	Low	No Impact
	On-street Parking Spaces Removed	0	0	0	0	0	0	0
Non-motorized	Pedestrian/Bicycle Impact	Low	Low	Low	Low	Low	Low	No Impact
Freight	Truck Delivery Impact	Medium	Medium	Medium	Medium	Medium	Low	Low
	Rail Delivery Impact	Medium	Low	Low	Low	Low	Low	Low
Navigable Waterways	No. of Bridge Crossings	0	0	0	0	0	0	0
Environmental Consequences								
Land Use	State, Regional and Local Plan Consistency	Medium	Medium	Medium	Medium	Medium	Medium	High
	Direct Land Use Impacts	Medium	Medium	Medium	Medium	Medium	Low	Medium
Economic Development	Indirect Development Impacts	Low	Low	Low	Low	Low	Low	Low
	Short-term Property Tax Impacts	$233,300	$150,300	$285,900	$288,100	$205,600	$155,800	$96,100
Acquisitions and Relocations[1]	No. of Full Acquisitions (& Partial Acquisitions)	10 (0)	14 (7)	6 (0)	13 (0)	18 (1)	14 (1)	13 (1)
	No. of Housing Units Acquired	0	0	0	0	0	0	1
Neighborhoods	Impact to Neighborhood Quality	No difference	No difference	No difference	No difference	No difference	No difference	No difference
	Social Barrier	Low	Low	Low	Low	Low	Low	Low

Notes: [1] Site M3 displaces a Bingo hall and police shooting range, all other displacements are industrial land uses. There are no partial encroachments.
The preferred alternative is identified in italics.

Table S.10-7 continued

Criteria		Alternative: M1-A S. Lander St.	M1-B	M1-C	M1-D	M1-E	M2 N.E. Boeing Access Rd.	M3 S.W. Boeing Access Rd.
Environmental Consequences continued								
Visual and Aesthetic	Adverse Impacts	Low	Low	Low	Low	Low	Low	Low
Air Quality	Local Impact[3]	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Noise and Vibration[4,6]	No. Buildings Impacted by Light Rail Noise	0	0	0	0	0	0	0
	No. Buildings Impacted by Traffic Noise	0	0	0	0	0	0	0
	No. Buildings Impacted by Vibration	0	0	0	0	0	0	0
Ecosystems	Acres of Filled Wetlands	0	0	0	0	0	1 Buffer Loss	1 Buffer Loss
	Wildlife or Vegetation Impact	None	None	None	None	None	None	Low
	Fisheries Impact	None	None	None	None	None	None	None
Water Quality & Hydrology	Overall Impact	Low	Low	Low	Low	Low	Medium	Medium
Energy		No difference	No difference	No difference	No difference	No difference	No difference	No difference
Geology	Long-term Impact Potential	Low	Low	Low	Low	Low	Low	Medium
Hazardous Materials	No. of Sites of Concern	12	12	14	4	4	4	6
EMF		None	None	None	None	None	None	None
Public Services	Potential Service Delays	Low	Low	Low	Low	Low	Low	Low
Utilities	Short-term Service Disruption	Low	Low	Low	Low	Low	Low	Low
Archaeological	No. of Known Sites Potentially Affected	0	0	0	0	0	0	2
	No. of High-Probability Areas	0	0	0	0	0	1	1
Historic[6]	No. of Sites Adversely Affected	0	0	0	0	0	0	0
Parklands	No. Significantly Impacted	0	0	0	0	0	0	0
Construction	Overall Temporary Impacts	Medium	Medium	Medium	Medium	Medium	Low	Medium-High
Financial Analysis								
Costs (1995$)	Capital (Total Cost with Access)[5]	$115-$126 M	$98 M	$102 M	$112 M	$116 M	$99-$118 M	$98-$126 M

Notes: [3] Based on evaluation of highest volume intersections with worst predicted level of service in each segment, regional pollutant concentrations are expected to decrease with any alternative.
[4] Both moderate and severe impacts over the FTA thresholds are reported.
[5] Capital costs vary according to the access necessary for each alternative route.
[6] Numbers in parentheses indicate impacts remaining after mitigation.
The preferred alternative is identified in italics.

S.11 FINANCIAL FEASIBILITY

The following discussion summarizes the financial aspects of constructing and operating the light rail system. The overall costs of the system alternatives are compared to costs in the *Sound Move* budget. The costs are then compared to the revenues for the project; the discussion of revenues explains *Sound Move's* assumptions and the results of recent analyses. This section also discusses how local revenues and expenditures would be distributed by subarea within Sound Transit's three-county district, which includes five designated subareas: Snohomish County, north King County, south King County, east King County, and Pierce County. (*Sound Move* provides that local tax revenues will be used to benefit the five subareas, based on the share of revenues each subarea generates. By the end of the first ten years, each subarea's local tax revenues must balance with the expenditures to which those revenues are applied. In practice, this means higher-than-projected light rail or other project costs in the north King County or south King County subarea would have to be covered by local revenues collected in that subarea or by other sources of funds.)

S.11.1 Costs

The total costs for the light rail project combine the segment capital costs, the costs of any potential stations, vehicle costs, maintenance base costs, and operating costs. Each of these cost items can vary depending on the choice of alternatives in each segment, the length of the total line, the decision whether to build any of the potential stations, and the choice of the maintenance base site.

Table S.11-1 summarizes the total costs for the preferred alternative and the MOS alternatives, including costs by subarea.

The preferred alternative and the MOS alternative costs are based on route and station alternatives selected by the Sound Transit Board. The total cost for the preferred alternative is $2,066 million, which exceeds current revenue assumptions by $216 million. Other combinations for N.E. 45th to SeaTac system would result in a system that would be as high as $2,456 million, or as low as $1,774 million (1995$). The *Sound Move* budget for the system was $1,736 million (1995$). An extension to Northgate could add between $343 million to $434 million to the project costs, including segment construction costs and the costs of additional vehicles.

The subarea budget issues for the preferred alternative are primarily in the North King County subarea. The cost for the preferred alternative in the north King County subarea is $271 million higher than the *Sound Move* budget, and it is $60 million over the budget in the south King County subarea. The increases above the *Sound Move* budget are attributed to the inclusion of the Lander Street tunnel with a Beacon Hill Station shell, the inclusion of a community investment fund in Rainier Valley, and changes to respond to plans for a new passenger terminal at Sea-Tac Airport. The project also assigns all costs of a maintenance base to the initial phase. Other changes or costs are due to project enhancements as well as revisions of cost estimates, particularly right-of-way.

Table S.11-1 Summary of Light Rail Costs by Subarea (Preferred Alternative and Minimum Operating Segments) (1995$ in Millions)

Capital Range	North King Subarea without Northgate				South King Subarea				Central Link
	Capital	Vehicles	Base	Total	Capital	Vehicles	Base	Total	
Preferred alternative	$1,448	$152	$81	$1,682	$319	$43	$23	$385	$2,066
MOS A: N.E. 45th to McClellan	$1,089	$108	$103	$1,300					$1,300
MOS B: Capitol Hill to Henderson	$925	$113	$103	$1,142					$1,142
MOS C: N.E. 45th to Lander	$879	$95	$103	$1,078					$1,078
Sound Move Budget				$1,411				$325	$1,736

Note: Preferred alternative and minimum operating segment costs reflects additional engineering beyond the conceptual design information used to compare impacts of segment alternatives.

S.11.2 Revenues

The revenue sources for light rail construction and operations include farebox revenues, local tax revenues, bonds, and federal funding.

The primary light rail operating revenue source would be the farebox; *Sound Move* projected that farebox revenues would cover approximately 55 percent of operating costs. Current projections indicate that the actual fare recovery ratio for the preferred alternative could be as high as 68 percent. The total cost for the preferred alternative, as identified by the Board in February 1999, to carry forward into preliminary engineering, exceeds the costs budgeted in *Sound Move*.

Sound Transit has two dedicated local tax sources: a 0.4 percent sales and use tax, and a 0.3 percent motor vehicle excise tax (MVET). Voters authorized both in November 1996, and the taxes went into effect April 1, 1997. Over the ten-year initial phase, the sales and use tax is expected to generate $1,655 million for all of Sound Transit ($1995). This is about $117 million higher then *Sound Move* originally projected. In the same period, the MVET is expected to generate $444 million for all of Sound Transit, in the same range projected for *Sound Move*.

Sound Transit anticipates issuing $1,102 million in bonds (1995$) between 1997 and 2006, with bond proceeds funding approximately 29 percent of the overall capital program. To date, Sound Transit has issued $350 million (year-of-expenditure (YOE)) in bonds. The anticipated total bonding amount is relatively conservative in relation to other national New Start projects (see below). It is also far below Sound Transit's statutory debt limit, which is 1.5 percent of assessed valuation within the Sound Transit district (giving a bonding capacity of approximately $2.6 billion in 1997).

Sound Move assumed a total federal funding level over the ten-year initial phase of $727 million ($1995), or $905 million (YOE). Of this, $550 million ($1995) was assumed for construction of the capital costs of light rail, or $694 million in YOE dollars. The preferred alternative identified by the Sound Transit Board would require $943 million (YOE). Achieving this level of federal funding within a ten-year time frame would require obtaining higher annual federal appropriations than have ever been appropriated to any single project over the same period. To achieve this funding level, Sound Transit anticipates requesting appropriations that extend beyond the project construction period. Sound Transit would need to develop interim financing options in anticipation of federal funding. These options are within Sound Transit's financial capacity.

S.11.3 Feasibility

Sound Transit would have adequate financial resources to build and operate the light rail within the ten-year initial phase, provided it receives federal funding consistent with the Financial Plan assumptions or has the assurance, through a Full Funding Grant Agreement (FFGA), of receiving the funds in future years. The financial analysis of the light rail program is consistent with the ability to deliver the program within budget.

The total cost of the lowest cost light rail alternatives are within Sound Transit's costs affordable with current revenue for light rail. There may be room in the *Sound Move* budget for the Board to select other than only the lowest cost alternatives. However, the total cost for the preferred alternative exceeds the costs affordable with current revenue, given current assumptions for local revenue and federal funding. This issue can only be addressed by the Sound Transit Board, in the context of the final selection of the alternative to be built. The Board has the ability to either modify the preferred alternative to reduce costs, seek additional grants, or modify financial policies to increase revenue available to the light rail project. From an overall project standpoint, or from a federal-funding standpoint, the Central Link Light Rail Project can be built within the revenue currently affordable by Sound Transit.

S.12 ENVIRONMENTAL JUSTICE

A comprehensive evaluation of the project's potential effects on minority and low-income populations is described in Appendix G - Environmental Justice, as required under Executive Order 12898 and the U.S. Department of Transportation's order on environmental justice (DOT Order 5610.2). Environmental justice in Department of Transportation decision making requires: (1) a fair process of developing and selecting the alternative to be funded that involves meaningful outreach to, participation of, and responsiveness to minority and low-income populations; and (2) non-discriminatory treatment of minority and low-income populations.

The environmental justice analysis describes the public process for the Link light rail project, and evaluates whether the project would have a disproportionately high and adverse effect on the minority and low-income populations of the Sound Transit District. Consistent with the DOT Order, offsetting benefits to the affected populations and mitigation and enhancement measures are considered. In response to concerns raised by some members of the Rainier Valley community, the environmental justice analysis compares the impacts and benefits of the preferred alternative with an alternative that would replace the at-grade alignment in the Rainier Valley with a tunnel the length of the Valley.

In evaluating the project's effects on the minority and low-income populations, Sound Transit conformed to Department of Transportation ("DOT") requirements and consulted with both the Federal Transit Administration ("FTA") and the Environmental Protection Agency ("EPA"). The primary conclusions reached are summarized below.

Public Outreach.

To assure a fair process, Sound Transit engaged in public outreach from the initial project planning stages through the completion of this Final EIS. Sound Transit has used public input to identify Link light rail project alternatives, impacts, and benefits. As part of this public process, Sound Transit has also implemented meaningful outreach to minority and low-income communities to assure their active participation in the project's development. These efforts include the establishment of telephone hotlines in Chinese, Vietnamese, Spanish, and Amharic, and Tigrinya; translation of Sound Transit informational materials and distribution at numerous community events; Sound Transit presentations at community meetings; and the establishment of a Sound Transit field office in the Rainier Valley, an area with high numbers of minority and low-income residents. Southeast Seattle's participation in project development and the environmental review process demonstrates how minority and low-income populations have shaped the alternatives considered in the Final EIS and the elements of the preferred alternative.

Project Effects.

Using the information presented in this Final EIS, Sound Transit has completed a comprehensive evaluation of the preferred alternative's impacts and their potential effects on the minority and low-income populations of the Sound Transit District

A number of impacts identified in the Final EIS would not be differentially distributed among different minority or low-income segments of the population. These include impacts to ecosystems, including wetlands, freight movement, water resources, and geology and soils. These impacts were not considered further for environmental justice purposes. Minor adverse impacts or beneficial impacts also were not further considered for environmental justice purposes. These include impacts relating to hazardous materials, public services, visual resources, parklands, historic and archeological resources, and electromagnetic fields.

Other impacts identified in the Final EIS, however, could be distributed differentially among minority or low-income populations. For the preferred and most other alternatives, neighborhood, noise and vibration, and transportation impacts would be minimized through design modifications and the use of mitigation measures. These modifications and mitigation measures include reducing the right-of-way for at-grade alternatives to reduce displacements; the installation of residential sound insulation and, where desired, sound walls; and additional traffic signals, pedestrian signals, parking mitigation, and streetscape improvements.

Residential and non-residential displacements, and construction impacts could have statistically greater effects on minority and low-income populations. This conclusion was reached after quantifying the effects of residential displacements identified in the Final EIS. This analysis indicated that residential displacements would unevenly affect minority and low-income populations. Most of these residential displacements would be concentrated in the Rainier Valley. Sound Transit conservatively assumed that non-residential displacements, which would also be concentrated in the Rainier Valley (although displacements in other areas such as Tukwila would also occur), and temporary construction impacts, would also unevenly affect minority and low-income populations.

The effects of the displacement and construction impacts, however, would be substantially mitigated. Displacement impacts would be mitigated through Sound Transit's provision of relocation assistance, commitment to minimize the effects of displacements, and other measures. Temporary construction impacts would be substantially mitigated through a variety of mitigation measures, including preparation of detailed construction traffic plans in close coordination with local jurisdictions, and scheduling traffic lane closures during off-peak hours to minimize delays during periods of higher traffic volumes as much as possible.

Project Benefits

Substantial benefits would accrue to minority and low-income populations through the implementation of the preferred alternative. These benefits include: improved access to transit, transit travel times savings, expanded access to employment and other amenities, streetscaping and other improvements, and the potential for increased economic development.

Improved access to transit results in transit travel time savings (discussed below) and other benefits to individuals and businesses. The analysis of demographic composition of the areas within one-half mile of the proposed stations (the area in which improved access to transit benefits would be greatest) indicates that 41 percent of residents living near proposed stations are likely to be minorities and 20 percent are likely to be low-income.

Transit users would experience substantial travel time savings with the Central Link Light Rail Project. The average savings for neighborhoods near all light rail stations is eight minutes. It is estimated that minority and low-income residents would receive 38 percent and 25 percent, respectively, of the total reduced travel time savings experienced by residents near light rail stations under the preferred alternative. Rainier Valley residents, for example, would save an average of 18 minutes of travel time, more than any other neighborhood and more than twice the system-wide average.

The Central Link Light Rail system would provide substantially better access with lower travel times to major employment and activity centers, such as downtown Seattle, Sea-Tac Airport, and the University of Washington. Minority and low-income residents would receive 47 percent and 17 percent, respectively, of the total increased employment access experienced by persons living near light rail stations. For example, after Link opens, Rainier Valley residents would have more than 195,000 additional jobs within an hour's ride by transit. When compared with today, their access to education would more than double, and access to health care services would increase by 27 percent.

Secondary benefits of light rail systems to the communities in which they are located include area beautification and other improvements and amenities provided as a result of increased investment or activity. An improvement program for existing street rights-of-way is built into the preferred alternative. These improvements generally include upgraded pedestrian amenities, such as wider sidewalks, signage, crosswalks, and improved bicycle facilities, as well as beautification features, such as street trees and other landscaping, lighting, and public art. These improvements would be concentrated along MLK Jr. Way S., S. Edmunds Street, S. Henderson in Segment D and Tukwila International Boulevard in Segment E.

Because light rail exposes riders to new areas and businesses, and increases pedestrian activity in station areas, being located near the rail line may be economically beneficial. The benefits of transit-oriented economic development can include: improved mobility; access and environmental conditions within communities; more affordable housing; more efficient urban form; and urban redevelopment. As with access to transit, transit travel time savings, and access to employment and other amenities, these secondary benefits would likely be provided principally to those located near stations.

Finally, Sound Transit has also proposed a local $50 million Transit Oriented Community Development Fund (Motion M99-14, adopted February 25, 1999), to benefit the Southeast Seattle light rail corridor. This fund would benefit the minority and low-income residents in that area.

Environmental Justice Conclusions

The preferred alternative would not have disproportionately high and adverse effects on the minority or low-income populations of the Sound Transit District. Many impacts associated with the preferred alternative would be eliminated or minimized. The remaining impacts are limited considering planned mitigation measures and the context of the Central Link Light Rail project. The impacts are not disproportionately high and adverse, particularly in light of the offsetting benefits to the minority and low-income populations.

Rainier Valley Tunnel Alternative

In response to concerns identified by Rainier Valley community, Sound Transit compared the impacts and benefits of the preferred alternative with an alternative that would replace the at-grade alignment in the Rainier Valley with a tunnel the length of the Rainier Valley. Sound Transit had previously evaluated the environmental impacts of the Rainier Valley Tunnel ("RVT") proposal in a separate Report and concluded that it is not a reasonable alternative. That report is included in Appendix Q of the Final EIS. The comparative analysis of the preferred alternative and the RVT proposal is set forth in Section G-7 of Appendix G. This comparison demonstrates that the RVT alternative was not included in the Draft EIS due to the planning history in Southeast Seattle and because it does not meet Sound Transit's design and engineering criteria for tunneling. In addition, the RVT alternative does not eliminate residential and non-residential displacements and construction impacts that would result from providing service to the Rainier Valley, nor would it provide the substantial streetscape and other benefits offered by the at-grade alignment. It would also result in greater construction impacts at station areas and portals, as well as greater vibration impacts. Finally, the RVT alternative would involve costs of extraordinary magnitude. For these reasons, the RVT alternative would not preclude implementation of the preferred alternative under the terms of the DOT Order.

S.13 FTA INDEX

The Federal Transit Administration (FTA) defines a Cost-Effectiveness Index which calculates the incremental cost per incremental rider (a person who did not previously ride any kind of transit), for the light rail alternative compared to a Transportation System Management (TSM) alternative. This index is used to compare light rail projects across the country and has become an important part of the FTA's procedure for reviewing major transit projects. While the FTA index is important, it does not account for many of the project's other benefits. These benefits include the long-term reduction in public infrastructure costs and environmental benefits that would result from the more efficient land use patterns associated with light rail, and mobility improvements and travel time savings for all riders (the FTA index shows savings only for new riders). These benefits are excluded from the captured index because an accurate means of monetizing them currently does not exist.

Central Link's FTA Index is $10.40 per new rider (Table S.13-1); the range for light rail systems recently reporting this index was $2.40 to $37.60 (FY 1999 New Starts Report).

Table S.13-1
FTA Index (1999$)

Annualized Capital Cost	$413.24 million
Annualized System Operating Cost	$500.18 million
Incremental Operating Cost Compared to TSM	($0.014) cost per passenger mile
Total Annualized Incremental Cost Compared to TSM	$185.72 million
Annualized Systemwide Ridership	138.2 million riders
Incremental Annual Systemwide Ridership Compared to TSM	17.85 million new riders
FTA Index	$10.40 incremental cost per new rider

Note: Central Link's FTA Index is $10.40 per new rider for Northgate to SeaTac corridor; $3.30 per new rider for MOS C; the range for other light rail systems recently reporting this index was $2.54 to $44.80 (FY 2000 New Starts Ratings). Link was equal to nationwide median index score last year at $10.39 in 1997$.

It is important to put the FTA Index in context. Cost-effectiveness does not address financial feasibility or the value of any benefit other than ridership. While cost-effectiveness is an important factor, these results must be considered in light of the relative benefits of the alternatives, which are not monetized or incorporated in these measures. The results must also be considered in light of the financial feasibility of the alternatives.

S.14 EFFECTIVENESS AND SIGNIFICANT TRADE-OFFS

This section compares the ability of the light rail system and the No-build Alternative to meet the goals of the proposed action. It also identifies the major tradeoffs associated with the alternatives and the maintenance base site alternatives.

S.14.1 Effectiveness of the Light Rail System

All of the light rail alternatives would provide substantial improvements in the quality and capacity of transit compared to the No-build Alternative. As a result, the light rail alternatives would offer a broad range of transportation, land use, and environmental benefits. These benefits will be weighed against the cost and impacts of the light rail alternatives. The following briefly summarizes the ability of the light rail alternatives to meet the goals and objectives of the proposed action.

Transportation Goal: Enhance Mobility

Objective: Provide an effective, high-quality transit system

A few years after opening day, the preferred alternative for the light rail line is projected to carry about 110,000 daily riders, which would make it among the busiest light rail lines in North America. Compared to riders on bus service operating in congested and ever-worsening traffic conditions in the corridor today, light rail's riders would experience average travel time savings of 9 to 18 percent. Because light rail would generally operate in its own right-of-way, service is expected to be reliable. During peak periods, Sound Transit expects light rail to operate in a 95 to 99 percent on-time range, regardless of traffic conditions on the surrounding roads and highways.

Objective: Design a system to accommodate future extensions and expansions

The design of the preferred alternative would allow extensions north to Northgate, and continue north to Snohomish County from Northgate. The line can also be extended south from SeaTac to Tacoma, east from downtown Seattle across Lake Washington on I-90 or SR 520, and east on I-405 from SR 518. Local funding for the extensions in future phases would require a vote of the region's citizens. All of the MOS alternatives were developed to accommodate further expansions.

Objective: Integrate services and fare policies with local transit providers and provide convenient connections

Sound Transit has been working with all of the region's transit providers to develop an integrated regional fare policy. The first elements of the integrated system were introduced in fall 1999 for use on the region's local transit and Sound Transit's Regional Express bus services. Light rail stations are being designed to offer convenient transfers to other travel modes. Depending on the station, other modes include local and regional bus, commuter rail, Amtrak, park-and-ride, walking and bicycling. Through workshops between Sound Transit, local jurisdictions and community groups, initial definitions of each station's access needs were developed; these efforts will continue through final design.

Objective: Enhance transportation equity

Light rail and all of Sound Transit's investments would greatly enhance the transportation access and mobility options of the transportation disadvantaged, including those who do not own cars and/or cannot drive because of age, economics, or disability. The preferred alternative and the other project alternatives are designed to meet this objective; since the Draft EIS, additional design modifications have been proposed to improve access to and around light rail facilities, particularly in at-grade sections of the route. The preferred alternative would substantially improve access to transit, reduce transit travel time, improve accessibility to employment, health care, recreation, shopping, and other amenities, as well as community improvements and potential economic development to minority and low-income populations. This distribution of benefits is discussed in Appendix G, Section G-5. The MOS alternatives do not all serve sections of the corridor with the highest concentrations of low-income persons; of the shorter alternatives, MOS B provides more transportation benefits to low-income persons.

Environmental Goal: Preserve Environmental Quality

Objective: Minimize potential adverse impacts to the natural and built environment

During the development of the EIS, potential adverse impacts to the environment have been identified for all alternatives. Sound Transit has focused on minimizing potential impacts by avoiding project alternatives with significantly higher impacts, by modifying project designs to reduce or minimize impacts, and by developing and evaluating potential mitigation approaches for significant impacts. The preferred alternative would offer environmental improvements over No-build conditions in several areas. The total miles traveled daily by vehicles in the region would be slightly lower with light rail, as would the total number of hours the vehicles would spend in travel. Implementation of light rail between Northgate and SeaTac would support regional efforts to reduce CO and ozone-causing pollutants being emitted into the regional airshed. The preferred alternative is expected to reduce regional energy use for transportation, compared to the No-build Alternative. The light rail construction could result in the cleanup of some existing hazardous materials sites that would otherwise remain contaminated, or would remain contaminated longer.

In most areas, the impacts of the preferred alternative are less than or the same as other light rail alternatives considered, and it has avoided or minimized more of the impacts previously identified in the Draft EIS.

The regional and local land use and transportation plans depend on high-capacity transit (HCT). Failure to implement the project would likely reduce the ability to meet regional residential and employment density goals. Lack of implementation would put pressure on the urban growth boundary, and would potentially result in indirect impacts to ecosystems, water quality, air quality, and open space in other locations. Impacts to archaeological, cultural, and parkland resources have been avoided or minimized by the preferred alternative.

The MOS alternatives would have fewer direct impacts to natural and built resources, but they also offer reduced levels of transportation benefits.

Land Use Goal: Support Regional and Local Land Use Goals and Objectives

Objective: Support adopted land use and transportation plans.

Light rail is integral to the Metropolitan Transportation Plan (MTP), which is an element of Vision 2020, the region's integrated long-range growth management, economic, and transportation strategy. The MTP calls for "light rail service along major regional corridors interconnecting the Seattle CBD with other regional centers in northern, eastern, and southern suburban areas, as well as north-south centers in the eastern corridor." The preferred alternative is consistent with these plans. The No-build Alternative would be inconsistent with Vision 2020 and the MTP. King County and the cities of Seattle, Tukwila, SeaTac and Renton have all adopted comprehensive plans with light rail-related transportation provisions. Urban centers identified in Vision 2020 and the MTP are located along the proposed project routes. The preferred alternative would serve designated urban centers at the University District, Capitol Hill/First Hill, downtown Seattle and SeaTac. It would not directly serve Tukwila's urban center at Southcenter and it would not serve the urban center at Seattle Center. Extension of the line north would provide service to the Northgate Urban Center. Overall, light rail would be consistent with all local comprehensive plans, although Alternatives E2 and E3 would be most consistent with Tukwila's plans and policies.

Of the length alternatives, the preferred alternative and the Northgate to SeaTac alternatives are most supportive of regional plans. MOSs A, B, and C are compatible with the regional vision, but they do not meet the same level of regional connections.

Objective: Support pedestrian-friendly and transit-oriented development

Light rail would serve some of the densest neighborhoods on the West Coast, and support existing pedestrian-friendly developments as well as future transit-oriented development elsewhere along the corridor. The cities of Seattle and SeaTac are engaged in station area planning in cooperation with Sound Transit. Each of these station area plans is intended to support opportunities for new mixed-use, higher-density development within walking distance of the light rail stations; this would tend to increase ridership on the line. In Segments D and E, additional pedestrian crossings and other pedestrian facilities have been proposed for the preferred alternative. All other segments also include pedestrian facility improvements, primarily in station areas.

Objective: Enhance neighborhoods

Light rail would increase access and mobility and reduce reliance on the automobile in the neighborhoods it serves. The station area planning efforts mentioned above are also targeted to ensure that stations fit into their neighborhoods and support individual neighborhood character.

Financial Goal: Achieve Financial Feasibility

Objective: Build a system within *Sound Move*'s budget

Sound Transit would have adequate financial resources to build and operate the light rail within the ten-year initial phase, provided it obtains federal funding at levels consistent with the Financial Plan Assumptions. The total cost for the preferred alternative currently exceeds the original *Sound Move* budget and exceeds the cost affordable with current revenue. This issue can be addressed only by the Sound Transit Board in the context of their selection of the light rail alternative to be built. The Board has the ability to either modify the preferred alternative or to modify local financial policies so as to increase revenue available to the light rail project. From an overall project standpoint, and from a federal funding standpoint, the light rail project can be built within the revenue currently available to Sound Transit. Each of the MOS alternatives is well within *Sound Move's* budget.

Objective: Build a system that can be operated and maintained within available revenues

The projected operating budget for light rail is approximately $37.4 million a year for the preferred alternative; this can be funded within available resources. The analysis of farebox revenues presented for the EIS assumes that $28.4 million would be generated annually by 2020, allowing 68 percent of operating costs to be covered by fares. The fare recovery range for other length alternatives would range between 60 percent and 86 percent with MOS C (N.E. 45th Street to McClellan Street) recovering the largest share of operating costs from fare revenue.

Objective: Build a system that is cost-effective

Light rail offers a cost-effective way to provide major new capacity in the region's most congested corridor at a lower cost than other alternatives, including adding new highway capacity. The HCT elements of *Sound Move* (light rail, commuter rail and express bus) are projected to improve ridership while making the entire regional transit system operate more efficiently. Regional transit modes in 2010 under *Sound Move* would support 52 percent more annual passenger miles than transit under the No-build Alternative and 33 percent more than a Transportation System Management alternative. The operating costs per passenger mile would be $0.27 for *Sound Move* transit services compared to $0.56 for the No-build and $0.61 for a bus-only network (Sound Transit 1997). Light rail is a cost-effective rail technology (PB/K 1992) and is more cost-effective than heavy rail when evaluated on a system-wide basis. The estimated FTA cost-effectiveness index for the project ranges from $10.34 (1995$) with the Northgate to SeaTac Alternative to $3.30 for MOS C.

Community Support Goal: Maximize community support

Objective: Involve the community in the project development and design process

The alternatives in this EIS are the result of nearly two decades of planning and community participation. Sound Transit's project development process has involved the community at every step. These involvement activities include formal agreements with the cities of Seattle and SeaTac to assist with route and station area planning. Sound Transit has conducted numerous formal workshops and hundreds of meetings with community and business groups and affected property owners and individuals, as well as making presentations and manning booths at fairs and community events. Multiple mailings have been sent to all residents, businesses and property owners within 1,000 ft of each route under study. A project office in Rainier Valley, open to the public, provides a convenient location for community members in that area to meet with project staff, view plans and collect project information. Development of the alternatives in the Draft EIS included a 60-day scoping process with 7 public meetings, followed by public workshops in each segment of the corridor and 2 hearings, after scoping, to refine the project alternatives. Sound Transit and FTA circulated over 1,500 copies of the Draft EIS to affected local jurisdictions, regional, state, and federal agencies, community organizations, environmental and other interest groups, and interested individuals. Using a variety of media targeted at communities throughout the corridor, Sound Transit published a notice of the Draft EIS availability and its public hearings. Public hearings for the project were held throughout the region during the Draft EIS 60-day comment period (see Section 2.2 of the Final EIS). Sound Transit will continue to engage the community and has just begun a station design process that will include workshops in most station areas.

Objective: Enhance community support

Community support was first expressed in the strong positive vote for *Sound Move* in 1996. It is Sound Transit's objective to build support through continuing the cooperative design process with affected jurisdictions along with extensive community outreach.

Public support for the light rail project comes from an understanding of the many benefits that the project will bring. Sound Transit has engaged the community in a continuous dialog about those benefits in the form of door-to-door outreach, presentations to community organizations, regular mailings, advertisements in local media, public workshops, field trips, and participation in community events and celebrations.

S.14.2 Trade-Offs Among the Route Alternatives

Segment A (Northgate to University District)

Trade-offs in this segment involve the station location at Northgate and the profile and station location in the Roosevelt neighborhood. Ridership and service levels are not significant distinguishing factors in the choice of alternatives or station options in this segment. The tunnel alternatives (A1.1 and A1.2) would have the highest cost and the Eighth Avenue elevated alternative (A2.2) would cost the least.

Northgate Station options B and C would best serve the mixed-use expansion of the regional shopping center. Option A would have less effective pedestrian-bus connections and would result in more wetland impacts near Thornton Creek. A station at Roosevelt Way N.E. (A1.2), or 12th Avenue N.E. (A1.1), would be the most centrally located site for the Roosevelt business district. The elevated station (A2.1 or A2.2) would be closer to the existing park-and-ride facility and the Greenlake neighborhood, and would have the potential to serve the Roosevelt as well as the Greenlake area and an area of future high-density residential development.

Alternative A2.1 would remove six homes along Eighth Avenue N.E. and require additional displacements at station entrances (total displacements would be ten properties). Alternative A2.2 would displace three properties and potentially obstruct views from Rainbow Point Park and some residences along I-5. The tunnel alternatives (A1.1 and A1.2) would have vibration impacts (four to nine properties), and the short elevated alternative (A2.1) would have vibration impacts to one property. The tunnel alternatives (A1.1 and A1.2) would require four to six displacements. Cut-and-cover construction for the tunnel stations in the Roosevelt commercial area (A1.1 and A1.2) would be less expensive but would cause the greatest disruption during construction.

The preferred alternative does not include an extension of the light rail to Northgate in the initial phase. However, an extension to Northgate would increase overall daily system ridership by nearly 23,000 in 2020.

The 15,800 to 15,900 daily boardings in 2020 in the Northgate-to-University-District segment make it potentially the third highest ridership segment in the system. Systemwide ridership without service to Northgate is projected to be about 133,000 daily boardings by 2020, but with Northgate it is projected to be about 149,000 daily boardings with a Northgate to SeaTac baseline system. If the preferred alternative were extended to Northgate, its ridership would be 156,400 daily boardings by 2020. Northgate is a major regional destination as well as a significant transfer point for riders from the north.

Extending the line to Northgate would significantly reduce the long-term impacts of removing the buses from the DSTT and returning them to surface streets, since many of those buses would be replaced by light rail service from Northgate. It would also provide an opportunity to create more efficient feeder bus connections outside of the University District and downtown Seattle.

Long term, it would be less expensive to construct a tunnel to a portal point north of the University District in a single phase, as compared to coming back in a subsequent phase and connecting to the tunnel while operating service in the already completed portions. Operations savings would also be less.

For several reasons, Northgate makes a better interim terminus to the light rail line than N.E. 45th Street. Northgate already has a major bus transit center to support connections to light rail, while the density of activities around N.E. 45th Street (University buildings, churches, commercial and retail buildings) and the limited street right-of-way widths there would make it very difficult to expand the already extensive bus network that serves the University District bus transit hub. Northgate is currently served by park-and-ride facilities that would allow people who come from north King County neighborhoods where bus service is not convenient to access the end of the light rail line; there is no possibility of providing park-and-ride spaces at N.E. 45th Street.

Segment B (University District to Westlake Station)

The preferred alternative has the fewest environmental impacts of the Segment B alternatives, and it avoids the environmental impacts associated with Alternative B2.1 (vibration, historic, visual, parks, and residential and commercial displacements).

The preferred alternative has a higher construction cost than the least-cost options for the Seattle Center route alternatives, but it supports significantly higher ridership both within the segment and systemwide. The preferred alternative would cost $862 million, which is more than the Seattle Center routes (B2.1 and B2.2) without a Convention Place Station. The preferred alternative would have 39,400 riders in Segment B in 2010, and 46,200 by 2020. This would result in systemwide ridership of about 24,000 to 30,000 more daily riders than the Seattle Center routes, and a segment ridership with 12,000 to 15,000 more daily riders. The Convention Place Station would cost $59 million without any gain in system ridership.

The station options at N.E 45th Street involve some trade-offs between impacts and effectiveness. Option C would be physically closer to the commercial center of the University District, offering better transit and pedestrian connections to the area. However, it would close a street, displace several properties and off-street parking, and have the greatest construction-period impacts including the temporary displacement of a 120-unit apartment building. Option B would be located to the east of 15th Avenue N.E., avoiding many of the property and construction impacts of Option C. It would offer less effective pedestrian connections to businesses and transit along University Way N.E., but would serve the UW campus more directly.

The cut-and-cover Capitol Hill Station options (B, C, and D) for the preferred alternative would have lower costs than a mined station. All alternatives for a Capitol Hill Station would involve property displacements at station entrance areas. Construction impacts would be of longer duration and would affect more properties with the shallower cut-and-cover station options. The Nagle option (Option D) avoids the traffic and construction disruption that would occur along Broadway with options B and C, but it would displace more businesses, residences, and off-street parking, and it would impact the historic Lincoln Reservoir site.

Segment C (Westlake Station to S. McClellan Street)

There are several significant trade-offs among the alternative choices in Segment C. Rail-only operations in the DSTT would improve rail system travel times and reliability, but could increase travel times for bus riders, particularly those who must travel the length of downtown. Joint bus/rail operations in the tunnel would slow and reduce the reliability of both bus and rail operations in the tunnel, and long-term rail system plans would eventually require rail-only operations.

The preferred alternative and other C1 routes would serve Safeco Field, the planned new football/soccer stadium and south downtown, and would avoid nearly all the impacts on the residences and businesses in north Rainier Valley. All of the C1 alternatives would remove over 200 off-street parking spaces.

The preferred alternative, at $228 million, is $78 million more than the lowest cost alternative but is similar in cost to the other alternatives. It would not provide service to the neighborhood around and north of Rainier Avenue S. and I-90. Similarly, the Royal Brougham Station, with a cost of $5 million, would serve 500 passengers daily, the lowest in the segment, but this figure does not include the "surge" demand of up to 3,000 passengers to Safeco Field or the new football stadium. The route and profile choices offered by the preferred alternative and other C1 routes using the E3 Busway involve trade-offs primarily involving displacement, land use or transportation impacts, as well as operational issues related to maintenance base alternatives. In terms of the route choices only, the preferred alternative (C1.2) has similar displacement impacts to the other alternatives with a Beacon Hill tunnel, and has reduced the street circulation and access impacts found with Alternative C1.1. It has higher impacts to rail freight movement and to circulation and access than the two elevated alternatives C1.3 (elevated on S. Lander Street) and

C1.4 (elevated south of S. Forest Street), but both of these alternatives are from $8 to $10 million higher in cost, not including the related costs of maintenance base sites. Alternative C1.5 (S. Massachusetts Street/I-5 right-of-way) also has slightly fewer impacts to access and circulation than the preferred alternative, and would be $3 million lower in cost, not including maintenance base costs, but it would not have a station in the S. Lander Street area.

Alternative C3 (S. Massachusetts Street Tunnel) would serve Safeco Field and the planned new football/soccer stadium, but it would not serve the industrial area to the south nor Beacon Hill. It has lower costs than C1.1, but would have the impacts associated with an elevated route along Rainier Avenue S., north of S. McClellan Street, including property acquisitions, historic resource, visual, access and parking impacts. Alternative C2.3, the lowest-cost alternative ($149 million), would provide light rail access for the neighborhood around and north of Rainier Avenue S. and I-90. It would have many of the same adverse impacts as C3, including displacements and visual impacts, and would also affect many of the businesses between Dearborn Street and I-90. With this alternative, there would be no service to the industrial area south of downtown Seattle or to Beacon Hill, and the closest access to the new stadiums would be the International District Station. Alternative C2.4, the highest cost alternative ($241 million), would avoid the negative impacts of C3 and C2.3 south of I-90, and it is the only alternative to place a station as far north as Poplar Place, near the Jackson Place neighborhood. It would not provide service to the industrial area south of downtown, and would serve the new stadiums only from the International District Station. It would have the same effects on businesses between Dearborn Street and I-90 as Alternative C2.3, and would displace 200 off-street parking spaces. Alternative C2.4 would also result in an at-grade station south of S. McClellan Street, rather than an elevated station, which would complicate the transition to some of the Segment D alternatives and cause greater impacts (in Segment D) to Cheasty Boulevard, a historic resource.

Segment D (S. McClellan Street to Boeing Access Road)

The preferred alternative (D1.1e) represents several significant choices in Segment D. It follows MLK Jr. Way S. rather than Rainier Ave. S., providing less direct connections to Columbia City, but avoids the higher displacements, construction impacts and costs of a Rainier Avenue route. It also avoids the higher impacts and costs for transitions from Rainier Avenue S. back to MLK Jr. Way S. in the south part of the segment. The preferred alternative route is primarily at-grade and lies within a narrower right-of-way than previous configurations that provided four lanes of through traffic; this avoids additional right-of-way costs, and reduces impacts. It includes a station at S. Edmunds Street (serving Columbia City) rather than at S. Alaska, but this has minimal impact to segment ridership, cost, or travel time.

Mitigation has eliminated most of the light rail and traffic noise impacts previously identified in the Draft EIS for all alternatives, particularly the D1.1 routes along MLK Jr. Way S. After mitigation, the preferred alternative and Alternatives D1.1c and D1.1f would not have significant noise or vibration impacts. Light rail vibration impacts have been reduced for other alternatives, but impacts affecting 6 to 16 properties would remain for Alternatives D1.1.d, D1.3, D3.3, and D3.4.

The 37th Avenue S. tunnel (D3.4), which would provide a station in the heart of the Columbia City business district, would have higher property displacements and the greatest construction impacts, since it would involve a relatively shallow tunnel through a residential neighborhood.

Elevated light rail on MLK Jr. Way S. (D1.3) would be about $53 million more expensive than the preferred alternative, but would offer slightly faster and considerably more reliable service. Its visual impacts would be greater than the preferred alternative; property displacements would be similar.

The preferred alternative and D1.1f would provide more signalized intersections and pedestrian crossings than other MLK Jr. Way S. alternatives, and provides for the highest number of U-turns and right-turn movements at intersections. There is a moderate difference between the traffic access and circulation impacts of the other at-grade or elevated light rail routes on MLK Jr. Way S. but none of them were found to be significant. All alternatives prohibit left turns to and from driveways and unsignalized cross streets. With mitigation, all alternatives would allow area traffic to operate at acceptable levels at area intersections.

A range of choices for the street features and right-of-way are possible, with the preferred alternative maintaining MLK Jr. Way S. as a four-lane urban arterial, but minimizing the right-of-way required. The preferred alternative includes seven new signalized intersections on MLK Jr. Way S., nine pedestrian-only signalized crossings and two new intersections on Rainier Avenue S. Bicycle travel would be accommodated on parallel routes. The other alternatives offer different choices including the number and width of through lanes (from two to four), and whether bike lanes, parking lanes or turn lanes will be required. The width of sidewalk or planting areas would vary slightly, although all would provide improved sidewalks and landscaping. The trade-offs from these features involve cost, neighborhood character, bicycle and parking lanes, the degree of right-of-way required, and a range of traffic operating factors. The traffic factors include the level of service to traffic that would be provided, the volume and speeds of vehicles on the roadway, whether emergency response times would be affected, and the ability in the future to modify the roadway to improve traffic conditions.

The preferred alternative and the other four-lane alternatives would provide a high-capacity arterial that carries both local and through traffic, including freight traffic; major intersections would include two additional turn lanes. All the four-lane alternatives have similar costs (approximately $200 million), not including the preferred alternative's $50 million community development fund. Alternatives D1.1d and D1.1f, which convert MLK Jr. Way S. to a two-lane neighborhood arterial, may have lower speeds and maintain acceptable levels of service, but would have a capacity that could serve local traffic only, with diverted traffic moving to Rainier Avenue S. and other north-south arterials. The two-lane street could also impact emergency response times. The preferred alternative, which would have higher average speeds and serve more traffic, would require the same or slightly more right-of-way than the two-lane alternatives.

The McClellan Station is included in all alternatives and would be a connecting point for both north/south and east/west bus service. An elevated McClellan Station (Options B or C) for the preferred alternative is higher cost, but it would provide a connection to MLK Jr. Way S. without requiring traffic to stop while trains cross, and it has fewer impacts to Cheasty Boulevard, an historic resource. An at-grade station (Option A) would block the east edge of Cheasty Boulevard, and also would affect traffic on MLK Jr. Way S.

The Edmunds Station in the preferred alternative would be about a five-minute walk from either the heart of Columbia City or the Rainier Vista Garden Community. The Graham Station, with a cost of $7.3 million, would serve an active, mixed-use community and provide good north/south and east/west bus connections.

Segment E (Tukwila)

The principal trade-off in Segment E focuses on the route choices. Alternative E1.1 (the preferred alternative) and Alternative E1.2 would follow Tukwila International Boulevard and provide stations at Boeing Access Road and S. 144th Street. (A station at S. 154th Street in Segment F would also be provided only with Alternatives E1.1 and E1.2). Alternatives E2 and E3 would locate stations at Longacres and Southcenter, with routes along Interurban Avenue S. (E2) or MLK Jr. Way S. (E3). The City of Tukwila prefers Alternative E3.

The preferred alternative would have the lower cost ($174 million), as compared to $329 million for Alternative E3 and $299 million for E2. Both E1.1 and E1.2 would be shorter by 3 to 3.5 miles, have lower travel times (about 3.4 to 7.7 minutes lower) and provide a more direct route to Sea-Tac Airport than E2 or E3. The alternatives serving Longacres and Southcenter would provide service to Tukwila's designated urban center, which encompasses an area with a growing employment base and a major regional shopping center. Alternatives E2 and E3 would have higher ridership within Segment E, but E1.1 and E1.2 would achieve similar system ridership levels by attracting more riders from other segments. Light rail is envisioned by the City's comprehensive plan as a major catalyst for redeveloping Tukwila's designated urban center at Southcenter into a pedestrian-oriented mixed-use center. Although the City's plans do not envision light rail on Tukwila International Boulevard, alternatives along this route could support the goals to revitalize and enhance this corridor. The preferred alternative has been revised to include most of the city's proposed improvements to Tukwila International Boulevard.

Impacts to the natural and built environment would be mixed between the basic route choices. The Tukwila International Boulevard routes would have greater transportation impacts, while the E2 and E3 routes would have greater overall ecosystem impacts but fewer wetland impacts. Alternative E2 would impact parks and recreational facilities more than other alternatives. Alternatives E1.2, E2 and E3 would all have significant visual impacts. The Tukwila International Boulevard route would offer Tukwila citizens increased regional access, while the other alternatives would provide the region with access to shopping and employment in the Southcenter area.

Stations at Boeing Access Road (E1.1 and E1.2) or Longacres (E2 and E3), would provide a direct connection to commuter rail and bus transit, and would offer park-and-ride facilities. Pedestrian and bike access is poor at the relatively isolated Boeing Access Road, and the station has wetland impacts. Longacres is near a multi-purpose regional trail, which also features an Amtrak Station and is close to major employment centers with high levels of projected growth.

The preferred alternative is for an at-grade route along Tukwila International Boulevard south of about S. 124th Street, while Alternative E1.2 would be elevated. Alternative E1.1 would be slightly slower and less reliable than an elevated route, but it is also about $39 million less expensive. The at-grade S. 144th Station would be more accessible to a pedestrian-oriented center around the station; however, there would be slightly greater displacements and parking impacts. All station options at S. 144th Street could significantly worsen operations at the intersection of S. 144th Street/Tukwila International Boulevard, but this can be mitigated. The elevated structure of Alternative E1.2 would result in visual impacts with parts of the neighborhoods along Tukwila International Boulevard.

The MLK Jr. Way S. alternative (E3) would be shorter and faster than the Interurban route (E2) by 0.64 mile and 3.6 minutes but would cost approximately $30 million more. The Interurban route would have higher impacts on aesthetics, fisheries, wildlife, vegetation and parklands. It also would cross the Duwamish/Green River three times compared to once for Alternative E3. Alternative E2 would have fewer vibration impacts and fewer acquisitions impacts than Alternative E3. While the station at Longacres is in a similar location for both Alternatives E2 and E3, the Strander Boulevard Station (E3) would have higher ridership than the Baker Boulevard Station (E2). Station options at the Strander Boulevard location also involve trade-offs between the number of parking spaces that would be displaced versus having on-site bus and passenger drop-off areas. Either station could be combined with either the E2 or E3 route alternatives.

Segment F (SeaTac)

The route alternatives and variety of station locations in this segment would serve the same general corridor through SeaTac. The alternatives differ in their costs, their connections to Sea-Tac airport; their service to the City's urban center; the impacts to resources along International Boulevard and on Port of Seattle property, and the location and impacts of park-and-ride lots.

At $221 million, the preferred alternative (F2.3) is $40 million more expensive than an at-grade route along International Boulevard (F1). The costs are higher due to the extent of elevated sections, but the preferred alternative avoids many of the property and traffic impacts of an at-grade route along International Boulevard (F1). It has three options for a station at North SeaTac (S. 154th Street) with a park-and-ride facility, which would improve transit access for residential neighborhoods east and west of the line. The park-and-ride facilities would displace commercial lands adjacent to the station, but Option A could offer the best economic and redevelopment benefits. Option B with a structure located southeast of the station would provide the most park-and-ride spaces (670).

The preferred alternative would serve the airport with a station at S. 170th Street (IMC) or at the NEAT. The NEAT site would provide the most benefits for travelers to and from the airport, and the IMC site would provide more benefits to travelers headed elsewhere in the region and could also serve the City Center. Both options would integrate with the airport's proposed ground transportation system and would serve the airport's future expansion plans, although the Port prefers the NEAT site.

The preferred alternative also has provisions for a potential station at South Central SeaTac to serve the City Center at S. 184th Street. Alternative F2.2, (Washington Memorial Park City Center East), would place a station closest to the City Center, but would cross Bow Lake on an elevated structure, resulting in visual impacts for area residents. Alternative F3.2 would serve the airport only at the existing main terminal, would not serve the city center and, while providing a direct pedestrian connection, would be more disruptive to airport operations, and more costly than a NEAT or IMC Station. Alternative F3.1, with a station just east of International Boulevard, would impact port properties, while F.1 would have a station in the median of International Boulevard, resulting in traffic circulation and displacement impacts.

South of the City Center area, the preferred alternative and all alternatives but F1 follow 28th Avenue S. to S. 200th Street, a route that would have fewer impacts to traffic and businesses than F1, which continues along International Boulevard to S. 200th. Five options exist for a south SeaTac Station, involving different park-and-ride facilities, station configurations, and surface operations, varying the treatment of 28th Avenue S., and varying the property displacement impacts. A surface park-and-ride facility and structured parking is proposed in the various options, with Option E providing a public/private partnership opportunity involving a privately operated park-and-ride structure that would be sited south of S. 200th Street.

S.14.3 Trade-offs Among the Maintenance Base Sites

All M1 maintenance base sites are well situated relative to the overall light rail corridor, and would be in the North Duwamish Industrial area. They also connect to existing BNSF tracks and could provide heavy maintenance for Tacoma's light rail vehicles. The surrounding land uses are compatible to industrial uses. The most significant environmental impacts involve the number of employees and businesses that would be displaced by various site and route combinations. Site M1-B would have the highest impacts to jobs. As there is limited land available for relocation in the Duwamish Industrial and Manufacturing area, relocation could be difficult, particularly for businesses that require large sites or rail access. All sites would require a conditional use permit from the City of Seattle. Sites M1-D and M1-E overall would have the least environmental impacts, but they also would require the selection of Alternative C1.4 along S. Forest Street. (Alternative C1.4, while one of the highest cost route alternatives in Segment C, has among the fewest environmental impacts of the Segment C routes.) The base costs for the site vary by $16 million, and up to $28 million when access routes are considered. The lowest cost combinations are M1-B and M1-C with any of the C1 alternatives ($98 to $102 million). Sites M1-A, M1-D, and M1-E have costs ranging from $112 to $126 million.

Site M2 (N.E. Boeing Access Road Maintenance Base) is well configured for a light rail maintenance base, has no significant environmental impacts, and would allow limited expansion of the base for future phases. Its costs would range from $99 to $118 million, depending on the route alternative. Its disadvantages are that access would require a grade-separated structure or, with an at-grade access, traffic would be impacted on MLK Jr. Way S. a few times during the day. There is no connection to existing freight rail tracks for delivery of vehicles and access for Tacoma vehicles for heavy maintenance.

Site M3 (S.W. Boeing Access Road Maintenance Base) is the lowest cost site (ranging from $108 million if paired with the preferred alternative to $126 million if paired with Alternative E3), and it has direct access to freight rail tracks. A maintenance base at this site would change the character of the site but it would remain consistent with the surrounding uses. However, the site is poorly shaped and has a number of potential adverse environmental impacts including wetland impacts and an impact on a culturally sensitive site. It has poor access by road and has no potential for expansion.

S.15 NEXT STEPS

Selection of the Alternative to Be Built

Following the issuance of this EIS, Sound Transit and FTA will finalize the route alternatives, station locations, and maintenance sites to be built. The Sound Transit Board is expected to make its decision in November 1999.

Obtain Federal Project Approval or Record of Decision

A Record of Decision (ROD) would be issued by the FTA following completion of the Final EIS and Sound Transit's decision on the alternatives to be built. FTA's ROD is expected by the end of 1999. The ROD certifies the adequacy of the project's NEPA environmental review process and itemizes Sound Transit's commitments to mitigation of project impacts. Issuance of the ROD and completion of preliminary engineering is a prerequisite to obtaining a Full Funding Grant Agreement (FFGA) with the FTA.

Secure Full Funding Grant Agreement (FFGA) with FTA

The revenue stream approved by regional voters provides a committed source of local funding, which assures implementation of the proposed light rail project and other components of the *Sound Move* plan. However, securing a reasonable share of federal funds would accelerate the implementation schedule and leverage the contribution of local taxpayers. Sound Transit must sign a Full Funding Grant Agreement with the FTA to compete effectively for federal funds. These agreements are signed after the completion of the ROD. The Full Funding Grant Agreement is scheduled for completion in the spring of 2000.

S.16 ISSUES TO BE RESOLVED

The Sound Transit Board identified a preferred alternative, including routes, station locations, and termini, on February 25, 1999. The Board's motion, however, did not identify a preference for several project elements, including some specific station options; routes and stations in Segment A; a maintenance base site; or a minimum operable segment (MOS). After release of the Final EIS, the Board will select the alternatives to be built, which may be the same, or modified version of the preferred alternative it identified in February 1999, and it will include those elements of the project where a preference had not yet been identified. The selection of the alternative to be built in Segment A may be deferred to a later time. The Board's decision on the project will determine the alternatives to be carried forward into final design, construction, and operation.

Other issues to be resolved include obtaining federal project approval (the Record of Decision) and securing federal funding, as discussed above in S.15, Next Steps. Other federal processes that will be resolved as part of the ROD or prior to the Full Funding Grant Agreement (FFGA) are the environmental justice determination, completion of the Endangered Species Act consultation with resource agencies, execution of the Programmatic Agreement for Section 106 compliance, and finalization of the Section 4(f) Evaluation.

S.17 AREAS OF CONTROVERSY

Although some individuals have expressed a desire for technologies other than light rail or for serving other areas with the light rail system, there is generally solid support regarding the corridor itself and the basic system that is proposed. Opinions vary regarding specific route and station locations, but are generally consistent in most parts of the corridor. The exceptions, where controversy surrounding certain project elements is notably high, are summarized below.

Although the Sound Transit Board did not identify a preferred alternative in Segment A, there were many comments during the Draft EIS comment period expressing a preference for a tunnel route through the Roosevelt commercial district and against the staff-recommended elevated alternative. There is also much sentiment from downtown Seattle stakeholders, and others, that the system needs to go to Northgate as part of the initial project. The main issue here is to reduce the number of buses that would operate on the downtown Seattle surface streets once light rail begins exclusive operation through the DSTT when the system opens. By extending the system to Northgate, light rail would replace a number of buses that currently go downtown.

In Segment B, opinions are divided on the station options at N.E. 45th Street. Following issuance of the Draft EIS, the University of Washington and several other organizations in the area requested that Sound Transit investigate a N.E. 45th Station option that would locate the station entrances off the University campus and nearer to the adjacent commercial district west of 15th Avenue N.E. (Option C). Sound Transit developed and investigated additional options, reporting the analysis in an Environmental Assessment (EA) made available to the public in early August. Most comments received on the EA regarding the N.E. 45th Station opposed Option C primarily because of impacts to housing and commercial uses. Also on Segment B, the Roy/Aloha Station or provisions for this station in the future is not included in the preferred alternative. The City of Seattle and some community members have supported a station at this location.

In Segment C, Sound Transit developed and evaluated additional maintenance base alternatives in the North Duwamish area and included them in the EA. Developed in response to industrial business concerns and to provide more maintenance base options that could be linked with a shorter light rail system, the new maintenance base sites would have a range of impacts and costs. These options could also reduce (depending on the option) the overall impacts to industrial uses in this area. There is still some opposition to siting a maintenance base in this industrial area, primarily because it would preclude the selected properties from being used by private industrial uses. In addition, one of the new options would limit the potential options for King County Metro to expand its existing Atlantic Bus Base.

The City of Seattle and many citizens support the preferred alternative in Segment D. However, a group of business owners, property owners and residents in Segment D have formed an organization named "Save Our Valley" that opposes Sound Transit's preferred alternative in this segment. This group would prefer a tunnel through the Rainier Valley to reduce the impacts associated with the aboveground alternative. In response to this concern, Sound Transit prepared the Rainier Valley Tunnel Environmental Technical Report, which evaluated the tunnel option and concluded that it is not a reasonable alternative (see Appendix Q). Sound Transit has also modified the preferred alternative and added mitigation to reduce impacts and increase benefits from the at-grade route. Save Our Valley has also filed a complaint with the Federal Transit Administration and Federal Housing Administration pursuant to Title VI and Title VIII of the Civil Rights Act regarding project-related impacts on minority and low-income communities. Sound Transit has been coordinating with this group since it first formed and is continuing to communicate with them regarding the analyses and choices in this area.

In Segment E, the City of Tukwila and many citizens do not agree with the Sound Transit Board's preference for Alternative E1.1. The City Council prefers an alternative that serves their designated urban center at Southcenter with a multi-modal station at Longacres. The City of Tukwila previously preferred Alternative E2, Interurban Avenue, which is supported by their Comprehensive Plan. However, the City changed its preference to E3 when citizen opposition to E2 arose. Sound Transit has reviewed the comments and information provided by the City of Tukwila. This information and their concerns have been addressed by updating the impact analyses, as appropriate, to reflect new information, and by modifying Alternative E1.1 to further reduce impacts and to incorporate elements of the City's Revitalization Plan for that corridor.

In Segment F, Sound Transit, the City and the Port of Seattle have been working together to coordinate the light rail project, the planned Sea-Tac Airport improvements and the city's land use plans. All parties generally agree with the light rail route and station locations preferred by the Sound Transit Board. The choice of station at the airport and park-and-ride options at S. 154th and S. 200th streets still needs to be determined.

CHAPTER 1
PURPOSE AND NEED

1. Purpose and Need

The purpose of the proposed light rail project is to construct and operate a starter electric light rail system designed to connect several of the region's major activity centers: the City of Seattle (Northgate, Roosevelt, the University District, Capitol Hill, First Hill, downtown, and the Rainier Valley area); the City of Tukwila; the City of SeaTac; and Sea-Tac Airport. Seattle Center and Southcenter Mall may also be served. These areas include the state's highest employment areas and contain the highest transit ridership in the region. The light rail line is envisioned as the initial phase of a long-range regional transit system, with future phases extending to the north, east, and south.

The Sound Transit Board approved the light rail transit technology and the general routes/corridors to be served for the light rail project in May 1996. The voters of the Central Puget Sound Region approved financing for the *Sound Move* plan on November 5, 1996. The *Sound Move* plan consists of high-capacity transit services, including electric light rail transit in the Central corridor, commuter rail, regional express bus service, and community connections defined as transit center park-and-ride facility and other intermodal transfer points. *Sound Move,* which represents the preferred transit system plan, was developed through a multi-year planning process that included substantial public and community involvement. *Sound Move* is consistent with, and implements, applicable federal, state, and local requirements for transportation and land use/growth management planning.

Implementation of the light rail element of the *Sound Move* plan would: expand transit capacity within the region's most dense and congested corridor; provide a practical alternative to driving a car on increasingly congested roadways; support comprehensive land use and transportation planning; provide environmental benefits; and improve mobility for travel-disadvantaged residents in the corridor.

1.1 NEED FOR THE PROJECT

1.1.1 Description of the Light Rail Corridor

Geography

The landscape of the light rail corridor area consists of alternating north/south ridges, hills and valleys, with Puget Sound to the west and Lake Washington to the east. Seattle has a distinctive hourglass shape that narrows to approximately 2.5 miles near its midpoint. The area has a number of smaller lakes, and the Duwamish/Green River valley extends south from Elliot Bay. The Seattle central business district lies near the center of the hourglass. This geography creates natural barriers to travel that have necessitated innovative and expensive solutions like massive hill re-grading and construction of railroad and transit tunnels, floating bridges, and many miles of highway on elevated structures.

The Sound Transit district includes the most congested urban areas of King, Pierce, and Snohomish counties, comprising the most intensely developed region in Washington State. The district boundary lines generally follow the urban growth boundaries each county created in accordance with the Washington State Growth Management Act (GMA). The Light rail system spans the north King County subarea (one of five subareas in the 3-county district) of which the City of Seattle comprises 89 percent, and the south King County subarea, including the cities of Tukwila and SeaTac.

Population and Employment

The light rail corridor is part of the rapidly growing central Puget Sound region, which has the third highest population growth in the nation among metropolitan areas with over two million people.

Regionally, the population increased by more than half a million people during the 1980s. Between 1990 and 1996, the population increased by 307,000 – an 11.6 percent gain. Jobs nearly doubled in the region between 1970 and 1995, from 804,000 to 1,570,000. Since the early 1970s, the region's services and trade sectors have grown rapidly, paralleling national trends. In addition to the manufacturing base, the region also houses a growing number of high-tech firms. High-density employment and population characterize the corridor.

- Downtown Seattle currently has over 167,000 jobs filled by employees coming from all three Sound Transit counties, as well as Kitsap County.
- Capitol Hill-First Hill is one of the densest urban neighborhoods in the nation, with 16,000 residents per square mile and over 55,000 jobs. Currently 54 percent of those employed on First Hill live outside the City of Seattle.
- Colleges and universities in this corridor enroll over 48,000 students, many of whom live outside Seattle and King County. The University of Washington has a daily campus population of over 50,000. The City of Tukwila, which currently has a population of about 15,000 and supports 47,000 jobs, is expected to support 62,000 jobs by 2010, and 74,000 jobs by 2020. The Southcenter Mall and the Duwamish industrial area are key employment sites.
- The City of SeaTac houses Sea-Tac Airport, the fastest growing airport on the west coast and the fifth fastest growing airport in the world. Over 23 million travelers frequent the airport each year, and more than 38 million are predicted in 2020 (PSRC 1995). The City is a regional employment center which supported 28,000 jobs in 1990, increasing by 75 percent to 49,000 jobs in 2010 and to 63,000 by 2020.

Highway network

The regional highway network serving the light rail corridor includes eight multi-lane controlled-access highways, and many miles of arterial and local streets. A 1998 study by The Texas Transportation Institute rated the Puget Sound region's traffic movement as among the three worst in the country, along with Los Angeles and San Francisco. The highways within the light rail study area are among the most heavily traveled and congested in the region (See Figure 1.1-1).

The Puget Sound Regional Council's (PSRC's) Metropolitan Transportation Plan includes extensive roadway network improvements such as completion of an interconnected system of freeway and arterial HOV lanes, construction of missing links for network continuity, expansion of capacity to and between centers, widening of major roadways as necessary, upgrading of highway safety and efficiency, provision of arterial access control, and expansion of automobile ferry capacity across Puget Sound. These projects would add over 1,200 lane miles of capacity to the metropolitan arterial network. Constraints on the construction of new highway capacity – such as the lack of available right-of-way and funding, environmental impacts, and community opposition – limit opportunities to expand the highway network within the light rail project area. Less than 10 percent of this added capacity will be located within the light rail project area, and virtually all of it will be devoted to the completion of either freeway high-occupancy vehicle (HOV) lanes or missing roadway links.

Freight traffic

Major population growth has increased demand for goods and services and put pressure on the region's ability to move regional freight via air, truck, rail, and water. As a major international center of waterborne commerce and a North American gateway for Pacific Rim trade, the region needs to move freight efficiently within and through the region. The number of container units handled by Port of Seattle facilities is expected to increase by well over 50 percent in the next decade. Air freight movements at Sea-Tac Airport are predicted to increase by 80 percent from nearly 500,000 annual metric tons to 880,000 in 2020. Air cargo activity at Boeing Field (King County airport) is also expected to more than double by 2020. The regional highway system provides vital linkages to the industrial base of the region, including Port of Seattle shipping facilities, railroad intermodal terminals, and other waterfront industrial facilities. The economic vitality of the region requires maintaining mobility on the highway network.

Other transportation facilities and services

A complex network of federal, state, regional, and local transportation facilities and services comprise the regional transportation system, including Amtrak rail passenger service, automobile and passenger-only ferries, local and commuter bus services, and future intra-regional commuter rail. Amtrak operates passenger rail service throughout the corridor, northward to Vancouver B.C. and southward to Los Angeles and San Diego. Current Amtrak operations use King Street Station in downtown Seattle. Sounder commuter rail operations by Sound Transit will also use King Street Station, connecting downtown Seattle with peak hour service from the Green River Valley and Tacoma by late 1999. Light rail would connect with Amtrak and Sounder commuter rail via a walkway between the Union and King Street stations, which are located on either side of S. Fourth Avenue in downtown Seattle. Amtrak has received funding for an inter-city rail station at Longacres that would operate in conjunction with Sound Transit commuter rail, and potentially with light rail, depending on the alternative selected. Sounder commuter rail will implement future extensions southward to Lakewood and northward to Everett. Washington State Ferries (WSF) provides passenger and automobile ferry service across Puget Sound between Kitsap County and the Colman Dock (Pier 52) on downtown Seattle's waterfront, which is six blocks from the Pioneer Square station and eight blocks from the University Station. The regional and inter-city bus terminal for Greyhound and Trailways at 8th Avenue and Stewart is located within 6 blocks of the Westlake Station in downtown Seattle. Within the light rail corridor, King County Metro provides local and regional bus service. Community Transit provides regional bus service from Snohomish County, and Pierce Transit provides regional bus service from Pierce County to the south. Sea-Tac Airport is located near the southern end of the study corridor. All of these transportation modes would connect with proposed light rail stations.

1.1.2 Decreasing Travel Abilities–A Mobility Alternative is Needed

Population and employment are increasing

Between 1990 and 2020, the central Puget Sound region's population is projected to grow from 2.7 million residents to 4.1 million, an increase of 52 percent. During the same period, the region's employment is expected to grow from 1.4 million jobs to 2.2 million jobs, an increase of 57 percent.

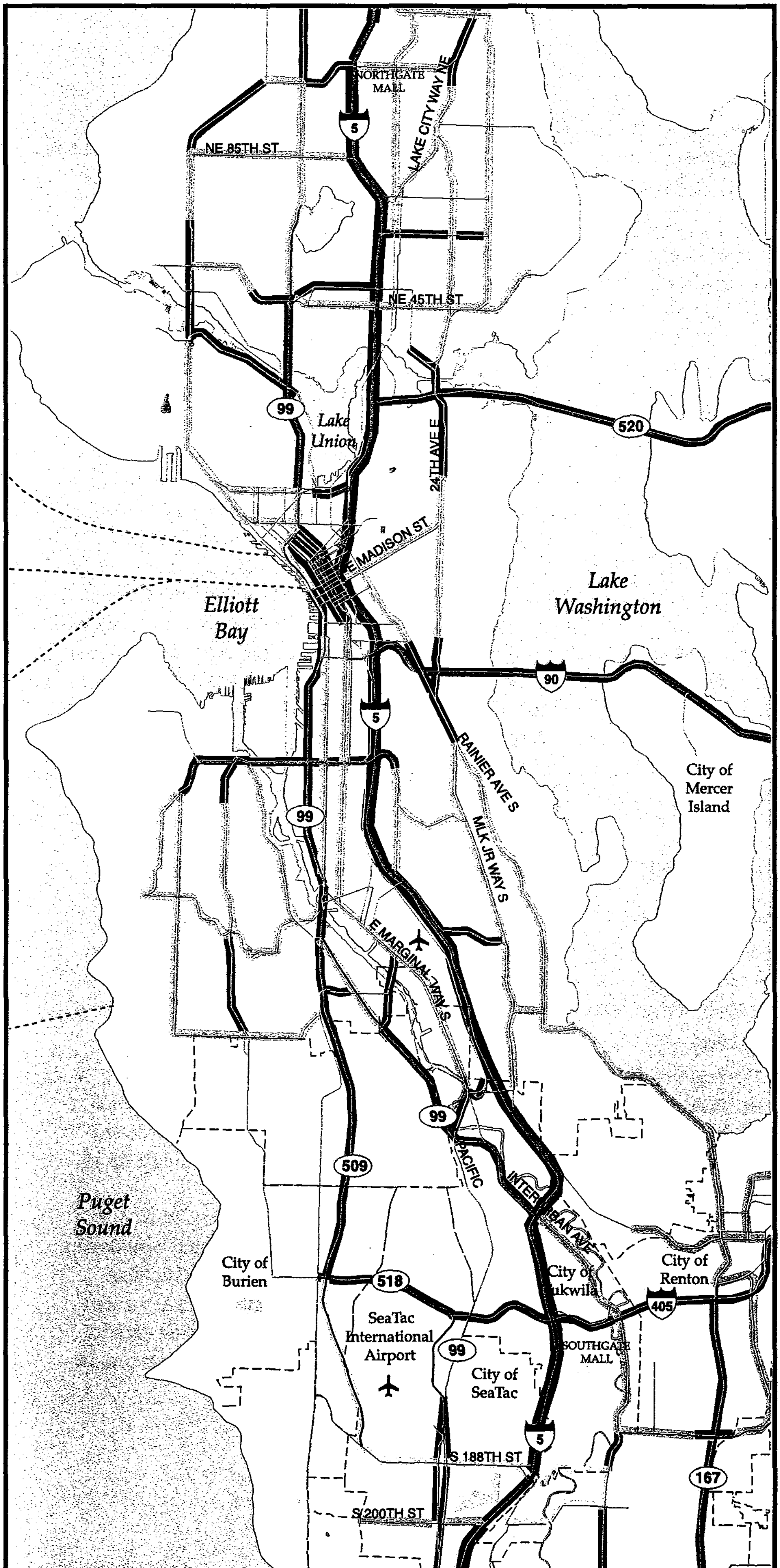
Traffic congestion is increasing

Between 1990 and 2020, regional P.M. peak period delay is projected to triple, and average freeway speeds are expected to drop by one-third. As shown on Figure 1.1-1, the 1995 P.M. peak congestion period exceeded two hours on almost all major roadways in the corridor, and exceeded four hours in some locations. By 2020, peak-period congestion on major roadways could last up to five hours each afternoon/evening.

Congestion in the Puget Sound region, which has grown rapidly in the last 10 years, now constricts travel on most major freeways, expressways, and arterials. Lane blockages and slowdowns caused by vehicle breakdowns, accidents, incidents, and foul weather contribute to unpredictable highway system performance, especially during peak hours. Peak commuting periods have grown longer, and congestion now occurs even on weekends in some areas. "Normal" congestion caused about 30 million annual person-hours of delay in 1984. This figure had risen by about 50 percent in 1990, and is expected to cause 75 million annual person-hours of delay by 2005.

SOUNDTRANSIT

Figure 1.1-1 Central Link Corridor Major Transportation Facilities and Congestion



1995 Roadway Congestion

Duration of PM Peak Period

- More Than 4 Hours
- 2 - 4 Hours
- Less Than 2 Hours

- Interstate Highway
- State Route
- Airports
- Washington State Ferry Service

Source: PSRC, Metropolitan Transportation Plan 1998 Progress Report, March 1998

0 1 MILES

Slower and less predictable travel is closely related to congestion. The average speed for all trips dropped by about 20 percent between 1970 and 1990. Peak-hour speeds on freeways and major arterials slowed by about 50 percent during the same period, and speeds are estimated to drop from 26 mph in 1990 to 14 mph by 2020. By that year, average travel time from downtown Seattle to Northgate is expected to be 45 minutes, and from Seattle to Sea-Tac Airport about 60 minutes, compared with 20 minutes and 30 minutes in 1998, respectively.

Vehicle miles traveled are increasing

Between 1980 and 1990, vehicle miles traveled (VMT) increased more rapidly than population or employment. The average daily VMT per capita in the region increased from 9.3 in 1960 to 22.2 in 1990. In King County, VMT per capita steadily increased from 5,800 miles per year in 1970 to 9,200 miles in 1990. Within the last four years, King County VMT and fuel consumption have both increased by seven percent. Changing household composition (with more workers and more licensed drivers) and development patterns may contribute to this trend. By 2020, even with growth management laws in place throughout Western Washington, VMT is expected to more than double from 1990 levels. In the same period, freeway mileage in the region will increase only slightly, and total roadway mileage will increase by 15 percent.

Today, the region's residents travel more, cover longer distances, and travel alone more often than in the past. Commute distance has increased nearly 40 percent since 1960, from 7.4 to 10.6 miles. Increasing numbers of people live in one county and work in another. The shortage of affordable housing near urban employment centers and the increase in two-wage earner households also contribute to increased commute distance.

Auto ownership is increasing

Another factor affecting peak-period commute times is the number of vehicles on the road; most are single-occupancy vehicles (SOV). In 1990, 75 percent, or over 1,000,000 of the region's trips to work per day were SOV. Looking at all trips, the average daily trips per capita rose from 1.5 in 1960 to nearly 3.3 in 1990. Currently, Seattle has more registered vehicles than it has residents. Between 1970 and 1990, Central Puget Sound automobile ownership increased by 108 percent, contributing to a drop in the number of people riding together. In 1990, there was roughly one car in the region for every person of driving age.

Existing transit service quality is deteriorating

Over recent years, as congestion has worsened, transit usage in the Puget Sound region has grown substantially, reaching 248,000 trips daily in 1995. Today, transit carries 40 percent of all trips in the region's most congested areas. Despite gains in overall transit ridership since the 1960s, transit patronage has steadily lost ground as a percentage of all trips. Public transit in the central Puget Sound region carried 10 percent of work trips in 1960; this figure declined to 7.5 percent of work trips in 1990.

Current bus service speed is deteriorating at a rate of 10 percent per decade. Reliability is declining even faster as buses are increasingly caught in congestion. Between 1962 and 1998, for example, peak transit travel speeds dropped from 7.8 mph to 4.8 mph along Broadway Avenue on Capitol Hill. Peak hour scheduled bus travel time between Broadway and downtown Seattle is currently 20 minutes. By comparison, a bus rider from Bellevue's Eastgate neighborhood can reach downtown Seattle in 20 minutes, and the trip from Broadway to downtown Seattle on light rail would take five minutes.

In addition to travel time and reliability impacts, congestion contributes to longer operating schedules, increased operating costs, and larger bus fleet requirements. Buses are caught in the same unpredictable lane blockages and slowdowns as other traffic due to accidents, breakdowns, and other incidents. The planned completion of the regional HOV system will offer some congestion relief; however, bus speed and reliability will continue to be compromised by several factors, including:

- Continued highway disruptions related to lane blockages for various causes.
- Congestion in HOV lanes
- Lowered speeds due to congestion adjacent to HOV lanes
- Lack of direct HOV connections at system interchanges
- Lack of direct HOV connections between freeways and surface streets
- Lack of separated guideways and HOV connections into downtown areas generally, and between downtown Seattle and the University District specifically.

1.2 PURPOSE OF THE PROJECT

1.2.1 Transportation benefits – Assistance to the region and its economy

The Sound Move alternative to traffic congestion

Sound Move, the regional transit system plan, which includes light rail, Sounder commuter rail, and Regional Express bus services, would deliver substantial travel time savings to its riders across the region. By 2010, the combined travel time savings for system users in the region, as a result of *Sound Move*, is estimated at 8.2 million hours annually. Of this total, 5.1 million hours are attributable to rail, 1.5 million hours to bus, and 1.6 million hours to carpools and vanpools. The annual value of these time savings in 1995 dollars is computed at approximately $98 million.

The region's investment in *Sound Move* would produce a net benefit of $9.9 billion during the average economic life of its assets, considering the value of travel time savings and other benefits, including reduced vehicular travel, savings in capital outlays, replacement of plant and equipment and operating costs.

Benefits of light rail for transit speed, reliability, and ridership

The light rail system would greatly improve transit capacity, connections, trip frequency, speed and reliability for average trips by transit within the project area. In contrast to conventional bus service, the proposed light rail service would operate mostly on rights-of-way independent of congested roadway traffic. This feature would allow the addition of new transit capacity with faster travel times than comparable bus service. It would provide more frequent service and greater reliability, avoiding transit service disruptions due to accidents, breakdowns, and other incidents. (Comparative average peak hour travel time information is provided for the light rail corridor in Appendix G: Environmental Justice and Chapter 3 Transportation impacts). Light rail would also have the capacity to serve future ridership demands by increasing the cars per train or the frequency of service. Limited road capacity and higher operating costs would limit the effectiveness of adding more buses; this would adversely affect traffic congestion without providing faster service. The light rail line would allow the re-allocation of 400,000 bus service hours annually to local routes without adding more buses. Integrated bus service to light rail stations from existing King County Metro bus routes would offer tremendous opportunities for service-enhancing travel time savings. Average 1998 Metro bus operating speeds are 10.4 mph on Rainier Avenue S. and 9.5 mph on Eastlake Avenue, considerably slower than the proposed average light rail operating speed of 28 mph.

Table 1-1 shows the estimated rail boardings by line for *Sound Move*. The figures include the light rail line from Northgate to SeaTac, the Tacoma Link line, and Sounder commuter-rail service between Lakewood and Everett. As shown, approximately 90 percent of the expected rail volumes—representing nearly two-thirds of transit boardings for the entire *Sound Move* plan—are due to ridership on the light rail.

Table 1-1
Rail Station Boarding in 2020

Line	Daily boarding	Annual boarding
Light Rail (Northgate to SeaTac)	133,000	40.3 million
Tacoma light rail	2,400	0.72 million
Everett-to-Seattle commuter rail	4,600	1.3 million
Lakewood-to-Seattle commuter rail	14,200	4.5 million
Total	154,200	46.82 million

Source: Light rail boardings from Sound Transit ridership model, July 1998, others from *Sound Move* plan.

The light rail corridor currently has the highest transit ridership in the region. The potential for substantial growth is based on the following:

- Currently, transit and HOVs (High-Occupancy Vehicle) carry about half of all trips to downtown Seattle.
- The University of Washington and its U-Pass program currently account for approximately 10 percent of Metro and Community Transit's total countywide ridership.
- The projected light rail ridership of over 133,000 daily riders would be difficult to serve with conventional bus service.
- PSRC's projections indicate that transit demand on the light rail system could easily surpass 133,000 daily riders, particularly if state commute trip reduction goals are reached and development occurs according to adopted land use and transportation plans. Even if equivalent bus service could be provided, this level of ridership would strain planned bus system capacity.
- The planned Capitol Hill light rail station is forecast to have the second highest ridership in the system (after the downtown Seattle Westlake Station, see Tables 3.2-8 through 3.2-13b).
- Approximately 40 percent of light rail riders are projected to access light rail via transfer connections from Metro, Community Transit, Pierce Transit, Amtrak, Sounder commuter rail, and WSF ferries (Sound Transit ridership forecasting model July 1998).

Light rail builds on prior strategic transit investments

The light rail project would connect Northgate to the University District, Capitol Hill-First Hill or Seattle Center, downtown Seattle, southeast Seattle, Tukwila, SeaTac and complete preliminary engineering for future extension to Northgate. These are Washington State's highest employment areas and have the highest regional transit ridership. The most significant investments required for the light rail system—the Downtown Seattle Transit Tunnel (DSTT) and stations—are already in place. The proposed light rail project would optimize use of this previous investment, providing a very significant increase in passenger-carrying capacity (a light rail train can carry from four to ten times as many riders as a bus). Long-range regional plans envision the light rail corridor to be the first part of a light rail system serving all three Sound Transit counties.

Provide equity in transportation opportunities

The principal purpose and one of the goals of the light rail transit system is to increase transit options and improve mobility. Transit users would benefit most directly by travel time savings, the ability to make new or longer trips due to expanded service and faster travel speeds, and improved access to jobs, education, and other destinations. Corridor transit users would experience PM peak hour travel time savings of nine to 18 percent over the No-build Alternative, depending on the light rail alternative. The corridor-wide transit travel time savings for the preferred alternative would total 3,373 hours, which is an average of seven minutes per trip, or 15 percent savings as compared to the No-build Alternative. Some neighborhoods would benefit more than others depending on the transportation system. All transit riders within the corridor area would also benefit from an increase of 1.27 million in the number of jobs accessible within 60 minutes. The light rail corridor would border or traverse 30 diverse neighborhoods. In eight of them, racial minorities comprise 50 percent or more of the population. Five of these eight neighborhoods also have large populations of low-income residents. These neighborhoods are concentrated near the southern end of downtown Seattle and along the corridor route to the south and east through the Rainier Valley (see Table 4.3.1 in Section 4.3). Routes and stations have been located to serve these populations, and on average they would enjoy greater access to jobs and other destinations, and significantly greater savings in travel time by transit as compared to the No-build Alternative.

Light rail would offer measurable benefit to southeast Seattle. In addition to having the largest minority and low-income populations along the corridor; this area has one of the highest per capita transit ridership levels in the entire existing Metro system, a substantial portion of all households in the city without access to a car, and one of the highest densities of seniors and children combined in the City of Seattle. The light rail preferred alternative would provide greater transit system access, resulting in average travel time reductions of 31 percent for P.M. peak hour trips by transit to Rainier Valley neighborhoods. The number of jobs located within 60 minutes travel time from Rainier Valley neighborhoods, by transit, would increase 57 percent from about 344,000 under the No-build Alternative to 540,000 with the light rail preferred alternative. Transit access to educational opportunities and health care services would also improve markedly for Rainier Valley residents, by 114 and 27 percent, respectively, as compared to the No-build Alternative. These transit travel time benefits are especially important because low income and minority populations depend more heavily on transit for mobility than the general population (see Appendix G). Employment accessibility improvements would also be greater than average for the University District, Beacon Hill/McClellan, Boeing Access Road, Foster/Riverton Heights, and City of SeaTac areas.

1.2.2 Environmental benefits – helping the region to maintain environmental quality

Benefit regional air quality conditions and trends

Prior to November 1996, the central Puget Sound region was designated by the U.S. Environmental Protection Agency (U.S. EPA) as a "non-attainment area" for carbon monoxide (CO) and ozone air quality standards. In other words the U.S. EPA's standards for levels of these pollutants in the atmosphere had been exceeded, and special measures were necessary to control them. Except for Particulate Matter of ten microns (PM_{10}), the central Puget Sound region is now in attainment for all criteria pollutants. The U.S. EPA re-designated the Central Puget Sound region to attainment for CO on October 10, 1996, and for ground level ozone on November 26, 1996. Maintenance plans for the two criteria pollutants were approved simultaneously. Part of Seattle's Duwamish industrial district technically remains a non-attainment designation for PM_{10} even though all required SIP demonstrations have been made and several years of monitoring data collected by the Puget Sound Clean Air Agency shows the area has attained the standard.

Ongoing air quality measurements and projections throughout the Puget Sound region indicate that ambient CO concentrations have been decreasing over the last decade. Measured ozone concentrations, in contrast, have remained fairly static. The decline in CO is due primarily to improved motor vehicle emission controls and the rate of turnover to cleaner vehicles. The required use of oxygenated fuels in winter, and vehicle inspection and maintenance programs have also had an effect (PSRC 1995). Over time, several factors may counteract this downward emission trend: (a) VMT continues to increase along with roadway congestion; (b) oxygenated fuels may be phased out as a control strategy; (c) increased speed limits on the region's highways; and (d) the vehicle fleet ages as people keep their cars longer. PSRC estimates that CO emissions will begin to increase again around the year 2010, making renewed violations of CO standards possible. This could trigger the region's redesignation to nonattainment status, forcing more stringent constraints on travel and economic growth, and possibly causing the loss of federal and state transportation funds for highway expansion (PSRC 1998).

The proposed light rail line is an integral component of the transit expansion strategy in the regional air quality maintenance plan. The proposed line would result in small reductions of tailpipe pollutant emissions as compared to the No-build Alternative, improving air quality and potentially contributing to continued attainment status and a higher quality of life.

Minimize right-of-way needs and neighborhood disruption

Compared to the construction of new roadways, transit facilities provide a very high-capacity level with less cost and impact. For example, a light rail line can move the same number of people at peak travel hours as a 12-lane highway, at only 25 to 33 percent of the cost, and in a much narrower right-of-way (less than 30 ft, as compared to more than 150 ft).

Reduce impacts to ecosystems, water quality, and hydrology

Several wildlife and fish species in the project corridor (chinook salmon, coho salmon, peregrine falcon, bald eagle, and bull trout) are currently listed as threatened, endangered, or candidate species under the Endangered Species Act, largely as a result of historic actions that have consumed and degraded habitat. These actions included flood control and irrigation, land reclamation and navigational improvements, draining of wetlands for urban development and roadways, discharges of pollutants, and a predominantly low-density land development pattern that markedly increased per capita land consumed while contributing to increased automobile travel, congestion, and parking demand. The proposed light rail line would provide the same people-moving capacity as a 12-lane highway within one-fifth of the needed right-of-way, reduce the need for parking facilities (contributing to impervious surface), and support higher density growth in designated urban centers rather than continued low density outward development of rural lands. As a result, both the direct and indirect cumulative impacts on water quality, wetlands, and habitat would be lower with the light rail system than without it.

1.2.3 Land use and transportation planning in a growing region

Land use conditions

Dispersed, low-density growth patterns have been a dominant feature of regional land use changes, particularly on the urban fringe. Open space is being consumed at an increasing rate. Between 1970 and 1990, while population grew by 30 percent, the amount of developed land in the central Puget Sound region expanded by 80 percent.

Vision 2020, the adopted economic, transportation, and land use plan for the four-county Central Puget Sound region, emphasizes a hierarchical system of relatively dense centers connected by high-capacity transit. Vision 2020 considered but rejected a "dispersed growth" alternative that emphasized increased highway capacity over high-capacity transit improvements. The region's counties and cities have also adopted land use plans that focus new growth in activity centers along major corridors supported by high-capacity transit. The light rail line is a critical element of these plans.

Transit-supportive land use planning

Approximately 18 miles of the proposed light rail system would be within the City of Seattle. Light rail would serve four of Seattle's five urban centers: downtown, Capitol Hill-First Hill and the University District would be served under the preferred alternative, with an extension to Northgate, the first planned extension of the system. It would also serve a hub urban village and four residential urban villages in southeast Seattle (as designated in Seattle's Comprehensive Plan). Further south, Sound Transit's preferred alternative would serve Tukwila's neighborhood center, while two of the alternative routes under consideration would serve the City of Tukwila's designated urban center in the Southcenter Mall area. All of the alternatives would serve the Sea-Tac Airport terminal and SeaTac's urban center, east of the existing main airport terminal.

High-capacity transit, specifically the light rail project, would be a critical step toward the region's adopted future land use vision and its efforts to maintain urban growth boundaries, thereby protecting agricultural and rural land from development. The light rail project would carry high numbers of people to and from the region's major urban centers during the most congested hours, and it would allow the region to develop in ways not otherwise achievable.

In Sound Transit's 1998 Annual New Starts Report to the FTA, the light rail project was evaluated for a set of transit-supportive land use factors. The results appear in Table 1-2.

Table 1-2
Summary of Transit-Supportive Land Use Factors

Factor	Summary Evaluation
Existing land use	Population and employment in the corridor already supports 140,000 daily transit riders, a per capita rate of over 100 rides per year. In the most dense part of the corridor (N.E. 45th to Boeing Access Rd.), the annual transit rides per capita exceeds 175. The central light rail line is expected to serve approximately 133,000 riders by 2020.
Sprawl containment	The region has a clearly enforceable and enforced Urban Growth Boundary. State, regional, and—most importantly for the corridor—locally adopted plans and policies require growth to be accommodated in designated urban centers and describe how it will be done. Much of the growth will occur within existing and increasingly dense urban centers.
Transit-supportive corridor policies	Dense, mixed-use transit- and pedestrian-oriented development is promoted and planned for in jurisdiction land use plans in the corridor. The station area planning process is well underway and neighborhood plans have incorporated light rail stations, including increased density, improved pedestrian environments and bus connections.
Supportive zoning regulations near transit stations	Existing plans support dense, mixed use development along the corridor, largely in areas already zoned for high density development which would be linked by the light rail system.
Tools to implement land use policies	The MTP includes light rail as a central transit investment to support regional land use goals. In Seattle neighborhood plans, underway for three years, are incorporating land use policies for station areas and proceeding for City Council adoption. The Seattle Transportation Strategic Plan, adopted in October 1998, includes strategies to improve pedestrian character, reduce automobile reliance, and increase densities to support transit. In Tukwila, The pedestrian-friendly Tukwila International Boulevard (previously known as Pacific Highway) Revitalization Plan was adopted in August 1998. The SeaTac Transit Supportive Land Use Master Plan was developed to guide the integration of light rail with the city's land use plan and other major transportation investments.
Performance of land use policies	Dense levels of housing and employment that would support very high levels of transit ridership characterize the corridor. Regional and local plans encourage increases in both jobs and housing, and recent development patterns in the corridor have added significant population and employment.

Source: Annual New Starts Report, Section 5309, Sound Transit, November 1998; Link ridership from Sound Transit, July 1998.

Sound Move is an integral component of the region's adopted Metropolitan Transportation Plan (MTP), and it provides a framework for further integrating the regional transit system with land use. The framework includes coordination at the regional level to ensure that future transit and development decisions are consistent with Vision 2020 and the MTP. At the local level it ensures that station-area design and development are compatible with community vision and goals. Sound Transit is fulfilling this commitment through interagency dialogue, public workshops, and ongoing coordination with regional, local, and neighborhood planning processes. These activities include routine meetings with the affected jurisdictions and transit operators, joint public transportation forums, and participation in neighborhood-level planning meetings.

Ability to satisfy "surge" demands

Large events attended by thousands of spectators and participants within the light rail project area often contribute to congestion-related breakdown of the Seattle area transportation system. The light rail project would potentially serve large-volume event facilities including the University of Washington's Husky Stadium, Seattle Center, the Washington State Convention and Trade Center, Safeco Field, and the future football stadium. Husky Stadium holds 72,000 people for collegiate football and other competitions. Seattle Center hosts 8 million visitors a year, including large annual festivals that draw up to 100,000 visitors a day to its 12,000 seat Memorial Stadium, 6,000 seat Mercer Arena, and 17,000-seat Key Arena. The 47,000-seat Safeco Field for Mariners baseball includes a 2,220-stall parking garage opened in 1999 at First Avenue S. and Royal Brougham Way. The 72,000-seat Seattle Seahawks football and soccer stadium to be built in 2002 will include a 325,000 ft^2 exhibition center and a 2,000-stall parking garage on the site of the present Kingdome. Both stadiums are within walking distance of the DSTT's International District Station. Sound Transit's preferred alternative includes a planned station at Royal Brougham that would improve transit access to the stadium district. The new stadiums will increase "surge" demands on the transportation system, but the light rail line would help to serve them. Improved transit service would also benefit trade, convention, and entertainment activities.

1.3 PLANNING CONTEXT

More than two decades of planning have gone into developing the light rail alternatives evaluated in this EIS. The planning process and the community and governmental involvement that went with it are shaped extensively by federal, state, regional, and local requirements. These requirements are described briefly below. A more detailed discussion of their application to the planning process can be found in Section 2.2.

1.3.1 State and federal regulations - Central Link is consistent

Washington State High-Capacity Transportation Act

In 1990, the Washington State Legislature passed the High-Capacity Transportation Act, which established a high-capacity transit (HCT) program, provided planning funds for local jurisdictions, and enacted tax mechanisms to pay for building a regional transit system. The legislation required a planning process modeled on the alternatives analysis prescribed by the former Urban Mass Transit Administration (UMTA, which became the Federal Transit Administration [FTA] in 1991). In August 1990, the Joint Regional Policy Committee (JRPC), made up of elected officials from Snohomish, Pierce, and King counties, was formed to oversee regional transit planning in accordance with state legislation.

In 1990, the legislature also passed provisions for HCT planning, funding, public involvement, review requirements for the use of state HCT funds, a detailed process for HCT project coordination, and a process for creating a regional transit authority. The Central Puget Sound Regional Transit Authority, now called Sound Transit, was formed through this process in 1993 and has since been responsible for regional HCT planning.

Washington State Growth Management Act

The basis of regional land use planning in the central Puget Sound area is the Washington State Growth Management Act (GMA) of 1990. The GMA requires the designation of urban-growth boundaries (UGBs) and adoption of comprehensive plans by the region's counties and cities. Within the UGBs, adequate infrastructure (transportation, water, sewer, and other urban services) must be provided to achieve population and employment targets established by the region. Jurisdictions are required to support the concentration of growth within the UGBs by setting standards for concurrency and levels of service (concurrency for transportation means that facilities and services are provided at levels that keep up with the increased demand of growth).

Planning under GMA proceeds from a regional to a local level, with each plan detailing and expanding on the goals of broader regional plans. In the Puget Sound region, the Vision 2020 plan establishes the economic, land use, and transportation strategy for Pierce, King, Snohomish, and Kitsap counties. The transportation strategy is further refined in the Metropolitan Transportation Plan (MTP), described below. Each county has established a set of planning policies that further the Vision 2020 goals. The Countywide Planning Policies (CPP) directly affecting the study area were ratified by King County cities and adopted by the King County Council in 1992. The CPP established the vision and framework for the county and cities to incorporate into their comprehensive plans. These local land use plans implement Vision 2020's growth management and transportation policies and promote the development of dense, walkable, mixed-use urban centers served by public transportation. Many of these plans reflect the fact that Sound Transit's enabling legislation requires it to favor cities and counties with supportive land use plans when implementing its programs.

The light rail line will run through the cities of Seattle, Tukwila, SeaTac, possibly Renton, and King County. Each of these jurisdictions has adopted transit-supportive plans and policies as part of its GMA compliance.

Washington State Commute Trip Reduction Act

In 1991, the state legislature passed the Commute Trip Reduction Act (HB 1671), which requires counties, cities, and towns to implement a commute trip reduction plan for major employers. Each plan must include goals to reduce single-occupant vehicle (SOV) commute trips and VMT per employee. Under the legislation, each employer with over 100 employees arriving at work during the 6 A.M. to 9 A.M. peak period must prepare a commute trip reduction plan to reduce SOV work trips. Such trips are to be reduced 25 percent by 1999, and 35 percent by the year 2005. Providing commute alternatives is essential to achieving the law's goals.

The impact of successful Commute Trip Reduction Act implementation on fixed-route transit ridership is forecast to be 50,000 additional daily transit trips in 2010; these trips are not included in current *Sound Move* ridership projections, and would increase system use beyond current forecasts.

ISTEA and TEA-21

The Puget Sound region's transit planning process occurred during a time of significant change in federal and state legislation, and in regional planning. The 1991 federal Intermodal Surface Transportation Efficiency Act (ISTEA) strengthened the role of local governments in coordinating transportation and growth management through regional metropolitan planning organizations (MPOs). The Puget Sound Regional Council (PSRC) is the Puget Sound region's MPO under ISTEA; it is also responsible for regional land-use planning under GMA. In 1992, PSRC adopted policies requiring that projects approved for federal transportation funds under ISTEA also support countywide and regional growth management plans and objectives.

ISTEA established a metropolitan transportation planning process designed to evaluate potential transportation improvements using coordinated, system-oriented intermodal approaches, all within a financially constrained framework. ISTEA also required that specific factors and criteria be used in evaluating transportation alternatives. It allowed agencies to analyze and eliminate project alternatives based on those criteria, and to develop a preferred transportation strategy before beginning federal environmental review. The preferred transportation strategy is required to be reflected in an MTP adopted by the MPO.

President Clinton signed the Transportation Equity Act for the 21st Century (TEA-21) into law in July 1998. It establishes federal transportation programs and policies, basically extending the initiatives of ISTEA, but at higher funding levels, through the year 2004. TEA-21 is the largest infrastructure funding in the nation's history (Metro Magazine July/August 1998). It calls for transportation investments that would: (a) link all forms of transportation; (b) improve public transportation systems and services; (c) provide better access to seaports and airports; and (d) enhance efficient operation of transportation facilities and services.

Major Investment Study (MIS)

The metropolitan transportation planning process established by ISTEA requires the development of a Major Investment Study (MIS) where federal funding is involved. The MIS generally focuses on corridors or subareas with the purpose of evaluating and resolving the conceptual design, mode, and routing of the investment. The MIS evaluates effectiveness and cost-effectiveness of alternative transportation investments and strategies in meeting certain goals and objectives. The MIS serves as the "alternatives analysis" formerly required under the Federal Transit Act. The output from the MIS process—a preferred transportation strategy, including a decision on mode and alignments—is approved by the MPO and incorporated into the MTP. The preferred transportation strategy is adopted in the MTP, and then becomes the basis for alternatives to be evaluated in the EIS.

The MIS on the *Sound Move* plan was completed by Sound Transit and approved by the PSRC (the MPO) in the spring of 1997. In approving the MIS, the PSRC concluded that the MIS satisfied applicable state and federal requirements. The PSRC also found that the MIS clearly documents how Sound Transit identified and evaluated a range of alternatives. In the MIS all of the alternatives are presented, together with a chronology of decisions leading to the preferred alternative. The preferred alternative adopted by the PSRC consists of HCT services, including light rail transit in the light rail corridor, commuter rail in the north and south corridors, and express bus service throughout the Sound Transit service area with an emphasis on service to the eastside. Finally, the PSRC found that the "reduced cost" of the *Sound Move* plan, "voter approved local funding" and reduced assumptions regarding future federal and state assistance help "satisfy" the federal requirement for a "financially balanced MTP."

Clean Air Act of 1970 and Amendments

Regional transportation plans (and individual projects within those plans) must demonstrate conformity with the State Implementation Plan for air quality. The criteria for conformity specify that a transportation activity cannot: (1) cause or contribute to any violation of the federal air quality standards; (2) increase the frequency or severity of any existing violation of the standards; or (3) delay timely attainment of the standards. The region's MTP has been found to meet the conformity tests as identified by the federal and state conformity regulations. The MTP incorporates the components of *Sound Move*, including the light rail project. The planned expansion of public transit furthers the goals of the regional air quality maintenance plan and helps ensure that regional business and industry are not hindered by further requirements to implement costly pollution control measures.

1.3.2 Regional and local plans and programs – Central Link is consistent

Sound Move: The Ten-Year Regional Transit System Plan - Adopted May 31, 1996

Sound Transit's ten-year plan culminates over seven years of effort by Sound Transit and its predecessor, the Joint Regional Policy Committee (JRPC). *Sound Move's* goal is to provide the Central Puget Sound region with a cost-effective public transportation system that is an attractive alternative to the SOV. Currently, the cost of traffic congestion on the regional transportation system is estimated at $1.2 billion per year in lost time, money, and resources.

Sound Move provides a balanced approach to increasing the capacity, utility, and convenience of the existing transit system by offering an integrated package of transportation improvements. Collectively, these improvements will provide a reliable, efficient, and congestion-free travel alternative by adding new high-capacity services and facilities in existing transportation corridors.

The *Sound Move* plan includes the following components:

- Approximately 24 miles of a starter light rail transit system (the subject of this Final EIS);
- An 82-mile commuter rail system on existing railroad tracks with 14 stations;
- A regional system of HOV improvements to create a continuous HOV network with direct access ramps for transit and carpools (in partnership with the WSDOT);
- New Regional Express bus routes that will use the improved HOV system; and
- Community connections to the new regional transit system, including transit stations, transit centers, rail stations, and park-and-ride facilities.

Vision 2020 and the MTP

PSRC's primary planning document is the Vision 2020 plan. Adopted in 1990 and amended in 1993 and 1995, Vision 2020 is an integrated economic, land use, and transportation strategy that includes the MTP required by ISTEA. Vision 2020 establishes a regional growth management strategy that includes identifying and maintaining urban growth areas, supporting compact communities, focusing growth in centers, and redeveloping urban transportation corridors. The MTP includes a regional rapid transit system to support higher densities, as well as policies and facilities to promote HOV use and discourage the use of SOV's. *Sound Move* is a central element of the MTP. The adopted mode choices (light rail, commuter rail, and express bus) and general transit alignments identified in *Sound Move* are integral components of the MTP.

In June 1996, PSRC found *Sound Move* consistent with the region's MTP. With respect to the MTP's major policies, the PSRC concluded that *Sound Move*:

- Supports pedestrian and transit-oriented land use patterns—*Sound Move* would support compact development, enabling people to make more trips by foot, bike, and transit and to depend less on automobile travel. Investments in community connections, rail routes, and stations would provide focal points for higher-density and mixed-use growth patterns.
- Manages the demand for travel—PSRC found that *Sound Move* offers a "well-matched combination of HCT services tailored to fit the distinct needs and constraints of travel demand in most of the major travel corridors in Sound Transit's three-county area. The proposal will improve transit as an option for regional trips and enhance the operation of local transit services to a point where public transit is far more competitive with the automobile than it is today."
- Optimizes the use of transportation facilities and services—*Sound Move* plans to maximize current transportation system investments by using existing facilities to increase overall regional capacity.

Local Land Use Plans

Transportation and land use planning in the Puget Sound region have become increasingly linked over the last 10 years, with a focus on dense development that supports mass transit, incorporates pedestrian-friendly design, and minimizes the need to construct new arterials and freeways. This section summarizes the comprehensive plans for the cities of Seattle, Tukwila, SeaTac, and Renton, and King County, through which the proposed project would pass.

City of Seattle. Seattle's 20-year comprehensive plan, adopted in 1994, envisions substantial population and employment growth that will be contained within a network of urban centers, hub urban villages, and residential urban villages. Among the plan's land use goals is the intent to "promote densities and mixes of uses that support walking and use of public transportation." This goal is facilitated by aggressive policies to reduce SOVs from 59 percent to 35 percent of peak-hour trips, while increasing transit from 16 percent to 27 percent. The Transportation Strategic Plan, which is designed to implement the transportation element of the Comprehensive Plan, includes strategies to target Sound Transit station areas for transit-oriented housing and appropriate commercial development, as well as other strategies to increase the transit use.

City of Tukwila. Tukwila adopted its comprehensive plan in 1995. The plan recognizes Tukwila's status, under Vision 2020, as an urban center in the Southcenter/CBD area and a Manufacturing/Industrial Center in the Duwamish Corridor. Tukwila currently has a residential population of about 15,000. The City's employment of 47,000 jobs is anticipated to grow to 62,000 by 2010 and 74,000 by 2020.

City of SeaTac. SeaTac adopted its comprehensive plan in 1994 and has updated it annually since. The Transit-Supportive Land Use Plan for the City Center was adopted in 1995 and updated in 1997. Vision 2020 designates the city as an urban center and a major regional employment center, with approximately 75 percent growth in jobs forecast by 2010. SeaTac is working to create a pedestrian-oriented urban center, and plans to incorporate a major city center development in cooperation with area businesses and the Port of Seattle. To this end, major pedestrian improvements have already been completed along International Boulevard (SR 99).

City of Renton. Renton's comprehensive plan was adopted in 1995. The city's 1990 population of 42,000 is expected to increase to 57,000 by 2010. During the same period, employment is expected to grow by 51 percent. The proposed Light rail project would not result in direct regional rail service to downtown Renton.

King County. The County-wide Planning Policies were ratified by King County cities and adopted by the King County Council in 1992. These policies, which provided the vision and framework for the county and its cities, were incorporated into the County's comprehensive plan. A comprehensive plan was adopted in 1994.

1.3.3 Goals and objectives of the proposed action

The goals and objectives of the light rail project are consistent with *Sound Move* and with the Regional Transit Long-Range vision adopted by the Sound Transit Board in May 1996. These policy elements have guided previous actions of the Sound Transit Board in designing the regional transit system, including the development and selection of route and station alternatives for evaluation in this Final EIS. The goals, objectives, and measures listed form the basis for the alternatives evaluation presented in Chapter 6 of this Final EIS:

1) Transportation Goal: Enhance Mobility

Objective 1A:	**Provide an effective, high-quality transit system**
Measures:	Ridership, reliability, travel time
Objective 1B:	**Design a system to accommodate future extensions and expansion**
Measures:	Qualitative/descriptive
Objective 1C:	**Support the region's transportation goals**
Measures:	System performance measures from Puget Sound Regional Council's Metropolitan Transportation Plan
Objective 1D:	**Integrate services and fare policies with local transit providers and provide convenient connections**
Measures:	Qualitative/descriptive
Objective 1E:	**Enhance transportation equity**
Measures:	Mobility and access improvements for transportation disadvantaged

2) Environment Goal: Preserve Environmental Quality

Objective 2A:	**Minimize potential adverse impacts to the natural and built environment**
Measures:	Displacements/encroachments, visual and aesthetic, air quality, noise and vibration, ecosystems, water quality, geology and soils, hazardous materials, public services and utilities, archaeological and historic, parklands, local transportation network

3) Land Use Goal: Support Regional and Local Land Use Goals and Objectives

Objective 3A:	**Support adopted land use and transportation plans**
Measures:	Qualitative/descriptive
Objective 3B:	**Support pedestrian-friendly and transit-oriented community development**
Measures:	Qualitative
Objective 3C:	**Enhance neighborhoods**
Measures:	Qualitative and quantitative.

4) Financial Goal: Achieve Financial Feasibility

Objective 4A:	**Build a system within *Sound Move's* budget**
Measure:	Project costs compared to project budget
Objective 4B:	**Build a system that can be operated and maintained within available revenues.**
Measure:	Project operating and maintenance costs and available revenues
Objective 4C:	**Build a cost-effective system**
Measure:	Cost-effectiveness index

5) Community Support Goal: Maximize Community Support

Objective 5A:	**Involve the community in the project development and design process**
Measure:	Qualitative/descriptive
Objective 5B:	**Enhance community support**
Measure:	Qualitative/descriptive

CHAPTER 2
ALTERNATIVES CONSIDERED

2. Alternatives Considered

2.1 DEFINITION OF ALTERNATIVES EVALUATED IN THE EIS

This EIS evaluates a "No-build" and several "build" alternatives, all of which are described in this chapter. The build alternatives would consist of constructing and operating a new light rail line (known as Central Link) extending up to 29 miles from Northgate or the University District in North Seattle to Sea-Tac Airport in SeaTac. This EIS evaluates route and station alternatives, and maintenance base site alternatives (see Figure 2.1-1). The light rail alternatives are being planned and evaluated in six geographic segments, including:

- Segment A – Northgate to the University District
- Segment B – University District to Westlake Station
- Segment C – Westlake Station to S. McClellan Street
- Segment D – S. McClellan Street to Boeing Access Road
- Segment E – Tukwila
- Segment F – SeaTac

A comparative evaluation of the alternative is summarized in the Executive Summary and discussed in greater detail in Chapters 3, 4, and 6. This chapter describes the alternatives and the evaluation and selection process.

2.1.1 The Preferred Alternative

On February 25, 1999, following the public comment period on the Draft EIS, the Sound Transit Board passed Motion 99-14, which identified preferred route and station locations for the Central Link light rail line from the University District to SeaTac. Sound Transit's preferred route is shown in Figure 2.1-2. The preferred alternative includes route and station alternatives evaluated in the Draft EIS, as well as modified route and station alternatives that were developed in response to public and agency comments following the release of the Draft EIS or as a result of recently available design information. The Final EIS continues to evaluate an extension of the line north to the Roosevelt and Northgate neighborhoods (Segment A), in keeping with the voter-approved *Sound Move* transit system plan. However, the extension to Northgate was not included in the preferred alternative. The preferred route and station locations by segment are:

Segment A – (Northgate to University District)

There was no preferred alternative identified for Segment A.

Segment B – (University District to Westlake Station)

Alternative B1a (Capitol Hill Tunnel) would begin with an underground N.E. 45th Street/15th Avenue N.E. terminus, with a tunnel under Portage Bay, Capitol Hill, and First Hill to the Downtown Seattle Transit Tunnel (DSTT). In the University District, there would be underground stations south of N.E. 45th Street at 15th Avenue N.E. (with an option for siting the station east of 15th, or a station west of 15th), and at N.E. Pacific Street to the west side of 15th Avenue N.E. (Option B). On Capitol Hill, the station would be under Broadway south of E. John Street (with three options involving construction technique and siting). On First Hill, there are two options for a station near E. Madison Street and Summit Avenue E. There would not be a station at Convention Place.

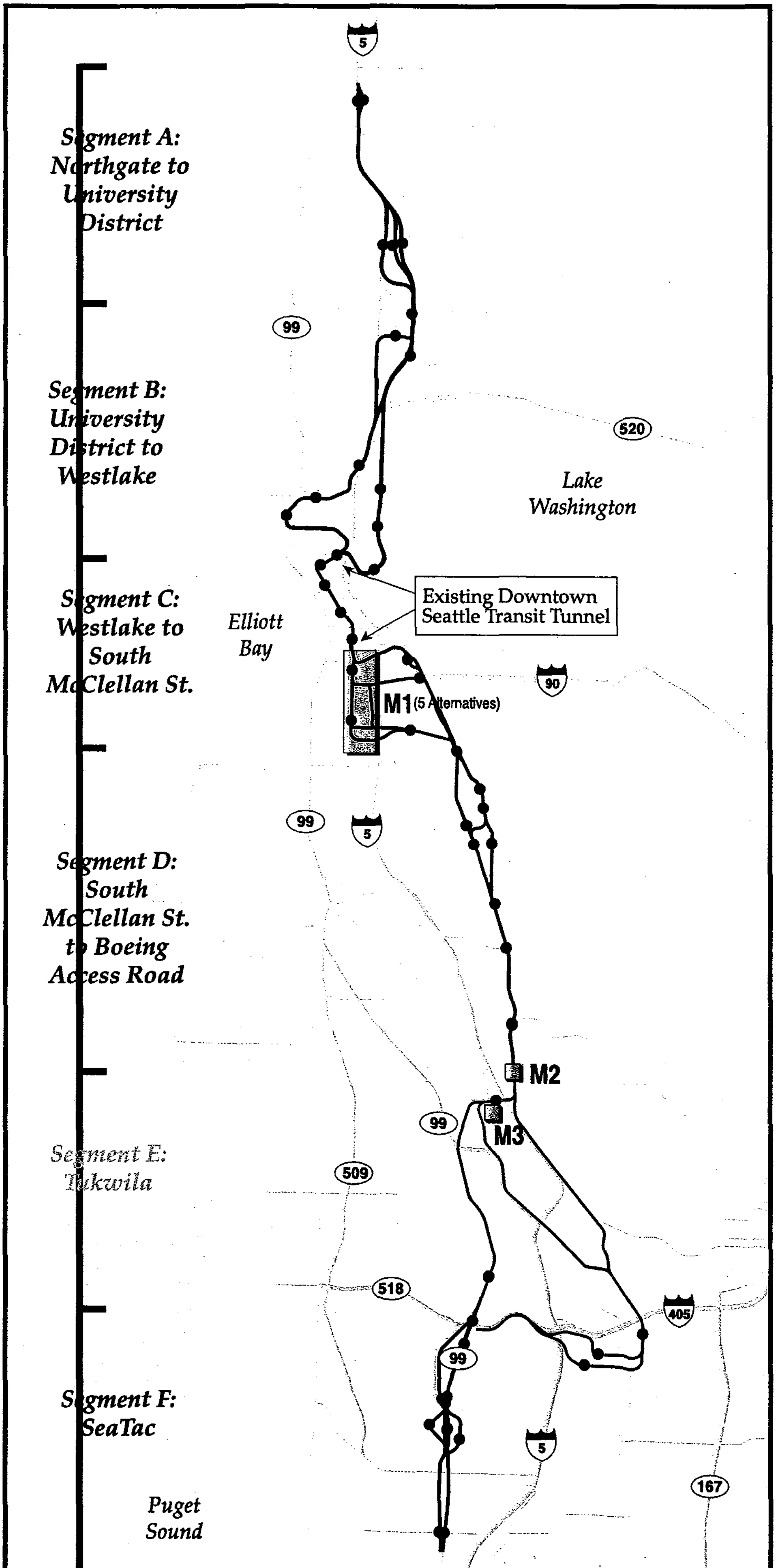


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Figure 2.1-1
Central Link Corridor Study Area

Proposed Light Rail Stations

Name	Segment
Northgate[2]	A
Roosevelt	A
NE 45th	B
Pacific	B
Campus Parkway	B
Roy / Aloha[1]	B
Capitol Hill	B
First Hill	B
Eastlake	B
South Lake Union	B
Seattle Center	B
Convention Place[1A]	B
Westlake	C
University Street	C
Pioneer Square	C
International District[3]	C
Royal Brougham	C
Lander	C
Beacon Hill[1]	C
Poplar Place	C
I-90	C
McClellan	D
Charlestown[1]	D
Genesee	D
Edmunds[1B]	D
Columbia City	D
Alaska	D
Graham[1B]	D
Othello	D
Henderson	D
Boeing Access Road[2,3]	E
South 144th	E
Longacres[2,3]	E
Southcenter	E
North SeaTac[1B,2]	F
North Central SeaTac	F
South Central SeaTac[1]	F
South SeaTac[2]	F

[1] Potential Station

[1A] Not Included in Preferred Alternative, Potential Station in Other Alternatives

[1B] Included in Preferred Alternative, Potential Station in Other Alternatives

[2] Includes New Park-and-Ride

[3] Potential Light Rail/ Commuter Rail Transfer

M2 Maintenance Base Alternatives

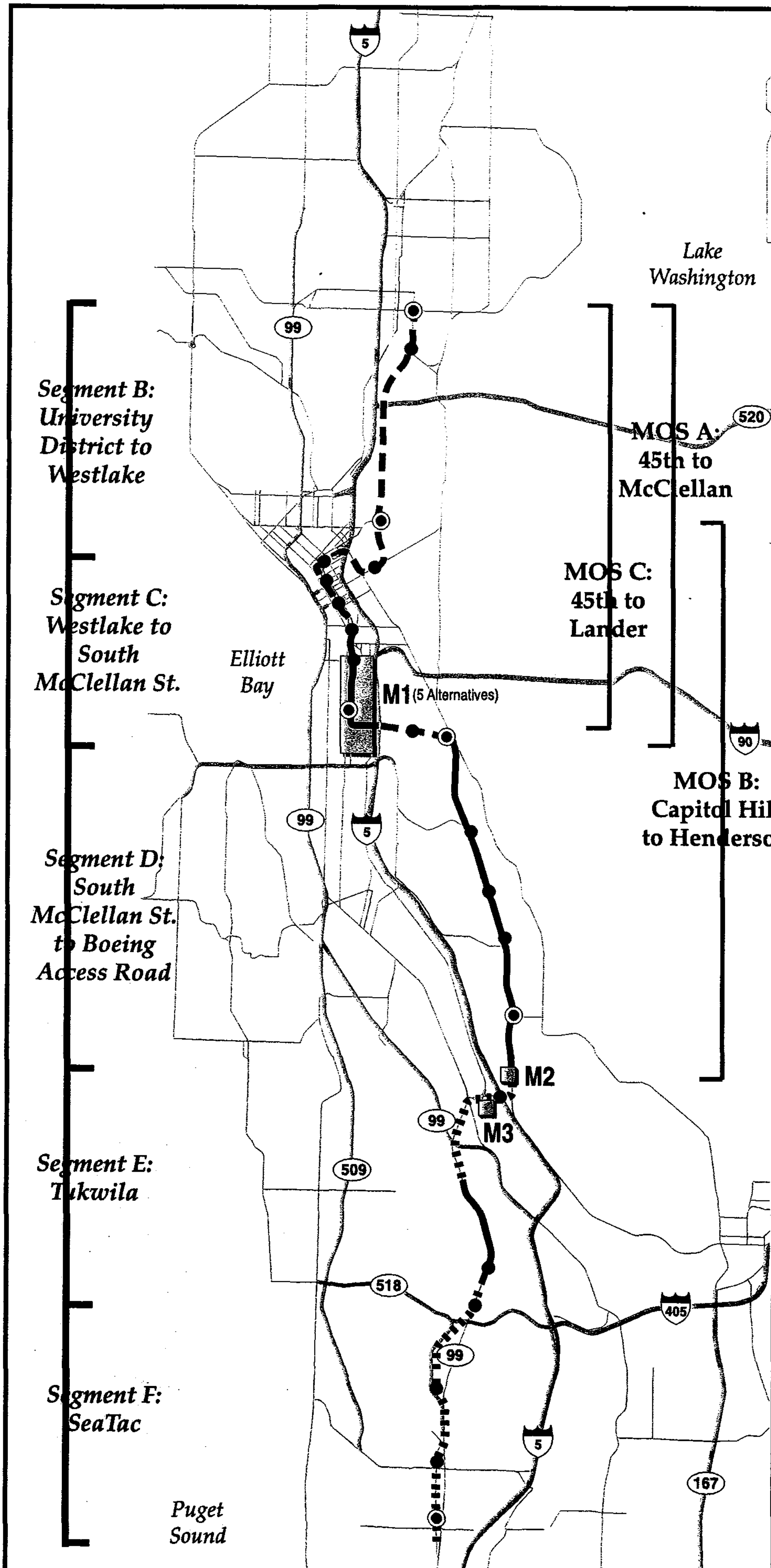
Route Alternative

Station

0 1 2
MILES

SOUNDTRANSIT

Figure 2.1-2
Preferred Alternative for Central Link Light Rail (With Minimum Operable Segment Alternatives)



Proposed Light Rail Stations

Name	Segment
NE 45th	B
Pacific	B
Capitol Hill	B
First Hill	B
Westlake	C
University Street	C
Pioneer Square	C
International District[3]	C
Royal Brougham	C
Lander	C
Beacon Hill[1] (Shell only)	C
McClellan	D
Edmunds	D
Graham	D
Othello	D
Henderson	D
Boeing Access Road[2, 3]	E
South 144th	E
North SeaTac[2]	F
North Central SeaTac	F
South Central SeaTac[1]	F
South SeaTac[2]	F

1 Potential Station

2 Includes New Park-and-Ride

3 Light Rail/Commuter Rail Transfer

MOS Minimum Operable Segment

M2 Maintenance Base Alternatives

Tunnel

Elevated

At Grade

Station

Potential Terminal Station

0 1 2

MILES

Segment C – (Westlake Station to S. McClellan Street)

Alternative C1.2 (at-grade north of Lander Street) is a modification of Alternative C1 studied in the Draft EIS. This new alternative was developed to minimize or avoid impacts that Alternative C1 would have in the Duwamish Industrial and Manufacturing area, particularly to freight movement and business access. The C1.2 route would use the DSTT from Westlake Station to the International District Station. The DSTT would be reserved for rail use only. After leaving the DSTT, the route would be at-grade along the east side of the E3 Busway (commonly known as the Metro busway) to the north side S. Lander Street, where it would turn east, cross Airport Way S. at-grade, and tunnel under I-5 and Beacon Hill. It would transition to elevated tracks near the McClellan Station. Stations in the DSTT would be at Westlake, University Street, Pioneer Square, and International District; at Westlake Station, there are station options involving new entrances on Pine Street at Fifth Avenue. Stations south of the DSTT would be located at S. Royal Brougham Way, S. Lander Street, and Beacon Hill (a tunnel station with the shell only constructed in the initial phase).

Segment D – (S. McClellan Street to Boeing Access Road)

Alternative D1.1e (at-grade, in 93-ft right-of-way with 4 traffic lanes) is a modification of Alternative D1.1c studied in the Draft EIS. The route is elevated at the McClellan Station, continues elevated over the southbound lanes of MLK Jr. Way S., before descending to the median of that roadway, north of S. Walden Street. MLK Jr. Way S. would be modified to provide four lanes of traffic within a 93-ft right-of-way. In response to public and agency comments, this alternative includes seven new signalized intersections on MLK Jr. Way S., and nine pedestrian-only signals. There would also be two new signals on Rainier Avenue S., and one new signal on S. Henderson for bikes, pedestrians, and buses. These changes considerably reduce the distance between controlled pedestrian crossings, and improve access and circulation over earlier proposals. Sidewalk and landscaping improvements would be provided along the route, including new sidewalks, street trees, and street lighting. Parallel bike facilities would be provided. Stations would be at S. McClellan (elevated), Edmunds, Graham, Othello, and Henderson streets. Modified station designs were developed for the McClellan, Edmunds, and Henderson stations in response to comments. The Edmunds Station area improvements include pedestrian-oriented streetscape features along Edmunds Street to a connection to the Columbia City business district, and similar improvements would be provided from the Henderson Station along Henderson Street and connecting to Rainier Beach at Rainier Avenue S. The preferred alternative also proposes a local $50 million fund to support light rail-related community development, ridership and appropriate mitigation activities in the Rainier Valley area.

Segment E – (Tukwila)

Alternative E1.1 is elevated at Boeing Access Road, crossing over I-5 and E. Marginal Way, before turning south along Tukwila International Boulevard (SR 99). The trackway would continue elevated over the Duwamish River, Riverton Creek, and SR 599. Light rail would descend to the median of Tukwila International Boulevard near S. 126th Street, continuing at-grade to near SR 518. Alternative E1.1 has been modified in response to comments to provide a 102-ft right-of-way with four through lanes and other design features. The modified design incorporates most of the City of Tukwila's planned improvements for the roadway, including new sidewalks, landscaping, new signalized pedestrian crossings, and two additional signalized intersections at S. 140th and S. 148th Streets. Stations at Boeing Access Road (including a 300-stall park-and-ride serving both the light rail and a separately proposed commuter rail station) and S. 144th Street are proposed.

Segment F – (SeaTac)

Alternative F2.3 (Washington Memorial Park, Elevated east of 28th Avenue S.) is a modified alternative derived from elements of the alternatives considered in the Draft EIS. It would be elevated along Tukwila International Boulevard from S. 152nd Street, continuing southwest to cross over SR 518 west of Washington Memorial Park, with a connection to the Airport's proposed North End Airport Terminal (NEAT) at the Intermodal Center at S. 170th Street. It would then continue elevated along the west side of International Boulevard, turn southwest to cross S. 188th Street, and continue elevated south along the east side of 28th

Avenue S. to S. 200th Street. Three stations are proposed: North SeaTac (at S. 154th Street, with three options involving a 260-, 454- or 670-stall park-and-ride), North Central SeaTac (at IMC or at NEAT), and South SeaTac (options E or F at S. 200th Street with a 630-stall park-and-ride). The design also provides for a potential South Central SeaTac Station at S. 184th Street.

Maintenance Base Sites

The Sound Transit Board has not yet identified a preferred a maintenance base site.

2.1.2 No-build Alternative

The No-build Alternative represents the transportation system as it would exist without the proposed light rail project. The No-build Alternative provides the EIS with a baseline condition for comparing the impacts of the "build" alternatives in two future forecast years, 2010 and 2020.

The 2010 No-build Alternative refers to the existing transportation system, plus funded projects in the Puget Sound Regional Council's (PSRC) adopted Transportation Improvement Program. These system improvements include: new arterial access to Sea-Tac Airport; the addition of a new third runway and north end terminal; HOV lane construction; upgrading of some bridges and arterial routes; and implementation of Sound Transit's Sounder commuter rail service and Regional Express bus service. Transit system and fleet expansions of King County Metro, Pierce Transit, and Community Transit are also assumed.

Sound Transit is working with other regional public transportation agencies to develop a seamless network of transportation options. Essential elements of this network include coordinated routes, schedules, and facility designs; unified fares structures; and a common method for pricing trips. For example, Community Transit, Everett Transit, King County Metro, Kitsap Transit, Pierce Transit, the Washington State Ferry System, and Sound Transit have cooperated on a single ticket or pass payment system for all types of transit within the region. Over the next few years, electronic debit cards called Smart Cards will become a common way of paying transit fares. Transit agencies are also developing a uniform way of pricing fares to reflect the value of each customer's trip.

By the 2020 horizon year, the No-build Alternative is assumed to include all the transportation projects and programs included in Puget Sound Regional Council's adopted Metropolitan Transportation Plan (MTP). The MTP includes extensive transportation network improvements such as completing an interconnected system of freeway and arterial HOV lanes, constructing missing links for network continuity, expanding transportation capacity to and between centers, widening major roadways where necessary, upgrading highway safety and efficiency, providing better arterial access control, and increasing auto ferry capacity across Puget Sound (PSRC 1999). These projects would add over 1,200 lane miles of new capacity to the metropolitan arterial roadway network. Selected major projects from the MTP are identified below by jurisdiction where they are located within the light rail study area.

The No-build Alternative also assumes planned changes in existing land use, and their related population and employment forecasts. Link project staff have identified major land developments that are expected to be built near the proposed light rail system before the 2010 and 2020 forecast years, including office developments, exhibit spaces, retail spaces, sport and other entertainment venues, apartments/condominiums, and hotel rooms. Other changes include a multi-billion dollar capital improvement program to expand and reconfigure Sea-Tac Airport, including over 10,000 new parking stalls. These changes are consistent with the land use forecasts of the Puget Sound Regional Council, which were used for the project.

Appendix M.1 lists the future land use developments and transportation projects which have been identified as part of the larger PSRC forecasts for the study area under the No-build Alternative.

2.1.3 Link Light Rail Alternatives

Light rail is a conventional term for urban rail systems that have the flexibility to operate in either street traffic or exclusive rights-of-way. Portions of the light rail system would be grade-separated (crossing over or under major roadways or other barriers). In the highest capacity portion of the corridor north of downtown

Seattle, light rail capacity would be 16,000 persons per hour, per direction. This is equivalent in people-carrying capacity to 5.8 freeway lanes (or 12 lanes for both directions), assuming lane capacity of 2,750 people per hour (2,200 vehicles at an occupancy of 1.25 people per vehicle). Portland's MAX, Calgary's C-Train, and Boston's Green Line are examples of existing light rail systems. Light rail uses electrically powered cars, in trains of up to four cars (approximately 360 ft long), running on steel rails.

2.1.3.1 Alternative Profiles

Electric light rail technology was chosen for the Central Link project because of its versatility to operate at-grade (on the surface), on elevated tracks, or in tunnels. Because of the varied conditions along the proposed corridor, the Central Link project would combine all three profiles. The at-grade operation is preferred wherever possible (see below); however, each profile type has benefits and disadvantages. Public transit projects such as Central Link typically have some criteria to help them evaluate when tunneling is feasible by measuring the trade-offs among profiles. The criteria used by other light rail transit projects surveyed by Sound Transit are consistent with those used by Sound Transit for the Central Link project (Larkin 1999).

Sound Transit developed its profile criteria as part of the process to identify alternatives to be considered in the EIS Scoping process. These criteria guided the selection and refinement of alternatives during and after development of the Draft EIS. The criteria are based on the physical limitations of light rail, and other factors considered in the industry. Tunnel construction is generally the most expensive method of building a light rail line, and like other transportation facilities such as roads and railroads, tunnels are used only where necessary and when funds exist to make tunneling possible.

For the EIS alternatives and for selection of the preferred alternative, Sound Transit used the following criteria to help develop and evaluate alternative profiles for the alternative routes:

At-grade: Light rail operating at-grade is best suited to areas where the grade is less than 5 to 6 percent, there is adequate room within reserved street right-of-way or off-street corridors, and levels of congestion are low to moderate. It works well with a moderate number of riders and with trains running approximately four minutes apart. The Institute of Transportation Engineers has published guidelines for light rail grade profile choices based on street operating conditions. When light rail is operating within a street, intersections must be controlled (often with a signal) to allow the train to have priority over general traffic. Signal prioritization can increase traffic delays on cross streets. It can also restrict left-turn movements and complicate adjacent property access. An at-grade profile includes the following benefits:

- Easy access for passengers;
- Flexibility to integrate the design of tracks and stations with community plans;
- Opportunity to revitalize streets with landscaping, sidewalks, lighting, and other improvements;
- Potential support for sustainable economic redevelopment;
- Opportunities to transform car-oriented arterials into pedestrian- and transit-friendly places;
- Greater safety and security resulting from a visible and easily accessible system;
- Lower construction costs.

Elevated: Light rail on elevated structures works well where the system must be grade-separated to cross over geographic or physical barriers, and where street or other rights-of-way are inadequate for rail. It is also appropriate for accommodating higher train frequencies where street or highway operating conditions would not allow at-grade rail (as in crossing a freeway or operating within a high-volume roadway). Maximum allowable grades are 5 to 6 percent. Elevated structures can add an undesirable visual element, restrict left turn movements (when within a street), and reduce access to adjacent properties; however, elevated light rail benefits include:

- Reduced interference with cross street traffic operations, compared to an at-grade profile;
- Higher train operating speeds because tracks are separated from street traffic; and

- Ability to serve more riders by allowing trains to run more often.

Tunnels: Tunnels are best-suited to situations where slopes are steep (more than 3 to 4 percent), right-of-way is inadequate for at-grade or elevated profiles, or the density of homes and businesses is high. It is also appropriate in congested areas where the combination of traffic, high ridership, and resulting high train frequencies would severely impact street-level operations. Tunnels are also appropriate where major ridership points cannot be directly served in another way. There are substantially greater costs and increased risks with building tunnels. Tunnel construction can be very disruptive where cut-and-cover construction methods are necessary. Light rail trains moving in tunnels:

- Travel through hills and under other barriers;
- Travel at higher speeds since tracks are separate from street traffic; and
- Serve more riders by running trains more often.

In summary, tunnels are constructed only when necessary and where above ground (either at-grade or elevated) profiles are infeasible. The factors that govern the choice of an appropriate operational profile throughout the Central Link project are (1) topography, (2) physical barriers, (3) available surface right-of-way, (4) train frequency, (5) density, and (6) cost.

Project Profiles: Figure 2.1-3 illustrates the project corridor's topography, ridership, and available surface right-of-way—factors that most determine the appropriate rail profile. For Segments A and B, the figure shows that high ridership, lack of right-of-way, and topographic factors would require primarily elevated and tunnel profiles. In Segment C, south of downtown Seattle, moderate density of development and moderate ridership levels make all three profiles viable, depending on the specific topographic and right-of-way availability along each route alternative. With limited exceptions, Segments D, E, and F have gentle topography, sufficient rights-of-way, lower density, and lower projected ridership and train frequencies, warranting profiles that are almost entirely at-grade or elevated. The profiles chosen in the preferred alternative provide services to the largest number of potential riders in the most cost-effective fashion. New tunneling will comprise only 30 percent of the profile length in the overall system in the preferred alternative.

2.1.3.2 Modifications to the Alternatives Since the Draft EIS

Following the issuance of the Draft EIS, Sound Transit modified some of the project alternatives being evaluated. These modifications were made to reduce or avoid impacts previously identified, to improve the way the project would function within the community, to respond to public and agency comments, and to reflect newly available design information. The modifications include adjustments to some route and station alternatives in each segment, as well as changes at the light rail system level. All of these modifications are consistent with state and federal regulations for environmental review. The modifications to the alternatives are summarized below:

- **Segment A:** The horizontal and vertical profiles of the alternatives along I-5 were revised to reduce impacts and to respond to public and agency comments. Tunnel depths were increased to respond to the need for a deeper tunnel in Segment B.
- **Segment B:** The profile of the tunnel Alternative B1 was modified in response to recent geotechnical and engineering information. Sound Transit developed new or revised station options at all stations for Alternative B1 to reflect changes in tunnel depth, to reduce impacts where possible, and to respond to comments regarding impacts, access, and siting.
- **Segment C:** Strategies for managing bus traffic on downtown surface streets were refined and evaluated in response to comments about the effects of the project on the Downtown Seattle Transit Tunnel. New maintenance base site options in Segment C were developed in response to community comments and an FTA request that each MOS be fully operational and include a maintenance base facility. Several new alternative routes based on a Lander Street route (C1) were developed to reduce impacts in the south downtown industrial areas, or to provide routes to the new maintenance base site options.

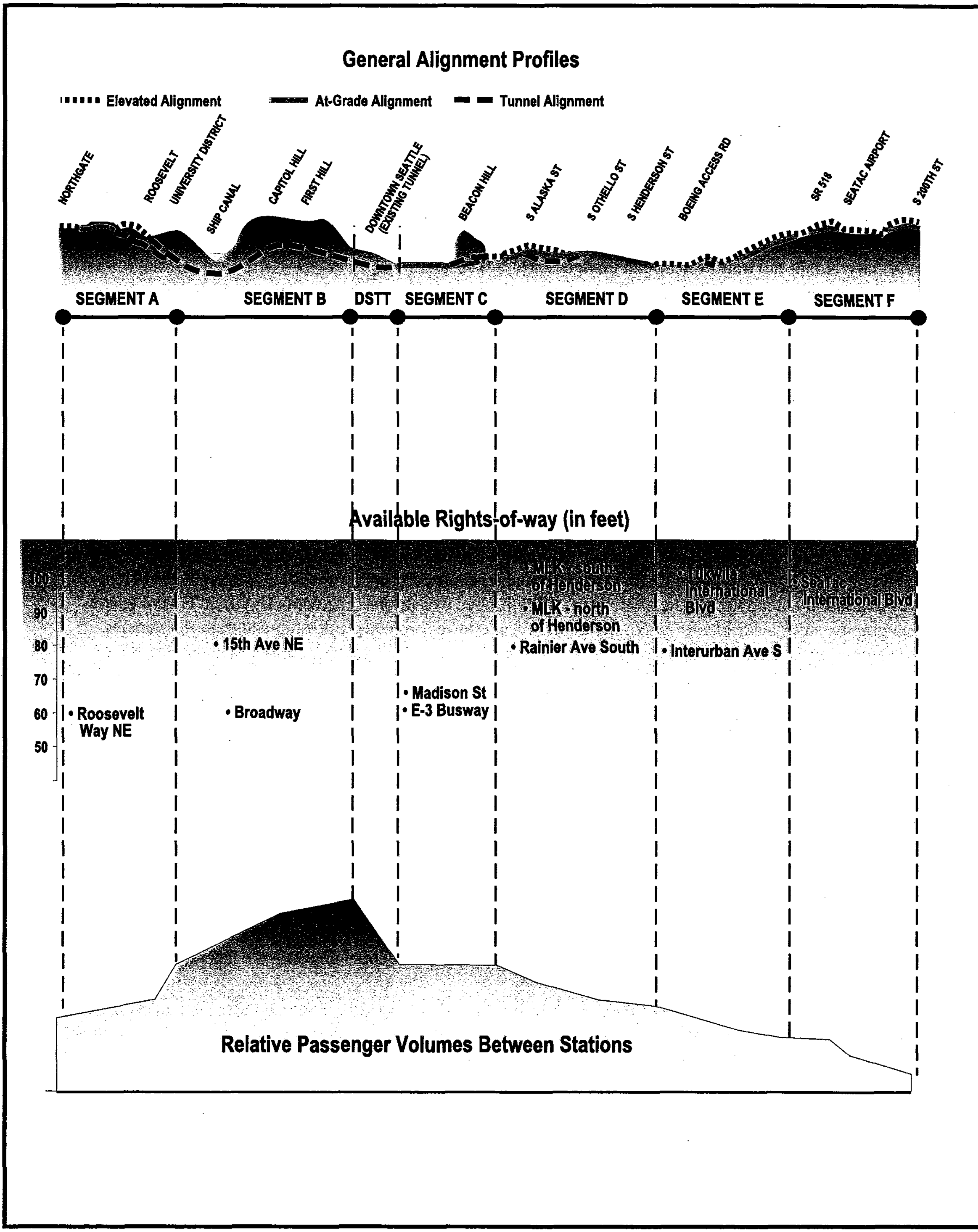


Figure 2.1-3
General Route Profile Characteristics

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- **Segment D:** Sound Transit worked closely with City of Seattle staff to develop several new options for an MLK Jr. Way S. route, including the features of the preferred alternative. The new options respond to a variety of public and agency comments. The major changes involved reducing the right-of-way required and increasing the number of signalized intersections and pedestrian crossings on MLK Jr. Way S. Sound Transit also modified alternatives to include measures that would minimize noise impacts and reduce delays for vehicles at intersections. The preferred alternative proposes a $50 million community development fund for light rail-related projects. New and revised options were developed for the McClellan, Graham, Othello, and Henderson stations, improving station area access, reducing impacts, or responding to the requirements of new system-length alternatives. An all-tunnel route alternative for Segment D was also developed and evaluated following the issuance of the Draft EIS. The Rainier Valley Tunnel Environmental Technical Report is incorporated into the Final EIS by reference and can be found in Appendix Q.
- **Segment E:** The preferred alternative (E1.1) and Alternative E1.2 now incorporate additional design treatments for Tukwila International Boulevard. These changes would reduce impacts by reducing the right-of-way required and by providing many of the street design features proposed in the City of Tukwila's plans for the corridor, including two additional signalized intersections and pedestrian crossings. The Longacres, Baker, and Strander station options for Alternatives E2 and E3 were revised in response to comments by the City of Tukwila and others. The changes at Longacres station involve bus transfer areas and station features related to the proposed Sounder commuter rail and Amtrak stations. The new options for the Baker and Strander stations reduce the area required for the station, reducing impacts.
- **Segment F:** Several new route alternatives (including the preferred) were developed by combining different elements of the alternatives considered in the Draft EIS. New or modified station options were developed for the preferred alternative and other alternatives, including the revised airport station at the IMC and NEAT, a potential new station at S. 184th Street, and options providing additional choices for siting, access, and park-and-ride facilities at S. 154th Street and S. 200th Street. The route and station modifications were made in response to comments; to reflect the plans of the Port of Seattle, the City of SeaTac, or other parties; or to reduce impacts or costs.
- **Construction Staging:** More detail about the construction assumptions has been defined for the Final EIS, including additional information on construction staging areas and tunnel and excavation spoils disposal plans. (See Section 4.17 of the Final EIS.)
- **Length Alternatives:** Six length alternatives are evaluated in the Final EIS, providing the full range of effects possible with the light rail system. As in the Draft EIS, the Northgate to SeaTac and N.E. 45th to SeaTac alternatives are evaluated, giving the range of effects possible under different combinations of route alternatives. Also evaluated are four different length alternatives, including three minimum operable segments that use the routes identified for the preferred alternative.

Some alternatives not given detailed consideration in the Draft EIS were developed and evaluated in additional studies following the issuance of the Draft EIS. These studies focus on specific areas in the corridor, or on specific elements of the proposed light rail system.

In response to public comments on the alternatives evaluated in the Draft EIS for southeast Seattle (Segment D), Sound Transit developed and evaluated an all-tunnel alternative. The Rainier Valley Tunnel Technical Report was released on February 1, 1999 for public review, prior to the identification of a preferred alternative by the Sound Transit Board. The report concluded that a tunnel would not be a reasonable alternative in this segment for several reasons. First, a Rainier Valley Tunnel would not meet criteria commonly used to warrant a tunnel. Second, it would cost nearly $400 million more than the other alternatives without providing significant additional transportation benefits, although it would reduce some adverse impacts. Finally, Sound Transit would face major constraints in obtaining additional funding for a Rainier Valley tunnel, based on the factors above, and considering the voter-approved funding program for the *Sound Move* plan.

Sound Transit also prepared an Environmental Assessment (EA) that was issued in August 1999. The EA evaluates several new maintenance base alternatives and new station options in the University District and Capitol Hill areas. These new alternatives were developed in response to public comments on the Draft EIS and in light of new geotechnical and system design information. The EA provided information about the impacts of these alternatives and potential mitigation measures, and allowed for public and agency review and comment prior to the issuance of the Final EIS. The Final EIS includes these new station options and maintenance base alternatives, and it responds to public and agency comments on the EA.

2.1.3.3 Route and Station Alternative Definition

From 21 to 26 light rail stations would be developed to serve the major transit markets in this corridor. Passenger stations would provide pedestrian and bicycle access to and from feeder bus lines, park-and-ride facilities, and major employment and activity centers. The boarding platform (in all station types) would be approximately 380 ft long (to serve 4-car trains) and may be either on the outer side of the tracks, or in the center with tracks on both sides. For elevated, below-grade, or tunnel stations, escalators, elevators, and/or stairs would be provided as appropriate. The stations would be designed to satisfy all applicable public access, fire, and life-safety requirements. Typical station cross sections are illustrated on Figure 2.1-4 for elevated, at-grade, and tunnel route sections.

The route and station alternatives developed for the light rail corridor is described below. The preferred alternative within each segment is described first; the remaining alternatives are then described in comparison. Sound Transit's project engineers have developed alternatives for the horizontal alignment (the route locations for the light-rail track), the vertical profile (tracks at-grade, elevated, or underground), and station locations and configurations. In general, the alternatives in each segment are compatible with those in adjacent segments, which allows decision-making on a segment-by-segment basis. However, there are some adjoining points that require consideration of more than one segment at a time.

Table 2.1-1 summarizes the route characteristics and number of stations by segment. Details on the proposed stations are summarized in Appendix K and shown in Appendix H, including the associated alternative routes, locations, configurations, conceptual plans, and cross sections. Visual simulations of the project, including several stations, appear in Appendix I.

Segment A (Northgate to University District)

The Sound Transit Board did not identify preferred route or station alternatives in Segment A. However, the Final EIS continues to evaluate Segment A alternatives, which could be built if additional funding is obtained. All Segment A alternatives would serve the Northgate Urban Center and Roosevelt residential urban village as designated by the City of Seattle's Comprehensive Plan. This segment (Figure 2.1-5) would start with a tail track adjacent to First Avenue N.E., and 800 to 1,000 ft north of 103rd Avenue N.E., adjacent to Northgate Mall. The tail track would be used for short-term light rail vehicle storage and layovers between scheduled runs. From the tail track, the route would continue south next to the Maple Leaf neighborhood and through the Roosevelt neighborhood. It would end at the northwest corner of the University of Washington campus, at 15th Avenue N.E. and N.E. 45th Street. Figure 2.1-5 shows route and station alternatives for this segment. The route alternatives would include traction power substations at each station, and near I-5 and N.E. 80th Street.

Alternative A1.1–12th Avenue N.E. Tunnel
Alternative A1.2–Roosevelt Way N.E. Tunnel

These alternatives begin near the Northgate Transit Center near Northgate Mall, either at the Northgate park-and-ride facility just east of I-5 (Northgate Option A) or adjacent to the Transit Center itself (Northgate Option B). The route would travel south on an elevated guideway and then in a retained cut on the east side of I-5, within the freeway right-of-way. A traction power substation would be located at I-5 near N.E. 80th Street. Near N.E. 76th Street, the routes would enter a tunnel running under the Lake City Way off-ramps and continue underground to a station at 12th Avenue N.E. in A1.1, or at Roosevelt Way N.E. in A1.2.

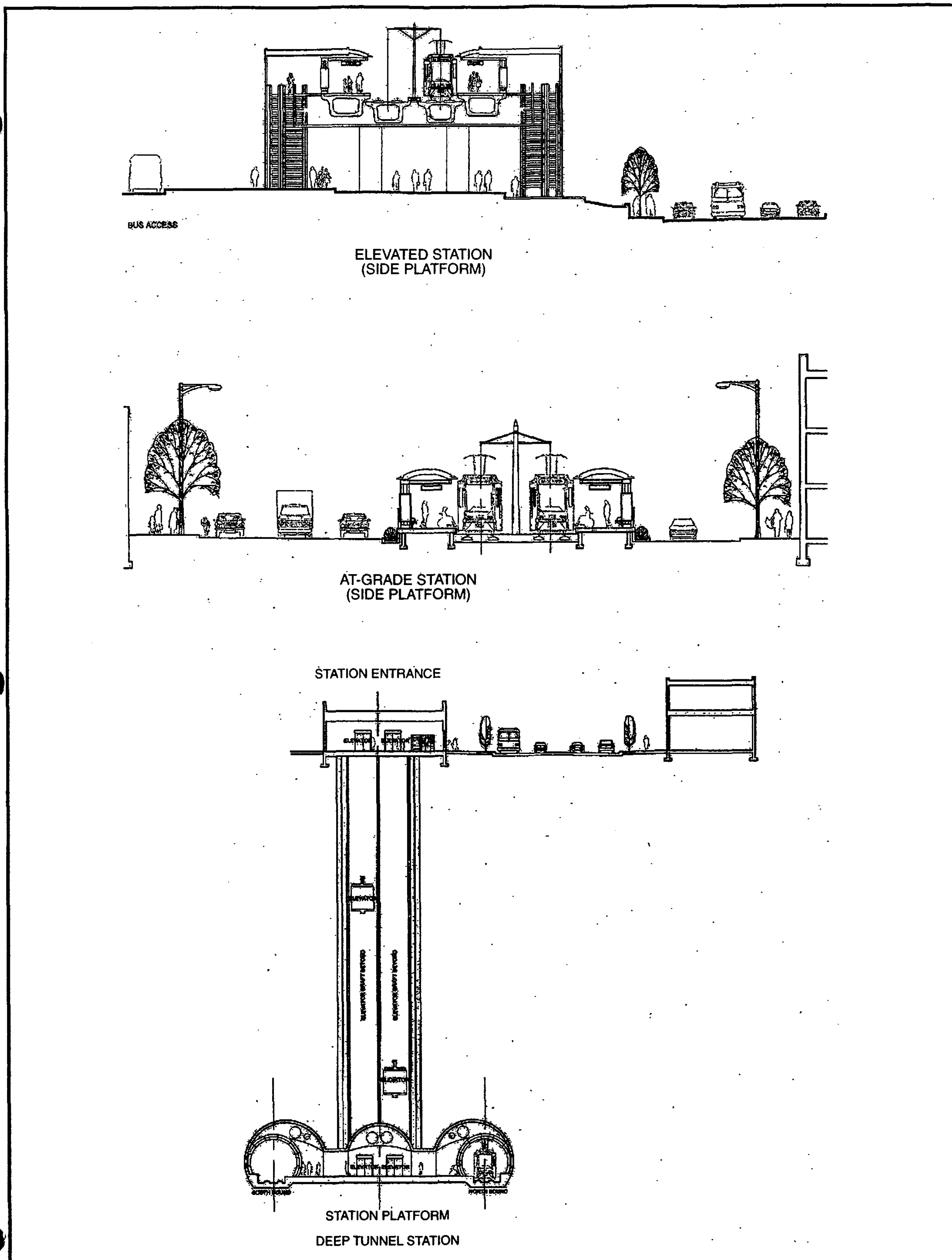
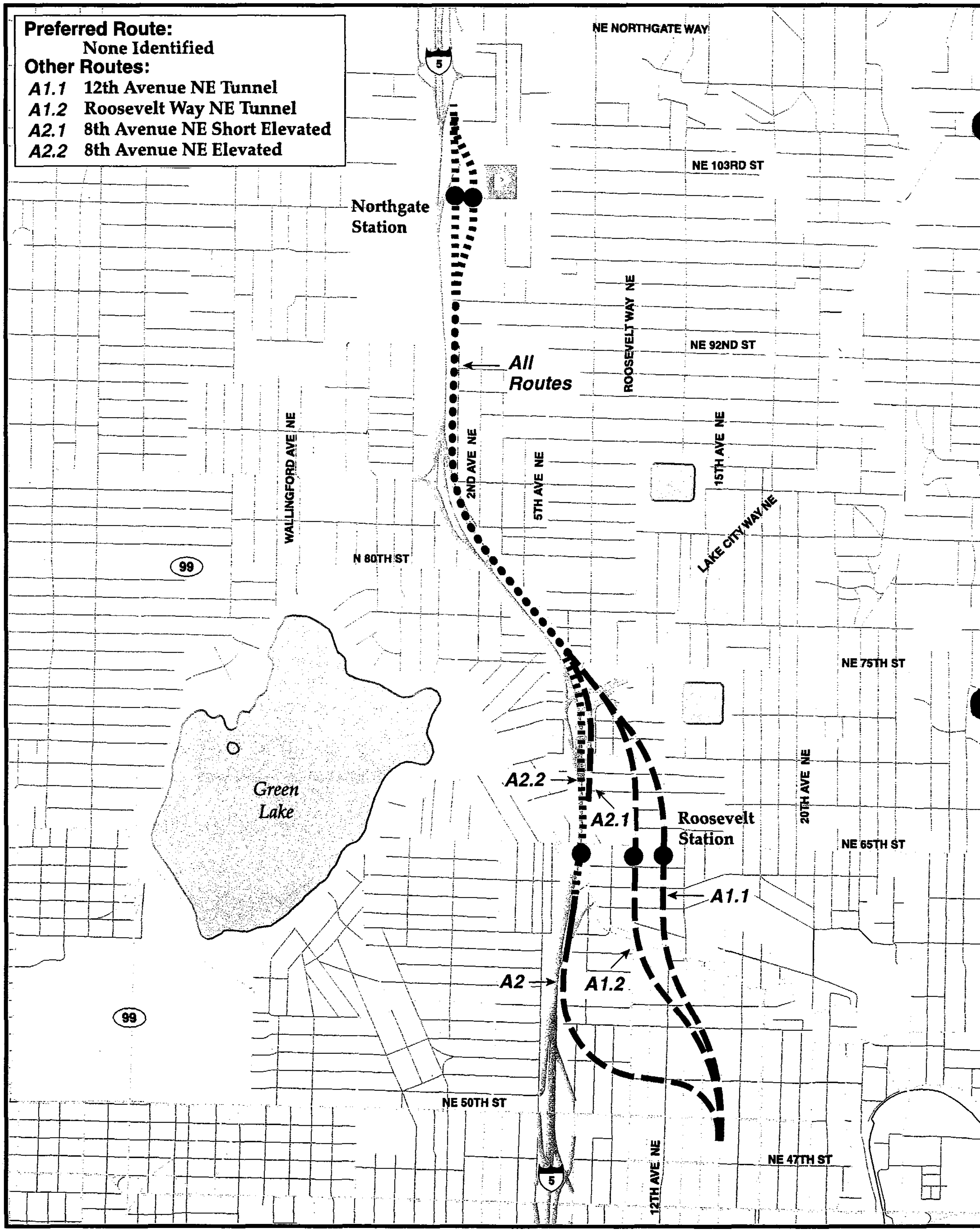


Figure 2.1-4
Typical Station Cross Section



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0 1,000 2,000 FEET

Tunnel
Elevated
At Grade
Retained Cut-Fill
Station
Potential Station
Park & Ride

Figure 2.1-5 Segment Northgate to University District

Table 2.1-1
Characteristics of Light Rail Route Alternatives

Route Alternatives and Options *(Preferred alternative italicized)*	**One-way light rail track (mi.)**	**Segment travel time (min.)**	**Number of stations**
Segment A (Northgate to University District)			
A1.1—12th Avenue N.E. Tunnel	3.12	5.3	2
A1.2—Roosevelt Way N.E. Tunnel	3.12	5.3	2
A2.1—8th Avenue N.E. Short Elevated	3.29	5.6	2
A2.2—8th Avenue N.E. Elevated	3.29	5.6	2
Segment B (University District to Westlake Station)			
B1a—Capitol Hill Tunnel	4.47	9.4	4
B1b—Capitol Hill Tunnel (with Roy/Aloha Station)	4.47	10.2-10.8	4-6[1]
B2.1—Seattle Center High-level Bridge	5.28	12.2-12.8	5-6[1]
B2.2—Seattle Center Portage Bay Tunnel	5.01	11.6-12.2	5-6[1]
Segment C (Westlake Station to S. McClellan Street)			
C1.1—At-grade center of Lander Street	3.76	11.4-12.2	6-7[2]
C1.2—At-grade north of Lander Street	3.75	11.5	7
C1.3—Elevated north of Lander Street	3.75	10.6-11.4	6-7[2]
C1.4—Forest Street/S. Lander Street Tunnel	3.96	11.1-11.9	6-7[2]
C1.5—Massachusetts Street and I-5 right-of-way	3.71	11.0-11.8	5-6[2]
C2.3—West of Rainier Avenue S. Elevated	3.58	10.5	5
C2.4—Rainier Avenue S. Tunnel	3.6	10.6	5
C3—S. Massachusetts Street Tunnel	3.66	11.0	6
Segment D (S. McClellan Street to Boeing Access Road)			
D1.1c—MLK Jr. Way S. At-grade, 4-lane (104' cross section)	4.59	9.8-10.5	4-5[3]
D1.1d—MLK Jr. Way S. At-grade, 2-lane (90' cross section)	4.59	9.8-10.5	4-5[3]
D1.1e—MLK Jr. Way S. At-grade 4-lane (93' cross section)	4.59	10.5	5
D1.1f—MLK Jr. Way S. At-grade 2-lane (93' cross section)	4.59	10.5	5
D1.3—MLK Jr. Way S. Combined Profile	4.59	8.9-9.6	5
D3.3—S. Alaska Street Crossover	4.80	10.1-10.8	4-5[3]
D3.3—S. Alaska Street Crossover (with alternative stations)	4.63	10.6-11.3	4-6[3]
D3.4—37th Avenue S. Tunnel	4.63	10.2-11.4	4-6[3]
Segment E (Tukwila)			
E1.1—Tukwila International Blvd. At-grade	4.37	7.6	2[4]
E1.2—Tukwila International Blvd. Elevated	4.37	6.9	2[4]
E2—Interurban Avenue S.	7.92	14.6	2[4]
E3—MLK Jr. Way S.	7.28	11.0	2[4]
Segment F (SeaTac)			
F1—International Boulevard At-grade	2.67	6.0-6.7	3-4
F2.1—Washington Memorial Park, City Center West	2.85	6.2	3
F2.2—Washington Memorial Park, City Center East	3.04	6.7	3
F2.3—Washington Memorial Park, Elevated east of 28th Ave. S.	2.77	5.1-5.9	3-4[5]
F3.1—West of International Blvd. Grassy Knoll	2.68	5.7	3
F3.2—West of International Blvd. Main terminal	2.82	6.5-7.2	3-4[6]
F3.3—West side of International Blvd.	2.63	4.8	3
F4—International Blvd. to 28th/24th	2.63	5.1	3

Source: Sound Transit, October 8, 1998, March 5, 1999, and July 8, 1999
Notes: Travel times prepared by PSTC are based on an incremental planning model.
1 Convention Place Station may or may not be rebuilt for light rail operations.
2 Potential station at Beacon Hill.
3 Includes a potential station at S. Graham Street (D3.3 and D3.4 also include a potential station at Charlestown Street).
4 The match point between Segments E and F at S. 160th Street was used to provide common distance and travel time comparisons. The actual match point could vary by 2,000 ft depending on the routes.
5 Potential future station at S. 184th Street.
6 Potential North SeaTac Station depending on the Segment E route chosen.

The routes would continue in a tunnel to N.E. 45th Street and 15th Avenue N.E.

Two stations are currently proposed along these routes:

- Northgate – An elevated station at Northgate next to I-5 (Northgate Option A), or Northgate Transit Center (Northgate Option B). A new option at the Northgate Transit Center (Option C) is similar to Option B, but with a different route for the tail track. All options would have a 1,300-stall park-and-ride structure.

Roosevelt – An underground station at N.E. 65th Street and either 12th Avenue N.E. (A1.1) or Roosevelt Way N.E. (A1.2).Alternative A2.1–8th Avenue N.E. Short Elevated Alternative A2.2–8th Avenue N.E. Elevated

These alternatives are identical to Alternatives A1.1 and A1.2 from Northgate to N.E. 76th Street. Near N.E. 76th Street, Alternative A2.1 would tunnel under the Lake City Way ramps, emerging near N.E. 66th Street, and ascending to an elevated station just south of N.E. 65th Street, adjacent to I-5. In Alternative A2.2, the route would transition from N.E. 76th Street to an elevated structure over the Lake City way off-ramps, then continue elevated along the east side of I-5 to a station just south of N.E. 65th Street. Both routes would continue parallel to I-5 and Eighth Avenue N.E., cross Ravenna Boulevard, and then enter a tunnel at a point between the Ravenna Boulevard off-ramp and I-5. They then would continue southeast in a tunnel to N.E. 45th Street and 15th Avenue N.E.

Two stations are currently proposed along this route:

- Northgate – An elevated station at Northgate next to I-5 (Northgate Option A) or Northgate Transit Center (Northgate Options B or C).
- Roosevelt – An elevated station at N.E. 65th Street and Eighth Avenue N.E. next to I-5.

Segment B (University District to Westlake Station)

The routes in this segment (Figure 2.1-6) that would start at N.E. 45th Street in the University District and cross under or over Portage Bay have increased. The preferred route would tunnel through Capitol Hill and First Hill before connecting to the DSTT at the site of the existing Convention Place Station, which would not be replaced. Other routes would head southwest near South Lake Union to Seattle Center, and then connect back to the DSTT. The other alternatives consider several options for connecting to the DSTT at Convention Place Station. The station could be closed or rebuilt for rail and bus use, or for rail-only use. Route and station alternatives for this segment are shown on Figure 2.1-6.

Alternative B1a—Capitol Hill Tunnel (Preferred)

The preferred alternative would serve the University of Washington area, Capitol Hill, and First Hill, designated major urban centers in the City of Seattle's Comprehensive Plan. It would begin at the underground station at N.E. 45th Street and 15th Avenue N.E. traveling underground to a station near N.E. Pacific Street and 15th Avenue N.E. The route would continue in a tunnel beneath the Lake Washington Ship Canal, and under the Portage Bay/Roanoke neighborhoods to 10th Avenue E. Still underground, the route would continue south under 10th Avenue E. and Broadway Avenue E. to E. Madison Street where it would cross under Madison moving southwest to Boren Avenue, and under I-5 to connect with the DSTT. The proposed depth of the tunnel has changed since the publication of the Draft EIS. Soil conditions under Portage Bay have increased the depth needed to cross under Portage Bay, which in turn would require deeper stations at the N.E. 45th and Pacific Street locations. New information on soil conditions near the Capitol Hill Station require either a much deeper or much shallower tunnel to avoid mining in unsuitable soils. A shallower tunnel would be constructed using excavation (cut-and-cover) rather than mining techniques. New and modified station options have been prepared in these locations, and other design features have been developed in response to local and agency comments. The deeper station option would be accessed by high-speed elevators.

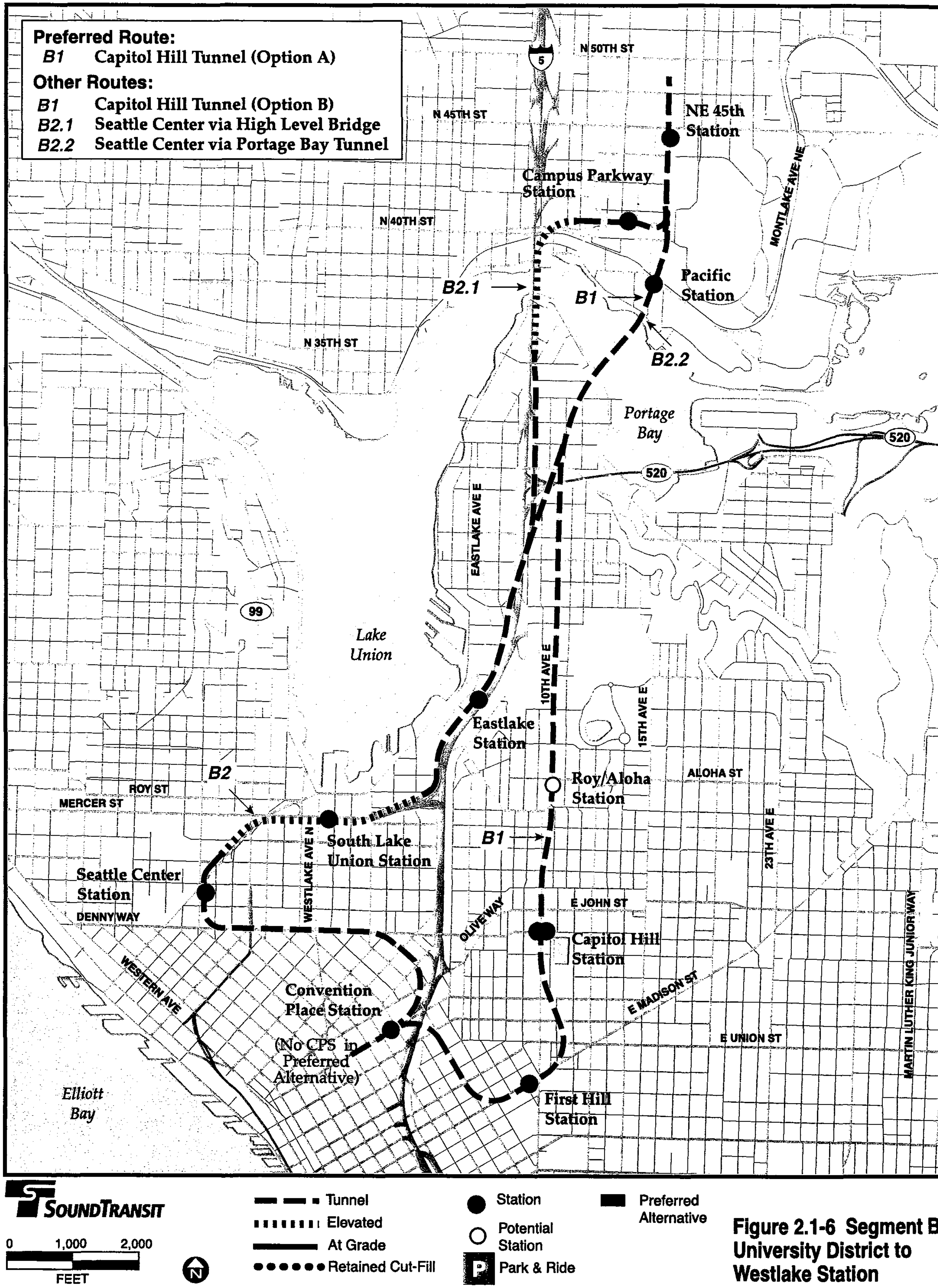


Figure 2.1-6 Segment B: University District to Westlake Station

The shallower station option would be accessed by both elevators and escalators. An Environmental Assessment (EA) evaluating the new station options was published in August 1999. The Final EIS responds to public and agency comments that were received.

Four stations are proposed for the preferred alternative:

- N.E. 45th – An underground station located on the east side of 15th Avenue N.E. and south of N.E. 45th Street (Option B), or on the west side of 15th Avenue N.E. (Option C).
- Pacific – An underground station located under Pacific Street west of 15th Avenue (Option B), with a design modified since the Draft EIS in response to comments and to accommodate the need for a deeper tunnel.
- Capitol Hill – The original design for the Capitol Hill Station has been modified and three new station options have been developed since the Draft EIS. The options are all for an underground station. Station Option A (Broadway Station—deep tunnel) would be under the west side of Broadway, between E. Howell and John streets. Option B would be directly under Broadway, and involve cut-and-cover construction for the station and mining construction for the adjacent crossover track, and Option C would be by cut-and-cover for both the station and crossover. Option D would be under Nagle Place, between E. Howell and E. Thomas streets, using cut-and-cover methods for the station and crossover (but is no longer a preferred station option).
- First Hill – An underground station at E. Madison Street and Summit Avenue E. (Option A) or slightly north of that intersection (Option B).

Traction power substations would be needed in the following areas: (a) within the N.E. 45th Station, (b) within the Pacific Station, (c) near the SR 520 right-of-way (within a tunnel vent shaft and emergency access structure), (d) within the Capitol Hill station, and (e) within the First Hill Station.

Alternative B1b–Capitol Hill Tunnel

This route is the same as Alternative B1 studied in the Draft EIS, except that some stations have been modified. There would be four to six stations:

- N.E. 45th – An underground station located under 15th Avenue N.E. south of N.E. 45th Street (Option A).
- Pacific – An underground station located under 15th Avenue N.E. south of Pacific Street (Option A).
- Roy/Aloha - A potential underground station near E. Roy Street/E. Aloha Street under 10th Avenue E.
- Capitol Hill – An underground station below the west side of Broadway, south of E. John Street (Option A).
- First Hill - Same as the preferred alternative (B1a).
- Convention Place – A potential new (relocated) station under Pine Street between Eighth and Ninth streets, with or without joint bus/rail operations.

Alternative B2.1–Seattle Center via High-level Bridge
Alternative B2.2–Seattle Center via Ship Canal Tunnel

These alternatives would serve South Lake Union (one of seven hub urban villages in the City of Seattle's Comprehensive Plan) and Seattle Center (one of the City's five major urban centers). Alternative B2.1 would start at the N.E. 45th Street/15th Avenue N.E. Station and travel underground and south to N.E. Campus Parkway. The route would turn west, emerge from the tunnel along Campus Parkway, then transition to an elevated structure with a high-level bridge crossing the ship canal. South of the ship canal, the route would enter a tunnel between I-5 and Harvard Avenue E., near E. Gwinn Place. It would continue southward under I-5 to an underground station near E. Nelson

Place (just east of Eastlake Avenue E.). The route would continue south in a tunnel from the Eastlake Station, then travel west and emerge from a portal between E. Yale and Minor streets. The route would transition to an elevated structure and cross over Fairview to run along the south side of Mercer Street. The route would enter a tunnel at the triangle near Broad Street and continue under Fifth Avenue N., then tunnel east under Denny Way to connect to the existing DSTT.

Alternative B2.2 would tunnel south from N.E. 45th Street under 15th Avenue N.E. to a station at Pacific and 15th Avenue N.E. The route would continue in a tunnel under the Lake Washington Ship Canal and under the Portage Bay/Roanoke neighborhoods. Crossing southeast beneath SR 520 and I-5, it would join the B2.1 alternative near I-5 and E. Boston Street. A traction power substation would be needed for the Alternative B2.2 tunnel section in the vicinity of the SR 520 right-of-way. A vent shaft would also be needed in the same location.

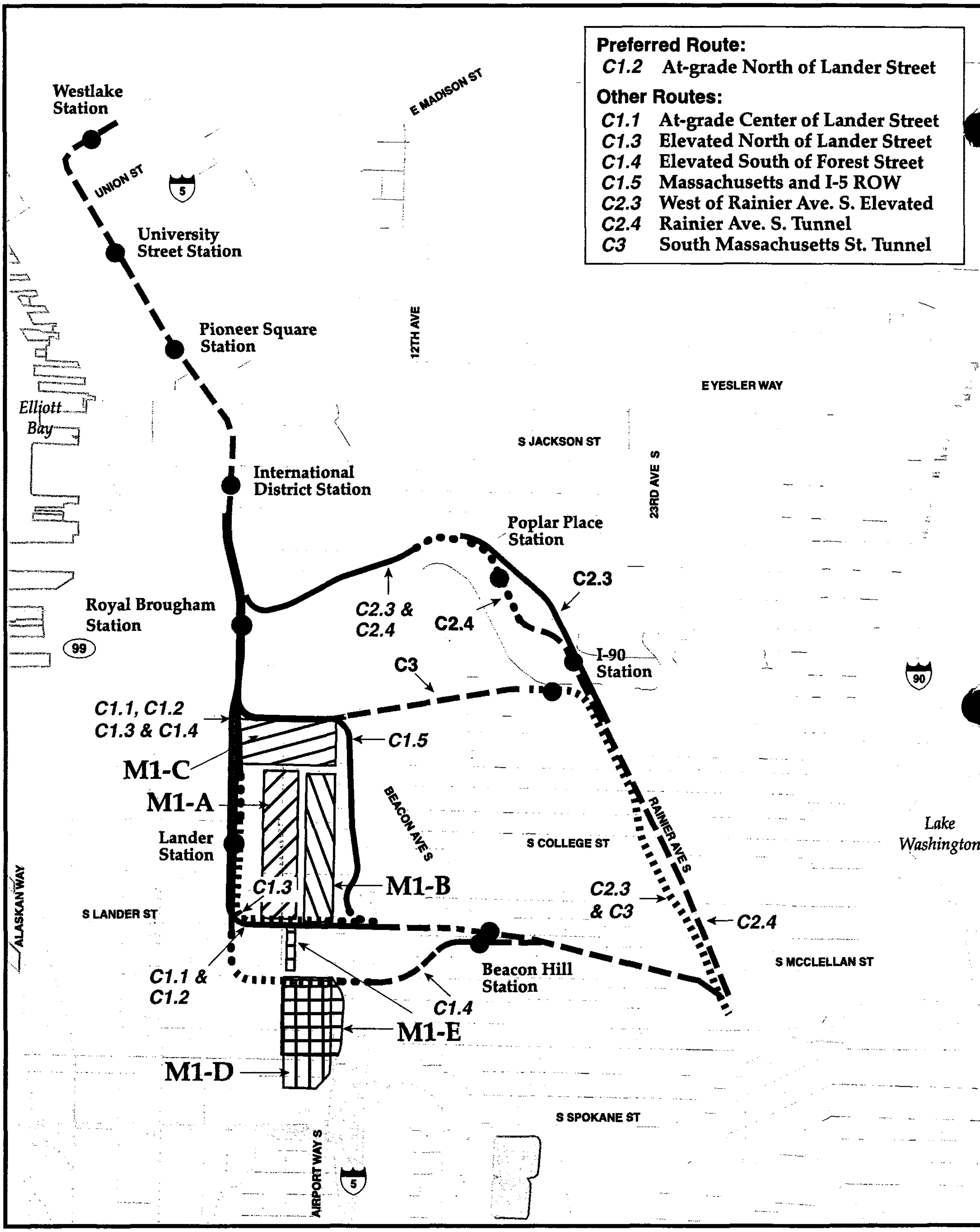
Five to six stations are currently proposed, depending on the route:

- N.E. 45th – Alternative B2.1 would use Option A as described in Alternative B1b. Alternative B2.2 would use Option B as described in the preferred alternative.
- Campus Parkway – Alternative B2.1 would have an underground station near N.E. Campus Parkway and N.E. Brooklyn Street.
- Pacific Street – Alternative B2.2 would have station Options A and B, as described above.
- Eastlake – An underground station near E. Nelson Place, just east of Eastlake Avenue E.
- South Lake Union – An elevated station near E. Mercer Street and Terry Avenue N.
- Seattle Center – An underground station near Seattle Center (east of Fifth Avenue and south of Broad Street).
- Convention Place – A potential new station at Convention Place, redesigned for light rail use only or for joint bus/rail operation.

Segment C (Westlake Station to S. McClellan Street)

This segment (Figure 2.1-7) includes the existing DSTT stations at Westlake, University Street, Pioneer Square, and the International District. Currently, only buses operate in the DSTT. If the preferred alternative were implemented, only light rail vehicles would operate in the DSTT. The displacement of buses from the tunnel would necessitate some operational changes to accommodate the buses on downtown Seattle streets (see section 3.2.2). Other alternatives could allow trains to operate with buses in the DSTT. The ability to operate both buses and rail in the tunnel, or moving all buses to surface streets, would affect bus riders from all parts of the region. Since the Draft EIS, additional inter-jurisdictional coordination and technical analysis have been performed to define and assess a range of surface street operating strategies. The existing stations in the DSTT would need to be modified to fit low-floor rail cars and their overhead power systems. Route and station alternatives for this segment are shown on Figure 2.1-7.

The Sound Transit Board identified Alternative C1 studied in the Draft EIS as the preferred alternative. Since then, Alternative C1 has been expanded to include five variations (C1.1 to C1.5) that serve new maintenance base alternatives (see Section 2.1.3.2), and include revisions that respond to comments on the Draft EIS. The Environmental Assessment published in August 1999 evaluated these route variations (C1.1 to C1.5) and maintenance base changes. Alternative C1.2 is evaluated as the preferred alternative in this Final EIS because it reduces impacts along Lander Street and it separates bus and rail traffic along the E-3 Transit-way, increasing the reliability of both. The Board may ultimately select one of the other C1 variations.



SOUNDTRANSIT

0 1,000 2,000
FEET

Tunnel
Elevated
At Grade
Retained Cut-Fill
Station
Potential Station
Preferred Alternative
Potential Maintenance Base

Figure 2.1-7 Segment C Westlake to S. McClellan Street

Alternative C1.2–At-grade north of Lander Street (Preferred Alternative)

The preferred alternative would start at the International District Station, to run at-grade on the east side of the existing E3 Busway, and then turn east along the north side of S. Lander Street. It would cross Airport Way at-grade, then enter a tunnel under I-5, continuing east under Beacon Hill, roughly following the alignment of S. Lander Street to connect with Segment D routes near the intersection of S. McClellan Street and Rainier Avenue S. The route would be elevated approaching Segment D. A vent shaft would be required on Beacon Hill near Beacon Avenue S. and 16th Avenue S., and power substations would be within several stations in the DSTT and at S. Lander Street. Three new stations, in addition to the four existing DSTT stations, are proposed along this route:

- Royal Brougham Station – At-grade on the east side of the E3 Busway south of Royal Brougham Way.
- Lander Station – At-grade on the E3 Busway north of S. Lander Street.
- Beacon Hill Station – The shell of a deep tunnel station would be mined under S. Lander and Beacon Avenue S. and vent/elevator shafts constructed, but the station itself may not be completed until future phases.

In addition, the Westlake Station in the DSTT has two options for developing a new entrance on Pine Street near Fifth Avenue.

Alternative C1.1–At-grade center of S. Lander Street

Alternative C1.1 (formerly C1 in the Draft EIS) would be similar to the preferred alternative, but it would locate light rail at-grade in the median of S. Lander Street. It has the same stations as Alternative C1.2, except the Lander Station would be on the median of the E3 Busway (Option A).

Alternative C1.3–Elevated north of Lander Street

This alternative follows the same route as Alternatives C1.1 and C1.2, but would be elevated on the north side of S. Lander Street within the right-of-way. The Lander Station would be elevated on the east side of the E3 busway.

Alternative C1.4–Forest Street/S. Lander Street Tunnel

This alternative follows the same route along the east side of the E-3 Busway as the preferred alternative. It would cross S. Lander Street at-grade and transition to an elevated structure, turn east at S. Forest Street, and continue elevated on the south side of the street. It would be elevated over Sixth Avenue, the BNSF spur line, and Airport Way S., then cross under I-5 to the Beacon Hill tunnel. It would have the same station options as Alternative C1.2 for the Royal Brougham and Lander stations, but the potential Beacon Hill Station would be located slightly south of the preferred station location.

Alternative C1.5–Massachusetts and I-5 right-of-way

Alternative C1.5 would be on the east side of the E3 Busway at-grade from the International District Station, then turn east to run at-grade along the south side of S. Massachusetts Street. It would cross Airport Way S. at-grade, and then turn south along I-5 in the old railroad right-of-way to the Beacon Hill Tunnel and continue to the McClellan Station. It would have the same stations as Alternative C1.2, but would not have a Lander Station.

Alternative C2.3–West of Rainier Avenue S. Elevated

From the International District station, the route would be at-grade on the D2 roadway (currently an HOV-only roadway connecting the International District to I-90 center lanes) to the vicinity of 12th Avenue S. and S. Dearborn Street. It would turn southeast and travel at-grade from the D2 roadway, through the industrial area west of Rainier Avenue S. and east of I-90, crossing to the median of Rainier Avenue S. just north of the I-90 eastbound on-ramp. The route would continue at-grade in the median of Rainier Avenue S. to S. Massachusetts Street, where it would transition to an elevated structure. In the vicinity of 23rd Avenue S., the route would shift one-half block west, generally following an elevated profile along an old railroad right-of way to S. McClellan Street.

In addition to the four existing downtown tunnel stations, one new station is proposed along this route:

- I-90 – An at-grade station on Rainier Avenue S. under I-90.

Alternative C2.4–Rainier Avenue S. Tunnel

This route would be the same as Alternative C2.3 to the vicinity of 12th Avenue S. and S. Dearborn Street. It then would turn south onto Poplar Place and transition into a retained cut and then into a bored tunnel starting north of the I-90 on-ramp, continuing under Rainier Avenue S. to a portal in a retained cut south of S. McClellan Street.

Alternative C2.4 would include the four existing DSTT stations plus:

- Poplar Place – A station in a retained cut on Poplar Place between S. Charles and S. Norman streets (just east of I-90 and south of S. Dearborn Street).

Alternative C3–S. Massachusetts Street Tunnel

The C3 route would follow the existing E3 Busway at-grade from the International District Station, then turn east into the median of S. Massachusetts Street, continuing at-grade across Airport Way and entering a tunnel portal under I-5. A bored tunnel would continue under northern Beacon Hill to a portal near 17th Avenue S. and S. Atlantic Street. The route would exit the tunnel on the east slope of Beacon Hill, transitioning into an elevated station at Atlantic Street south of I-90. It would then continue elevated in the median of Rainier Avenue S. before transitioning to a route one-half block west of Rainier Avenue S. to S. McClellan Street, as in Alternative C2.3. A vent shaft would be required near S. Massachusetts Street and 14th Avenue S. Alternative C3 includes two stations in addition to the four existing downtown tunnel stations:

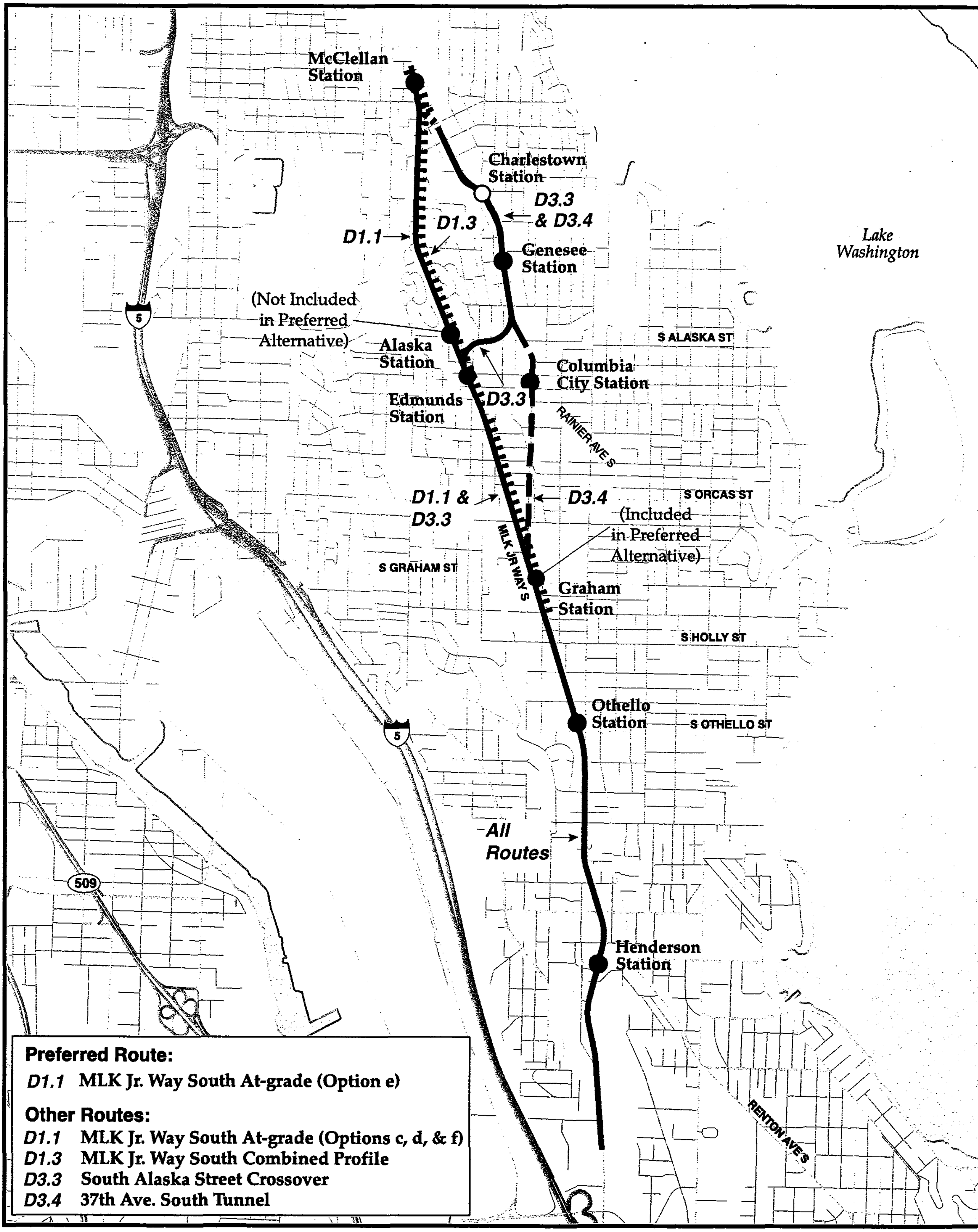
- Royal Brougham Station – An at-grade station on the E3 Busway south of Royal Brougham Way.
- I-90 – An elevated station just south of I-90, near 17th Avenue S. and S. Atlantic Street.

Segment D (S. McClellan Street to Boeing Access Road)

This segment would begin at S. McClellan Street and continue south to the Boeing Access Road. Figure 2.1-8 shows route and station alternatives for this segment. The McClellan Station would serve the hub urban village at the north end of Rainier Avenue S.; other stations would be located within or on the edge of urban centers or villages designated by the city. After the release of the Draft EIS, Sound Transit prepared a Technical Report on a potential Rainier Valley Tunnel, comparing it to the Draft EIS alternatives. In identifying the preferred alternative, the Sound Transit Board considered the Rainier Valley Tunnel Technical Report, the Draft EIS, and public and agency comments. Several new options for at-grade routes that reduce project impacts have been developed for the Final EIS, including Alternative D1.1e.

Alternative D1.1e–MLK Jr. Way S. At-grade 4-lane Street (93 ft cross section) (preferred alternative)

- Alternative D1.1e, the preferred alternative, would depart the S. McClellan Station in an elevated profile. The route would then enter the median of MLK Jr. Way S. and continue south at-grade, serving planned urban village communities near the Rainier Vista garden community and the west edge of Columbia City. The route would continue south at-grade to serve urban villages near S. Graham St., the Holly Park garden community, and the South Shore neighborhoods near S. Henderson Street, before continuing south to Boeing Access Road. Alternative D1.1e proposes a 93-ft-wide right-of-way, allowing four lanes, improved sidewalks, and added lighting and landscaping.



SOUNDTRANSIT

0 1,500 3,000
FEET

Tunnel
Elevated
At Grade
Retained Cut-Fill

Station
Potential Station
Preferred Alternative

Figure 2.1-8 Segment D: S. McClellan Street to Boeing Access Road

On MLK Jr. Way S., there would be seven new signalized intersections and nine new pedestrian-only signalized crossings. A traction power substation would be needed, along with a small building for signals/communications, near the McClellan and Graham stations. Streetscape improvements would be provided along Edmunds and Henderson streets to improve the pedestrian links with Columbia City and Rainier Beach, respectively. The Sound Transit Board also proposed a local $50 million community development fund for the Rainier Valley area in association with the preferred alternative. The use and management of the fund is being determined through workshops and discussions with community groups and local agency staff and officials.

Five stations are included:

- McClellan – An elevated station at S. McClellan Street with two design options for a bus transfer facility and for traffic circulation and street treatments. Option B would close 27th Avenue S. to general traffic. Option C would keep 27th Avenue S. open to general traffic. Both options include improvements to Cheasty Boulevard. Both options would provide a revised intersection at MLK Jr. Way S. and Rainier Avenue S., including pedestrian crosswalks.Edmunds – An at-grade side platform station in the median of MLK Jr. Way S., north of S. Edmunds Street, with improvements along S. Edmunds connecting to Columbia City (the station plan was revised since the Draft EIS).
- Graham – An at-grade side platform station in the median of MLK Jr. Way S., south of the Graham Street intersection (Option D).
- Othello – An at-grade station in the median of MLK Jr. Way S., centered between Othello and Myrtle streets.
- Henderson – An at-grade station in the median of MLK Jr. Way S., near S. Henderson Street, with a train turnback facility south of the platform (Option B). Improved pedestrian connections to Rainier Beach along S. Henderson would be developed, and a bus layover area would be east of the station.

Alternative D1.1c–MLK Jr. Way S. At-grade, 4-lane Street (104 ft cross section)
Alternative D1.1d–MLK Jr. Way S. At-grade, 2-lane Street (90 ft cross section)
Alternative D1.1f–MLK Jr. Way S. At-grade 2-lane Street (93 ft cross section)

The other Alternative D1.1 options would depart the S. McClellan Street station in an at-grade profile (Option A) or elevated profile (Option B), depending on the Segment C route. They would all be in the median of MLK Jr. Way S. Alternative D1.1c proposes a 104-ft right-of-way, allowing widening of the existing lanes, improved sidewalks, and added landscaping. Alternative D1.1d proposes a narrower street within a 90-ft right-of-way, reducing the existing four through-lanes to two lanes, with a parking lane; this would change the function of the street from a through arterial to a neighborhood collector. Alternative D1.1f – also a 93-ft right-of-way – would provide two traffic lanes and a parking lane that would accommodate bicycle travel.

Four to five stations are included:

- McClellan – Option A would be an at-grade station, one-half block west of Rainier Avenue S. and south of McClellan Street; Options B and C would be elevated stations, as described for the preferred alternative.
- Edmunds – Alternative D1.1f would only have an at-grade station near MLK Jr. Way S. between S. Edmunds and Alaska streets.
- Alaska – Alternatives D1.1c and D1.1d would feature an at-grade staggered station in the median of MLK Jr. Way S. near S. Alaska Street.
- Graham – A potential at-grade station in the median of MLK Jr. Way S. at S. Graham Street; Alternatives D1.1c and D1.1d would feature staggered platforms north and south of Graham (Option A), and D.1.1f would be the same as the preferred alternative (Option D).

- Othello – An at-grade side platform station in the median of MLK Jr. Way S., centered between S. Myrtle Street and S. Othello Street, as in the preferred alternative.
- Henderson – Same as the preferred alternative.

Alternative D1.3–MLK Jr. Way S. Combined Profile

Leaving the S. McClellan Street station in an elevated profile, this alternative would enter the median of MLK Jr. Way S. and continue south in an elevated configuration along the same route as Alternative D1.1. Near S. Holly Street, the route would descend to street-level and continue south to Boeing Access Road at-grade. MLK Jr. Way S. would be a four-lane roadway, as described in Alternative D1.1e. Streetscape improvements would be provided along pedestrian linkages of S. Edmunds and S. Henderson streets to the west of MLK Jr. Way S. A traction power substation and signal/communications building would be needed near the stations at S. Alaska and Graham Streets.

Four to five stations are proposed along this route:

- McClellan – An elevated station (Option B), one-half block west of Rainier Avenue S., and south of S. McClellan Street.
- Alaska – An elevated station in the median of MLK Jr. Way S., north of S. Alaska Street.
- Graham – A potential elevated station in the median of MLK Jr. Way S., north of S. Graham Street (Option C).
- Othello – An at-grade station in the median of MLK Jr. Way S., at S. Othello Street.
- Henderson – Same as the preferred alternative.

Alternative D3.3–Alaska Street Crossover

Alternative D3.3 would leave an at-grade McClellan Station and cross over MLK Jr. Way S. The route would continue in a retained cut-and-fill configuration in a new right-of-way (to be acquired) occupying the half block west of Rainier Avenue S. The route would continue south parallel to Rainier Avenue S., with service to planned urban village communities near S. Genesee Street and Columbia City. Just north of S. Alaska Street, the route would turn west, then south into the median of MLK Jr. Way S. From S. Edmunds Street, the route would continue southward at-grade in the median to Boeing Access Road. A traction power substation and signal/communications building would be needed near the station at MLK Jr. Way S. and S. Graham Street. Streetscape improvements would extend along S. Alaska Street and S. Henderson Street to the east.

Four to six stations are proposed along this route. One station near S. Genesee Street or two potential stations at S. Charleston and S. Edmunds streets would serve the Columbia City area.

- McClellan – An at-grade station (Option A) one-half block west of Rainier Avenue S., south of S. McClellan Street.
- Charlestown – A potential at-grade station in a retained cut located one-half block west of Rainier Avenue S. at Rainier Valley Square, between S. Charlestown and Andover Streets.
- Genesee – An at-grade station in a retained cut, one-half block west of Rainier Avenue S. and north of S. Genesee Street.
- Edmunds– A potential at-grade station near MLK Jr. Way S., between S. Edmunds and Hudson streets.
- Graham – A potential at-grade station with staggered platforms, to the north and south of S. Graham Street (Option A).
- Othello – Same as the preferred alternative.
- Henderson – Same as the preferred alternative.

Alternative D3.4–37th Avenue S. Tunnel

This route is similar to Alternative D3.3, up to Rainier Avenue S. and S. Oregon Street. At that point the trackway would enter a tunnel section, jogging east under Rainier Avenue S. From S. Angeline Street, the tunnel would turn southward under 37th Avenue S. to MLK Jr. Way S. and S. Raymond Street. The route would return to the surface in the median of MLK Jr. Way S. south of S. Graham Street, the same as the preferred alternative, and continue south at-grade in the median to Boeing Access Road. A traction power substation and signal/communications building would be needed near the station at MLK Jr. Way S. and S. Graham Street. South Henderson Street would include streetscape improvements to the west of MLK Jr. Way S., and a bus layover facility. The route continues in a tunnel under MLK Jr. Way S. until it is past S. Graham Street, where a portal would be located.

Four to six stations are proposed along this route:

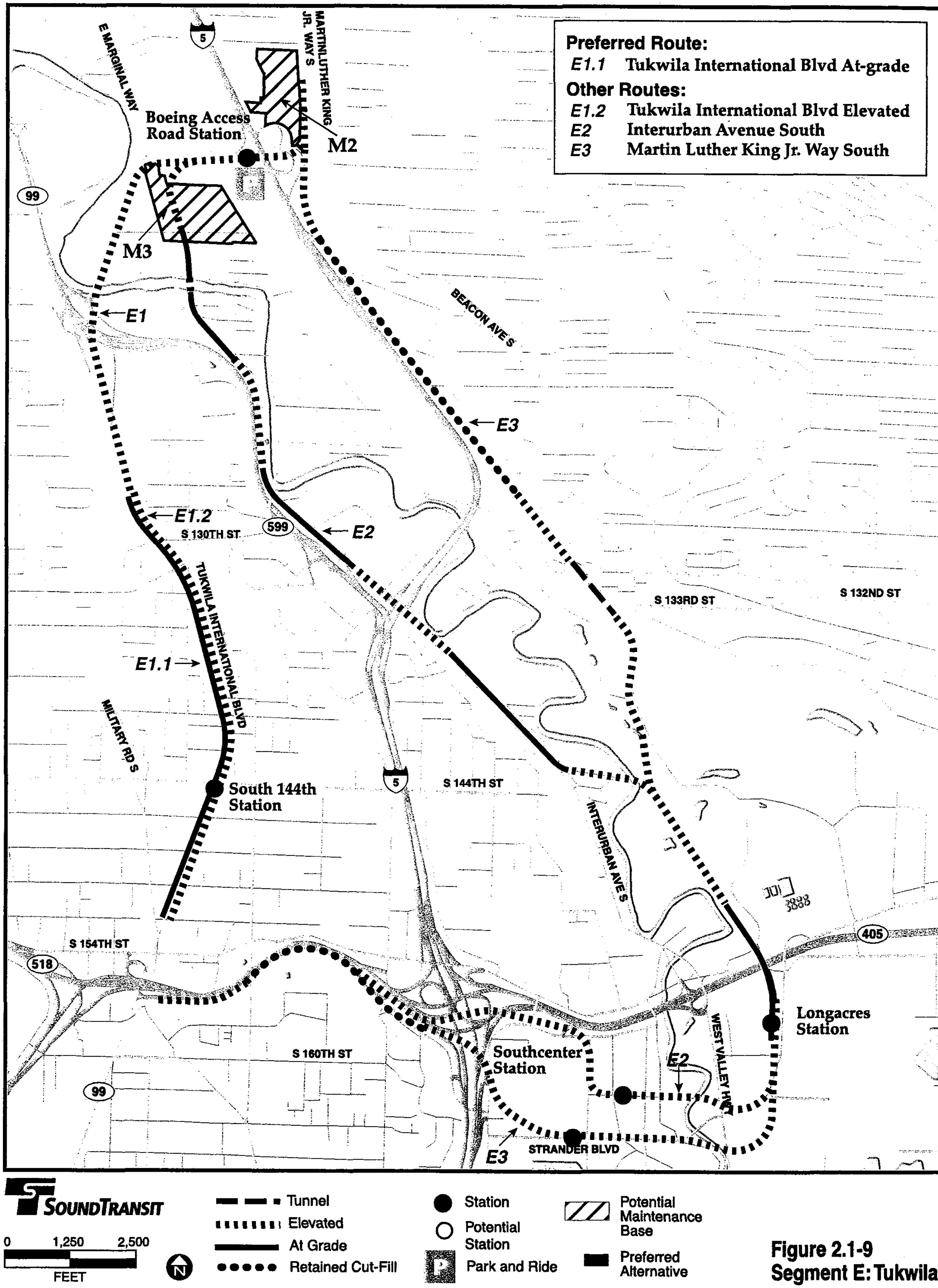
- McClellan – An elevated station (Options B or C) one-half block west of Rainier Avenue S, south of S. McClellan Street, with adjacent street changes as described for the preferred alternative.
- Charlestown – A potential at-grade station in a retained cut, one-half block west of Rainier Avenue S. at Rainier Valley Square (between S. Charlestown and Andover Streets).
- Edmunds (Columbia City) – A subway station under 37th Avenue S. at S. Edmunds Street in Columbia City.
- Graham – A potential station in a retained cut in the median of MLK Jr. Way S., south of the intersection with S. Graham Street (Option C).
- Othello – Same as the preferred alternative.
- Henderson – Same as the preferred alternative.

Segment E (Tukwila)

The Tukwila segment starts at the Boeing Access Road and continues south through the city of Tukwila to approximately SR 518. The preferred alternative (E1.1) is along Tukwila International Boulevard, with a connection to Sounder Commuter Rail and service to a neighborhood commercial district along Tukwila International Boulevard. Alternatives along Interurban Avenue S. (E2), and MLK Jr. Way S. (E3), offer a connection to Sounder Commuter Rail service at Longacres Way, and serve Tukwila's Southcenter urban center at either Baker Boulevard or Strander Boulevard. The City of Tukwila opposes Alternative E1.1, preferring Alternative E3, which would serve Southcenter, the City's designated urban center. The route and station alternatives for this segment are shown on Figure 2.1-9. The end points of this segment approximate the City of Tukwila's boundaries, but portions of the routes are in Seattle, King County, and Renton. In addition, the areas (within ¼ mile) of two station locations in Segment F (S. 154th Street and S. 160th Street) would be partially in the city of Tukwila.

Alternative E1.1–Tukwila International Boulevard At-grade (preferred alternative)

- The preferred alternative route would be elevated from the Boeing Access Road station across E. Marginal Way, along the east side of Tukwila International Boulevard, and over the Duwamish River, Riverton Creek, and SR 599. From SR 599 south, to approximately S. 126th Street, the route would be elevated to the east and then in the median of Tukwila International Boulevard. Alternative E1.1 would transition to grade in the median of Tukwila International Boulevard at approximately S. 126th Street, then proceed at-grade in the median to approximately SR 518. A traction power substation would be needed near the intersection of Tukwila International Boulevard and S. 126th Street. The section of the E1.1 route in the median of Tukwila International Boulevard would reconstruct the highway within a 102-ft cross section, 2 ft narrower than proposed in the Draft EIS.



SOUNDTRANSIT

Figure 2.1-9
Segment E: Tukwila

Design changes included since the Draft EIS incorporate many of the City's proposed improvements to Tukwila International Boulevard. Improved sidewalks, landscaping, and lighting would be provided. New signalized intersections would be provided at S. 140th and S. 148th streets, and three signalized pedestrian-only crossings would be provided near S. 130th, 132nd, and 142nd streets. The City's plan calls for no new signal-protected pedestrian-only crossings, but did include ten new unsignalized pedestrian crossings, four with pavement embedded lighting along the crosswalk. Two stations are proposed along this route:

- Boeing Access Road – An elevated station at Boeing Access Road with pedestrian connections to a Sounder commuter rail platform and a 300-stall park-and-ride facility. A traction power substation would be sited near the station.

S. 144th – An at-grade station at Tukwila International Boulevard, south of S. 144th Street.

Alternative E1.2–Tukwila International Boulevard Elevated

This route would be the same as the preferred alternative until it reaches Tukwila International Boulevard. The route would then remain elevated in the median of the roadway. The proposed roadway and intersection changes would be the same as Alternative E1.1.

Two stations are proposed:

- Boeing Access Road – Same as Alternative E1.1.
- S. 144th – An elevated station at Tukwila International Boulevard, south of S. 144th Street.

Alternative E2–Interurban Avenue S.

This alternative would originate at the elevated section along the south side of the Boeing Access Road (without a station), then turn south just east of E. Marginal Way, touching down behind currently industrial buildings. It would continue south at-grade, crossing the Duwamish River on a short bridge at approximately S. 115th Street, then running adjacent to SR 599/Interurban Avenue and the existing Duwamish Trail continuing at-grade to approximately Gateway Drive, where it would transition to an elevated profile. After crossing over I-5, it would return to grade near S. 56th Avenue. The route would continue south to S. 143rd Street, then turn east, transitioning to an elevated profile to cross the Duwamish River and the Burlington Northern Santa Fe (BNSF) and Union Pacific (UP) railroad tracks. It would proceed on the east side of the BNSF/UP tracks at Black River Junction (in the city of Renton) and return to grade approaching I-405 and Longacres. The route would become elevated, turn west into the city of Tukwila, over the BNSF and UP railroad tracks, the West Valley Highway, and the Duwamish River.

On the west side of the Duwamish River, the route would continue elevated in the median of Baker Boulevard, move northward along Andover Park W. to Tukwila Parkway, then proceed west along the north side of the Parkway, across the street from the Southcenter Mall property. Gaining more elevation, the route would cross over the interchange of I-5, I-405 and SR 518. It would follow the south side of SR 518, cross under 51st Avenue S., and continue in a mixture of elevated structures and retained cut-and-fill to approximately International Boulevard (SR 99).

Two stations would be located along this route:

- Longacres – An elevated station at Longacres Way with pedestrian connections to a Sounder commuter rail platform (modified since the Draft EIS to include a shared park-and-ride facility with commuter rail and increased bus transfer/layover areas.)
- Southcenter – An elevated station over Baker Boulevard just east of Andover Park West and Southcenter Mall; Option A provides additional bus layover areas and vehicle access areas, while Option B does not, using a smaller station area footprint.

Alternative E3–MLK Jr. Way S.

Beginning on an elevated profile along MLK Jr. Way S. in the city of Seattle, the route would cross over Boeing Access Road into the city of Tukwila, then proceed as a retained cut/fill along the sloping east side of MLK Jr. Way S. A short, elevated section would cross over S. 129th Street, and then the route would cross under MLK Jr. Way S. in a short cut-and-cover tunnel. The route would then descend a steep slope on an elevated structure to the Black River Junction, and across the BNSF Renton branch line. It would return to grade adjacent to the south end of Fort Dent Park and follow the east side of the BNSF and UP tracks under I-405 to Longacres, where the trackway would become elevated. Next it would turn to the west across the railroad tracks and become elevated across West Valley Highway and the Duwamish River to Strander Boulevard. It would follow the north side of Strander Boulevard, through the Southcenter parking lot, swing north over Southcenter Parkway and the I-5/I-405 interchange, cross under Klickitat Drive, and follow the Alternative E2 route along the south side of SR 518 to International Boulevard.

Two stations are proposed along this route:

- Longacres – An elevated station at Longacres Way with pedestrian connections to Sounder Commuter Rail. This station design was modified since the Draft EIS to include a park-and-ride shared with commuter rail and increased areas for bus transfer/layover.
- Southcenter – Two options for an elevated station on the north side of Strander Boulevard near Southcenter Mall; Option A provides additional bus stops and layover areas and vehicle access areas, while Option B does not, allowing a station area with a smaller footprint.

Segment F (SeaTac)

The preferred alternative, and other alternatives in this segment (Figure 2.1-10), would serve the City of SeaTac urban center and Sea-Tac Airport, with station options in each of the City's designated high-capacity transit districts. The SeaTac segment extends from the northern boundary of the City of SeaTac, at S. 152nd Street and Tukwila International Boulevard, to S. 200th Street. The preferred route entering SeaTac would be along Tukwila International Boulevard from the north, with other routes entering from SR 518 from the east (E2 or E3). Eight route alternatives, including the preferred alternative, have been identified (as shown on Figure 2.1-10).

Alternative F2.3–Washington Memorial Park, Elevated east of 28th Avenue S. (Preferred Alternative)

The preferred alternative would be elevated along Tukwila International Boulevard from 152nd Street, continuing southwest to cross over SR 518 west of Washington Memorial Park, and connect to the Airport's proposed North End Airport Terminal (NEAT) and Intermodal Center (IMC). It would then continue elevated along the west side of International Boulevard, crossing S. 188th Street and continuing south along the east side of 28th Avenue S. to S. 200th Street. Three stations are proposed, with one alternative station and another potential station.

- North SeaTac – Option B is an elevated station located north of S. 154th Street and west of International Boulevard, with a 670-stall park-and-ride facility southeast of the intersection. Option F is an elevated station and 260-stall park-and-ride at the northeast corner of the S. 154th Street/International Boulevard intersection, and Option G is an elevated station and 454-stall park-and-ride at the northwest corner of the intersection.
- North Central SeaTac – Option C is an elevated station at IMC, with a planned people mover connection to the existing airport terminal and future NEAT. A future Personal Rapid Transit station could be accommodated at that site. An alternative station would be located at the NEAT (Option D) with a direct pedestrian connection to NEAT, and people mover access to the existing Sea-Tac Airport terminal and the IMC.

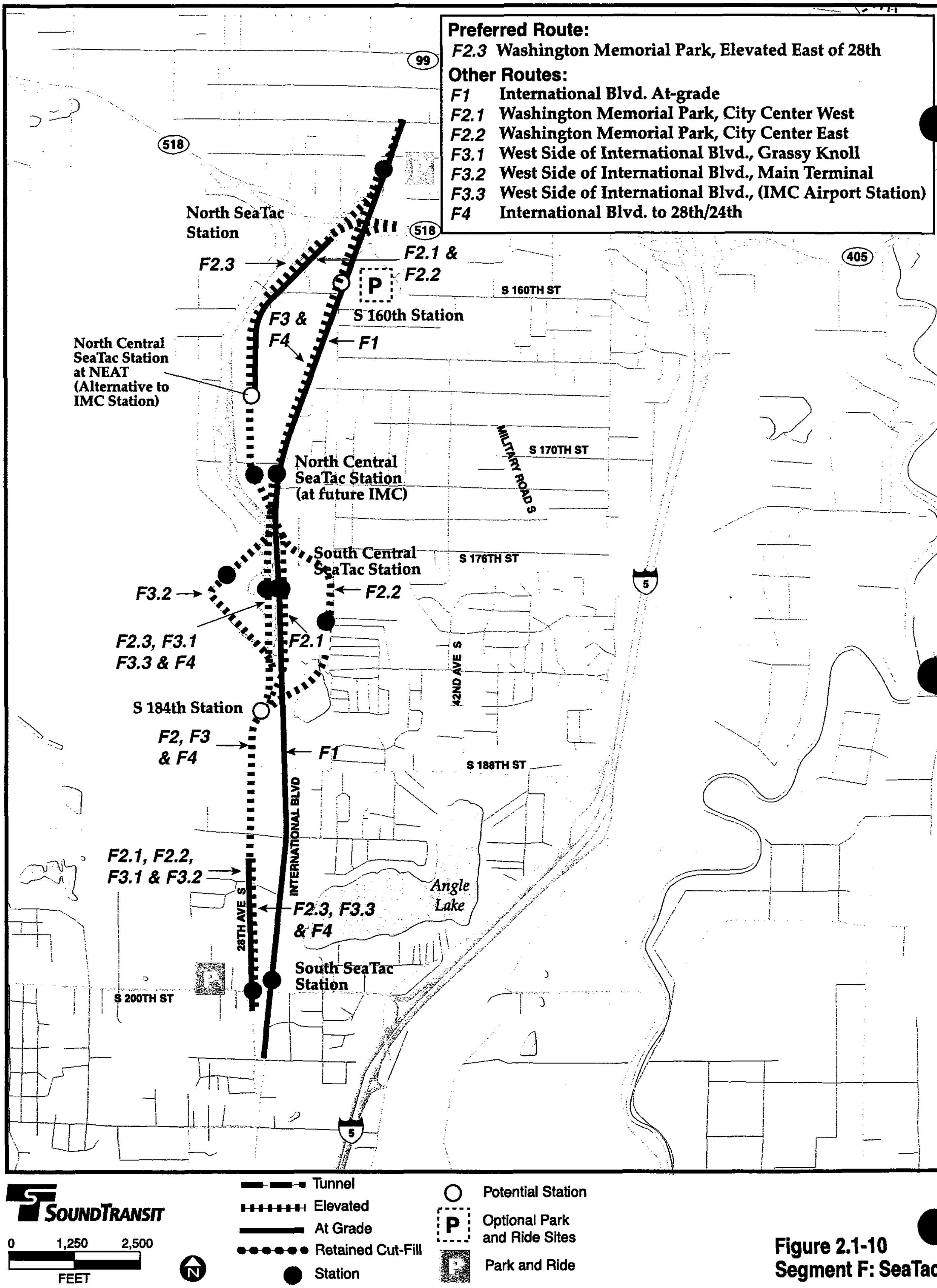


Figure 2.1-10
Segment F: SeaTac

- South Central SeaTac – This is a potential elevated station at S. 184th Street on the west side of International Boulevard.
- South SeaTac – Both options E and F have a 630-stall parking garage. Option E has an elevated station south of S. 200th Street. Option F has an elevated station over and north of S. 200th Street, and both options would include bus transfer areas. Options C and D could also combine with F2.3 but are evaluated with Alternative F4. A traction power substation would be sited near the station.

Alternative F1–International Boulevard in Median

This route would include the light rail tracks at-grade in the median of International Boulevard, either coming from the north over SR 518 on a new or widened existing bridge (Alternative E1) or from the east along SR 518 (Alternative E2 or E3). From SR 518, the route would continue in the International Boulevard median to S. 200th Street, and as a tail track to approximately S. 204th Street. As requested by the City of SeaTac, the existing lane configuration of International Boulevard would be maintained, with additional landscaping provided. All stations would be in the median. This requires expanding the street right-of-way approximately 30 ft to the east in the northern section.

The three to four proposed stations along this route are:

- North SeaTac – A potential at-grade station in the median of International Boulevard, located at S. 154th Street (Option A with Alternative E1.1, and Option B with Alternative E.1.2), or at S. 160th Street (Option C with Alternatives E2 or E3).
- North Central SeaTac – An at-grade station at International Boulevard and S. 170th Street near the Radisson Hotel site, with pedestrian connections to the Port of Seattle's proposed IMC, the airport people-mover system, and the North End Airport Terminal (NEAT).
- South Central SeaTac – An at-grade station in the median of International Boulevard, east of the main terminal, with a pedestrian underpass connection to the SeaTac City Center on the east side of International Boulevard. A future connection to a station for the City of SeaTac's planned Personal Rapid Transit (PRT) system could be accommodated.
- South SeaTac – An at-grade station in the median of International Boulevard north of S. 200th Street, with a 400- to 950-stall surface park-and-ride facility.

Alternative F2.1 - Washington Memorial Park, City Center West
Alternative F2.2 - Washington Memorial Park, City Center East

The north section of both Alternatives F2.1 and F2.2 would begin with a transition to an elevated trackway following either Tukwila International Boulevard from the north (Option A) or SR 518 from the east (Option B), depending on which alternative is selected for Segment E. The route would be elevated on the western side of International Boulevard, and would return to grade between S. 152nd and S. 154th streets along the west property line of Washington Memorial Park cemetery. The light rail trackway would be elevated from north of S. 170th Street and continue elevated on a structure to the Port's proposed IMC at the Radisson Hotel just south of S. 170th Street. The route would then cross over International Boulevard on structure to a Central SeaTac station east of International Boulevard, before continuing along the east side of International Boulevard to south of the airport terminal. The route would then cross to the west side of International Boulevard on an elevated structure and continue southwest, following the existing right-of-way of Air Cargo Road/28th Avenue S., passing over S. 188th and S. 192nd streets. The tracks would return to grade at approximately S. 193rd Street and would continue at-grade in the 28th Avenue S. right-of-way, to be vacated through the S. 200th Station.

Alternative F2.2 would be the same as F2.1, except that the City Center station would be located about one-quarter mile east of International Boulevard, adjacent to the west right-of-way line of 32nd Avenue S., and centered on the intersection with S. 180th Street. As the trackway continues southwest it would cross the northern end of Bow Lake before going elevated over International Boulevard on its way eastward to the 28th Avenue S. route.

Three stations are proposed along these routes:

- North Central SeaTac – Option C is an elevated station at the Port's proposed IMC south of S. 170th Street at Radisson Hotel, with a direct pedestrian walkway and/or airport people-mover connection to the airport terminal. A future Personal Rapid Transit station could be accommodated.
- South Central SeaTac – Alternative F2.1 would have an elevated station at City Center West adjacent to the east side of International Boulevard at S. 180th Street, with pedestrian overpass across International Boulevard. Alternative F2.2 would include a station at City Center East near 32nd Avenue S.
- South SeaTac – Option B is an at-grade station in the center of 28th Avenue S., north of S. 200th Street, with 400-to 850-surface park-and-ride stalls in two lots. Bus transfer areas would be provided.

Alternative F3.1–West Side of International Boulevard, East of Parking Structures
Alternative F3.2–West Side of International Boulevard, Main Terminal

Both alternatives would include an elevated trackway along the west side of International Boulevard north of the airport. The route would continue south with an elevated profile. There would be an elevated South Central SeaTac Station in the open area between the airport parking garage and International Boulevard. Alternative F3.1 would continue along the west side of International Boulevard, while Alternative F3.2 would turn west on an elevated structure above the airport drives at the main terminal, and its elevated station would be located between the parking garage and the airport terminal. South of the terminal, F3.2 would turn southwest into the proposed south airport access road, then onto the 28th/24th Avenue S. right-of-way (south of S. 188th) and follow the route of Alternative F2 to the southern terminus of the light rail line and tail track at S. 200th Street.

Three to four stations are proposed along these routes:

- North SeaTac – Alternative F3.1 would not have a North SeaTac Station. Alternative F3.2 would have an elevated station, near S. 154th Street, (Option B), or Option D near S. 160th Street if either the Alternative E2 or E3 routes were selected.
- North Central SeaTac – Both alternatives would use Option B, an elevated station on the west side of International Boulevard south of S. 170th Street near the Radisson Hotel, with direct pedestrian connections to the IMC and airport people-mover system. A future station for the City's planned Personal Rapid Transit system could be accommodated.
- South Central SeaTac – Both Alternatives F3.1 and F3.2 would have elevated stations in the vicinity of the airport terminal. Alternative F3.2 would use Option A above the airport terminal arrivals drive (between the terminal and parking garages) with pedestrian connections on the airport access drives and International Boulevard to SeaTac City Center. Alternative F3.1 would use Option B between the terminal parking garages and International Boulevard.
- South SeaTac – Both alternatives would have an at-grade station in the center of 28th Avenue S., north of S. 200th Street, with 400- to 850-surface park-and-ride stalls in two facilities, and bus transfer areas.

Alternative F3.3–West side of International Boulevard, Intermodal Center

This route begins at grade north of S. 148th Street in the median of International Boulevard, and is elevated approaching S. 152nd Street. Streetscape and landscape improvements are incorporated throughout the roadway segment where light rail is in the median. The route moves to the west side of International Boulevard at S. 154th Street, and continues along the west side, with landscape improvements and roadway modifications, from near the 16200 block to 170th Street S. The route turns southwest from International Boulevard to Airport Cargo Road, and is on the same route as F2.3 from S. 188th to the terminus at S. 200th Street. Three stations are proposed:

- North SeaTac – Option B with an elevated station at 154th Street.
- North Central SeaTac – Option B is an elevated station on the west side of International Boulevard south of S. 170th Street near the Radisson Hotel/NEAT site.
- South SeaTac – Options E and F, as in Alternative F2.3.

Alternative F4–International Boulevard to 28th/24th

Alternative F4 is at grade in the median of International Boulevard from 150th Street, transitioning to elevated approaching S. 160th Street, and then moving to the west side of International Boulevard at 170th Street S., continuing to the 18000 block, where it turns southwest to Airport Cargo Road, following the same route as Alternative F2.3. Three stations would be provided:

- North SeaTac at S. 154th Street – Option A is an at-grade station in the median of International Boulevard, with a 350-stall park-and-ride.
- North Central SeaTac – Option B is an elevated station on the west side of International Boulevard south of S. 170th Street, with direct pedestrian connections to the airport terminal.
- South SeaTac – Options C and D are for elevated stations at S. 200th Street, with a 630-stall parking garage and a potential bus/transit facility.

2.1.3.4 Maintenance Base Site Options

This Final EIS evaluates seven alternative maintenance base locations, including three that were evaluated in the Draft EIS and four that were developed and evaluated in the August 1999 Environmental Assessment in response to public and agency comments. Some of the maintenance base sites are possible only with specific route and length alternatives, while others could be matched with multiple route and length alternatives. A maintenance base would provide for running repairs, heavy maintenance, and storage of light rail vehicles. An appropriate site should be industrially zoned, from 21 to 30 acres in size, adequate to accommodate storage of a fleet of at least 100 vehicles, and located centrally within the light rail corridor. The site should also be relatively flat, of regular shape, with good roadway and preferably railroad access. Maintenance base buildings would include a maintenance shop for operations, control functions and training facilities, a maintenance-of-way building, and a traction power substation. Outdoor storage and parking for 150 employees and visitors would also be provided. The main building would cover approximately 80,000 ft^2, including a large shop floor; and the control center would be housed on an upper floor. The Environmental Assessment of the impacts of the additional maintenance base sites was issued by Sound Transit in August 1999, and its findings and the resulting public and agency comments are addressed in the Final EIS. The seven alternative maintenance base sites, shown on Figure 2.1-1, include:

- M1-A – Lander Street, bounded by S. Lander and S. Holgate streets, and Sixth and Eighth avenues S. (could be included with the Segment C preferred alternative [C1.2], and Alternatives C1.1, C1.3, and C1.4).
- M1-B – Lander Street, bounded by S. Lander and S. Holgate streets, and Eighth Avenue and Airport Way S. (could be included with the preferred alternative [C1.2] and Alternative C1.1).
- M1-C – Atlantic/Central, bounded by the E3 Busway and Airport Way S., and Massachusetts and Holgate streets (could be included with the Segment C preferred alternative (C1.2), and Alternatives C1.1, C1.4, and C1.5).

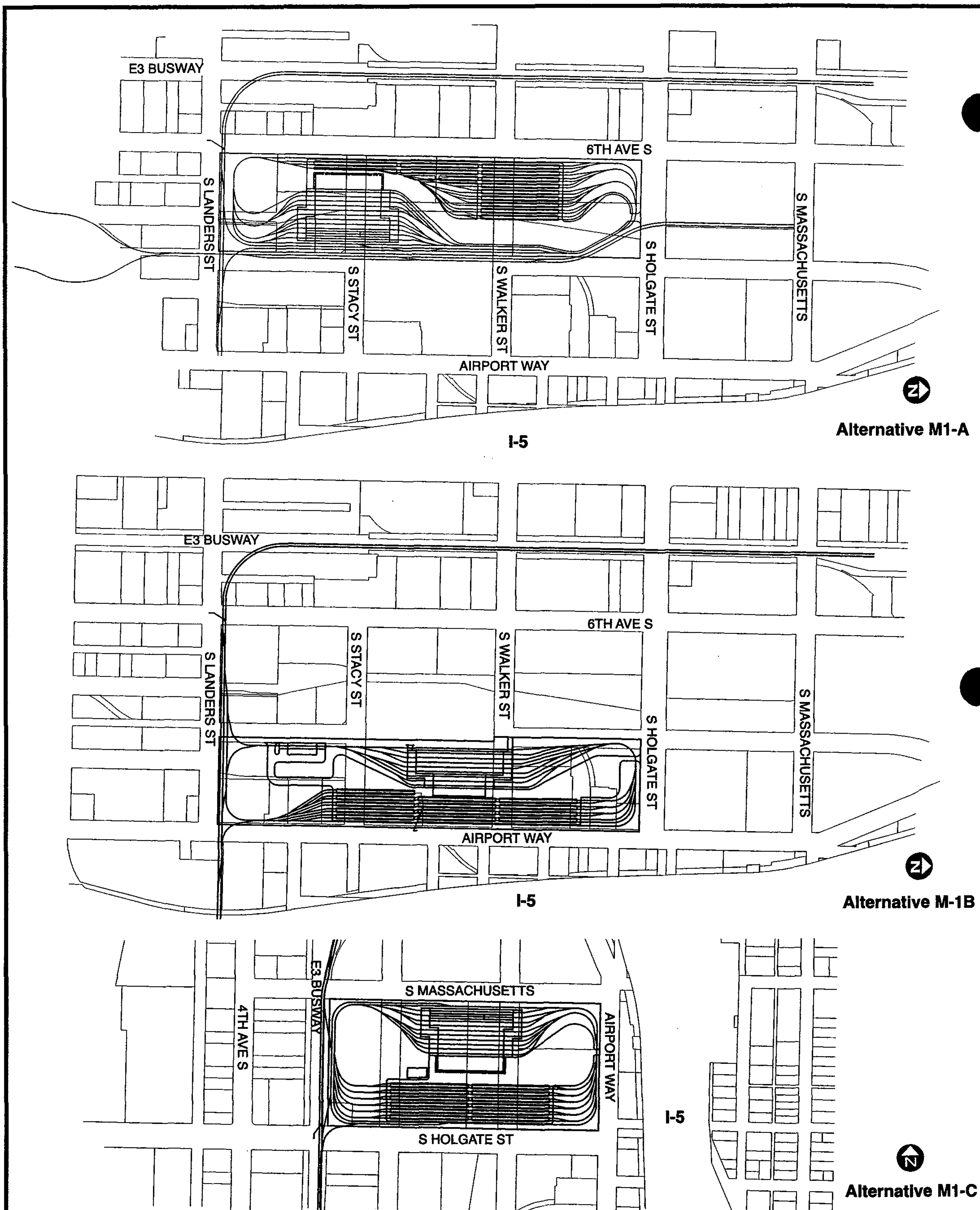


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Figure 2.1-11a
Maintenance Base Alternatives

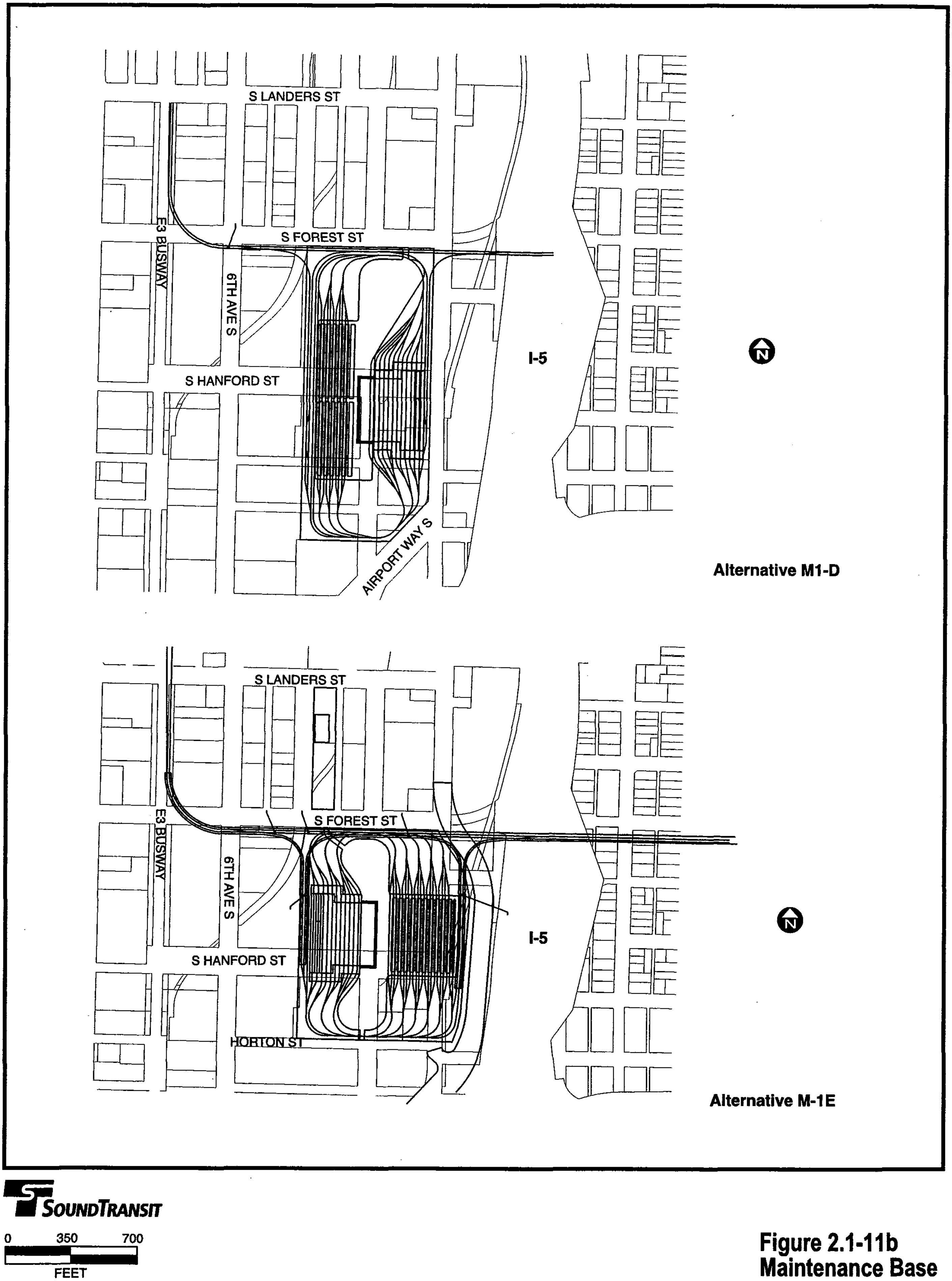
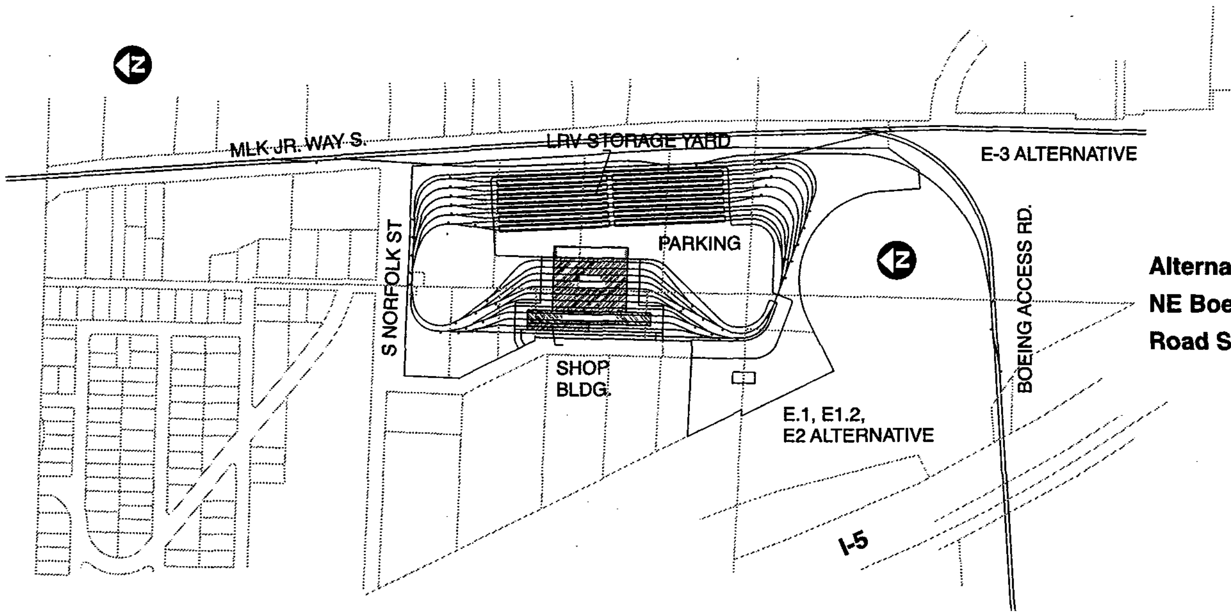
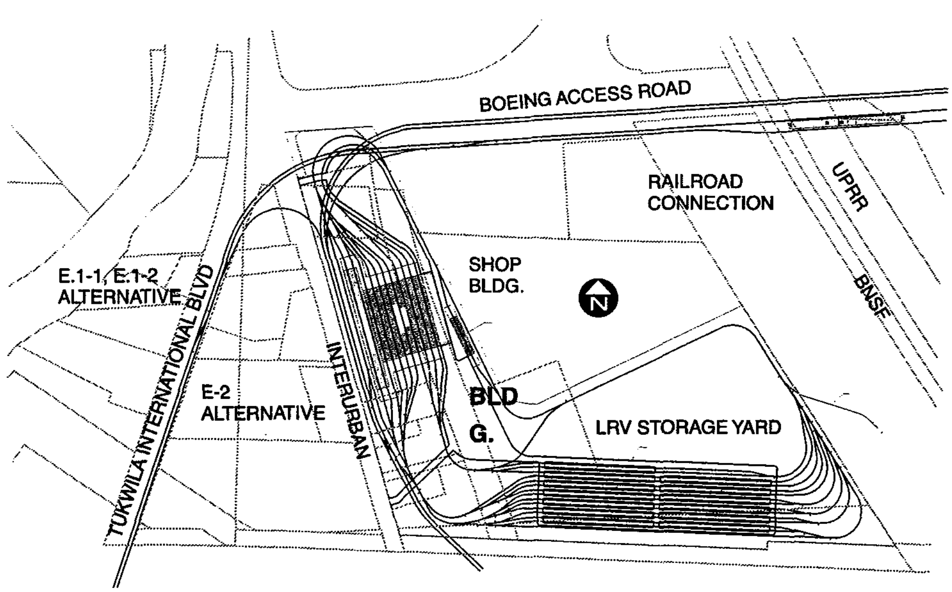


Figure 2.1-11b Maintenance Base Alternatives



Alternative M-2
NE Boeing Access
Road Site



Alternative M-3
SW Boeing Access
Road Site

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Figure 2.1-11c
Maintenance Base
Alternatives

- M1-D – Rainer Brewery/Roadway Express, bounded by Seventh Avenue S., S. Airport Way and S. Forest Street, and south of S. Hinds Street; this site is only possible with the C1.4 alignment.
- M1-E – Rainier Brewery/Airport Way, on a portion of the M1-D site above, but shifted to the east, relocating Airport Way to the east; this site is only possible with the C1.4 alignment.
- M2 – Northeast of the Boeing Access Road, in a site bounded by Boeing Access Road, I-5/40th Avenue S., Norfolk Street, and MLK Jr. Way S.
- M3 – Southwest of the Boeing Access Road, in a site bounded by Boeing Access Road, E. Marginal Way, Duwamish power transmission line right-of-way, and the BNSF railroad.

Site plans for each of the maintenance base sites are shown in Figures 2.1-11a through 2.1-11c, which show the conceptual track layouts, the locations of buildings, parking, and roadway access.

2.1.3.5 Length Alternatives and Terminus Stations

This EIS evaluates a variety of "system" scenarios, also known as "length alternatives," for the proposed Central Link light rail line. The length alternatives combine route and station alternatives and options to provide a summation of "system" impacts. They would also result in a range of possible terminus stations for the project, although all options would allow for future extensions. The Northgate to SeaTac Alternative (Segment A through F) extends 24 to 29 miles, from 103rd Avenue N.E. in Northgate, to S. 200th Street in SeaTac. The N.E. 45th to SeaTac alternative (Segments B through F), approximately 3.4 miles shorter, extends from N.E. 45th Street in the University District to the S. 200th Street terminus in SeaTac; the N.E. 45th Station in the University District would be an interim northerly terminus. The EIS examines the range of costs and impacts possible under different combinations of alternatives between N.E. 45th Street and SeaTac.

In addition, the EIS evaluates the system impacts of the preferred alternative from N.E. 45th Street to SeaTac, and for three Minimum Operable Segments (MOSs). MOS A would be from N.E. 45th Street to S. McClellan Street. MOS B would be from Capitol Hill to S. Henderson Street. MOS C would be from N.E. 45th Street to S. Lander Street. The evaluation of each of these scenarios is based on the cumulative impacts resulting from the preferred route and station alternatives, as defined in Section 2.1.1. In addition, the Maintenance Base options could vary, and each potential terminus station could function differently than would a station at that same location, given a longer system. Under the various scenarios, the potential terminus stations would be at Northgate, N.E. 45th Street, Capitol Hill, S. Lander Street, and S. 200th Street. Only the Northgate and S. 200th Street terminus options would feature park-and-ride facilities; the potential for bus or other functional changes is described in the Transportation Analysis in Sections 3.2 and 3.3. MOS A and MOS C would include any of the M1 Maintenance Base sites. MOS B would include Site M2. In the system totals for MOS A and C, the worst-case maintenance base impacts are included.

In compliance with Federal regulations for implementing the National Environmental Policy Act (23 CFR 771.111(f)), the light rail system length alternatives evaluated in this EIS connect logical termini and have independent utility. The defined termini of this initial system allow environmental matters to be addressed on a broad scope. This system would provide direct access to high concentrations of employment, commercial, and residential uses and it could be operated independently of any future light rail improvements. The full-length system alternatives, as well as the MOS alternatives, provide logical points for connecting to other existing transportation modes, and to future light rail system extensions. This operating system and its termini have been planned to accommodate and/or complement as much as possible, other planned transportation improvements. Roadway and bus transit modifications, required to accommodate the light rail alternatives, are included in the project description and/or impact assessment.

2.1.3.6 Route and Station Planning and Development

Station design guidance

In August 1998, Sound Transit adopted general policy guidelines (Motion No. 1798-58) for the design of passenger amenities and features of the stations, including access, lighting, signage, weather protection, heating/cooling, automated teller machines, and bicycle facilities. Space could also be provided at some stations for private vendors, like espresso stands and other rider conveniences. Detailed station designs will be developed during final design. Sound Transit guidance on station design is as follows:

- Design in character with the community and recognize the need to develop stations as part of a larger community environment;
- Develop in conjunction with local agencies and their adopted neighborhood plans;
- Improve areas equitably throughout the entire system;
- Limit improvements to those required for operations of the transit system and to the confines of the right-of-way disturbed by the construction of the system;
- Provide ample pedestrian access from adjacent streets;
- Provide connections to other adjacent transit facilities, whenever possible;
- Collaborate with public and private parties to maximize joint development and transit-oriented development opportunities (see below); and
- Work with local public transportation agencies, communities, and local governments to include making improvements within one-half mile of each station for safe, easy transit, pedestrian, and bicycle access as outlined in *Sound Move* (see non-motorized access discussion below).

Joint development potential

Joint development projects would involve the development of rail stations with other facilities that may be above, below, or directly adjacent to the station. The station and the other facilities may share common entrances or structures, and they may be jointly designed or constructed. Joint-development project financing often involves cost sharing and land or lease-sharing arrangements. The joint development opportunities may help reduce project costs, provide new revenue streams, enhance station access, and gain additional public amenities. Land acquired for project construction, but that is not needed after construction is complete, can provide opportunities for joint development.

Stations with potential for joint development include, but are not limited to:

- Northgate – A relocated transit center and a new park-and-ride facility, with accommodations for shopping mall expansion and new office/retail development.
- Roosevelt – Station entrances in a proposed mixed-use Roosevelt Square project, and residential development south of Roosevelt Square.
- N.E. 45th – Station entrances are possible at the University Bookstore. Other potential elements include other retail sites, a church-related project, and the expansion of University of Washington's Burke Museum or Law School.
- Pacific – Entrances south of N.E. Pacific Street could be incorporated in future building sites in the UW southwest campus area.
- Broadway – Station entrances could be developed at Seattle Central Community College, at an existing bank, or at other nearby redevelopment sites.
- First Hill – Seattle University, Swedish Hospital, two banks, and other medical facilities are potential station entrances.
- Convention Place – A large office/retail project is possible on the site of the existing station.
- McClellan – Station development could offer opportunities for public/private partnership on-site.

- Othello – Station development could offer opportunities for public/private partnership adjacent to platform.
- Sea-Tac Airport and S. 200th Street – Joint development could provide the core of an intermodal facility at either the airport station or the terminus station at S. 200th Street. A S. 200th Station could also feature a park-and-ride structure with retail or commercial uses on the ground floor.

Transit-oriented development

Transit-oriented developments are commercial, housing, retail, and mixed-use projects with designs that support ridership on transit systems. Development around stations is often a mix of commercial, retail, community services, and housing, and features pedestrian-supportive amenities. In April 1998, Sound Transit adopted agency-wide policies to support transit-oriented development.

Sound Transit has developed interlocal agreements that provide the local jurisdictions with funding for land use planning efforts around station areas. The cities will engage local communities in station area planning with an emphasis on transit-oriented development. The cities' work plans include market analysis and initial assessment of development potential around route and station alternatives.

Non-motorized access

Many riders are expected to walk or ride bicycles to travel to and from Sound Transit facilities. Sound Transit has been working with local jurisdictions and communities to determine appropriate pedestrian and bicycle improvements within a one-half mile radius of stations. Where appropriate, streets that would be reconstructed as part of building the light rail system would include pedestrian and bicycle facilities consistent with the adopted policies of the local jurisdictions. Sound Transit facilities would be designed to provide ample space for pedestrian volumes and for maneuvering bicycles in and through stations and onto vehicles. A mix of storage lockers and locking racks at stations would allow users of the system to safely store their bicycles. The initial operating plan assumes that bicycles would be accommodated on light rail vehicles at all times. The proposed storage facilities for each station are described in Appendix H. Sound Transit would coordinate with other transit agencies to provide riders with an understandable and effective system for bicycle transport.

2.1.3.7 Environmental Commitments

Sound Transit is committed to satisfying all applicable federal, state, and local environmental regulations, and to apply reasonable mitigation measures to reduce significant adverse effects. The EIS identifies measures to mitigate the significant impacts of the project alternatives. Mitigation measures committed as part of the project are identified along with other potential measures that would reduce or eliminate impacts. In addition, The Preferred Alternative Mitigation Plan (Appendix O) provides a more detailed description of committed mitigation measures incorporated into the design of the preferred alternative, along with a listing of the additional mitigation commitments Sound Transit will make. During the preparation of the Final EIS, and preliminary engineering and final design, Sound Transit is engaging in the following activities to facilitate the development and resolution of mitigation measures for the Central Link project:

- Ongoing community relations program – Involve community in design development to ensure that the chosen design avoids or minimizes community impacts.
- Partnerships with agencies and local jurisdictions – Continue regular meetings with agencies and partner jurisdictions to involve them in the development of project design and mitigation measures.
- Design development – Ensure compliance with adopted design criteria to avoid or minimize impacts.

- Commitment to best practice construction methods.

The National Environmental Policy Act (NEPA) and the State Environmental Policy Act (SEPA) require that the EIS describe reasonable mitigation measures addressing project impacts for the decision-makers to consider. Where the current level of design, information, and coordination allow it, the EIS identifies mitigation commitments. Where additional design, information, and/or coordination are required, the EIS identifies potential mitigation measures to be considered by decision-makers. Mitigation commitments will be refined through final design and permitting. The Record of Decision (ROD) (expected in late 1999) will include a list of committed mitigation measures for the preferred alternative. Mitigation measures can range from specific design items like noise walls to plans or programs to develop the mitigation details (e.g. parking mitigation monitoring). Mitigation commitments may also include performance standards that commit to meeting certain measurable criteria (such as a maximum vibration level) but do not yet commit to the precise means through which that standard will be met. This approach allows the on-going design work and community and agency consultation and coordination work to better define the precise approach to mitigating impacts. Sound Transit is working with the agencies of jurisdiction and other interested parties to determine appropriate mitigation commitments. These commitments may be documented through a Memorandum of Understanding, as conditions for required permits, or through some other mechanism.

2.1.3.8 Projected Light Rail Ridership

Projected ridership for the light rail line, a factor that determines many system design decisions, is very high. The system would connect some of the region's largest employment centers, including downtown Seattle and the University District. Depending on the route, it would serve Capitol Hill/First Hill, the south downtown industrial area, or Seattle Center, and other major employment centers. Light rail would also serve many major institutions, dense residential neighborhoods, and regional destinations such as Sea-Tac Airport. The ridership forecast for the preferred alternative is approximately 110,000 weekday riders in the year 2010, and 133,000 for the year 2020, based on the assumed route, station locations, and operating plan shown in Appendix M.2. Projected daily boardings by MOS, segment, and station appear in Table 3.2-8 through 3.2-13 in the Transportation Impacts and Mitigation section.

2.1.3.9 Capital Equipment and Operations

Substations, ventilation, and communications

The light rail system would be electrically powered using an overhead catenary (contact wire). The power to the catenary is fed from electrical traction-power substations, typically one-story buildings about 650 ft^2 in size. Substations would be incorporated within the elevated or tunnel stations or located at-grade within or adjacent to the right-of-way. The substations would be built a minimum of one and a half miles apart, although some operational scenarios could require fewer substations. The power supply would be provided by overhead lines along the tracks, except in tunnel sections where the power supply would attach to the ceiling. Above ground vent shaft structures are required along all tunnel sections as described for the Segment A, B, and C tunnel routes. Light rail systems also require signal and communications buildings of about 160 ft^2 located at each station.

Light rail vehicles and operations

Light rail would provide frequent, convenient, and reliable service, running 18 to 20 hours daily. The light rail fleet would include 64 to 76 vehicles for light rail operations in 2010 and 83 to 106 vehicles by 2020, depending on which alternatives are selected. If the system is extended to Northgate, an additional 21 vehicles would be required. Cars are typically 70 to 95 ft long by 8 to 9 ft wide, and are able to seat from 60 to 80 riders while accommodating 200 or more at peak periods. Conventional low-floor light rail vehicles would likely be used to provide level boarding for all passengers, and would be easily accessible by people with disabilities. Trains would operate with four cars during peak periods and fewer cars during off-peak times.

The EIS describes the two operating plans that were assumed for the evaluation of alternatives. Operating plan A would have peak period trains operating every four minutes north of the International District Station, and every eight minutes to the south; mid-day, evening and early-late service levels would be less frequent, ranging from 8 to 15 minutes. Operating plan B would have peak period trains every 5 minutes north of the Henderson Station, and every 10 minutes to the south, with lower frequencies at other times. Operating Plan B has been used for all 2020 forecasts and analysis, and is what Sound Transit expects to operate on opening day. See Appendix M.2 for more detail.

Light rail speed limits would range from the posted roadway speed limit (where operating in streets) to a maximum of 55 mph on exclusive right-of-way segments. With station stops, the light rail trains are expected to average 28 mph. Light rail operating speed would be determined by right-of-way characteristics, including grade, curves, and degree of separation from roadway traffic.

Light rail trains would stop in each station for about 20 seconds to load and unload passengers. In downtown Seattle stations, greater passenger activity would increase this "dwell" time to about 30 seconds. Bus transfer facilities would be provided at most light rail stations, and existing on-street transfer locations would continue in downtown Seattle. Transfers to Sounder commuter rail service are proposed at the International District Station and the Boeing Access Road Station under the preferred alternative, or the Longacres/I-405 Station in Tukwila for alternative routes. Transfers to Amtrak could occur at the International District Station or possibly the Longacres/I-405 Station in Tukwila (depending on the route in Segment E).

Downtown Seattle Transit Tunnel (DSTT)

The light rail route alternatives assume light rail vehicles would use the existing DSTT, and the preferred alternative proposes light rail-only use of the tunnel. Currently, about 145 buses per hour use the tunnel during peak commuting times. The tunnel, which opened to bus traffic in 1990, was built to accommodate light rail operations. However, recent studies show the rail bed in existing stations would need to be lowered by six inches to fit with the newest technology, low-floor light rail vehicles. Other potential modifications include trackwork changes, emergency ventilation changes, and changes to access at Westlake Station. In addition, the route extension from Westlake Station to First Hill or Seattle Center would require reconstruction of the existing tracks east of Westlake Station. Conversion of the existing DSTT for rail operations would require the closure of the tunnel to all operations, beginning sometime mid-2004 to early 2006.

Sound Transit, King County Metro, Community Transit, and the City of Seattle have been working together since early 1998 to develop alternatives to address increased bus traffic on surface streets when the tunnel is closed for construction in mid to late 2004 and for continued long-term light rail operations. Alternatives have generally focused on providing adequate street space and traffic control to allow buses to maintain travel times and reliability through downtown, and on providing adequate sidewalk space to accommodate increased numbers of waiting bus passengers. These alternatives are being developed to minimize negative impacts on other street and sidewalk users and on adjacent businesses. The alternatives emphasize strategies for changing bus routes or stops, adding street capacity, and providing priority to transit movements. Some or all of the improvements could remain in place during operation of light rail. The Downtown Seattle Surface Report (Sound Transit April 1999) discusses the operating alternatives and their potential effects in more detail, with results summarized in Section 3.2.

The surface streets considered for these strategies include Second, Third, and Fourth avenues in central downtown; Fourth and Fifth avenues in south downtown; and Olive Way, Pike Street, and Virginia Street in north downtown.

2.1.3.10 Project construction

To construct trackway, structures, park-and-ride, and related facilities, the Link light rail project will be divided into line sections. To ensure consistency, several system-wide contracts would be used for work involving power, signals and communications, and fare-collection equipment. During the project's final design phase, the construction plan would be further refined, including definitions of the various construction phases and construction contracts, their schedule, duration, and sequencing. The construction impacts discussion (Section 4.17) provides more detail.

Light rail construction activity sequences would vary depending on the location and existing conditions. In areas where a paved trackway is constructed within an existing right-of-way, grading activity could be minimized, but extensive reconstruction of streets and sidewalks is likely to occur. Sound Transit will take steps to minimize disruption during construction and to maintain access to adjacent properties to the greatest extent possible. Overall project phasing is summarized in Section 2.2.5. Construction assumptions are further described in Section 4.17.

2.1.3.11 Budget and Funding

The total approved capital budget of $1.736 billion (in 1995 dollars) for the light rail line was based on cost estimates to build the line from the University District to SeaTac, and to conduct preliminary and final engineering and environmental analysis from the University District to Northgate. Approved by voters in November 1996, the funding plan includes four-tenths of one percent local sales tax, three-tenths of one percent motor vehicle licensing fee, and federal funds. The long-range *Sound Move* plan identifies the University District to Northgate line as the first priority for extension. The preferred alternative extends from the University District to SeaTac, consistent with the *Sound Move* plan. If additional federal or other funds become secured, the initial light rail system could be built to Northgate. Additional detail regarding project costs, revenue, and funding is provided in Chapter 5 Financial Analysis.

Sound Move also includes funding for light rail operations within the plan's 10-year timeframe. After the 10-year implementation period, local taxing authority would remain in place at sufficient levels to fully fund light rail operations and cover long-term bonding obligations.

2.2 EVALUATION AND SELECTION PROCESS

The Link light rail alternatives evaluated in this EIS result from nearly two decades of federal, state, and regional legislation, planning, and community participation. This planning process considered a wide range of potential land use and transportation options, including numerous high-capacity transit corridors, technologies, and operating strategies. To determine which options best serve the needs of the region, screening and evaluation has taken place at several levels. This section provides a brief history of the different evaluation processes and major milestones leading up to the alternatives presented in this EIS.

The outcome of the planning process described below was the adoption of a preferred transportation strategy and incorporation of that strategy into the region's Metropolitan Transportation Plan (MTP). That preferred strategy includes decisions on mode choice (in this case, light rail) and on the general corridors and alignments to be evaluated further in this environmental impact statement. The alternatives in this EIS are consistent with the Major Investment Study (MIS) completed and approved on the *Sound Move* plan in 1997; the 1996 *Sound Move* Plan; the 1995 Metropolitan Transportation Plan (MTP) and subsequent updates; and the 1993 Regional Transit System Plan Environmental Impact Statement. Additional details about the planning process can be found in the MIS and documentation incorporated therein.

2.2.1 Early Planning Studies

The first rail transit system proposed for Seattle, in recent history, was part of the Forward Thrust Public Transportation Plan. That plan consisted of a combined bus/rail plan with 47 miles of heavy rail rapid transit and 32 stations. The plan was placed before the voters in 1968 and again in 1970 and failed to receive the necessary 60 percent approval for the associated property tax levy. After this, rail planning was largely suspended until the early 1980s. A more extensive examination of rail alternatives began with the 1981 Light Rail Feasibility Study for the Puget Sound Council of Governments. The study concluded that regional rail transit was feasible and warranted detailed assessment. From 1982 to 1990, rail and busway analyses for the central corridor included The North Corridor Alternatives Analysis (NCAA), the Downtown Seattle Transit Project, the Multi-Corridor Project, the Metro 2000 High Capacity Transit Study, and the Regional Transit Project.

During the North Corridor Alternatives Analysis (1982-84), a wide variety of Transportation Systems Management (TSM) and light rail alternatives were considered for a major transit investment in the North Corridor as far north as Lynnwood. The North Corridor Alternatives Analysis looked at light rail routes on or in I-5, Aurora Avenue, 15th Avenue N.E., East Capitol Hill, Lake City Way, the Burke-Gilman Trail, and the Burlington Northern Santa Fe railroad right-of-way. It recommended continuing study of Aurora Avenue and I-5.

At the same time, Metro completed an alternative analysis for the downtown Seattle Transit Project. Following this study, the Metro Council (Municipality of Metropolitan Seattle) selected the Third Avenue/Pine Street bus tunnel as the preferred alternative; Metro completed construction of a tunnel with five stations in 1990. The project included direct access from the tunnel to freeways via new ramps or busways, and the capability to convert the tunnel and stations to electric light rail operation in the future.

The Multi-Corridor Project (1984-86) studied three routes including new routes to the south and east. It introduced several route options between downtown Seattle and SeaTac. Alternatives from downtown Seattle to the south were Tukwila via Duwamish; SeaTac via Duwamish; Burien via Duwamish; Burien via SR 509; Burien via West Seattle; Duwamish via Rainier Valley; and Renton via Rainier Valley. For the north, the study recommended dropping the Aurora route and continuing to study I-5 and Broadway routes to Northgate via the University District.

The Metro 2000 High Capacity Transit Study (1990-91) began with a re-screening of all previous routes for both busways and light rail lines in the central corridor. After analysis, I-5 and the First Hill/Capitol Hill tunnel were recommended for further study in the northern segments, SeaTac via the Rainier Valley and/or Duwamish were identified for the southern segments, and I-90 was recommended for study to the east.

2.2.2 Transportation and Rail Technology Alternatives

Land Use and Transportation Alternative Milestones

In 1990 the Puget Sound Regional Council (PSRC) adopted the Vision 2020 Growth and Transportation Strategy for the Central Puget Sound Region. Vision 2020 was adopted after the PSRC had reviewed six alternatives strategies for managing growth, ranging from a "dispersed growth" alternative that was served by an expanded roadway network to "major centers" alternative that was served by an expanded regional transit system. The preferred alternative adopted by the PSRC was a hybrid of a major/multiple centers and emphasized transit over highways. With the approval of this alternative, the construction of major new highways as a strategy for responding to additional growth was effectively screened from further consideration. The process to reach this decision included broad participation by local governments, the region's policy makers, and the public, as well as preparation of an EIS.

The Regional Transit Project (1991-94), analyzed in detail the impacts of various system alternatives, including Transportation System Management (TSM), Transitway/TSM, and "Rapid

Rail"/TSM. The rapid rail system evaluated included a largely grade-separated right-of-way with overhead catenary for power supply. "Surface Light Rail" was also evaluated as a viable alternative that could reduce costs while maintaining the level of service.

The TSM alternative included added bus service, operational changes, and modest infrastructure investments to improve mobility. The Transitway/TSM alternative included the TSM improvements as well as major investment in bus-only and bus-carpool lanes radiating from downtown Seattle to other parts of the region, including Northgate, Bellevue and Tukwila. At the ends of the transitway, buses would continue on freeway HOV lanes. The Rail/TSM Alternative proposed an extensive electric rail system running north, south, and east of downtown Seattle. To the north, rail would run between downtown Seattle, Capitol Hill, the University District, Northgate, Lynnwood, and Everett. To the south, rail would link downtown Seattle, Rainier Valley or the Duwamish Industrial Area, SeaTac, Federal Way, and Tacoma. It also included electric rail service across Lake Washington to Bellevue, Redmond, and Issaquah. Another rail line would directly link Paine Field, Bothell, Kirkland, Bellevue, Renton, and Burien. In addition, this alternative included 40 miles of commuter rail line linking Seattle and Tacoma.

The Municipality of Metropolitan Seattle (Metro), Pierce Transit, Community Transit, Everett Transit, SNO-TRAN, and the Washington State Department of Transportation (together, the Joint Regional Policy Committee or JRPC) jointly issued the Regional Transit System Plan and Final Environmental Impact Statement in March 1993, in compliance with the State Environmental Policy Act. The Final EIS evaluated the No-build, TSM, Transitway/TSM, and Rail/TSM alternatives and determined the benefits and impacts of different systems. The public involvement program for the Regional Transit System Plan included three series of public forums, numerous meetings with community and business groups, discussions with special interest groups, a specially formed citizens group, as well as public hearings on the EIS. Public involvement continued through the development of the Final EIS and final decision-making.

After considering cost and ridership projections, environmental analysis, and public comment on the alternatives, the JRPC adopted the Regional Transit System Plan in May 1993. The Rail/TSM alternative ($13.2 billion in $1993) was selected because it demonstrated the greatest: 1) mobility – the transit capacity it added would meet the high end of projected demand; 2) environmental benefits – it reduced air pollutant emissions and energy consumption; and 3) land use plan support – it fully supported regional plans to concentrate new growth in existing activity centers, limiting urban sprawl and open space consumption.

In November 1993, Metro prepared the Central Corridor Project Justification Report, which described the rationale for selecting the central corridor as the first potential federally funded rapid rail segment, and provided justification for initiating preliminary engineering and environmental analysis. The selection of the corridor was based on: 1) the highest current and potential transit ridership in the region; 2) the most severe congestion and capacity limitations in the region; 3) the greatest impact on relieving downtown Seattle's bus constraints while optimizing use of the investment in the downtown bus tunnel; 4) the highest concentration of transit dependent, low income and minority populations in the region; 5) the flexibility to be extended to the north, south and east to support the future system; 6) the highest support for the regional growth management plan by serving the region's top three transit trip generators (downtown Seattle, University District and Capitol Hill/First Hill); and 7) stand-alone capability, including access to a rail vehicle storage and maintenance site and a northerly terminus for train storage and turnaround.

The Central Puget Sound Regional Transit Authority (RTA) was formed in 1994, with a Board consisting of local elected officials. After evaluating the JRPC-recommended system plan, RTA concluded that voters would not likely support a request to fund the full system plan at that time. Accordingly, the RTA forwarded a scaled-down version of the JRPC recommendation (referred to as Phase I) to the ballot for voter approval. The $6.7 billion ($1993) plan included 68 miles of light rail connecting Lynnwood to Tacoma and across I-90 to Bellevue and Redmond; 81 miles of commuter rail linking Everett, Mukilteo, Edmonds, Seattle, Tukwila, Kent, Auburn, Sumner, Puyallup, Tacoma, and Lakewood; and new regional bus services. Within the central corridor, the plan described a fully grade-separated University District/Capitol Hill segment and grade separation (at-grade and elevated) in the Rainier Valley only as far south as Othello Street, with a generally at-grade line from Othello Street to SeaTac. In March 1995, regional voters turned down this initial phase proposal.

Concurrent with the development of the initial phase proposal, the PSRC was developing the regional Metropolitan Transportation Plan (MTP) required by the Intermodal Surface Transportation Efficiency Act (ISTEA). The 1995 MTP included the mode choices (light rail, commuter rail, and express bus) and alignments from the RTA's failed 1995 plan, acknowledging that the plan needed to be reconfigured and resubmitted to the voters. To help craft a new proposal following the failed vote, the Regional Transit Authority enlisted an advisory panel of civic leaders to provide overall guidance, with review and input by subregional groups of elected officials. To engage citizens, the agency held subarea forums, community and business meetings, and roundtable sessions; the agency also used the media to communicate and develop the public plan. Between March 1995 and November 1996, the RTA participated in over 400 meetings with community and special interest groups to discuss regional transit planning. The revised transit package was tailored to reflect subarea interests, and to lower-investment, shorter timeframe subarea budgets. The resulting $3.9 billion ($1995), ten-year package is reflected in the *Sound Move* plan adopted by the RTA in May 1996. *Sound Move* includes 25-miles of an electric light rail starter system and 26 stations near major destinations, with connections to local bus service. The route was designed to connect Northgate, Roosevelt, the University District, Capitol Hill, First Hill, downtown Seattle, the Rainier Valley area, and SeaTac (terminating at S. 200th Street). The PSRC reviewed the plan and found it to be consistent with the 1995 MTP, noting that it should be incorporated into the MTP following a successful vote on local financing for the plan. In November 1996, 56 percent of the voters in the three-county Sound Transit District and 70 percent of voters in the city of Seattle approved financing for the plan. The EIS provides project-level environmental review for the electric light rail system approved in the *Sound Move* plan.

In May 1997, RTA completed a Major Investment Study (MIS) for the *Sound Move* plan, as required by ISTEA. The MIS reviewed the prior planning and community involvement efforts leading to the preferred transportation strategy set out in the MIS. That strategy describes the central corridor light rail alternatives as follows:

- Downtown Seattle to Boeing Access Road: South from the DSTT, east along I-90 to Rainier Avenue S., south through Columbia City and along MLK Jr. Way, turning west at Boeing Access Road and crossing over I-5.
- Downtown Seattle to the University District: From the DSTT under Capitol Hill/First Hill and the ship canal to the University District.
- University District to Northgate: This section would be built if funding were secured.
- Boeing Access Road to SeaTac: Two primary alternatives were to be analyzed further, the SR 99 route and another along Interurban Avenue S.

According to specific measurements proposed by FTA, the MIS concluded that *Sound Move* would improve mobility, result in environmental benefits and transit operating efficiencies, support land use and transportation plans, and take advantage of existing institutions and capabilities.

In April 1997, the PSRC approved the MIS, concluding that it satisfies applicable federal and state requirements. The PSRC concluded that the MIS "clearly documents how the RTA identified and evaluated a range of alternatives together with a chronology of decisions leading to the preferred alternative." Among other things, the preferred alternative includes the light rail transit mode in the Central corridor along the routes described above. With the approval of the MIS, the proposal was cleared to proceed into project-level environmental review.

2.2.2.2 Rail Technology Alternatives

Studies completed in the early 1990s (Gannet-DeLeuw 1990, Parsons Brinckerhoff/Kaiser 1991j and k) as part of the JRPC's recommendations on the draft System Plan took a comprehensive look at potential rapid transit technologies. Technologies examined included light rail, heavy rail, automated guideway transit/people mover, and monorail. Alternative technologies, such as Maglev and Terrafoil, were also examined. The technologies were evaluated for their ability to meet general performance requirements for the corridor as well as needs specific to the system, such as compatibility with the DSTT, Ship Canal crossing, at-grade crossings, and elevated structures. These studies concluded that conventional-tracked rail (light or heavy) would be most practical to implement in this area. This conclusion was largely because this technology has wide use and has stood the test of time in crucial issues such as switching, crossing lines, and carrying large passenger loads between urban stations. Also, some of the facilities that would be used for the long-range system, including the downtown tunnel and the I-90 floating bridge, were specifically designed to accommodate a conventional-tracked rail system. Other technologies would be more difficult or impossible to accommodate on these facilities.

Light rail was considered the easiest rail technology to implement over the range of conditions that would be encountered in the system. Heavy rail (such as San Francisco's BART, with electrified third rail) was originally eliminated from full consideration because it was thought to have too large a capacity for use on the system. However, heavy rail was reevaluated in 1991 and recommended for continued study. The major constraints of heavy rail were considered to be the use of high level platforms and third rail power pickup (although overhead catenary can be used). The RTA ultimately screened heavy rail from further consideration in 1994 when it moved from the $13.2 billion JRPC plan to its own $6.7 billion plan (see discussion in Section 2.2.2.1 above). One of the reasons for this choice was the need (from a cost-effectiveness perspective) to run the system at-grade within street rights-of-way in the less dense sections of the system as it moved away from the Seattle urban center. Light rail was more cost-effective than heavy rail when evaluated on a system-wide basis.

2.2.3 EIS Scoping and Development of Alternatives

In August 1997, the Regional Transit Authority Board adopted Sound Transit as its popular name. It chose the names "Link" for light rail services, "Sounder" for commuter rail, and "Regional Express" for regional bus services. With the MIS complete and the overall system plan approved, Sound Transit began to refine light rail route alternatives. The central corridor was divided into six segments to facilitate environmental analysis and community participation: (A) Northgate to University District, (B) University District to Westlake Station, (C) Westlake Station to S. McClellan Street, (D) S. McClellan Street to Boeing Access Road, (E) Tukwila, and (F) SeaTac.

Determination of Significance and Scoping Notice

A formal scoping process was initiated in November 1997 when the Federal Transit Administration (FTA) issued notice of its intent to publish an Environmental Impact Statement (EIS) for the central corridor. Concurrently, Sound Transit issued a determination of significance and scoping notice for the preparation of an EIS under state environmental laws. FTA and Sound Transit agreed to combine their reviews into a single EIS.

The EIS scoping notice described a two-phased process. First, an initial set of alternatives would be described, analyzed, and evaluated; second, a smaller set of the "most promising" alternatives would be identified and studied further in a EIS.

Scoping Information Report

The Scoping Information Report detailed the alternatives and environmental issues being considered for evaluation in the central corridor EIS.

From November 1997 to February 1998, Sound Transit distributed the Scoping Information Report to approximately 4,500 households, held seven public open houses, and collected over 400 written comments on the environmental analysis and alternatives proposed.

Scoping Summary Report

In March 1998, comments were described in a Scoping Summary Report. Approximately 25 percent of the comments related to route and station alternatives. For the potential Northgate to the University District segment, many comments focused on the route and profile options from the I-5 corridor to Roosevelt. Most of the remaining comments involved impacts of a Capitol Hill tunnel, route choices south of downtown, routes serving Southcenter, the route choice, and location of stations in SeaTac.

Evaluation Criteria for the Most Promising Alternatives

Sound Transit applied two levels of evaluation criteria for screening alternatives. Level One criteria were intended to establish the project as the first phase of a future regional public transit artery providing high speed, high-capacity service, connecting major origins and destinations, and operating in exclusive rights-of-way. The criteria were: minimization of travel time, maximization of ridership potential, exclusive right-of-way, station spacing to serve regional markets, minimization of grade changes, and vehicle designs to accommodate regional ridership. Level Two criteria demonstrate the advantages and disadvantages of the alternatives in each segment and highlight the differences among them. These criteria included community compatibility, cost, impacts to the natural and built environment, political and community acceptance, ridership, and transportation impacts. Since each segment has unique characteristics, different Level Two criteria were important in different segments to identify the most promising alternatives for continued study. The Level Two criteria were applied to screen alternatives for inclusion in the Draft EIS. The Sound Transit Board Briefing Book, prepared for the May 14, 1998 meeting, identified for each route alternative relevant information from the criteria that contributed to the screening decision. An example includes alternative routes E2.1, E2.2, and E2.3, which were not recommended for further study because of impacts on Fort Dent Park and a lack of community support.

Public Outreach to Define Route Alternatives

Between February and June 1998, Sound Transit solicited input from citizens, organizations, and agencies to help define the route alternatives. Under the campaign theme "From Here to Alternatives," Sound Transit distributed material describing the route options to approximately 8,000 households along the corridor. To allow community leaders to experience rapid transit systems, Sound Transit sponsored ten field trips to Portland, Oregon and Vancouver, B.C. Eleven community workshops and several walking tours of the proposed routes were sponsored by Sound Transit to engage citizens in exploring the route options and evaluation criteria. Representatives from local jurisdictions assisted Sound Transit in refining the route alternatives. The City of SeaTac, Port of Seattle, City of Tukwila, City of Seattle, and King County Metro were involved through special briefing sessions, council presentations, and ongoing coordination meetings.

The outreach process identified several new route alternatives, such as an alignment one-half block west of Rainier Avenue S.; a tunnel under S. McClellan and S. Massachusetts Street (C3) on Beacon Hill; the 37th Avenue S. tunnel; the MLK Jr. Way S. alternative (F3) in Tukwila; and several route variations in SeaTac.

Two formal public hearings served as the final events in the process. The Board Briefing Book of Central Link Light Rail Alternatives summarized findings from these outreach efforts and staff presented these findings to the Sound Transit Board on May 8, 1998.

On May 14, 1998, the Sound Transit Board approved the route and station location alternatives for study in the EIS. The Sound Transit Board, on June 25, 1998, confirmed that the 37th Avenue

Tunnel should be studied as a tunnel alternative for Columbia City and added the S. Massachusetts Tunnel alternative in Segment C.

2.2.4 Draft EIS and Identification of Preferred Alternative

The Final EIS follows the completion of seven previous required steps in Sound Transit's and FTA's decision-making process. These steps include system planning (1993 and revisited in 1995-1996), corridor selection (1993), preliminary alternatives analysis (1994-1995), Major Investment Study (1997), scoping (1997-1998), preparation of the Draft EIS (1998), and identification of Sound Transit's preferred alternative (1999). The remaining Sound Transit decision to define the project will be the final selection of route and station locations, following the completion of environmental review.

The Draft EIS was issued on December 4, 1998. The draft included 24 route alternatives under consideration within the six geographic segments of the corridor. The Draft EIS evaluated 61 alternative station locations and three alternative maintenance facility sites. The primary objectives of the Draft EIS were to: 1) illuminate the differences among alternatives, 2) disclose the significant environmental impacts associated with the range of reasonable alternatives, and 3) identify ways to mitigate significant impacts. The Draft EIS disclosed information on both the adverse and beneficial impacts associated with the proposed alternatives on a segment-by-segment basis for each element of the environment. By disclosing the environmental impacts of various alternatives, the Draft EIS helped decision-makers make informed choices in identifying a preferred alternative from among the alternatives.

Draft EIS Public Review and Comment Process

Sound Transit and FTA widely circulated the Draft EIS to affected local jurisdictions; regional, state, and federal agencies; community organizations; environmental and other interest groups; and interested individuals. Over 1,500 Draft EISs were distributed. Sound Transit and FTA jointly held public hearings on the Draft EIS on January 13th 1999 at the Tukwila Community Center, January 14th at the SeaTac City Council Chambers, January 20th at the Lake Washington School District Board Room, January 26th at Kane Hall, University of Washington Campus, and January 28th at the Filipino Community Center. During the 60-day comment period (45 days is the minimum required under NEPA and 30 days minimum under SEPA) the public, agencies, and jurisdictions were provided the opportunity to comment on the Draft EIS to Sound Transit and the FTA. Sound Transit received more than 900 comment letters or public hearing testimonies. These comments, and Sound Transit's responses, are included in the Final EIS. In response to these comments, Sound Transit updated its analysis, made factual corrections, modified some alternatives, developed new alternatives, and made other appropriate project changes.

Identify a Preferred Alternative

The identification of a preferred alternative by the Sound Transit Board was a specific step in the project development process. The selection followed the public review and comment on the Draft EIS. Sound Transit's preferred alternative is called a "locally preferred alternative" by the FTA to make clear that the federal government has not made a decision until it issues a "Record of Decision" following the Final EIS. The preferred alternative is based on design and environmental information, goals and objectives, community comments, and technical data (such as ridership, integration with other transit systems, cost-effectiveness, and financial feasibility). The step identifies which route, station locations, and maintenance facility alternative will likely move forward into preliminary engineering (30 percent design). The Final EIS evaluates the preferred alternative with all of the alternatives considered in the Draft EIS, but also includes new or modified alternatives developed in response to public and agency comments, newly available design information, and additional technical study. Other technical reports have also been prepared in response to agency and public comments, providing additional information on specific project issues. The studies include the Downtown Seattle

Surface Report (April 1999), the Rainier Valley Technical Report (January 1999), and the Environmental Assessment of Maintenance Base options, N.E. 45th Station and the Capitol Hill Station options (August 1999). The Sound Transit Board identified a preferred alternative on February 25, 1999 (Motion M99-14).

2.2.5 Final EIS and Next Steps

Following completion of the Final EIS, the Sound Transit Board will adopt the final route alternatives, station locations, and maintenance sites to be built. Under NEPA, that decision does not become final until the federal government certifies the Record of Decision (ROD) on the Final EIS.

Obtain federal project approval or Record of Decision

The ROD by the FTA is anticipated by fall/winter of 1999. The ROD certifies the adequacy of the project's environmental review process and itemizes Sound Transit's commitments to mitigate project impacts. Issuance of the ROD and completion of preliminary engineering is a prerequisite to the execution of a Full Funding Grant Agreement (FFGA) with the FTA.

Secure Federal Funding for Construction

The revenue stream approved by regional voters provides a committed source of local funding that assures implementation of the proposed light rail project and other components of the Sound Move plan. However, securing a reasonable share of federal funds would accelerate the implementation schedule and leverage the contribution of local taxpayers. Sound Transit must sign a Full Funding Grant Agreement with the FTA to be able to compete effectively for federal funds. The FFGA would be signed after completion of the ROD and is expected to be signed in the spring of 2000.

Benefits and Disadvantages of Delaying Project Implementation

As required by SEPA (WAC 197-11-440(5)(c)) this EIS discusses the benefits and disadvantages of reserving for some future time the implementation of the proposed project, as compared with possible approval at this time. The primary potential benefit of delaying implementation of the proposed light rail project would be to allow additional time to resolve currently unresolved issues. However, the Sound Transit and federal actions subsequent to the Final EIS provide the appropriate forum to address the unresolved issues (see Section S.14). It is therefore not necessary to delay implementation in order to resolve these issues. The EIS provides the necessary environmental information to support decisions related to the unresolved issues.

The primary disadvantages of delaying implementation include potential transportation and land use concerns and potential impacts to project funding.

As discussed in Section 4.1.2 of the EIS, the proposed light rail project is integral to the four-county Central Puget Sound region's Vision 2020 strategy and the Metropolitan Transportation Plan. These plans establish integrated, long-range growth management, economic, and transportation strategies. The strategies are based on a vision of urbanized centers linked by a regional rapid transit system. Link light rail and other elements of the Sound Move plan are integral elements to achieving the region's vision and are essential to implementing the plan and policies. A significant delay in implementing the light rail project would inhibit the ability of the region to accommodate growth as planned.

The potential funding implications associated with delaying project implementation are that Sound Transit could miss the opportunity to obtain federal funding under TEA-21, or receive a lower amount of federal funding. In addition, any delays in project construction will result in higher construction costs due to inflation. Significant delays would result in cost increases potentially as high as $100 million per year of delay, or more.

2.2.6 Central Link Project Schedule

The schedule below summarizes the overall Central Link project development schedule.

Central Link Project Development Timeline

Date	Action
November 1996	Central Puget Sound voters approve financing for *Sound Move*
1996—1997	Sound Transit mobilizes
May 1997	MIS for *Sound Move* completed and approved
November 1997—February 1998	Scoping for Draft EIS
February—May 1998	Screening route alternatives for further study
December 1998	Publish Draft EIS
January 1999	Hold public hearings on Draft EIS
February 1999	Sound Transit Board identifies preferred route and station locations for Final EIS
August 1999	Publish Draft EA
Summer/Fall 1999	Produce and publish Final EIS
Fall 1999	Sound Transit Board adopts final route and station locations
Fall/Winter 1999	Obtain federal approval, known as Record of Decision
Spring 2000	Secure full funding grant agreement with FTA, begin final design
Spring 2000 – Fall 2001	Final design
Late 2000/Early2001	Begin construction
2005–2006	Purchase and test Link vehicles and systems
2006	Begin Link operations

CHAPTER 3
TRANSPORTATION

3. Transportation Impacts and Mitigation

This chapter summarizes transportation system characteristics in the study area, and discusses the impacts from the light rail alternatives on the transit system, traffic and parking, property access, truck circulation, rail, and navigable waterways. The Transportation Technical Report discusses these issues in more detail.

3.1 REGIONAL TRAVEL

3.1.1 Affected Environment

3.1.1.1 Travel Patterns

Since 1980, the region's travel demand has increased substantially, and travel patterns have become more dispersed and complex. The Metropolitan Transportation Plan (PSRC May 1995) and the Six-Year Action Strategy (PSRC January 1999) document travel trends in the Puget Sound area. They predict that with no significant improvements in regional transportation systems, there would be:

- More congested roads – P.M. peak period delay would increase from 150,000 hours to 660,000 hours per day in 2020
- Slower travel speeds – Average P.M. peak period travel speeds would decrease from 26 mph in 1990 to 18 mph in the year 2020
- Continued reliance on auto travel – Although total transit trips are projected to increase, transit's share of all trips could actually decline from 4.0 percent in 1990 to 3.9 in 2020. This is offset to some degree by an increase in carpools from 28.3 percent in 1990 to 31.2 percent in 2020.

As part of the Six-Year Action Strategy, PSRC modeled traffic delays. Over 326,100 hours of delay would affect drivers in the year 2010 if current trends continue. This represents a 239 percent increase over the 1995 base condition. Table 3.1-1 summarizes regional travel statistics.

Table 3.1-1
Regional Travel Performance Trends

Performance Indicator	1995 Base Year	2010 Trend	Percent Change
Daily vehicle miles traveled (VMT)	68,000,000	88,500,000	+30
VMT during P.M. peak period	15,800,000	32,600,000	+206
Average P.M. peak period speed (mph)	28.2	22.8	-19
P.M. peak period hours of delay	96,100	326,100	+239

Source: PSRC Six-Year Action Strategy (PSRC January 1999)

Between 1995 and 2010, PSRC forecasts a slight shift from single-occupant vehicles (SOVs) to carpools and transit (Table 3.1-2). This forecast is based on a transportation system with few additional capacity improvements and no new major investment in transit. Work trips would account for much of the shift from SOV to carpools and transit.

The I-5 corridor, between north Seattle and south King County, has the highest demand for travel of any regional corridor. Population and employment forecasts suggests it will continue to be the region's highest travel demand corridor.

Table 3.1-2
Mode Choice for Average Daily Person Trips

Trip Type & Mode	1995 Base Number of Trips	1995 Base Share %	2010 Trend Number of Trips	2010 Trend Share %
Work				
Transit	163,756	7.8	266,502	9.4
SOV	1,508,534	71.9	1,895,973	67.2
Carpool	425,813	20.3	658,886	23.4
Total Work Trips	2,098,103	100	2,821,261	100
Non-work				
Transit	119,087	1.6	231,860	2.2
SOV	4,464,347	59.7	6,048,515	58.4
Carpool	2,896,594	38.7	4,078,962	39.4
Total Non-work Trips	7,480,028	100	10,359,337	100
All Trips				
Transit	282,843	3.0	498,362	3.8
SOV	5,972,881	62.4	7,944,388	60.3
Carpool	3,322,407	34.6	4,737,848	35.9
Total All Trips	**9,578,131**	**100**	**13,180,598**	**100**

Source: PSRC Six-Year Action Strategy, (PSRC January 1999)

3.1.1.2 Regional Highways

Approximately 15,000 miles of roadways serve the central Puget Sound region. The interstate and state highway system, representing only 7 percent of the road network, accounts for nearly one-half of the region's vehicle miles traveled (VMT). Major roadway facilities that serve at least a portion of the corridor include I-5, SR 99, SR 520, I-90, I-405, SR 509, and SR 518.

The primary performance measure for critical highway segments is the vehicle volume-to-capacity ratio (v/c), or the ratio of demand flow rate to capacity. The Congestion Management System Baseline System Performance Report (PSRC 1998) provides current v/c data on regional conditions. Currently, capacity deficiencies are identified where a v/c of 0.9 is exceeded. On such facilities, drivers would see unstable traffic flows, limited vehicle maneuverability, and disruptions caused by any traffic stream shifts, such as vehicles entering from ramps or changing lanes.

In the Seattle vicinity, I-5 the major north-south freeway for the western United States, is primarily ten (eight general purpose and two HOV) lanes. Average daily traffic volumes range from 129,000 to 252,000. Peak hour v/c ratios for critical segments along I-5 may range from 0.66 to 1.05. In the A.M. and P.M. peak periods, traffic congestion occurs regularly into downtown Seattle. I-5 is generally congested in the southbound direction during the afternoon peak hour, particularly on the Southcenter Hill and near the I-5/I-405/SR 518 interchange (see Table 3.1-3).

SR 99 (also known as International Boulevard) is a north-south highway that serves as a major arterial south of the West Seattle Bridge and north of the Aurora Bridge. Between the West Seattle Bridge and the Aurora Bridge, SR 99 is a six-lane limited-access highway with average daily volumes of 35,000 to 64,000. No major capacity deficiencies currently exist along SR 99.

SR 520, an east-west freeway, links I-5 in Seattle to east King County via the Evergreen Point Floating Bridge. In the Seattle area, SR 520 operates with four general-purpose lanes. Average daily traffic volumes range from 79,000 to 109,000.

I-90 is the major east-west freeway for the northern United States, extending from Boston, Massachusetts, to Seattle. In the Puget Sound region, I-90 carries eight lanes of traffic. Between I-5 and I-405, two of these are additional reversible HOV lanes in the median. Average Daily Traffic volumes currently range from 103,000 to 131,000. The I-90 segment from Rainier Avenue S. to I-405 has capacity deficiencies westbound during the A.M. peak hour.

I-405 is a north-south freeway supporting traffic on the east side of Lake Washington. It connects to I-5 in Tukwila. Currently capacity deficiencies occur in many segments of the freeway.

SR 509 is a four-lane north-south freeway from SR 99 to S. 188th Street. This segment of SR 509 currently does not experience v/c ratios above 0.9 on an average weekday.

SR 518 is a four-lane east-west freeway, which serves as an extension of I-405, connecting I-5 in Tukwila to Sea-Tac Airport and SR 509 in Burien. SR 518 does not currently experience v/c ratios above 0.9 on an average weekday.

Table 3.1-3
Existing Volume to Capacity (v/c) Ratios on Regional Highways

Freeway	Location	Peak Hour	Direction	v/c Ratio
I-5	South of I-405 (Southcenter Hill)	A.M.	NB	0.97
		P.M.	SB	0.93
I-5	South of downtown Seattle	A.M.	SB	1.05
		P.M.	SB	1.01
SR 99	South of downtown Seattle	A.M.	NB	0.84
		P.M.	SB	0.86
SR 520	Montlake Blvd.	A.M.	EB	0.83
		A.M.	WB	1.00
		P.M.	EB	0.81
		P.M.	WB	0.98

Note: Capacity deficiencies are identified when volume to capacity is higher than 0.90.

3.1.2 Impacts and Mitigation

3.1.2.1 Regional Travel Impacts

This section discusses the effects the project alternatives would have on regional travel. Regional travel factors analyzed include VMT, and vehicle hours traveled (VHT). Table 3.1-4 compares 2010 and 2020 No-build and Build conditions (Northgate terminus and N.E. 45th Street terminus) for these performance measures for the A.M. peak period, P.M. peak period, non-peak periods, and the daily total. In both 2010 and 2020, light rail alternatives with a Northgate terminus or a N.E. 45th Street terminus would result in improved conditions, compared to the No-build Alternative. VMT and VHT are lower with the Northgate terminus than with the N.E. 45th Street terminus, and both are less than the No-build Alternative.

3.1.2.2 Regional Travel Corridors

For the years 2010 and 2020, project staff compared the general shifts in traffic flow that would occur under the No-build and light rail alternatives. Imaginary "screenlines" were drawn across one or more roadways to compare changes in traffic volumes and person-moving capacities in the study area. Table 3.1-5 compares year 2020 P.M. peak hour/peak direction No-build and light rail person-moving capacities (at I-5 corridor screenlines) by equivalent general-purpose lane capacity. The lane capacities shown for the No-build Alternative include projected general-purpose and HOV lane capacities on I-5. Person-moving capacities (equivalent lane capacities) at all I-5 screenline locations would nearly double with the light rail alternatives.

Table 3.1-4
Regional Travel Impact Comparison Summary 2010 and 2020 Conditions

Criteria	2010 Alternatives						2020 Alternatives					
	2010 No-build	MOS A N.E. 45th to McClellan	MOS B Capitol Hill to Henderson	MOS C N.E. 45th to Lander	Northgate Terminus	N.E. 45th St. Terminus	2020 No-build	MOS A N.E. 45th to McClellan	MOS B Capitol Hill to Henderson	MOS C N.E. 45th to Lander	Northgate Terminus	N.E. 45th Terminus
Vehicle Miles Traveled (VMT)												
A.M. Peak	12,076,236	12,053,230	12,056,770	12,057,654	12,044,382	12,046,151	12,831,050	12,791,087	12,795,576	12,796,016	12,780,544	12,783,350
Off Peak	40,265,384	40,188,676	40,200,478	40,203,428	40,159,173	40,165,074	43,055,852	42,921,752	42,936,816	42,938,293	42,886,375	42,895,790
P.M. Peak	15,897,998	15,867,711	15,872,371	15,873,536	15,856,063	15,858,393	16,996,434	16,943,497	16,949,444	16,950,027	16,929,532	16,933,249
Total Daily	68,239,618	68,109,618	68,129,618	68,134,618	68,059,618	68,069,618	72,883,336	72,656,336	72,681,836	72,684,336	72,596,451	72,612,389
Vehicle Hours Traveled (VHT)												
A.M. Peak	444,417	443,570	443,701	443,733	443,245	443,310	480,033	478,538	478,706	478,722	478,143	478,248
Off Peak	1,301,655	1,299,175	1,299,557	1,299,652	1,298,222	1,298,412	1,421,870	1,417,441	1,417,939	1,417,988	1,416,273	1,416,584
P.M. Peak	554,191	553,135	553,298	553,338	552,729	552,810	605,393	603,507	603,719	603,740	603,010	603,142
Total Daily	2,300,263	2,295,881	2,296,555	2,296,724	2,294,195	2,294,533	2,507,296	2,499,487	2,500,364	2,500,450	2,497,426	2,497,975

Source: Puget Sound Regional Travel Model and Sound Transit Ridership Model.

Table 3.1-5
Year 2020 P.M. Peak Hour/Peak Direction Screenline Equivalent Lane Capacity
No-build and Light Rail Alternative

Screenline	Equivalent Lane Capacity	
	No-build Alternative	**Build Alternative**
I-5 at Ship Canal Bridge	8 lanes	15.2 lanes
I-5 at S. Spokane Street	5.7 lanes	10.6 lanes
I-5 at S. 188th Street	5.5 lanes	10.9 lanes

The Transportation Technical Report provides further information on traffic volume changes across screenlines. In most cases, the traffic volumes across screenlines with light rail alternatives are within 1 percent of the No-build volumes. This small difference is generally within reliability levels of regional models. Therefore, based upon traffic forecasts, the light rail system will not result in a significant difference in regional traffic volumes, but it will provide needed additional travel capacity. Peak hour volumes for the No-build and light rail alternatives are also expected to be similar across all screenlines.

3.1.2.3 Significant Unavoidable Adverse Impacts

No significant adverse impacts to regional travel would occur.

3.2 TRANSIT

3.2.1 Affected Environment

Metro Transit, Community Transit, Pierce Transit, and Sound Transit provide public transit in the project area. The implementation of the light rail system would potentially affect the services of these transit providers. The Transportation Technical Report summarizes information on the bus routes and other services provided by these operators.

The one transit center in the project area is located just south of Northgate Mall. Fourteen routes currently serve this transit center. At nine major transfer points in the project area, transit riders can transfer to other routes in the system.

King County Metro serves all of King County with fixed route local and express services. It also provides demand response, ADA paratransit, vanpool, and ride-matching services. Most routes operate into the evenings and on weekends. Midday service frequency is typically 15 to 30 minutes in the denser portion of the urban area and 30 to 60 minutes in the more suburban areas. Peak hour service is more frequent. King County Metro is implementing a Six-Year Plan (1996-2001), that emphasizes a "multi-centered" system focused on a series of transit "hubs" where convenient connections can be made to multiple destinations.

Pierce Transit serves approximately 475 square miles in the urban areas of Pierce County. They also operate an express bus service between Lakewood, Tacoma and Seattle, and provide express connections to Gig Harbor and Olympia.

Community Transit serves Snohomish County's urban areas and major portions of the more rural areas. Commuter services to and from Snohomish County serve downtown Seattle and the University of Washington all day weekdays and Saturday.

Other transit facilities currently enhance transit service reliability:

- The Downtown Seattle Transit Tunnel (DSTT) allows buses to avoid surface street traffic congestion in downtown. The DSTT currently serves 145 buses (72 northbound, 73 southbound) during the P.M. peak hour
- The South E3 Busway is an exclusive busway that connects to the south end of the DSTT and extends south to Spokane Street. This busway allows King County Metro, Sound Transit, and Pierce Transit buses to bypass congestion on I-5 south of downtown Seattle
- The D-2 roadway is a shared-use facility for buses and HOVs connecting Fourth Avenue S., east of the Kingdome, with the I-90 center roadway
- HOV lanes on I-5, I-90, I-405 and SR 520 improve travel time and reliability for buses to and from major population and employment centers.

3.2.2 Transit Impacts and Mitigation

3.2.2.1 Regional Transit Service

The project's benefits and impacts on regional transit service are evaluated considering changes in:

- Hours of operation as a measure of the level of service
- Travel times for transit riders
- Transfers required
- Speed and service reliability
- Service coverage and structure
- Operations in the DSTT.

Generally, the project would cause beneficial regional changes in overall transit service operations. While the rate of transfers is anticipated to increase, the transit travel times, total amount of transit service offered, speeds and service reliability would improve.

Level of Service

Transit vehicle hours of operation are a key measure of system-wide service levels. For King County Metro, year 2010 annual bus operation hours are estimated to be about 3,769,000. In 2010, light rail hours are estimated at 86,000 for service to the N.E. 45th Street only, and 111,000 for service to Northgate. On the surface, the additional service hours seem modest: 2.3 to 3 percent of the estimated bus hours. However, each light rail hour provides much more capacity than a bus hour. Table 3.2-1 compares bus capacity with light rail capacity. Using a conservative overall comparative capacity factor, light rail service will represent a substantial increase in the region's public transportation service levels.

Service frequency is another level of service measure. Light rail service would be very frequent, with five-minute peak period headways from Henderson Station to the north and ten-minute peak headways for service to the south. Early morning and late night service would be every 10 to 20 minutes.

Light rail is planned to operate 20 hours per day, from 5 A.M. to 1 A.M. on weekdays and 7 A.M. to 1 A.M on weekends. This is equivalent to or better than service provided on the major bus routes. Further, some of the redeployable hours (existing bus services on routes duplicated by light rail) are likely to be used to extend service on some bus routes to match light rail operating periods more closely. While overall transit service levels will be much higher with light rail, some individual routes or route segments may have reduced frequency due to service restructuring.

Table 3.2-1
Comparative Capacity Per Service Hour

Vehicle	Seated Load	Total Load [1]	Comparative Capacity[2]
40-foot Bus	40	52	1.0
60-foot Bus	60	78	1.5
2-Car Train	144	266	5.1
3-Car Train	216	400	7.7
4-Car Train	288	533	10.2

[1] Bus total load equals 1.3 times seats. The light rail assumption is 72-seat cars. Portland operates at about a 1.8 load factor in peak periods. The light rail operational analysis assumes a 1.85 peak period load factor. The operating plan assumption for the Final EIS is three-car trains for service in 2010 and four-car trains for service in 2020.
[2] Comparative capacity indicates the relative passenger capacity (total load) for each vehicle divided by the total load for a 40 ft bus.

Transit Travel Times

Travel time is one of the most important factors in determining transit ridership. For some potential transit riders, especially riders who have other travel mode choices available to make a trip, the relationship between transit and auto travel time is probably as important as actual travel time. The number and ease of transfers is also very important. Travel time for transit riders includes walk or bicycle time to stop or station, wait time, transfer wait time, in-vehicle time, and walk time to final destination.

Research indicates that many riders perceive some out-of-vehicle travel time (e.g., wait time, transfers, walking to and from the bus stop) differently than in-vehicle time. Consequently, when estimating ridership, it is common to penalize or weight some or all of these out-of-vehicle times. The highest penalty is usually given to transfer wait time, usually in the range of 2 to 3 times the actual time.

Transit riders making trips where the origin and destination are both served directly by light rail would have the greatest travel time benefits: shorter waits, no transfer times, and high in-vehicle speeds. Table 3.2-2 shows average transit travel time comparisons for the area around one or more related stations using light rail, versus bus transit travel times for the No-build Alternative. The comparisons reflect the weighted average of all transit trips within each station analysis area in peak periods and include time in-vehicles, waiting, walking/driving, and boarding. In most cases, travel times on light rail are much less than by bus, ranging from 9 to 18 percent lower.

Transfers

In the light rail system, the transfer rate is estimated at 1.48 to 1.50, versus 1.44 for the No-build Alternative, and 1.32 when measured by other transit agencies in 1992. This data indicates system-wide transfers may be about 7 percent higher with light rail. However, background transfer rates have increased since 1992 under King County Metro's 6-year plan and are likely to increase further with Sounder and Regional Express mainline services beginning in 2000. Most of the additional transfers due to light rail will involve bus/rail transfers at the light rail stations. There are also transfers between commuter rail and light rail at King Street Station/Union Station in the International District and in Segment E. The light rail/commuter rail transfers at Boeing Access Road (E1.1 and E1.2) are less convenient than at Longacres (E2 and E3).

Table 3.2-2
Year 2020 Comparative Analysis of Average Door-to-Door P.M. Peak Transit Travel Times

Station Area Cluster	Total Travel Time to Station Area (minutes)	
	No-build	Light Rail[1]
Segment A		
Northgate	48	37-43
Roosevelt	49	36-45
Average Time Savings of 7-26%		
Segment B		
University District	46	36-43
Capitol Hill / First Hill	40	31-38
South Lake Union	45	36-43
Average Time Savings of 4-23%		
Segment C		
Downtown/Pioneer Square	41	36-38
ID/Duwamish	54	46-49
I-90	47	41-44
Beacon Hill / McClellan[2]	50	33-40
Average Time Savings of 6-35%		
Segment D		
Rainier Valley	58	39-55
Average Time Savings of 6-33%		
Segment E		
Boeing Access	66	58-64
Foster/Riverton Heights	66	59-64
Southcenter	66	59-65
Average Time Savings of 3-12%		
Segment F		
Airport/City Center	70	60-68
South SeaTac	61	53-60
Average Time Savings of 2-15%		
Weighted Average over All Station Areas	**46**	**38-41**
Average Time Savings of 9-18%		

Source: Sound Transit patronage model, August 1999.
Note: The travel times presented here have been weighted by the 2020 No-Build P.M. Peak trips to the neighborhood for all of the alternatives. Out-of-vehicle time for waiting, walking/driving, and boarding are included, but are not weighted. See Appendix G for detail on method of grouping station areas.
[1] Light rail travel times show the range between route alternatives (including the three MOS routes) for station areas in each segment.
[2] Beacon Hill is in segment C, McClellan is in segment D. Stations are clustered into one analysis area because the immediate travel sheds overlap.

While the number of transfers would be expected to increase, overall travel times and the amount of transit service would substantially improve. For passengers transferring from bus to light rail, the wait times would be short. Transfer wait times from light rail to bus will sometimes be longer, particularly when bus frequency is less than light rail frequency, although bus route frequencies may increase with implementation of the light rail system. Due to the high reliability of rail service, riders may choose a light rail trip that will result in a short transfer wait for the bus, over a longer and potentially less reliable bus-only trip.

Speed and Reliability

Average speed and reliability, whether for light rail or bus, depends on the right-of-way used. Transit vehicles in mixed traffic are more subject to delays caused by congestion, accidents, breakdowns and other incidents. Slower bus operating speeds and lower reliability have been a long-term problem in this area, including in the light rail corridor. Despite numerous system improvements and service modifications, bus operating speeds have steadily deteriorated in the corridor, as a result of ever growing traffic volumes and a lack of routing alternatives. Slower bus speeds affect the quality of service to riders, and they increase capital and operating costs. Table 3.2-3 summarizes the history of operating speeds along three key arterial segments in the Central Corridor. Operating speeds have declined 22 to 46 percent on the arterial segments shown during the 36-year period from 1962 to 1998. This condition is expected to worsen in the years ahead.

The light rail system would improve average speed and reliability in a number of ways:

- Light rail would be more reliable than buses because it would operate primarily in a separate right-of-way, which is a more controlled environment. Light rail is expected to operate in the 95 to 99 percent on-time range. In Portland, Tri-Met's Eastside light rail has a 98 percent A.M. peak on-time performance, while buses have an 82 percent on-time performance.
- Many bus routes could be restructured into shorter routes connecting to a light rail station. In general, shorter bus routes are more reliable.

Table 3.2-3
Central Corridor Trends in Bus Operating Speeds

	Operating Speed by Arterial Segment		
Year	**Rainier Avenue (Third/Jackson to Graham)**	**Broadway (Third/Pike to Roy)**	**Eastlake Avenue (Third/Pike to 45th)**
1962 Schedule[1]	13.3 mph	7.8 mph	12.3 mph
1971 Schedule[1]	12.8 mph	7.8 mph	11.7 mph
1985 Schedule[1]	11.8 mph	6.8 mph	10.3 mph
1992 Schedule[1]	10.9 mph	5.4 mph	9.9 mph
1992 Observed[2]	9.6 mph	4.4 mph	8.9 mph
1998 Schedule[1]	10.4 mph	4.8 mph	9.5 mph
36-Year Change	-22%	-38%	-23%
Light rail Speeds[3]	26.2 – 28.1 mph	26.8 mph	24.6 – 24.8 mph

[1] Sources: Seattle Transit (predecessor of Metro Transit) and Metro Transit published schedules
[2] Source: 1992 Metro Transit Automatic Passenger Count Data
[3] Projected average light rail speeds.

Service Coverage and Structure

Implementation of the light rail project will greatly increase the region's overall level of public transportation services. The preliminary service integration planning that has been done to date provides a starting point for detailed service implementation planning, which will begin about one to two years before actual implementation. The implementation planning will provide exact details on routings, service levels, transfer connections, and bus sizes. It will have a public process led by King County Metro, with final approval of the service plan by the King County Council. Existing Community Transit and Pierce Transit routes would not be significantly changed, although there would be potential for Community Transit route modifications if light rail extends to Northgate.

The restructuring of bus routes will accomplish two major objectives:

- Routes would be restructured to provide access to and from light rail. The intent is to create a "seamless" system where bus routes are an extension of light rail and vice-versa.
- The restructuring would be done to support transit agency systems, in particular, King County Metro's reorientation of service into a more "multi-centered" structure. This restructuring would include transit centers not served by light rail.

An important aspect of the restructuring would be the redeployment of service hours that are replaced by light rail. The governing board of each transit agency has the final statutory authority to change bus routes and schedules. Sound Transit and local jurisdictions have agreed on redeployment guidelines (Sound Transit 1998). Light rail may appear to only slightly increase transit coverage, a measure that indicates how well households and employment are served by transit, because the areas to be served by light rail already have extensive coverage. Some increase in local service frequency and coverage would result from the redeployment of service hours replaced by light rail.

Following is a general discussion by light rail segment where changes to transit service could occur. These changes are based on a conceptual future local service network that has not yet been approved by King County. Any local transit service changes would be subjected to public review and comment before they are implemented. In Segments A through D, any bus route changes would need to be coordinated with Seattle's Transit Street Classification System.

Segment A (Northgate to University District)

The preferred alternative does not extend beyond the University District (N.E. 45th Street) and there are no stations at Roosevelt or Northgate. However, given continued implementation of Metro's Six-Year Transit Plan, and considering dual mode coach operational characteristics and age, there will likely be changes to the route network.

If the project does extend to Northgate, construction of the Northgate or Roosevelt station options would likely result in some changes to the bus network. For most of the area between Shoreline and Seattle north of N.E. 125th Street, all day, direct feeder bus access could be provided to the Northgate Station. From Northgate, light rail could provide connections to major destinations in Seattle and to Sea-Tac Airport.

The feeder bus routes could also connect at Northgate, and could increase local mobility within the City of Shoreline and north Seattle. In the area from N.E. 125th Street to the Ship Canal there could be a grid of routes connecting to the Roosevelt and Northgate stations. Consistent with King County Metro plans, service frequency on many of the north-south routes west of Greenlake could be improved.

Segment B (University District to Westlake Station)

For Alternative B1 (the preferred alternative), the Capitol Hill, Montlake, Central District, Squire Park, Leschi/Madison Park, Judkins Park, Mt. Baker, and First Hill neighborhoods could benefit from a local bus feeder system that would provide improved local circulation and frequent connections to the light rail system at the First Hill and Capitol Hill stations. Most radial routes from downtown Seattle to the neighborhoods to the east may remain largely unchanged. Although not part of the preferred alternative, a station at Roy Street would provide additional direct access to light rail.

With the preferred alternative, approximately 1,000 ft of overhead electric trolley bus wire would be installed in the eastbound and westbound directions on N.E. 47th Street between 15th Avenue N.E. and Brooklyn Avenue N.E. These new wires would connect to existing wires used by routes on 15th Avenue N.E.

Alternatives B2.1 and B2.2 could establish feeder bus service from Capitol Hill and First Hill to the Eastlake, S. Lake Union and Seattle Center areas. Either route could also result in less direct bus routing between the north end, downtown Seattle and destinations south of downtown. Because

Alternatives B2.1 and B2.2 connect Seattle Center to Westlake Station, current ridership on the monorail may be reduced.

Segment C (Westlake Station to S. McClellan Street)

With exclusive rail use of the tunnel (preferred alternative), bus riders and other users of surface streets and sidewalks could be impacted. See the Downtown Seattle Bus Operations section below for further discussion of impacts in downtown Seattle. Route patterns in downtown Seattle would remain largely unchanged by joint bus/rail tunnel operations.

South of downtown, Alternatives C1.1, C1.2 (preferred alternative), C1.3, C1.4, and C1.5 include a potential station on north Beacon Hill at about Lander Street and Beacon Avenue. Very few bus route changes may be required for these alternatives, but there may be an opportunity to provide a direct bus link from West Seattle to the Lander Station and on to Beacon Hill and southeast Seattle. Alternatives C2.3 and C3 could provide a light rail station at I-90 and Rainier Avenue, allowing transfers between eastside buses and light rail. Alternatives C1.1, C1.2, C1.3, C1.4, and C1.5 would not have an I-90 Station but would extend light rail service south of downtown using the E3 Busway, with stations at Royal Brougham (all C1 alternatives) and S. Lander Street (Alternatives C1.1, C1.2, C1.3, and C1.4). Alternative C2.4 would not have an I-90 Station but would have a station on Poplar Place south of Dearborn Street. This alternative would require no changes to the base bus route network.

Segment D (S. McClellan Street to Boeing Access Road)

Rainier Valley would be directly served by light rail and continue to receive a high level of bus service regardless of the alternative selected. The area south of Henderson Street could be served by both regional and local feeder bus service to the light rail station. Bus connections are also envisioned from Beacon Hill to the Rainier Valley Stations. Alternatives D3.3 and D3.4 do provide direct rail service to different areas in the northern portion of this segment but would likely be the same as the base bus network associated with Alternatives D1.1 (preferred alternative) and D1.3.

With the preferred alternative, approximately 6,200 ft. of overhead electric trolley bus (ETB) wire would be installed through the McClellan Station bus facility (connecting to existing wire on Rainier Ave. S.) from the Rainier Ave. S./S. Hanford Street intersection via MLK Jr. Way S. and Cheasty Blvd. An additional 2,400 ft of new eastbound/westbound trolley bus wire would also be installed on S. McClellan Street between Rainier Ave. S. and 31st Ave. S., connecting to existing trolley bus wires. In the Henderson Station vicinity, 800 ft of new trolley bus wire would be installed for the trolley bus turnaround. An additional 3,800 ft would also be installed on Henderson Street (eastbound and westbound) between the proposed signalized bus facility entrance and Rainier Ave. S. (connecting to the existing trolley bus turnaround near the Rainier Beach neighborhood).

Near the Othello Station, King County Metro has also identified plans (in their Six-Year Plan) to extend electric trolley bus wire across MLK Jr. Way S. and the proposed light rail route. This is possible but not desirable for light rail operations, since special design, manufacture, and installation of a device is required to permit the passing of ETB poles in one direction and light rail vehicle pantograph in the other. The overhead crossing equipment would appear as a "hard spot" to the light rail vehicle and cause excessive wear and damage to the carbon collecting surfaces. In addition, any incident at the rail crossing would simultaneously close down the ETB and light rail operations. Sound Transit is currently engaged in a process of negotiating this issue with King County Metro. The goal is to resolve the issue in advance of final design.

Segment E (Tukwila)

Alternatives E1.1 (preferred alternative) and E1.2 would serve the Tukwila International Boulevard corridor and thus provide the most direct and fastest service to the airport for most light rail riders. In addition, all of Tukwila could have feeder bus service that would connect to light rail at the Boeing Access Road, S. 144th or North SeaTac stations. Service to Burien, Renton, SeaTac, and Kent would be routed to the SeaTac stations with Alternatives E1.1 and E1.2. Overall, light rail travel times via Southcenter or south Renton (Alternatives E2 or E3) to downtown Seattle are longer to Burien and SeaTac and shorter to Renton and Kent than for Alternatives E1.1 or E1.2. However, all light rail travel times are shorter than bus-only transit travel times with the No-build Alternative. Alternatives E1.1 and E1.2 would provide transfer opportunities to the Sounder Commuter Rail at the Boeing Access Road Station. Alternatives E2 and E3 serve the manufacturing/industrial center for Tukwila and the designated urban center in Tukwila at Southcenter. Alternatives E2 and E3 would provide transfer opportunities to the Sounder commuter rail at the Longacres Station, as well as Amtrak and other regional bus transit service. Alternatives E2 and E3 do not include the Boeing Access Road Station, and could require some bus route extensions to the Henderson Station in Segment D.

Segment F (SeaTac)

Alternative F2.3 (preferred alternative) would have three light rail stations including a park-and-ride at the 154th Station and S. 200th Station. These would be supported by very frequent local bus service, including connections to the Renton Transit Center, Kent, Federal Way, and Burien. The only exception would be if the North Central SeaTac Station is located at the North End Aviation Terminal (NEAT) instead of the Intermodal Center (IMC) with the preferred alternative (F2.3). With this station option, the Automated People Mover (APM) would be needed for bus transfers, which would increase transfer times. Bus transfer opportunities exist at all stations in this segment. Most alternatives and station options have similar impacts to bus service and would not substantially impact the bus route network.

Downtown Seattle Bus Operations

The Downtown Seattle Transit Tunnel (DSTT) Report was published on September 21, 1998. The report documents the findings of studies undertaken by Sound Transit in cooperation with King County Metro and the City of Seattle concerning changes and modifications that may be required to the DSTT to accommodate the operations of the light rail trains. These studies examine a number of the physical and operational issues and explore the feasibility and impacts of joint bus/rail operations in the DSTT.

The report made several findings concerning joint/bus operations as outlined below.

- *Limited time* – Depending on the growth in rail ridership and the timing of future rail extensions, joint operation might be possible for a period of no more than 2 to 10 years.
- *Fewer buses* – Currently 70 buses per hour per direction operate in the tunnel during the peak hour. By 2004, that number is expected to increase to 80 buses per hour. Under joint operation a maximum of 30 buses would be able to operate in each direction.
- *Safety concerns* – The system must depend on operator judgement to maintain a safe stopping distance due to the lack of a fail safe signal system.
- *Slower* – The travel time for light rail vehicles would be two minutes slower with joint operation and buses would operate 2 to 4 minutes slower than they do today with joint operation.
- *Less reliable* – Buses could not pass each other or light rail trains and there would be additional conflicts in the staging areas, resulting in less reliable service for both buses and rail.
- *Costs more* – The overhead conductor system and signal system would cost more to install with joint operation.
- *Replace buses* – To maintain joint operation, King County Metro would need to replace a portion of their tunnel fleet.

Based on these findings and other information, the preferred alternative is to only operate light rail in the tunnel when it is re-opened in 2006. Buses would not be able to use the DSTT and would operate on surface streets through downtown. A working group of staff from the City of Seattle, King County, Community Transit, and Sound Transit, supported by Sound Transit consultants, have explored alternatives to improve transit operations on downtown surface streets, both during bus tunnel retrofit for light rail, and in the longer term, after light rail is in operation. The preliminary findings from this effort are summarized in the Downtown Seattle Surface Street Report, published and made available to the public on April 14, 1999.

Since then, Sound Transit has evaluated the feasibility of spreading the bus volumes over more north/south streets and identified additional options for reducing transit travel times and increasing reliability.

Downtown Seattle Bus Volumes

There are currently 481 buses operating on the key downtown north/south avenues during the 4:30 to 5:30 P.M. weekday peak hour (see Table 3.2-4). An additional 145 buses currently operate in the tunnel. As shown in Table 3.2-4, bus volumes are anticipated to increase both in the tunnel and on the surface streets before the tunnel is closed in 2004. The following assumed changes in bus service account for these increases in bus volumes:

- King County Metro and Community Transit will each add PM peak hour trips to various routes as a result of ridership growth between now and 2004;
- Several King County Metro routes will be discontinued and replaced by Sound Transit's Sounder commuter rail service between Lakewood and downtown Seattle;
- Several King County Metro routes will be shifted among Second, Third and Fourth avenues to improve operating reliability and efficiency;
- Five new Sound Transit Regional Express bus routes will be operating at full service levels into and out of downtown Seattle. Two of those routes will replace existing Metro Route 226 and Pierce Transit routes 590 through 594.

Table 3.2-4
Downtown Seattle Transit Volumes - Spring 1999 and Future Baseline 2004 Weekday P.M. Peak Hour (4:30 to 5:30)

Corridor	Bus volume (Spring '99)	Future Baseline 2004 bus volumes	Change in Bus Volume
Northbound			
First Avenue	31	28	(3)
Third Avenue	84	90	6
Fourth Avenue	111	112	1
Subtotal	**226**	**230**	**4**
Southbound			
First Avenue	39	29	(10)
Second Avenue	126	111	(15)
Third Avenue	80	90	10
Fifth Avenue	10	20	10
Subtotal	**255**	**250**	**(5)**
Surface Total	**481**	**480**	**(1)**
Tunnel Northbound	72	82	10
Tunnel Southbound	73	88	15
Tunnel Total	**145**	**170**	**25**
Grand total	**626**	**650**	**24**

Source King County Metro, September 1999.

Downtown Seattle Boardings

Tables 3.2-5 summarizes 2010 and 2020 peak hour bus and light rail transit trips and boardings to downtown Seattle with and without light rail. Between today and the year 2010, Sounder commuter rail service will replace some of the current peak hour surface bus activity, creating room for growth in other bus corridors. As shown in Table 3.2-5, this would result in increases in tunnel usage and slightly fewer surface boardings downtown in the year 2010. In the year 2020, the No-build Alternative would result in a significant increase in tunnel and surface boardings over existing conditions. Metro would need to replace the existing dual mode Breda bus fleet under the No-build Alternative.

Table 3.2-5. Seattle CBD Peak Hour Transit Person Trip Boardings, Transit Trip Origins and Auto Vehicle Trip Origins.

		2010			2020		
	1999 Existing	No-build	Preferred	Northgate to SeaTac	No-build	Preferred	Northgate to SeaTac
Tunnel Boardings	4,250	4,700	5,850	7,000	4,700	7,500	9,150
King Street Station	N/A	2,100	2,100	2,100	3,000	3,000	3,000
Surface Boardings	14,500	14,100	14,800	13,100	17,000	17,950	15,700
Total Boardings	18,750	20,900	22,750	22,200[1]	24,700	28,450	27,850[1]
Total Transit Origins	15,200	16,700	18,000	18,200	20,600	23,400	23,600
Auto Vehicle Trips[2]	26,800	30,800	30,100	29,800	34,400	32,400	32,000

Source: Patronage forecasting model developed by Parsons Brinckerhoff for Sound Transit.

1 Total downtown boardings are lower with an extension of the light rail line to Northgate even though transit trips to downtown increase due to reduced transfer activity in downtown Seattle. The rail line would allow north Seattle transit riders to reach multiple destinations without having to transfer buses in downtown Seattle.

2 Average vehicle occupancy in downtown Seattle is 1.34

With light rail only, the tunnel would be expected to accommodate more through trips while the shorter downtown trips would most likely remain on the surface bus transit. Overall, total transit trips to downtown would increase after light rail implementation. This increase in total transit boardings would lead to a reduction in downtown auto vehicle trips for the preferred alternative compared to No-Build. In addition, Metro would not need to replace its fleet of dual mode tunnel buses with the preferred alternative.

Downtown surface transit boardings would increase with the preferred alternative (compared to the No-build Alternative). However, overall congestion levels for the downtown intersections would likely improve or remain the same compared to the No-build Alternative, due to the decrease in downtown auto vehicle trips (see Table 3.2-5).

If Sound Transit chooses to open the light rail systems with only a Minimum Operating Segment (MOS) constructed, downtown surface boardings would be greater than with the preferred alternative. All three MOS's would result in less transit ridership than the preferred alternative, but the resulting increase in auto trips to downtown would still be less than the No-build Alternative. Under such a scenario, surface street mitigation put in place during conversion of the DSTT to rail-only operations may need to remain in place until construction of the preferred alternative is completed. Of the three MOS's evaluated, the Capitol Hill to Henderson MOS (MOS B) would have the highest surface bus boardings downtown, as it has the lowest rail ridership.

Downtown Bus Intercept Options

Three bus intercept options are being evaluated to reduce surface bus volumes in downtown Seattle following conversion of the DSTT to light rail operations. The options range from bus intercept terminals at the north and south ends of downtown that would be connected by a light rail shuttle operating through the DSTT to the truncation of several routes at the Lander Station. The shuttle and bus intercepts would operate during A.M. and P.M. 3-hour peak periods, allowing bus passengers to transfer to the shuttle or a mainline light rail vehicle to reach their ultimate downtown destination in the morning, and to use the light rail shuttle or the mainline light rail vehicle to reach their bus terminals in the evening. The three alternative concepts being considered include:

- *Option 1:* Construction of bus intercept terminals at Convention Place (CPS), International District (IDS), and Lander stations, connected by a light rail shuttle operating through the DSTT. A new light rail station and shuttle turnback would be constructed at the Convention Place Station.
- *Option 2:* Construction of bus intercept terminals at International District (IDS) and Lander stations, connected by a light rail shuttle operating through the DSTT. A turn back track would be established at the Convention Place Station, but no bus intercept or light rail station would be provided.
- *Option 3:* Use of the Lander Station to intercept buses and to transfer riders to the mainline light rail vehicles.

Options 1 and 2 could result in a reduction of approximately 170 buses per hour in downtown Seattle and would have few impacts on traffic. The increased train volumes through the at-grade crossings of Royal Brougham Way and S. Holgate and S. Lander streets would increase traffic delays at these three intersections compared to operations without the shuttle; however, these intersections would continue to operate at LOS D or better in the year 2020. Option 3 would result in no impacts to traffic.

3.2.2.2 Bus Transit Mitigation

Strategies

A number of strategies, described below, could be used to mitigate the closure of the DSTT for retrofit to light rail and help accommodate increased bus volumes on downtown Seattle streets for the two years that the tunnel is closed. These strategies would be needed to mitigate construction impacts of the project. Some of these mitigation strategies could also be continued beyond the construction time frame and into the period of Link operations. The multi-agency working group would monitor downtown bus circulation and overall traffic congestion and decide on the appropriate strategies to implement or continue after Link begins operating.

- *Change Bus Routes*: Re-routing buses among the available streets in downtown Seattle could help to balance bus volumes against available capacity on each street.
- *Change Bus Stops:* Changing the stop pattern of buses and/or the location and size of bus stops in the downtown core could help to speed service and balance the demands for sidewalk space for awaiting bus passengers. Existing stops could be moved, expanded or closed, and new stops could be added to support different stop patterns and higher demand for sidewalk space.
- *Add Street Capacity*: The physical capacity of streets could be modified to accommodate higher volumes of buses. Methods for increasing physical street capacity include widening streets, narrowing existing traffic lanes, and/or prohibiting parking to provide more space for vehicle travel.
- *Prioritize Transit:* The ability to move more buses through downtown could be enhanced by restricting the flow of other vehicles. Separating transit and other vehicles from each other

through space restrictions for cars, and modifying traffic control devices to factor transit movement are techniques for achieving transit priority.

- *Reduce Auto Traffic:* Reducing auto traffic reduces competition for limited vehicle operating space. Transportation demand management strategies such as flexible work hours, which spread auto traffic demand across longer time periods, and charging high parking fees, which discourages driving, could be used to both reduce auto demand for street space, and increase transit ridership.
- *Reduce Buses:* The number of buses operating in downtown could be reduced by consolidating routes and/or reducing bus trips. Most buses arriving and departing downtown during weekday peak hours are currently full of riders who would have to find other ways to travel downtown, or travel on overcrowded buses. There will be opportunities to reduce the number of buses traveling to/from downtown Seattle when those buses are replaced by trains in their own rights-of-way, but significant reductions may not be possible until train services are operating.
- *Implement Downtown Bus Intercept Options:* As described previously, bus intercept options are being evaluated to facilitate bus transfers at the outer edge of downtown Seattle and/or reduce surface bus volumes in downtown Seattle following conversion of the DSTT to light rail operations. The options range from bus intercept terminals at the north and south ends of downtown that would be connected by a light rail shuttle operating through the DSTT, to the truncation of several routes at the Lander Station. These options would reduce downtown surface bus volumes by up to 170 buses, resulting in lower surface bus volumes downtown compared to pre-tunnel closure conditions. These options would not mitigate construction impacts since the DSTT would be closed for construction.

Sound Transit, King County Metro, Community Transit and the City of Seattle have been working together since early 1998 to develop alternatives to address increased bus traffic on surface streets when the tunnel is closed in mid to late 2004. Alternatives have generally focused on providing adequate street space and traffic control to allow buses to maintain travel times and reliability through downtown, and on providing adequate sidewalk space to accommodate increased numbers of waiting bus passengers. These alternatives are being developed to minimize negative impacts on other street and sidewalk users and on adjacent businesses. The alternatives emphasize the first four of the strategies described above.

Reducing auto traffic through various transportation demand strategies should continue to be pursued by downtown employers with the help of the local transit agencies through the commute trip reduction law. Because these programs are well established and ongoing they were not further analyzed in the Downtown Seattle Surface Report. The strategy of reducing bus volumes will also continue to be considered.

Mitigation Alternatives Considered

The alternatives considered in the Downtown Seattle Surface Report were developed to address increased bus traffic on surface streets during the time the tunnel is closed for retrofit to light rail. The alternatives considered for the construction period were developed for each of the three major areas of downtown, as listed below:

Central Downtown (north/south streets) – includes north/south streets roughly between Stewart Street/Olive Way on the north and Yesler Street on the south.

- Third Avenue Transit Priority without Auto Circulation
- Third Avenue Transit Priority with Auto Circulation
- Second and Fourth Avenue (Ottawa-Style) Bus Bulbs
- Second and Fourth Avenue Dual with-Flow Transit Only Lanes
- Second and Fourth Avenue Dual Contra-flow Transit Only Lanes

North Downtown – includes streets connecting the central downtown corridors to I-5.

- Olive Way and Virginia Street Transit lanes
- Olive Way and Stewart Street Contra-flow Lane

South Downtown – includes streets connecting the central downtown corridors to I-5 via the E-3 busway and I-90.

- Splitting bus volumes between Fourth and Fifth avenues S.
- Concentrating buses on Fourth Avenue S. only

All north/south (Central Downtown) and North and South Downtown transit priority alternatives were analyzed and evaluated using the criteria listed below:

- Transit capacity – Ability to handle anticipated bus volumes
- Travel Time – Minutes to travel through downtown on surface streets
- Reliability – On-time performance of buses operating on the surface
- Traffic – Congestion on streets and the need for operational changes
- Parking – Number and type of spaces affected
- Bicycles – Bicycle routing opportunities
- Sidewalks – Congestion levels
- Bus Stops – The need for relocation and modifications

Based on the evaluation, described in the Downtown Seattle Surface Report and additional technical analyses, the north/south (central downtown) alternative with the least impacts is the Third Avenue Transit priority option.

Proposed Mitigation in Downtown Seattle

Operational Improvements on North/South Streets

Bus routes that currently use the DSTT would be reassigned to Second, Third and Fourth avenues to group routes serving similar rider markets, provide higher service frequency and simplify bus routes through downtown. A monitoring program and strategies would be developed that can be used to modify and change the downtown street operations if needed during construction. Some or all of these street modifications would continue to exist after Link begins operation. Sound Transit would also work with the Downtown Seattle Association and other interested parties to develop a campaign to promote the downtown area during both the two-year construction period and after Link is in operation. During the construction period, it is recommended that buses that currently use the DSTT be concentrated on Third Avenue based on the following assumptions:

- Third Avenue between Stewart Street and Yesler Street would be restricted to public transit buses, charter buses, and emergency vehicles on weekdays from 6 to 9 A.M. and 3 to 6 P.M. It may be possible to reduce the hours of restricted operation.
- Traffic circulation on Third Avenue could be allowed by permitting right turns onto and off Third Avenue to provide opportunities for passenger pick-up, deliveries and circulation for vehicles entering and exiting side-street parking garages.
- Some bus stops would be modified or closed or new ones added. Buses will operate in a skip stop pattern.
- When the modifications are first put in place, autos on Third Avenue would be allowed to make left turns during the midday. However, if the monitoring program finds that this movement results in impacts to transit travel time and reliability, midday turn restrictions may be required.

Connections to I-5 in North Downtown

Providing transit priorities in the north downtown area provides significant challenges. The current access to I-5 on Olive Way is unreliable from a transit travel time perspective, which affects reliability and increases travel times. To respond to these problems, the following improvements are recommended:

- Split the buses bound for I-5 in the afternoon between Pike Street, Olive Way and Virginia Street.
- Route Community Transit and Sound Transit buses on Pike Street. (Currently only trolley service operates on Pike Street.) Add a second bus stop and shelter on the eastside of Sixth Avenue adjacent to the Sheraton Hotel.
- Add a transit-only contra-flow lane on Ninth Avenue between Olive Way and Stewart Street for buses exiting Convention Place Station (access for the I-5 reversible lanes) to reach Stewart Street.
- Add a peak period transit only lane on Olive Way between Fourth Avenue and Boren Avenue (eliminate westbound auto lane between Boren Avenue and Howell Street). Using the transit lane on Olive Way, operate buses in a skip-stop pattern.
- Add transit signal priority to the signal at the intersection of Boren Ave and Olive Way.

Connections in South Downtown

To accommodate the volume of buses entering downtown from the south and I-90; it is recommended that bus volumes be split between Fourth and Fifth avenues. In addition the following changes are recommended:

- Prefontaine Place would be a transit only street at all times.
- Third Avenue south of Yesler Street would be restricted to public transit buses, charter buses and emergency vehicles on weekdays from 6 to 9 A.M. and 3 to 6 P.M.
- Establish a contra-flow lane on Fifth Avenue South between Jackson Street and Washington Street. Allow auto use of the Fifth Avenue S. contra-flow lane between Jackson Street and Washington Street, but require autos to turn right at either Main Street or Washington Street. Monitor transit travel time and reliability to determine if the transit only contra-flow lane should be extended north from Washington Street to Terrace Street, and if autos should continued to be allowed to use the contra-flow lane between Jackson Street and Washington Street.
- Provide transit priority on Royal Brougham Way, Sixth Avenue S., and Airport Way between the E-3 busway and South Jackson Street.

Impacts of the Proposed Mitigation

Table 3.2-6 summarizes the downtown Seattle Transit Volumes for the 2004 baseline and the current mitigation proposal during construction. As shown in Table 3.2-6, 480 buses would be expected to operate north and southbound on Second, Third and Fourth avenues and 170 buses would operate in the DSTT, for a total of 650 buses in the PM peak hour in the year 2004, before construction of the tunnel begins. When the tunnel is closed for retrofit the number of buses operating on Second, Third and Fourth avenues would also be about 650.

Table 3.2-6
Downtown Seattle Transit Volumes - 2004 Baseline versus Current Mitigation Proposal during Construction - Weekday P.M. Peak Hour (4:30 to 5:30)

Corridor	2004 baseline bus volumes	Preferred plan during construction bus volumes
Northbound		
First Avenue	28	28
Third Avenue	90	144
Fourth Avenue	112	140
Subtotal	**230**	**312**
Southbound		
First Avenue	29	29
Second Avenue	111	144
Third Avenue	90	140
Fifth Avenue	20	25
Subtotal	**250**	**338**
Total	**480**	**650**
Tunnel Northbound	82	---
Tunnel Southbound	88	---
Total	**170**	**—**
Grand total	**650**	**650**

Source: King County Metro, September 1999.

The current mitigation proposal would also result in the following impacts while the tunnel is closed for retrofit:

- **Transit capacity:** There would be sufficient capacity for the projected volume of buses with the recommended transit priority treatments.
- **Travel Time:** Buses on Third Avenue are projected to operate as fast as today even with a doubling of transit volumes; however, buses would experience increased travel times as they pass through the north and south downtown areas. Some passengers would benefit from shorter walk times to bus stops on the surface versus the time to access the tunnel today. The greatest impact would be on riders who travel the entire length of downtown.
- **Reliability:** The surface routes would not be as reliable as those that operate in the tunnel today. The entire downtown transportation system is becoming increasingly fragile and subject to impacts from traffic congestion and events both within downtown and on the regional highway system.
- **Traffic:** The diversion of traffic from Third Avenue to Second and Fourth avenues in the PM peak hour would result in additional travel time for drivers travelling the entire length between Yesler Street and Stewart Street (average increases will be approximately 30 seconds on Second Avenue and up to 2 minutes on Fourth Avenue). Some impact is expected on the level of service of individual intersections in north downtown, but increased bus volumes would require intersection improvements in south downtown.
- **Parking and Access:** Passenger pick-up and garage access would be provided for autos on Third Avenue, using a "round-the-block" movement (right-on, right-off). Parking on Olive Way would be restricted during the PM peak period, and parking on a two-block stretch of Fifth Avenue between Jackson Street and Washington Street would be eliminated to create a transit contra-flow lane.
- **Sidewalks/Bus Stops:** Some bus stops would be relocated and new ones added. Several bus stops would be expanded and modified to accommodate increased passenger demand.
- **Operating and Capital Costs:** Increased time for buses to operate through downtown would increase operating costs for the transit agencies Capital costs will include such things as new

bus shelters, signage, traffic signals, intersection modifications, street changes and streetscape improvements.

After Link service begins in 2006, the number of surface buses would decrease compared to conditions during construction. However, surface bus volumes could still be higher than before the tunnel closes. It is assumed that there will be significant increases in transit ridership in downtown Seattle (as shown in Table 3.2-4), some of which will be accommodated on rail and some on buses. Some of the impacts identified above would remain after construction, unless changes are made to the bus network and surface street operations.

3.2.3 Light Rail Transit Ridership

Tables 3.2-7a and 3.2-7b present the projected 2010 and 2020 daily system boardings for the N.E. 45th Street to SeaTac, Northgate to SeaTac, MOS alternatives, and preferred alternatives, by segment. Table 3.2-7c shows the projected 2010 and 2020 daily system boardings, by station, for the preferred and MOS alternatives. With the preferred alternative, which would operate between the N.E. 45th and SeaTac stations, 109,900 to 110,400 daily boardings would be expected in the year 2010, and 133,000 daily boardings would be expected by the year 2020. By extending the system from N.E. 45th Street to Northgate, daily boardings increase by 19,000 in the year 2010 and 23,700 in the year 2020. In all cases, except for at the S. Lander and McClellan stations with MOS A and International District Station with MOS C, the MOS alternatives would result in lower daily ridership at stations than the preferred alternative. Therefore, less significant traffic impacts would be expected with the MOS alternatives than with the preferred alternative. Mitigation identified in this document for the preferred alternative would likely still be needed in most cases with MOS A, MOS B, and MOS C because the ridership differences are not significant. If MOS A, MOS B or MOS C is selected, mitigation identified for the full-length alternative would need to be verified.

The Sound Transit ridership forecasting model used to develop the system ridership estimates was validated against actual bus route ridership in the base year. The model proved accurate to within 5 or 10 percent in the base year, which is the appropriate margin of error when considering overall system wide ridership. Within a segment, ridership differences can be considered significant if the forecast variation between route alternatives meets or exceeds 2,000 daily boardings or approximately 500 in the peak and approximately 1,500 in the off-peak. Ridership differences of less than 2,000 daily boardings are not considered to be significantly different.

For the year 2010 forecasts, Operating Plan A, which includes peak headways of 4 minutes north and 8 minutes south of the International District Station and 8-minute off-peak headways, was assumed for all technical analysis. Subsequently, that plan was refined to more efficiently serve the forecasted demand. The new plan, Operating Plan B, includes peak headways of 5 minutes north and 10 minutes south of the Henderson Station and off-peak headways of 7.5 minutes north and 15 minutes south of the Henderson Station. Operating Plan B has been used for all 2020 forecasts and analysis, and is what Sound Transit expects to operate on opening day.

Table 3.2-7a
Year 2010 Sound Transit Light Rail Daily System Boardings

Alternative	Segment A	Segment B	Segment C	Segment D	Segment E	Segment F	System Light Rail Boardings
Northgate Terminus (Baseline)[1]	13,200	40,400	47,900	12,200	2,100	8,200	124,000
N.E. 45th Terminus (Prebase)[2]	N/A	40,100	42,500	12,100	2,100	8,200	105,000
Preferred (Operating Plan A)[3]	N/A	39,300	50,300	10,700	2,000	7,500	110,400
Preferred (Operating Plan B)[4]	N/A	39,400	50,900	11,700	1,600	6,300	109,900
MOS A[5]	N/A	36,100	45,100	5,500	N/A	N/A	86,700
MOS B[6]	N/A	14,300	37,900	10,400	N/A	N/A	62,600
MOS C[7]	N/A	34,900	35,100	N/A	N/A	N/A	70,000

Source: Sound Transit, 1998

1 These numbers were held constant in the comparison of alternatives in all other segments. The segment totals shown are for the following combination of alternatives: A1.1/A1.2, B1, C2.3, D3.3, E1.1, and F3.
2 The prebase alternative reflects the light rail Alternatives B1.1, C2.3, D3.3, E1.1, and F3.
3 Operating plan A assumes 4/8 min. peak and 8 min. off-peak headways with peak turn-back in the International District.
4 Operating plan B assumes 5/10 min. peak and 7.5/15 min. off-peak headways with a turnback located at Henderson Street.
5 The MOS A Alternative assumes that light rail service would be provided between the N.E.45th St. and McClellan St. stations.
6 The MOS B Alternative assumes that light rail service would be provided between the Capitol Hill and the Henderson Street stations.
7 The MOS C Alternative assumes that light rail service would be provided between the N.E. 45th and Lander stations.

Table 3.2-7b
Year 2020 Sound Transit Light Rail Daily System Boardings

Alternative	Segment A	Segment B	Segment C	Segment D	Segment E	Segment F	System Light Rail Boardings
Northgate Terminus (Baseline)[1]	15,800	47,200	60,200	15,300	2,300	8,200	149,000
N.E. 45th Terminus (prebase)[2]	N/A	47,300	52,500	15,100	2,300	8,100	125,300
Preferred (Operating Plan B)[3]	N/A	46,200	63,000	13,700	2,200	7,900	133.000
MOS A[4]	N/A	43,200	56,200	6,700	N/A	N/A	106,100
MOS B[5]	N/A	17,600	46,700	12,600	N/A	N/A	76,900
MOS C[6]	N/A	42,200	45,100	N/A	N/A	N/A	87,300

Source: Sound Transit, 1998

1 These numbers were held constant in the comparison of alternatives in all other segments. The segment totals shown are for the following combination of alternatives: A1.1/A1.2, B1, C2.3, D3.3, E1.1, and F3.
2 The prebase alternative reflects the light rail Alternatives B1.1, C2.3, D3.3, E1.1, and F3.
3 Operating plan B assumes 5/10 min. peak and 7.5/15 min. off-peak headways with a turnback located at Henderson Street.
4 The MOS A Alternative assumes that light rail service would be provided between the N.E.45th St. and McClellan St. stations.
5 The MOS B Alternative assumes that light rail service would be provided between the Capitol Hill and the Henderson Street stations.
6 The MOS C Alternative assumes that light rail service would be provided between the N.E. 45th and Lander stations.

Table 3.2-7c. Station Boardings for Preferred, MOS A, MOS B, and MOS C alternatives

	2010				2020			
Station	**Preferred**	**MOS A**	**MOS B**	**MOS C**	**Preferred**	**MOS A**	**MOS B**	**MOS C**
N.E. 45th	9,800	8,700	N/A	8,300	12,300	11,000	N/A	10,700
Pacific	10,300	9,200	N/A	8,900	10,900	10,400	N/A	10,000
Capitol Hill	12,700	12,000	8,500	11,500	15,300	14,600	10,600	14,200
First Hill	6,600	6,200	5,800	6,200	7,700	7,200	7,000	7,300
Convention Place	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Westlake	19,000	16,200	14,600	13,600	23,900	20,600	18,100	17,700
University	11,400	9,100	7,200	6,500	14,800	11,700	9,300	8,600
Pioneer Square	4,800	3,700	2,800	3,000	6,200	4,800	3,600	4,100
International District	7,900	7,800	6,400	8,500	9,900	9,900	8,100	10,700
Royal Brougham	500	400	400	400	500	400	500	400
Lander	3,200	3,700	2,800	3,100	3,500	4,300	3,200	3,600
Beacon Hill	4,100	4,200	3,700	N/A	4,200	4,500	3,900	N/A
McClellan	2,200	5,500	2,100	N/A	2,500	6,700	2,300	N/A
Edmunds	2,800	N/A	2,300	N/A	3,300	N/A	2,800	N/A
Graham	2,100	N/A	1,800	N/A	2,600	N/A	2,300	N/A
Othello	600	N/A	400	N/A	600	N/A	500	N/A
Henderson	4,000	N/A	3,800	N/A	4,700	N/A	4,700	N/A
Boeing Access Road	1,200	N/A	N/A	N/A	1,600	N/A	N/A	N/A
Tukwila	400	N/A	N/A	N/A	600	N/A	N/A	N/A
North Sea-Tac Airport	2,000	N/A	N/A	N/A	2,600	N/A	N/A	N/A
Central Sea-Tac Airport	3,000	N/A	N/A	N/A	3,000	N/A	N/A	N/A
S. 200th	1,300	N/A	N/A	N/A	2,300	N/A	N/A	N/A
Totals	**109,900**	**86,700**	**62,600**	**70,000**	**133,000**	**106,100**	**76,900**	**87,300**

Segment A (Northgate to University District)

Alternatives A2.1 and A2.2 would result in the highest daily ridership in the Northgate to University District segment. Table 3.2-8 shows the breakdown of daily boardings expected at each station in the Northgate to University District segment, assuming that the project extends from Northgate to S. 200th Street in SeaTac. As shown in Table 3.2-8, the Roosevelt Station would experience higher daily ridership with Alternatives A2.1 and A2.2.

The total daily light rail boardings produced by this segment's alternatives range between 124,000 and 125,000 in the year 2010. By the year 2020, total daily light rail boardings produced by this segment's alternatives would increase to between 149,000 and 150,100. The variation in boardings within this segment is small due to nearly identical travel times and markets served.

Table 3.2-8
Segment A: Year 2010 and 2020 Daily Station Usage (Boardings), by Light Rail Alternative

	Alternative A1.1/A1.2		Alternative A2.1/A2.2	
Stations	**2010**	**2020**	**2010**	**2020**
Northgate	10,600	13,000	10,600	13,000
Roosevelt	2,600	2,800	2,700	2,900
Segment A totals	*13,200*	*15,800*	*13,300*	*15,900*
System light rail boardings	*124,000*	*149,000*	*125,000*	*150,100*

Segment B (University District to Westlake Station)

Alternative B1 (preferred alternative) would result in the highest daily ridership in the University District to Westlake Station segment. Tables 3.2-9a and 3.2-9b show the breakdown of daily boardings expected at each station in the University District to Westlake Station segment.

The key ridership forecasting issues for Segment B are:

- For the year 2010, the Capitol Hill tunnel (B1) forecast is for 124,000 daily light rail boardings, as compared to 95,100 boardings for the Seattle Center/High-level Bridge (B2.1) or 99,500 boardings for the Seattle Center/Portage Bay Tunnel (B2.2). For the year 2020, Alternative B1 would result in 149,100 daily boardings as compared to 119,000 boardings for Alternative B2.1. The large differences are due to a weaker transit market served by the Seattle Center alternatives, and to increased travel time between the University District and downtown Seattle. The daily station boardings for the Seattle Center Station area are for an average day without a large event at Seattle Center. On days with large special events at Seattle Center, ridership to the Seattle Center Station could be up to 4 to 5 times higher. Alternatives B2.1 and B2.2 could reduce current ridership on the monorail; however, the effect is not expected to be significant.
- Campus Parkway Station (B.2.1) has lower boardings than Pacific Station (B2.2) in the University District. Boardings in the University District drop by 2,200 under B2.1, the Seattle Center alternative that uses a high-level bridge to cross the Ship Canal. This decrease is due to the combination of a slightly longer travel time and the fact that the Campus Parkway Station does not serve the University of Washington campus and University hospital as well. On days with special events at Husky Stadium, ridership could be 2 to 3 times higher for the University District stations.

Table 3.2-9a
Segment B: Year 2010 Daily Station Usage (Boardings), by Light Rail Alternatives

Stations	Alternative			
	B1a (pref.)	B1b[1]	B2.1	B2.2
N.E. 45th	8,700	8,600	7,400	6,500
Pacific	10,400	10,200	—	8,900
Roy/Aloha (potential)	—	5,300	—	—
Capitol Hill	12,800	8,100	—	—
First Hill	6,700	6,700	—	—
Campus Parkway	—	---	5,800	—
Eastlake	—	---	1,200	1,300
South Lake Union	—	---	1,400	1,500
Seattle Center	—	---	6,400	6,600
Convention Place	1,800	1,800	3,000	3,000
Segment B Totals	*40,400*	*40,700*	*25,200*	*27,800*
System light rail Boardings [2]	*124,000*	*124,000*	*95,100*	*99,500*

Note: [1] With the Roy/Aloha Station.
[2] System light rail boarding totals shown are for the SeaTac to Northgate alternative.

Table 3.2-9b
Segment B: Year 2020 Daily Station Usage (Boardings), by Light Rail Alternative

Stations	Alternative			
	B1a (pref.)	B1b[1]	B2.1	B2.2
N.E. 45th	10,800	10,700	9,200	8,100
Pacific	11,300	11,100	—	11,100
Roy/Aloha (potential)	—	6,400	—	--
Capitol Hill	15,400	9,700	—	--
First Hill	7,400	7,400	—	--
Campus Parkway	—	--	6,700	--
Eastlake	—	--	2,000	2,200
South Lake Union	—	--	2,200	2,400
Seattle Center	—	--	8,100	8,400
Convention Place	2,300	2,300	3,800	3,800
Segment B Totals	*47,200*	*47,600*	*32,000*	*36,000*
System light rail Boardings[2]	*149,000*	*149,100*	*119,000*	*125,100*

Note: [1] With the Roy/Aloha Station.
[2] System light rail boarding totals shown are for the SeaTac to Northgate alternative.

Segment C (Westlake Station to S. McClellan Street)

Alternative C1, the preferred alternative (with a Beacon Hill Station), would result in the highest daily ridership in Segment C. Table 3.2-10a shows the breakdown of daily boardings expected at each station. As shown in Tables 3.2-10a and 3.2-10b, daily ridership forecasts for the Westlake, University Street, Pioneer Square, and International District stations would be similar for all segment alternatives. The I-90/Rainier and Royal Brougham Station combination, associated with Alternative C3, would result in slightly higher ridership south of the International District Station than with the Alternative C2.3 I-90 Station.

Table 3.2-10a
Segment C: Year 2010 Daily Station Usage (Boardings), by Light Rail Alternative

Stations	Alternative				
	C1[1] (pref.)	C1	C2.3	C2.4	C3
Westlake	18,600	18,300	18,000	17,900	18,100
University Street	12,900	12,500	13,000	12,900	12,900
Pioneer Square	5,700	5,600	5,700	5,600	5,700
International District	9,200	9,200	9,300	10,000	9,000
Royal Brougham	400	400	---	---	1,000
Lander	2,500	2,400	---	---	---
Beacon Hill (potential)	3,900	---	---	---	---
I-90/Rainier	---	---	1,900	---	1,900
Poplar Place	---	---	---	500	---
Segment C Totals	*53,200*	*48,400*	*47,900*	*46,900*	*48,600*
System light rail Boardings[2]	*127,900*	*124,700*	*124,000*	*122,800*	*124,300*

Note: [1] Includes Beacon Hill Station.
[2] System light rail boarding totals shown are for the SeaTac to Northgate alternative.

Table 3.2-10b
Segment C: Year 2020 Daily Station Usage (Boardings), by Light Rail Alternative

Stations	Alternative				
	C1[1] (pref.)	C1	C2.3	C2.4	C3
Westlake	23,500	22,800	22,700	22,600	22,900
University Street	16,600	16,200	16,500	16,400	16,400
Pioneer Square	7,300	7,100	7,200	7,200	7,300
International District	11,100	11,100	10,700	12,300	11,100
Royal Brougham	500	500	---	---	1,000
Lander	3,600	3,500	---	---	---
Beacon Hill (potential)	4,400	--	---	---	---
I-90/Rainier	---	--	3,100	---	3,100
Poplar Place	---	--	---	600	---
Segment C Totals	*67,000*	*61,200*	*60,200*	*59,100*	*61,800*
System light rail Boardings[2]	*156,200*	*151,700*	*149,000*	*147,400*	*149,800*

Note: [1] Includes Beacon Hill Station.
[2] System light rail boarding totals shown are for the SeaTac to Northgate alternative.

The key ridership forecasting issues for Segment C are:

- The range of total daily light rail system boardings produced by this segment's alternatives in the year 2010 with the Northgate terminus is between 122,800 and 127,900 (a difference of 5,100 or 4 percent). By the year 2020, this range increases to 147,400 to 155,500 (8,100 or 5 percent). In the mid-range is the west of Rainier Avenue S. elevated alternative (C2.3) with 124,000 daily light rail boardings in 2010 and 149,000 daily boardings in 2020.

- The Rainier Avenue tunnel alternative (C2.4) produces fewer daily light rail boardings, as compared to west of Rainier Avenue S. elevated (C2.3), because it lacks a connection to eastside buses at I-90 and does not improve travel time.
- Adding a Beacon Hill tunnel station to the S. Lander Street tunnel (C1) would produce a gain of light rail boardings by improving access to light rail from Beacon Hill and significantly improving travel times from Beacon Hill to the north. However, the boardings at S. McClellan would decrease with a Beacon Hill Station. Overall system boardings would be higher with the Beacon Hill Station. However, light rail boardings in Segment D south of the McClellan Station would slightly decrease due to the decrease in boardings at the McClellan Station.

Segment D (S. McClellan to Boeing Access Road)

Alternative D1.1e (preferred alternative) would result in slightly lower ridership within Segment D and systemwide. Alternative D3.3 would result in the highest daily ridership in the S. McClellan to Boeing Access Road segment. Tables 3.2-11a and 3.2-11b show the breakdown of daily boardings expected at each station in the segment for the years 2010 and 2020.

The key ridership forecasting issues for Segment D are:

- The range of total daily light rail system boardings produced by this segment's alternatives is relatively small due to similar travel times and transit markets among all alternatives.
- Adding stations improves accessibility to light rail and increases boardings in Rainier Valley, but decreases boardings in south King County due to increased travel times to downtown Seattle and the north corridor. With the initial phase of light rail terminating at SeaTac, the net effect on total daily boardings is neutral to positive. Losses of through-riders due to increased travel times would be compounded with southern extensions to light rail in future phases.

Table 3.2-11a
Segment D: Year 2010 Daily Station Usage (Boardings), by Light Rail Alternative

Stations	Alternative				
	D1.1e,f (pref.)	**D1.1c,d**	**D1.3**	**D3.3**	**D3.4**
McClellan	3,300	3,300	3,400	3,300	3,400
Charlestown (Rainier Valley Square)*	---	---	---	1,200	---
Columbia City	---	---	---	---	2,100
Alaska	---	2,100	2,200	---	---
Edmunds*	2,100	---	---	2,000	---
Graham*	2,200	2,200	2,200	2,000	2,200
Othello	800	800	800	700	800
Henderson	3,700	3,700	3,800	3,600	3,800
Segment D Totals	*12,100*	*12,100*	*12,400*	*12,800*	*12,300*
System light rail Boardings[1]	*123,300*	*123,300*	*124,300*	*124,100*	*124,000*

Note: *Denotes potential Station.
[1] System light rail boarding totals shown are for the SeaTac to Northgate alternative.

Table 3.2-11b
Segment D: Year 2020 Daily Station Usage (Boardings), by Light Rail Alternative

Stations	Alternative				
	D1.1e,f[1] *(pref.)*	D1.1c,d	D1.3	D3.3	D3.4
McClellan	4,000	4,000	4,100	4,000	4,100
Charlestown (Rainier Valley Square)*	---	---	---	1,500	---
Columbia City	---	---	---	---	2,700
Alaska	---	2,700	2,800	---	---
Edmunds*	2,700	---	--	2,500	---
Graham*	2,900	2,900	2,900	2,600	2,900
Othello	1,000	1,000	1,000	900	1,000
Henderson	4,700	4,700	4,800	4,500	4,800
Segment D Totals	*15,300*	*15,300*	*15,600*	*16,000*	*15,500*
System light rail Boardings[2]	*148,200*	*148,200*	*149,400*	*149,200*	*149,100*

Note: * Denotes potential station, except in preferred alternative.
[1] Alternative D1.1e represents the preferred alternative. Preferred stations are slightly different and are shown with preferred alternative forecast.
[2] System light rail boarding totals shown are for the SeaTac to Northgate alternative.

Segment E (Tukwila)

The preferred alternative (E1.1) would have lower ridership within Segment E, but overall system ridership would be similar to the other alternatives. Alternative E3 would result in the highest daily ridership in Segment E. Tables 3.2-12a and 3.2-12b show the breakdown of daily boardings expected at each station in the Tukwila segment. As shown in these tables, the Longacres and Southcenter Station combination associated with Alternatives E2 and E3 would generate higher ridership (in Segment E) than the Boeing Access Road and S. 144th Station combination for Alternatives E1.1 and E1.2; however, they would result in little change to total system ridership.

The comparison of Tukwila International Boulevard routes (E1.1 – the preferred alternative, or E1.2) to an Interurban Avenue (E2) or MLK Jr. Way S. (E3) route includes trade-offs between boardings gained at Southcenter and Longacres versus increased travel times of 3.4 to 7.7 minutes for riders heading to or from SeaTac. With the Interurban alternative (E2), the loss of riders to SeaTac is nearly the same as the boardings gained at Southcenter and Longacres.

Table 3.2-12a
Segment E: Year 2010 Daily Station Usage (Boardings), by Light Rail Alternative

Stations	Alternative			
	E1.1 (pref.)	E1.2	E2	E3
Boeing Access Road	1,700	1,800	---	---
South 144th	400	400	---	---
Longacres	---	---	1,900	2,700
Southcenter	---	---	2,100	1,800
Segment E Totals	*2,100*	*2,200*	*4,000*	*4,500*
System light rail Boardings[1]	*124,000*	*124,800*	*123,700*	*125,300*

Note: [1] System light rail boarding totals shown are for the SeaTac to Northgate alternative.
[2] Forecasts for Alternatives E2 and E3 constrain Link ridership from drive access to the Longacres Station, since no parking spaces will be built due to Link beyond those planned by Sounder (commuter rail).

Table 3.2-12b
Segment E: Year 2020 Daily Station Usage (Boardings), by Light Rail Alternative

Stations	Alternative			
	E1.1 (pref.)	E1.2	E2	E3
Boeing Access Road	1,700	1,800	---	---
S. 144th	600	600	---	---
Longacres	---	---	2,000	3,000
Southcenter	---	---	1,700	1,800
Segment E Totals	*2,300*	*2,400*	*3,700*	*4,800*
System light rail Boardings[1]	*149,000*	*149,800*	*149,300*	*151,900*

Note: [1] System light rail boarding totals shown are for the SeaTac to Northgate alternative.

Segment F (SeaTac)

Alternatives F2.3 (preferred alternative), F3.2 and F4 would result in the highest daily ridership in the SeaTac Segment. As shown in Tables 3.2-13a and 3.2-13b, the ridership forecasts for each station are relatively similar for all alternatives. Variations in station placement would result in the small differences in ridership between the alternatives.

Table 3.2-13a
Segment F: Year 2010 Daily Station Usage (Boardings), by Light Rail Alternative

Stations	Alternative					
	F2.3[1]/F4	*F2.3[1] (with 184th)*	F1	F2.1/F2.2	F3.1	F3.2
North SeaTac[2]	2,400	2,300	---	---	---	2,600
North Central SeaTac	3,000	3,000	3,000	3,000	3,000	---
South Central SeaTac	---	100	1,300	1,300	1,300	3,000
South SeaTac	2,100	1,900	2,100	2,100	2,300	2,600
Segment F Totals	*7,500*	*7,300*	*6,400*	*6,400*	*6,600*	*8,200*
System light rail Boardings	*123,100*	*123,200*	*122,700*	*122,700*	*123,100*	*124,000*

Notes: [1] Alternative F2.3 is the preferred alternative
[2] Two potential station locations (S. 154th Street or S. 160th Street) are being considered on International Blvd. in the north central SeaTac area. One of these two alternate sites would be selected depending upon route choices elsewhere in Segments E and F.

Table 3.2-13b
Segment F: Year 2020 Daily Station Usage (Boardings), by Light Rail Alternative

Stations	Alternative					
	F2.3[1] (with 184th)	F2.3[1]/F4	F1	F2.1/F2.2	F3.1	F3.2
North SeaTac	2,500	2,600	---	---	---	2,600
North Central SeaTac	3,000	3,000	3,000	3,000	3,000	---
South Central SeaTac	200	---	1,300	1,300	1,300	3,000
South SeaTac	2,000	2,300	2,100	2,100	2,300	2,600
Segment F Totals	*7,700*	*7,900*	*6,400*	*6,400*	*6,600*	*8,200*
System light rail Boardings	*148,800*	*148,900*	*147,900*	*147,900*	*148,300*	*149,000*

[1] Alternative F2.3 is the preferred alternative

To account for likely underestimation of airport station boardings, Sound Transit staff in 1996 surveyed actual boardings at airport rail stations around the United States. After accounting for differences in airport employment, annual passengers, and transit characteristics in the surveyed cities, Sound Transit estimates that the most likely ridership at Sea-Tac Airport Station would be about 3,000 daily boardings. The estimated 3,000 daily airport station boardings have been consistently applied to the station (in each alternative) that is intended to serve Sea-Tac Airport.

3.2.4 Significant Unavoidable Adverse Transit Impacts

No significant unavoidable adverse transit impacts have been identified.

3.3 ARTERIALS AND LOCAL STREETS

3.3.1 Affected Environment

3.3.1.1 Congestion

The Transportation Technical Report describes the physical characteristics of arterial streets. Figures 3.3-1 through 3.3-6 show the major arterial streets and intersections analyzed for the light rail alternatives.

Level of Service (LOS) is a measure of operational conditions and their perception by drivers; it also describes the quality of traffic operations on roadway facilities. The Highway Capacity Manual (HCM) provides a widely accepted methodology for calculating LOS at signal-controlled intersections. At these intersections, level of service relates to the average delay experienced by all vehicles as they approach the intersection. Table 3.3-1a summarizes the relationship between level of service and average delay for signalized intersections.

As described in Table 3.3-1a, LOS ratings range from "A" to "F." LOS A represents the best operation, and LOS F the poorest. LOS D is usually considered the minimum acceptable standard in urban areas; with this level of service, some delays are expected for certain traffic movements.

The City of Seattle defines arterial level of service standards based on the P.M. peak hour directional volume-to-capacity (v/c) ratio at designated screenlines. (A screenline is an imaginary line across two or more parallel arterials). The City of Seattle's v/c ratios are averaged across a series of parallel arterials to determine if the LOS threshold has been exceeded. The level of service standard is 1.0 (LOS E) at more than half of the screenlines identified in the Comprehensive Plan. The remaining screenlines, including many of the screenlines in the light rail corridor, have a v/c ratio of 1.2 (LOS F). At a v/c ratio of 1.20 or greater, traffic congestion and vehicle queuing at intersections would be expected. When the calculated LOS for a screenline approaches the LOS standards, strategies would be pursued to reduce vehicular travel demand and/or increase the operating capacity across the screenline.

Table 3.3-1a
Level of Service Criteria for Signalized Intersections

Level of Service	Average Delay (seconds per vehicle)	Traffic Flow Characteristics
A	< 5.0	Virtually free flow; completely unimpeded.
B	> 5.0 - < 15.0	Stable flow with slight delays; less freedom to maneuver.
C	> 15.0 - < 25.0	Stable flow with delays; less freedom to maneuver.
D	> 25.0 - < 40.0	High density but stable flow.
E	> 40.0 - < 60.0	Operating conditions at or near capacity; unstable flow.
F	> 60.0	Forced flow; breakdown conditions.

Source: Highway Capacity Manual 1995.

The City of Tukwila has developed LOS standards for its Central Business District (CBD) (Southcenter area) and residential areas. According to these standards, LOS E, with a volume-to-capacity ratio less than or equal to 1.0, would be acceptable for intersections and arterials within the CBD. LOS D, with a v/c ratio less than or equal to 0.90, would be acceptable for residential areas. Individual intersections and/or arterial roadways may exceed the area LOS standard as long as the area average meets the standard.

The City of SeaTac established level-of-service standards for arterial routes where LOS E or better would be considered acceptable on arterials. LOS D or better would be considered acceptable on Collector Arterials and lower classification streets. Some exceptions to these standards exist where improvements are planned or where improvements are not considered feasible.

The Transportation Technical Report describes existing LOS analysis results and P.M. peak hour directional approach volumes for all major signalized intersections that could be impacted by route alternatives and station areas in the light rail system. Table 3.3-1b summarizes all analyzed intersections currently operating at LOS D, E, or F.

3.3.1.2 Non-Motorized Transportation

There are five major regional off-street bicycle trails within the study corridor: the Burke-Gilman Trail, the I-90 Trail, the Duwamish Trail, the Green River Trail and the Interurban Trail. All of these trails form an interconnected system that runs in various directions within the study corridor. Other major proposed facilities include the Chief Sealth Trail, which would extend from Beacon Hill to Renton, the Potlatch Trail, which would provide a route between South Lake Union and the Seattle Center, and the E-3 Busway Path, which would run parallel to light rail in Segment C.

According to a 1995 user-count, the Burke-Gilman Trail near the University of Washington had 2,239 daily bicyclists. The 1985 user-count for this location had 1,591 UW vicinity bicyclists[1]. In ten years, the UW vicinity has experienced a 41 percent increase in users; or an average annual compounded growth rate of 3.5 percent. No additional user counts are currently available.

There are also many regional arterials with bicycle lanes or wide shoulders within the study corridor. These facilities include N.E. Ravenna Boulevard between Greenlake and Brooklyn Avenue N., 17th Avenue N.E., N.E. 40th Street, Eastlake Avenue E. (University Bridge) between N.E. Pacific Street and Fuhrman Avenue E., E. Pine Street between Terry Avenue and 12th Avenue, Broadway E., 12th Avenue E., S. Dearborn Street between Sixth Avenue S. and Poplar Place S., Beacon Avenue S., S. Orcas Street, S. Cloverdale Street, and S. Henderson Street.

Table 3.3-1b
P.M. Peak Hour Level of Service Summary for Existing Intersections Operating at LOS D, E, or F

Analysis Location	Volume/ Capacity	Avg. Delay (Sec.)	LOS	Approach Volumes NB	SB	EB	WB
Segment B (University District to Westlake Station)							
N.E. 45th Street at 15th Ave. N.E.	9.80	29.8	D	614	396	937	942
Mercer Street at Fairview Ave. N.	1.15	60+	F	1490	61	3136	2614
Segment C (Westlake Station to S. McClellan Street)							
I-90 Ramp at 4th Avenue S.	0.92	28.5	D	1302	1530	797	0
Lander Street at 4th Avenue S.	0.98	38.8	D	1148	1069	625	464
Dearborn Street at Rainier Ave. S.	0.89	25.7	D	1315	1264	816	107
Segment D (S. McClellan Street to Boeing Access Road)							
S. McClellan Street at Rainier Ave. S.	0.78	25.1	D	1161	1764	541	366
Segment E (Tukwila)							
Boeing Access Rd. at MLK/Ryan Way	1.196	60+	F	692	1138	1687	274
S. Boeing Access Rd. at E. Marginal Way S.	0.841	28.0	D	628	1988	687	1407
S. 112th St. at Tukwila International Blvd.	1.394	43.9	E	678	1757	548	135
S. 144th St. at Tukwila International Blvd.	0.780	31.5	D	574	1203	406	373
Interurban at 42nd Ave. S./Macadam Rd. S.	0.775	29.1	D	114	306	300	384
Interurban at Gateway Dr.	0.847	29.1	D	978	682	370	514
Interurban at Fort Dent Way	1.161	40.8	E	1305	1046	409	223
Interurban at S.W. Grady Way	0.985	36.8	D	1177	1509	1071	1398

[1] Counts for 1985 and 1995 are total daily counts taken on Tuesdays from 7 A.M. to 7 P.M.

Table 3.3-1b continued

Analysis Location	Volume/ Capacity	Avg. Delay (Sec.)	LOS	Approach Volumes NB	SB	EB	WB
West Valley Highway at S. 156th St.	1.210	28.1	D	1706	939	832	45
West Valley Highway at Strander Blvd.	0.963	40.6	E	1514	1553	771	44
Andover Park W. at Strander Blvd.	0.714	35.1	D	678	622	616	843
Segment F (SeaTac)							
International Blvd. at S. 160th St.	0.826	26.9	D	893	1214	343	442
International Blvd. at S. 170th St.	0.880	29.4	D	965	1236	791	331
International Blvd. at S. 182nd St. (Airport Driveway)	0.762	27.1	D	1212	1556	414	28
International Blvd. At S. 188th	0.893	32.4	D	970	1398	1341	1084
28th Ave. S. at Air Cargo Rd. S./S. 188th St.	0.567	27.0	D	184	196	1074	821
International Blvd. at S. 200th St.	0.989	48.9	E	965	1540	530	576

Bicycle volumes on arterials are not regularly counted, but in 1997 an estimated 2,100 bicycles per day entered the downtown Seattle area.

King County Metro, Community Transit and Pierce Transit have equipped all buses with racks that can carry two bicycles. Metro estimates that the "Bikes-on-Buses" program transports 465,000 bikes a year. Transit routes serving the SR 520 Evergreen Point Bridge have especially high demands for bicycle racks; capacity deficiencies primarily occur during morning peak period between 6 and 9:30 A.M.

The number of streets lacking sidewalks is the highest in Segments D, E, and F. Most street segments lacking sidewalks are in residential neighborhoods or local access streets. Most arterial street segments currently have sidewalks. A detailed list of locations lacking sidewalks is provided in the Transportation Technical Report.

School walk route information obtained from the Seattle, Highline, and Tukwila School districts was used to determine the location of existing walk routes that cross or are adjacent to any of the proposed light rail alternatives. The Transportation Technical Report summarizes school walk routes for each segment.

3.3.1.3 Traffic Accidents and Safety

In the light rail corridor, 24 intersections had an average of over 10 accidents a year between 1994 and 1996. Ten of the high accident locations are in Seattle, seven are in Tukwila, and seven are in the City of SeaTac. These locations are listed in Table 3.3-2. In Seattle, the high accident locations are in corridors that serve some of the highest traffic volumes in the study corridor. In both Tukwila and SeaTac, improvements have been made that will likely improve safety and lower annual accident rates. No fatalities occurred at the high accident intersections in Seattle and Tukwila, and three accidents in SeaTac involved fatalities.

Table 3.3-2. Existing High Accident Locations – By Segment.

Segment/Intersection	Average Annual Accidents (1994 – 1996)
Segment B	
N.E. 50th Street/15th Avenue N.E.	11.0
Broad Street/Thomas Street/5th Avenue N.	10.3
Broad Street/9th Avenue N.	11.3
Mercer Street/9th Avenue N.	31.0
Mercer Street/Westlake Avenue N.	17.0
Denny Way/Broad Street	10.0
E. John Street/Broadway E.	10.7

Table 3.3-2 continued

Segment/Intersection	Average Annual Accidents (1994 – 1996)
Segment C	
Beacon Avenue S./S. McClellan Street	11.3
Segment D	
S. Othello Street/MLK Jr. Way S.	10.7
S. Orcas Street/Rainier Avenue S.	15.3
S. Henderson Street/Renton Avenue S.	11.0
Segment E	
Boeing Access Road/MLK Jr. Way S./S. Ryan Way	24.7
Boeing Access Road/E. Marginal Way S.	12.7
Tukwila International Blvd./S. 116th Street	14.7
Tukwila International Blvd./S. 144th Street	13.0
Interurban Avenue S./S. Grady Way	14.7
Andover Park W./Strander Blvd.	11.0
W. Valley Highway/Strander Blvd.	12.7
Segment F	
S. 154th Street/International Blvd.	25.0
SR 518 Eastbound On-Ramp/International Blvd.	10.7
S. 160th Street/International Blvd.	27.3
S. 170th Street/International Blvd.	20.0
Sea-Tac Airport Access/International Blvd.	17.0
S. 188th Street/International Blvd.	29.3
S. 200th Street/International Blvd.	14.0

Notes: Between January 1994 and December 1996, these locations averaged over 10 accidents per year.

3.3.1.4 Parking Supply and Demand

Local jurisdiction zoning codes govern the operation of the existing parking supply and development of future parking resources in the light rail corridor. Comprehensive Plan policies encourage use of bus transit, bicycle, and pedestrian travel modes. Parking policies are an important component of strategies to emphasize alternatives to single-occupant vehicle travel.

Parking supplies and costs vary throughout the corridor, ranging from high parking supplies and relatively high costs in downtown Seattle and around Sea-Tac Airport, to no or low parking costs in Northgate, Tukwila and the Rainier Valley. Likewise, parking demand varies, with relatively high demand in downtown Seattle, the University District, around Sea-Tac Airport, and at Northgate and Southcenter malls, and significantly lower parking demand in other locations.

The analysis for parking supply, demand and potential parking impacts from light rail focused on areas with the greatest potential impact, particularly areas within an approximate ¼-mile radius of proposed or potential station areas (reasonable maximum walking distance for this activity). Parking impacts may result from light rail patrons parking in residential neighborhoods or commercial areas with unrestricted parking. This type of parking is referred to as "hide and ride."

In addition to parking inventory data, current parking demand data was surveyed to identify areas where impacts would be more significant and/or mitigation measures could be beneficial. Parking demand data were collected and analyzed for the same areas described above, and included a space occupancy count by block face, taken once during the hours of 9:30 A.M. to 3:30 P.M. on weekdays, generally during March or April 1998. This time period was determined to represent "typical" conditions for parking demand based on the type of land use surrounding each of these station areas.

Parking supply and demand were inventoried and summarized in four categories:

- on-street unrestricted parking includes all on-street parking not restricted by meters, time limit signs, residential parking zones, loading zones or other restrictions
- on-street restricted includes all on-street parking currently restricted by one of the above methods
- off-street public parking includes all spaces open for anyone to use
- off-street private parking includes all spaces reserved for a particular business or other use

Table 3.3-3a summarizes on-street unrestricted parking supply and demand at all proposed station area locations. The Northgate, University District, Roy/Aloha, Capitol Hill, First Hill, South Lake Union, and Seattle Center Station areas appear to be at or near capacity in the on-street unrestricted category. Within other station areas there is a greater availability of unrestricted on-street parking.

Because mid-day surveys indicated that little parking would be available for hide-and-ride activity, A.M. parking demand counts (between 7 and 9:30 A.M.) were also conducted for the University District, Capitol Hill, and First Hill stations to assess early morning space availability. Table 3.3-3b summarizes the results of these A.M. parking surveys. The surveys showed that on-street unrestricted parking is currently fully utilized (95 to 101 percent utilized) before 9:30 A.M. within 0.25-mile radius of these stations.

3.3.1.5 Transportation Plans

Transportation improvement plans in the study corridor exist at state, regional and local levels of government. The Washington State Department of Transportation's State Highway System Plan identifies state highway improvements. The Puget Sound Regional Council's Metropolitan Transportation Plan and Six-Year Action Strategy identify regional projects. Comprehensive plans and Six-Year Transportation Improvement Programs for Seattle, Tukwila and SeaTac identify local transportation improvements for each city. Appendix M.1 summarizes the transportation improvements assumed for the Year 2010 and 2020 No-build and light rail alternative networks.

3.3.2 Local Impacts and Mitigation

Localized long-term traffic impacts are measured in terms of year 2010 and 2020 level of service or volume-to-capacity changes at intersections, compared to the No-build Alternative. These impacts could result from changes in traffic volumes related to the provision of light rail service. For instance, local traffic volumes could increase due to ingress to and egress from proposed station areas and park-and-ride lots. Other long-term impacts could result from light rail signal priority treatments at intersections, at-grade light rail crossings, and other access, circulation and roadway modifications required for light rail right-of-way and operations. Short-term access and circulation impacts are discussed in Section 4.17.1 Construction Impacts. Non-motorized facility and parking impacts associated with light rail stations and park-and-ride lots are also discussed by segment. Potential mitigation measures that would address the segment's local traffic impacts are summarized. Alternatives and stations associated with the preferred alternative are italicized in all tables.

Table 3.3-3a
Existing (1998) On-Street Unrestricted Parking Inventory Near Proposed Light Rail Stations[1]

Station	Supply	Demand	% Utilization
Northgate	223	214	96
Roosevelt	1256	837	67
University District (All Stations) [2]	870	841	97
Potential Roy/Aloha	692	684	99
Capitol Hill	814	780	96
First Hill	238	236	99
Eastlake	561	370	66
South Lake Union	718	642	89
Seattle Center	315	309	98
Royal Brougham	606	468	77
Poplar	657	339	52
I-90	993	255	26
Lander	589	374	63
Beacon Hill	1862	585	31
McClellan	520	277	53
Charlestown (Rainier Valley Square)	1356	247	18
Genesee	917	270	29
Alaska	913	248	27
Edmunds	1385	268	19
Columbia City	1390	484	35
Graham	2161	372	17
Othello	925	120	13
Henderson	523	91	17
S. 144th St.	39	13	33
Longacres	None	None	None
Southcenter	None	None	None
North SeaTac (S. 154th St.)	75	2	3
North SeaTac (S. 160th St.)	None	None	None
North Central SeaTac	134	29	22
South Central SeaTac	124	55	44
South SeaTac	55	6	11

Note: The preferred alternative is in italics.

[1] Parking inventory reflects unrestricted on-street parking available within a 0.25-mile radius of each station. Parking demand was surveyed during mid-week between 9:30 A.M. and 3:30 P.M.

[2] Surveys conducted in the University District extend approximately 2,000 ft north of the N.E. 45th Station, to N.E. 55th Street

Table 3.3-3b
Existing (1999) AM (7-9:30 AM) On-Street Unrestricted Parking Inventory Near Proposed Light Rail Stations

Station	Supply	Demand	% Utilization
University District (All Stations) [1]	888	899	101
Capitol Hill	690	657	95
First Hill	241	242	100

Note: [1] Surveys conducted in the University District extend approximately 2,000 ft north of the N.E. 45th Station, to N.E. 55th Street.

3.3.2.1. Segment A (Northgate to University District)

Figure 3.3-1 shows the traffic and parking analysis locations for Segment A.

Congestion

Table 3.3-4 summarizes the 2010 and 2020 No-build and light rail project LOS evaluation results. LOS was only calculated for the year 2020 at intersections that would be expected to operate at LOS C and 20 or more seconds of delay per vehicle in the year 2010. With the No-build Alternative, all intersections in the project area would operate at acceptable levels during the P.M. peak hour in the years 2010 and 2020, except for the N.E. 100th Street/First Avenue N.E. intersection, which would operate at LOS F in the year 2020. The N.E. 100th Street/First Avenue N.E. intersection would also operate at LOS F with all light rail alternatives in the years 2010 and 2020. In the year 2020, the N.E. 103rd Street/First Avenue N.E. intersection would also be expected to operate at LOS F. The additional traffic from the expanded Northgate Park-and-Ride lot would increase traffic congestion at these intersections.

Access and Circulation

Segment A alternatives have subway, elevated, or retained cut-and-fill profiles. Elevated-profile sections are located just east of I-5, minimizing property-access impacts. No traffic access or circulation impacts occur in this segment except for a short transition area from a tunnel to elevated section north of the Roosevelt Station and N.E. 65th Street (A2.1 and A2.2). The rail alignment transition area could relocate the Eighth Avenue N.E./N.E. 66th Street/Weedin Place N.E., Eighth Avenue N.E./N.E. 67th Street, Eighth Avenue N.E./N.E. 68th Street, and I-5 NB Off-Ramp/N.E. 59th Street intersections for Alternative A2.1 and the I-5 NB off-ramp/N.E. 59th Street intersection for Alternative A2.2.

Traffic Safety

No significant traffic safety impacts would occur with any of the alternatives.

Table 3.3-4 Segment A: P.M. Peak Hour Level of Service Summary 2010 and 2020 No-Build and Project Conditions

Nearest Station	Intersection	No-build Alternative		Alternatives A1.1 and A1.2		Alternatives A2.1 and A2.2	
		2010	2020	2010	2020	2010	2020
Northgate	N.E. 103rd St. at First Ave. N.E.	D (25.2)	D (26.0)	D (28.8)*[1]	E (53.0)[1]	D (26.7)*[2]	E (41.1)[2]
	N.E. 100th St. at First Ave. N.E.	C (19.5)	F (1.77)*	F (1.38)*[1]	F (2.52)*[1]	F (1.49)*[2]	F (2.71)*[2]
Roosevelt	N.E. 65th St. at Eighth Ave. N.E.	B (14.1)	—	C (15.1)	—	C (15.6)	—
	N.E. 65th St. at Roosevelt Way N.E.	C (18.2)	C (20.3)	C (19.7)	C (21.0)	C (20.2)	C (21.1)
	N.E. 65th St. at 12th Ave. N.E.	C (22.0)	C (23.6)	C (24.1)	C (26.4)	C (24.4)	C (26.7)
	N.E. Ravenna Blvd. at Roosevelt Way N.E.	C (23.7)	D (32.8)	D (25.2)	D(34.7)	D (25.2)	D (34.1)
	N.E. Ravenna Blvd. at 11th Ave. N.E.	C (17.5)	—	C (16.9)	—	C (16.9)	—

Sources: 2010 LOS Calculations, HNTB, 1998.
2020 LOS Calculations, Heffron Transportation, 1999.

Notes: * Average delay could not be calculated by HCM volume-to-capacity ratio shown
( ) Average intersection delay, in seconds per vehicle
[1] Northgate Station Option A: All Alternatives
[2] Northgate Station Option B: All Alternatives

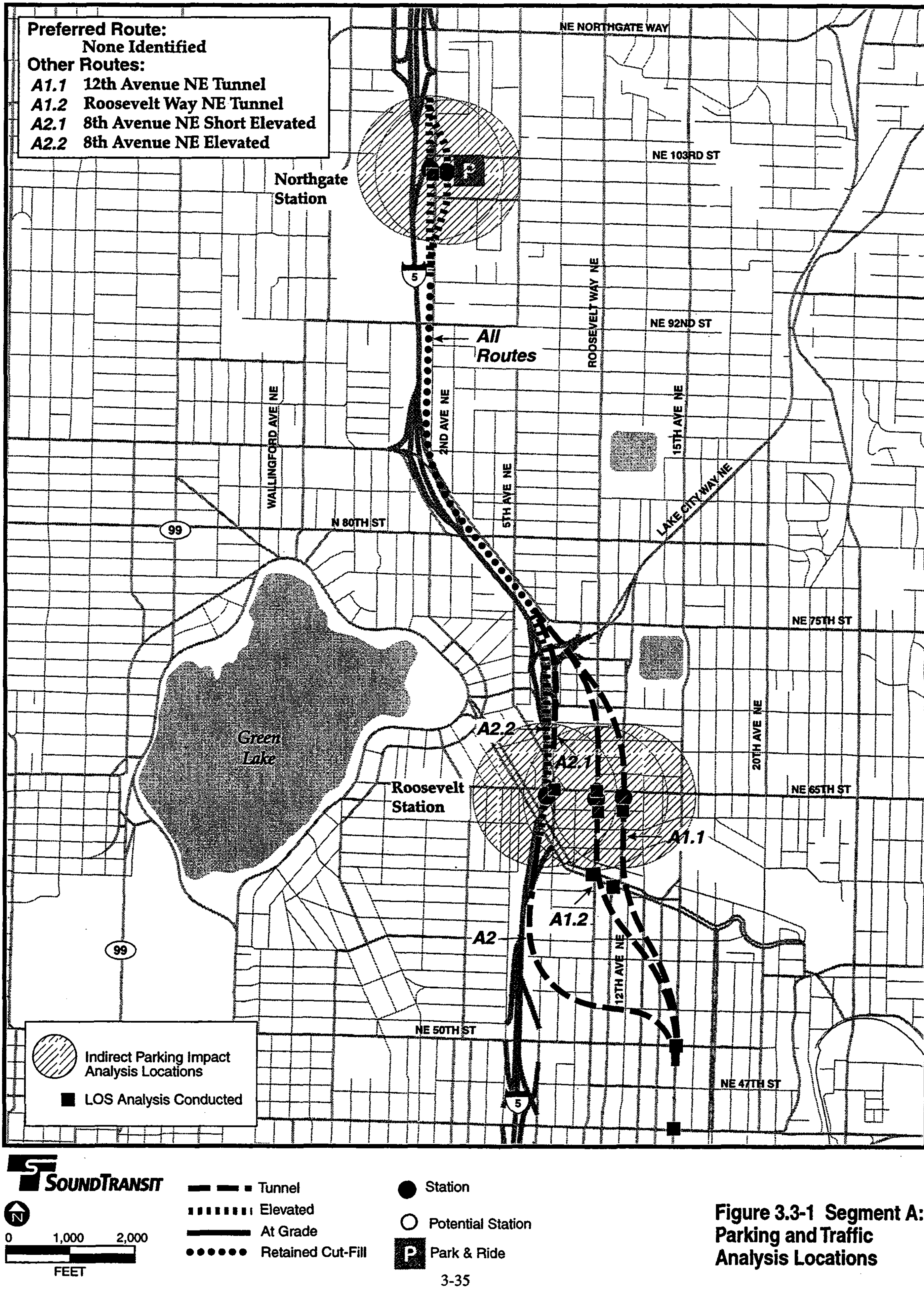


Figure 3.3-1 Segment A: Parking and Traffic Analysis Locations

Non-Motorized Facility Impacts

Table 3.3-5a summarizes the number of pedestrian trips expected in Segment A. Table 3.3-5b shows the proposed bicycle storage facilities that would be provided in Segment A.

Table 3.3-5a
Segment A: Non-Motorized Facility Impact Summary

Station	2010 P.M. Peak Period Walk Trips[1]		2020 P.M. Peak Period Walk Trips[1]		Proposed Pedestrian Facilities
	Ingress	Egress	Ingress	Egress	
Northgate	590	1,495	790	1,975	Overpass or underpass from light rail platform to park-and-ride structure (option B only)[2]
Roosevelt	60-100	685-740	65-115	780-895	Potential grade-separated station walkways under 12th Ave. (Alt. 1.1) and under Roosevelt (Alt. 1.2)

Notes: [1] Walk trips are summarized for the P.M. peak 3-hour period. Walk-trip range reflects different estimates for each station option. (Source: Sound Transit)
[2] A potential overpass is also being considered for station Option A.

All potential station locations have been evaluated for their impact on current and future pedestrian and bicycle access through the vicinity of the station. In the Roosevelt Station vicinity, bicycle route connections are lacking between the Roosevelt Station and existing bicycle routes on N.E. 70th Street, N.E. 65th Street, N.E. Ravenna Boulevard, and 20th Avenue N.E. Table 3.3-5b summarizes bicycle facilities proposed for the stations in Segment A.

Table 3.3-5b. Proposed Bicycle Facilities for Segment A

Station Name	Proposed Bicycle Facilities	Proposed Quantity	Proposed Expansion Area
Northgate	Racks and lockers	Storage for 24 bikes	1,200 ft^2
Roosevelt	Racks	Storage for 20 bikes	1,200 ft^2

Note: Facilities would be sheltered.

Parking Impacts

Overall, the four alternatives would have very similar parking impacts, with a loss of 8 to 18 on-street parking spaces, and 140 to 196 off-street spaces (Table 3.3-6a). Alternatives A1.1, A1.2, and A2.2 would have no impacts from the trackway sections; Alternative A2.1 would displace up to 10 on-street spaces. Most of the parking impacts would be caused by station alternatives, which are summarized in Table 3.3-6b.

The proposed 1,300-space park-and-ride lot for the Northgate Station would meet the highest estimated parking demand from light rail, after accounting for existing park-and-ride spaces displaced by the station and the parking structure. The combined area around the three Roosevelt Station options would have nearly 800 unrestricted parking spaces within a quarter-mile radius. Some hide-and-ride parking by light rail patrons would be expected in this station area.

Table 3.3-6a
Segment A: Parking Impacts Summary

Alternative	Parking Spaces Removed	
	On-Street	Off-Street
A1.1 12th Avenue Tunnel	18	140 to 196
A1.2 Roosevelt Way	10	140 to 196
A2.1 8th Avenue Short Elevated	18	140 to 196
A2.2 8th Avenue Elevated	8	140 to 196

Table 3.3-6b
Segment A: Parking Impacts in Station Areas

Station	Spaces Displaced	Area Affected by Displacement
Northgate Station (Option A)Station	140	North Seattle Park-and-Ride lot
1,300-space parking structure	196	Northgate Transit Center Park-and-Ride lot
Northgate (Option B) Station	196	Northgate Transit Center Park-and-Ride lot
1,300-space parking structure	180	Surface lot next to Northgate Transit Center
Northgate (Option C) Station	140	North Seattle Park-and-Ride lot
1,300-space parking structure	196	Northgate Transit Center Park-and-Ride lot
Roosevelt Option (A1.1)	18	On N.E. 65th St.
Roosevelt Option (A1.2)	10	South side of N.E. 64th Street
Roosevelt Options (A2.1, A2.2)	8	On N.E. 65th St.

Mitigation

The N.E. 103rd Street/First Avenue N.E. intersection operations would improve from LOS E to LOS D with all light rail alternatives in 2020 by converting the signal to a five-phase signal and optimizing signal timing. This improvement would likely require some additional signal hardware (for overlapping eastbound right turn) and some signal controller modifications.

The combination of very large pedestrian volumes crossing First Avenue N.E. and new (conflicting) westbound-to-northbound right turns result in operational failure at the N.E. 100th Street/First Avenue N.E. intersection. Three possible mitigation options were evaluated.

1. The intersection would operate at LOS C with all light rail alternatives if a pedestrian bridge or tunnel is constructed over First Avenue N.E. Based on the forecast traffic volumes, a three-phase signal should operate well. Phasing would occur as follows: Phase 1, eastbound and westbound would proceed with permissive lefts in both directions (as exists today); Phase 2, southbound lefts, thrus, and rights would proceed with overlapping westbound rights; Phase 3, southbound lefts (permissive), thrus and rights would proceed with northbound thrus and rights. This improvement will likely require some additional signal hardware (for the southbound protected left-turn, and the overlapping westbound right-turn) and some signal controller revisions.
2. If a pedestrian bridge or tunnel is not constructed over First Avenue N.E., the intersection would operate at LOS D for all light rail alternatives with the addition of a second westbound right-turn lane. This improvement would serve the most light rail traffic; however, it would also conflict with the heaviest pedestrian traffic volumes. This improvement would also require widening of northbound First Avenue N.E. (to provide two receiving lanes) north of N.E. 100th Street. A three-phase signal, as described above, should operate well based on the forecast traffic volumes. Some additional signal

hardware may be required with this improvement (for the southbound protected left-turn, and the overlapping westbound right-turn) and some signal controller revisions.

3. If a pedestrian bridge or tunnel is not constructed over First Avenue N.E., the intersection would operate at LOS F for Alternatives A1.1/A1.2 and A2.1/A2.2 (v/c=1.26 and 1.25, respectively) with the construction of a northbound-to-eastbound right-turn lane. While the intersection would continue to operate at LOS F in 2020 with the project, the improvement would improve the v/c ratio to better than no-build conditions (v/c=1.77). A three-phase signal, as described previously, should operate well based on the forecast traffic volumes. Some additional signal hardware may be required with this improvement (for the southbound protected left-turn, the overlapping westbound right-turn, and the overlapping northbound right-turn) and some signal controller revisions.

To further improve non-motorized access, Sound Transit would work with local public transportation agencies, communities and local governments to place and design transit facilities that fit with local community plans. These facilities could include improvements within one-quarter mile for pedestrian and one-half mile of each station for safe, easy bicycle access, consistent with the Sound Transit policy recommendations for bicycle access. Sidewalks on or immediately adjacent to light rail station property would be provided. At minimum, existing sidewalk widths would be maintained and any improvements would be sufficiently wide to accommodate pedestrian volumes from light rail and will be designed to conform to City standards. With respect to bicycles at all new stations/facilities, Sound Transit would:

- Design facilities to provide ample space for maneuvering bicycles in and through stations and on to vehicles.
- Provide a mix of storage lockers and locking racks.
- Provide storage areas open to circulation, on direct paths from access points, but not impeding pedestrian and vehicular traffic flows.
- Designate areas, where possible, for storage expansion to accommodate bicycle access increases.

The potential for hide-and-ride and the best ways to mitigate the impact are unique to each individual station area. Sound Transit will conduct additional parking surveys of on-street unrestricted parking supply within proposed station areas where signficant potential for hide-and-ride activity exists. The pre-project survey will occur approximately six months prior to Link system opening. The survey study area and times are identified for each station area below.

Approximately six months after Link system opening, Sound Transit will repeat the surveys described below for all locations and times. In cases where on-street parking utilization is greater than 90 percent, the surveys after system opening will focus on whether utilization is increasing in areas greater than ¼ mile from that station. Parking surveys will be collected on two consecutive weekdays similar to the surveys conducted before the Link system opens. The results of all surveys will be used to identify potential mitigation measures.

Mitigation measures will be identified on a case-by-case basis for all locations where parking surveys show that 50 percent or more of unutilized parking spaces prior to Link implementation are utilized after Link begins operation.

This increase threshold will be used for each block face to assess whether mitigation should be considered. For locations exceeding the parking utilization threshold, Sound Transit will work with the local jurisdictional staff to determine the appropriate mitigation for each block face, if any.

Potential mitigation measures include new or expanded residential parking zones (RPZs), hourly and day of week parking restrictions, parking meters, monitoring of use, enforcement and public education campaigns. RPZs are generally applicable on residential streets with greater than 75 percent parking utilization, while parking restriction signs and meters are more applicable in commercial business areas.

For locations where the mitigation is accepted and approved by City staff and local community or neighborhood groups, Sound Transit would likely provide proportionate funding for direct start-up costs of mitigation. In the case of residential parking zones, Sound Transit expects the affected City to recoup any on-going monitoring, enforcement, education and other costs from parking fines and permit fees.

3.3.2.2 Segment B (University District to Westlake Station)

Figure 3.3-2 shows the traffic and parking analysis locations for Segment B. In most locations, there is little difference between year 2010 and 2020 conditions under the No-build, preferred and other alternatives. For this segment, the preferred alternative is B1.1a. The N.E. 45th Station would be the northern terminus for the preferred, MOS A and MOS B alternatives, and the Capitol Hill Station would be the northern terminus for MOS C. The MOS alternatives would result in lower daily ridership at the light rail stations than the preferred and other full-length alternatives. Therefore, traffic impacts are also expected to be less significant.

Congestion

Table 3.3-7 summarizes the 2010 and 2020 LOS analysis results for the No-build, preferred, and other alternatives for all major signalized intersections that could be impacted by light rail route alternatives and station areas in this segment. LOS was only calculated for the year 2020 at intersections that would be expected to operate at LOS C and 20 or more seconds of delay per vehicle in the year 2010. All LOS calculations include increases in pedestrian, transit vehicle, and other vehicle volumes associated with the No-build and Build alternatives.

Most intersections would operate at acceptable levels during the P.M. peak hour in 2010 and 2020. Exceptions include the Mercer Street/Fairview Avenue N. intersection, which would operate at LOS F with the No-build, preferred and all other light rail alternatives by the year 2010, and the E. John Street/Broadway Avenue E intersection, which would operate at LOS F in the year 2020 with the light rail project.

The N.E. 45th Street/15th Avenue N.E. intersection would be expected to operate at acceptable levels in the years 2010 and 2020 with the No-build, preferred and other light rail alternatives if the N.E. 45th Station is constructed on the east side of 15th Avenue N.E. (station options A and B). However, additional signal timing optimization may be required to accommodate additional bus traffic (depending on how many buses make the northbound left turn from 15th Avenue N.E. once King County Metro service integration plans are finalized) and increased pedestrian activity. The LOS and delays shown in Table 3.3-7 represent worst case conditions with the northern terminus located at the N.E. 45th Station (options A and B). Saturation flow rates at the N.E. 45th Street/15th Avenue N.E. intersection were also manually adjusted, based on multiple field observations, to accurately represent current conditions. With a Northgate terminus, vehicle trips would decrease by 22 in 2010 and by 46 by 2020, which would slightly improve intersection delays. With N.E. 45th Station Option C, the N.E. 45th Street/15th Avenue N.E. intersection would operate at LOS E in the year 2020.

Access and Circulation

Few property access and circulation impacts are expected, since no alternatives include an at-grade profile, and all proposed elevated sections (Alternatives B2.1 and B2.2) are located off-street or in areas where left turns are already prohibited. The only impact caused by the light rail alternatives would be the closure of the Ninth Avenue N.E. access to N.E. Campus Parkway (Alternative B2.1). With N.E. 45th Station Option C, N.E. 43rd Street would be closed between 15th Avenue N.E. and the alley east of University Way. With this closure, traffic destined for the private parking lot east of the University Bookstore would need to access the lot from the west.

Traffic Safety

No significant traffic safety impacts would occur with the preferred or other light rail alternatives.

Table 3.3-7 Segment B: P.M. Peak Hour Level of Service Summary 2010 and 2020 No-Build and Project Conditions

Nearest Station	Intersection	No-Build		*Alternative B1*		Alternative B2.1		Alternative B2.2	
		2010	2020	*2010*	*2020*	2010	2020	2010	2020
N.E. 45th	N.E. 50th St. at 15th Ave. N.E.[2]	C (15.1)	—	B (15.0)	—	C (15.1)	—	B (15.0)	—
	N.E. 45th St. at 15th Ave. N.E.[2]	D (28.1)	D (31.0)	D (38.2)[4]	D (39.7)[4]	D (33.9)[4]	D (39.2)[4]	D (38.2)[4]	D (39.7)[4]
	N.E. 43rd St. at 15th Ave. N.E.	B (6.8)	B (7.0)	B (6.9)[4]	B (7.0)[4]	B (6.9)[4]	B (7.0)[4]	B (6.9)[4]	B (7.0)[4]
Campus Pkwy.	N.E. Campus Pkwy at 15th Ave. N.E.	B (10.6)	—	B (11.2)	—	B (11.5)	—	B (11.2)	—
	N.E. 40th St. at 15th Ave. N.E.	B (11.5)	—	B (11.9)	—	B (11.9)	—	B (11.9)	—
Pacific	N.E. Pacific St. at 15th Ave. N.E.	C (24.1)	D (26.8)	D (31.1)	D (37.2)	D (25.4)	D (35.4)	D (31.1)	D (37.2)
	Eastlake Blvd. at Fuhrman Ave.	C (22.3)	D (25.9)	C (22.8)	D (26.3)	C (22.9)	D (26.3)	C (22.8)	D (26.3)
Eastlake	Fairview Ave. N. at Eastlake Ave. E.	B (9.1)	B (9.5)	—[1]	—[1]	B (9.2)	B (9.7)	B (9.2)	B (9.7)
	Valley St. at Fairview Ave. N.[2]	C (21.8)	—	—[1]	—	C (23.6)	—	C (23.6)	—
South Lake Union	Valley St. at Broad St./Westlake Ave. N.[2]	B (6.7)	—	—[1]	—	B (6.7)	—	B (6.7)	—
	Broad St. at 9th Ave. N.[2]	C (17.3)	—	—[1]	—	C (17.6)	—	C (17.6)	—
	Mercer St. at 9th Ave. N.[2]	C (17.6)	—	—[1]	—	C (17.6)	—	C (17.6)	—
	Mercer Street at Westlake Ave. N.[2]	C (21.3)	C (21.9)	—[1]	—[1]	C (22.0)	C (23.9)	C (22.0)	C (23.9)
	Mercer Street at Fairview Ave. N.	F (1.25)*	F (1.72)*	—[1]	—[1]	F (1.26)*	F (1.73)*	F (1.26)*	F (1.73)*
Seattle Center	Thomas St. at 5th Ave. N.	C (16.2)	—	—[1]	—	C (16.7)	—	C (16.7)	—
	Denny Way at Broad St.	C (17.2)	—	—[1]	—	C (17.1)	—	C (17.1)	—
First Hill	E. Madison St. at Summit Ave. E.	A (4.9)	—	A (4.9)	—	—[1]	—	—[1]	—
Roy/ Aloha	E. Aloha St. at 10th Ave. E.[3]	B (13.4)	—	C (17.8)	—	—[1]	—	—[1]	—
Capitol Hill	E. Denny Way at Broadway Ave. E.	B (13.8)	—	B (14.8)	—	—[1]	—	—[1]	—
	E. John St. at Broadway Ave. E.	C (17.1)	D (35.0)	C (22.8)	F (1.17)*	—[1]	—[1]	—[1]	—[1]

Sources: ( ) Average intersection delay, in seconds per vehicle
* Average delay could not be calculated by HCM. Volume-to-capacity ratio is shown.
The preferred alternative is shown in italics.
2010 LOS Calculations, Heffron Transportation and Parametrix, Inc., 1998.
2020 LOS Calculations, Heffron Transportation, 1999.
Some stations may not be included in the preferred alternative.

Notes: [1] LOS expected to be the same as for the No-build Alternative.
[2] Level of service for these intersections does not reflect the potential downstream effects from queuing since the HCM methodology assumes that each intersection is isolated from any residual traffic congestion impacts. Therefore the actual LOS may be worse than shown in the table; however, the relative difference between the No-Build and light rail alternatives would be similar. The 45th Street terminus was also assumed to represent worst case scenarios.
[3] LOS analysis at this intersection assumes that the potential Roy/Aloha station is constructed.
[4] These intersections were analyzed, assuming that the N.E. 45th Station would be located on the east side of 15th Avenue N.E. (options A and B). With the N.E. 45th Station located on the west side of 15th Avenue N.E. (Option C), the N.E. 15th Street/15th Avenue N.E. intersection would operate at LOS E (45.8 seconds of delay/vehicle), the N.E. 43rd Street/15th Avenue N.E. intersection would operate at LOS A (5.0 seconds of delay/vehicle), and the N.E. Campus Parkway/15th Avenue N.E. intersection would operate at LOS B (14.7 seconds of delay/vehicle) in the year 2020.

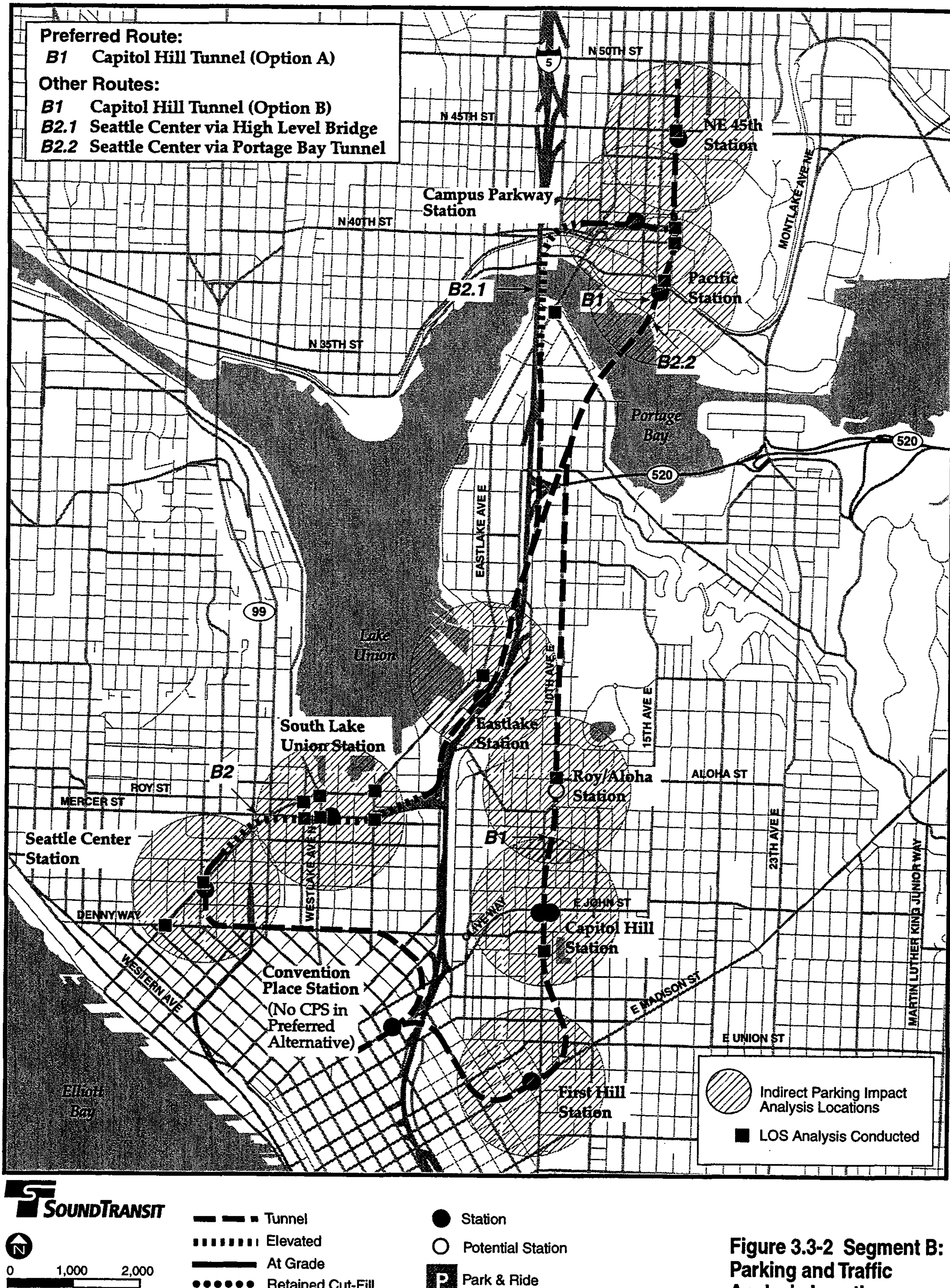


Figure 3.3-2 Segment B: Parking and Traffic Analysis Locations

Non-Motorized Facility Impacts

Table 3.3-8a summarizes the number of pedestrian trips expected and proposed pedestrian facilities in Segment B for the preferred and all other light rail alternatives. Pedestrian and bicycle facilities are sufficient, except for direct bicycle connections to the Eastlake, S. Lake Union, and Seattle Center stations for Alternatives B2.1 and B2.2. Table 3.3-8b summarizes the bicycle storage facilities proposed for stations in Segment B.

Table 3.3-8a
Segment B: Non-Motorized Facility Impact Summary

Station	2010 P.M. Peak Period Walk Trips[1]		2020 P.M. Peak Period Walk Trips[1]		Proposed Pedestrian Facilities
	Ingress	Egress	Ingress	Egress	
N.E. 45th	1,440–1,650	1,520	1,880–2,250	1,815–2,000	Potential grade-separated walkway under 15th Ave. N.E.
Pacific[2]	2,790–3,415	670–740	3,140–3,690	850–995	None
Campus Parkway	1,410	425	1,585	540	Grade-separated platform under Campus Parkway
Roy/Aloha (potential)	775	890	970	1,010	Potential grade-separated platform under 10th Ave E
Capitol Hill	1,510–2,265	2,320–3,190	2,835	3,610	Potential grade-separated platform under Broadway
First Hill	2,365	1,190	2,575	1,275	None
Eastlake	240	620	295	1,060	Pathway to Eastlake
S. Lake Union	485	150	600	220	Grade-separated walkways over Westlake and Terry Avenue
Seattle Center	1,580	670	1,885	930	None

Notes: [1] Walk trips are summarized for the P.M. peak 3-hour period. (Source: Sound Transit)
[2] Pacific Station entrances would be designed to minimize impacts to bicycle flow on the Burke-Gilman Trail.
Stations associated with the preferred alternative are shown in italics.

Table 3.3-8b. Proposed Bicycle Parking Facilities for Segment B

Station Name	Proposed Bicycle Parking Facilities	Proposed Quantity	Proposed Expansion Area
N.E. 45th Street	Racks and lockers	Racks for 40, Lockers for 8	1,250 ft^2
Pacific Street	Racks and lockers or Bike Station	At least 130[1]	N/A
Campus Parkway	Racks and lockers	Racks for 40, Lockers for 8	1,150 ft^2
Roy/Aloha	Racks	Racks for 20	1,200 ft^2
Capitol Hill	Racks	Racks for 20	760 ft^2
First Hill	Racks	Racks for 20	1,000 ft^2
Convention Place	Racks	Racks for 20	400 ft^2
Eastlake	Racks	Racks for 20	950 ft^2
S. Lake Union	Racks	Racks for 20	950 ft^2
Seattle Center	Racks	Racks for 20	950 ft^2

Note: Facilities would be sheltered.
[1] A 3,000 ft^2 area is available for bicycle parking at the Pacific Station. This would accommodate at least 130bicycles assuming a ratio of 20 bicycle racks per 450 ft, though a higher capacity bicycle storage type is being pursued for this site.
Stations associated with the preferred alternative are shown in italics.

Bicycle demand estimation methods are not necessarily reliable for predicting bicycle storage needs in the University District and Capitol Hill neighborhoods, due to the close proximity of proposed stations to campus environments. Therefore, expansion areas will be provided at most stations. Pedestrian volumes for the Seattle Center Station are for an average weekday. On days with large events at Seattle Center, pedestrian walk trips could be substantially higher. All sidewalks near light rail stations in Segment B are currently at least 5 ft wide (the minimum standard sidewalk width) and are expected to operate at LOS D or better. The large number of riders entering and exiting the Pacific Station could potentially have a significant impact on the Burke-Gilman Trail, which runs parallel to Pacific Street. However, the current conceptual plan for the Pacific Station (Option B), shown in Appendix H, minimized this impact by providing station locations away from the Burke-Gilman Trail and closer to other pedestrian crossings.

Parking Impacts

Parking displacements for Segment B alternatives are summarized in Table 3.3-9a. The preferred alternative, the Capitol Hill tunnel (Alternative B1), would result in a loss of 27 to 31 on-street and 0 to 10 off-street spaces at station areas. Since the preferred alternative (Alternative B1) is entirely in a tunnel, it would have no trackway-related impacts. The B2 alternatives would have higher impacts overall than Alternative B1. Alternatives B2.1 and B2.2 would result in a loss of 55 to 59 and 19 to 23 on-street spaces, respectively, and both would displace 40 to 50 off-street spaces. There would be few parking impacts for the trackway sections of Alternatives B2.1 and B2.2, with losses typically lower than 10 to 20 spaces in any location. Alternative B2.1 would displace on-street parking on Campus Parkway and Harvard Avenue E. (approximately 33 spaces); both B2.1 and B2.2 would displace up to 40 surface parking spaces at Seattle Center. The Eastlake Station area has some potential for hide-and-ride activity due to the amount of unrestricted parking available. Even with the high existing occupancy of on-street parking at all other Segment B station areas, hide-and-ride impacts could still occur since some light rail patrons would arrive during early morning hours when some of this parking is available. Station area parking displacements are summarized in Table 3.3-9b.

Table 3.3-9a
Segment B: Parking Impacts Summary

Alternative	Parking Spaces Removed	
	On-Street	Off-Street
B1 Capitol Hill Tunnel	27-31	0-10
B2.1 Seattle Center via High-level Bridge	55-59	40-50
B2.2 Seattle Center via Portage Bay Tunnel	19-23	40-50

Stations associated with the preferred alternative are shown in italics.

Table 3.3-9b
Segment B: Parking Impacts in Station Areas

Station	Spaces Displaced	Area Affected by Displacement
N.E. 45th Station (options A, B)	10	Burke Museum (UW) surface lot
N.E. 45th Station (Option C)	4	N.E. 43rd Street
Pacific Station (options A, B)	11	15th Ave. N.E. south of N.E. Pacific St.
Campus Parkway Station	14	11th Ave. N.E. and 12th Ave. N.E.
Roy/Aloha Potential Station	16	Broadway, 10th Ave. E., E. Aloha St., E. Roy
Capitol Hill Station	8	Expansion of existing bus stops
First Hill Station	8	E. Madison Street
Eastlake Station	8, plus loading	Eastlake Avenue
South Lake Union Station	None	None
Seattle Center Station	Up to 40	Seattle Center Surface Lot
Convention Place Station	None	None
Portal location at Harvard	6	Harvard Ave. E north of Gwinn Place

Note: The preferred alternative is in italics.
Multiple station options exist. Parking issues would be similar for all options.
Stations associated with the preferred alternative are shown in italics.

Some parking impacts could also occur in private pay lots on the University of Washington campus. Most light rail patrons, however, would find that the parking cost, added transit transfer time, and light rail fare would make this option cost-prohibitive. Therefore, this impact would not likely be significant and could be regulated by existing University of Washington parking policies and enforcement.

Mitigation

Most intersections would operate at LOS D or better in the years 2010 and 2020 with the No-build, preferred and other light rail alternatives. The only exceptions are the Mercer Street/Fairview Avenue N. and E. John Street/Broadway Ave. E. intersections. The Mercer Street/Fairview Ave. N intersection already operates at LOS F and would continue to do so in the years 2010 and 2020 with either the No-build or Build alternatives.

In 2020, the very high pedestrian volumes, crossing both Broadway Avenue and E John Street at the E. John Street/Broadway Ave. E intersection, combined with additional bus and automobile traffic, would result in intersection failure. The intersection would operate at LOS C with the addition of eastbound and westbound left-turn lanes on E John Street. These left-turn lanes could be added by removing on-street parking on E. John Street. This improvement will likely require some additional signal hardware (for the eastbound and westbound left-turns) and some signal controller revisions.

The Segment B non-motorized facility improvements would be consistent with the non-motorized facility mitigation approach described in Section 3.3.2.1 under Segment A. Specific mitigation would be provided at the Pacific Station entrances, which include sidewalk widening at two locations, and two new crosswalks that would be designed to minimize impacts to bicycle flow on the Burke-Gilman Trail. With the preferred alternative, channelization, signing, and/or physical improvements, if necessary, would also be provided to separate pedestrian and bicycle flows between the Burke-Gilman Trail and Pacific Station.

Mitigation for Segment B hide-and-ride parking impacts is the same as described in Section 3.3.2.1 under Segment A. The University District, Capitol Hill, and First Hill neighborhoods currently experience high parking utilization rates ranging from 96 to 99 percent during all hours surveyed. Therefore, there is currently little space available for hide-and-ride activity within ¼ mile of the N.E. 45th, Pacific, Capitol Hill, or First Hill stations. City of Seattle staff consequently identified these stations as areas within Seattle where people would be most likely to walk farther to access the light rail system.

To address the potential for Link riders to park and walk more than ¼ mile from the station, the survey areas at these stations would be expanded to include a 2,000-ft radius and would be conducted during one period of the day: (1) in the morning, between 7:00 to 9:30 A.M., to assess the potential for Link patrons to occupy available parking prior to the arrival of users with a later parking peak period, or (2) between 9:30 to 3:30 P.M. to assess potential impacts of Link hide-and-ride activity during the likely parking peak of Link users. The N.E. 45th and Capitol Hill station areas would also be surveyed between 6:00 P.M. and 9:00 P.M. to assess the potential for light rail parking impacts associated with the evening 'restaurant' peak parking period.

3.3.2.3 Segment C (Westlake to S. McClellan Street)

Figure 3.3-3 shows the traffic and parking analyses locations in Segment C. For this segment, the preferred alternative is C1.2. The Lander Station would be the southern terminus for MOS C. Daily ridership at the Segment C stations is expected to be similar or lower with the MOS alternatives than with the full-length alternatives. Traffic impacts are expected to be generally the same.

Congestion

Table 3.3-10a summarizes the LOS analysis results for the No-build, preferred and other light rail alternatives for all major signalized intersections impacted by light rail route alternatives and station areas in Segment C. The C1 alternatives were refined further for the year 2020 LOS analysis, which represents a worse case than the year 2010 analysis. Mitigation was developed based on the year 2020 LOS results, to capture all potentially significant impacts that could occur in the year 2010 as well as the year 2020. Table 3.3-10b summarizes the year 2020 LOS analysis results for Alternatives C1.1, C1.2, C1.3, C1.4, and C1.5. A more detailed discussion of these alternatives in conjunction with the Segment C maintenance base alternatives can be found in the N.E. 45th/Capitol Hill Station Options and Maintenance Base Alternative Environmental Assessment (August 1999). In the year 2010, all intersections in the project area would operate at acceptable levels during the P.M. peak hour with No-build and light rail alternatives. As a worst case scenario, full signal preemption for light rail vehicles was assumed for intersections along at-grade sections on S. Lander Street (Alternatives C1.1 and C2.2—preferred alternative) and S. Massachusetts Street (Alternatives C1.5 and C3). With Alternative C1.1 and C1.2 (the preferred alternative), signal preemption for the Sixth Avenue S./S. Lander Street intersection would be required to accommodate the at-grade light rail alignment. In addition, for Alternative C1.1, signal-phasing revisions would be needed at this intersection to accommodate light rail in the median of S. Lander Street. Currently, east-west movements are served by a concurrent left-turn phase and a concurrent through/right-turn phase. Alternative C1.1 would require that the east-west movements be accommodated with split phasing (i.e., phase one - eastbound movements, phase two - westbound movements). This intersection would worsen from LOS C to LOS D with this revision to accommodate the at-grade light rail operations. With Alternative C1.5, a new traffic signal would be needed at the S. Massachusetts Street/Airport Way S. intersection to control light rail movements across Airport Way S.

Table 3.3-10b indicates that all intersections would operate at LOS D or better in 2020 with all C1 alternatives without the vacation of Sixth Avenue S. The only exception is the S. Lander Street/Fourth Avenue S. intersection, which would operate at LOS E for the No-build and light rail alternatives. Level of service at the S. Holgate Street/Fourth Avenue S. and S. Lander Street/Fourth Avenue S. intersections would worsen to LOS F in 2020 with any of the alternatives combined with the vacation of Sixth Avenue S., which would occur with the M1-C Maintenance Base Alternative. This worsening of level of service would be due to vehicles diverting from Sixth Avenue S. to Fourth Avenue S. Based on the level of service analysis, the C1 light rail alternatives, by themselves, would not significantly affect traffic operations in the study area.

Joint operation of HOVs and light rail vehicles on the D-2 roadway would not be possible with Alternatives C2.3 and C2.4. HOVs would be relocated to the I-90 mainline lanes with these alternatives, and this was assumed in the traffic forecasts. As a worst case scenario, relocating all vehicular traffic from the D-2 roadway to the I-90 mainline would result in an 8 percent volume increase in the eastbound direction during the P.M. peak hour. Using an estimated peak hour lane capacity of 2,000 vehicles per day, mainline P.M. peak hour LOS would worsen from D to E in the year 2010. With the same assumptions, A.M. peak hour traffic volumes in the westbound direction would increase by 3 percent and LOS would remain at E in the year 2010 with the No-build Alternative, Alternatives C2.3 or C2.4.

An analysis of the impacts of DSTT closure alternatives on surface streets in Segment C was also performed. The options for addressing light rail-only tunnel operations on surface street bus operations are summarized in the transit discussion (Section 3.2.2). The results of the LOS analysis for the Third Avenue Transit Priority alternative (preferred alternative) is summarized in the Transportation Technical Report. Based on the analysis, most intersections would operate at LOS D or better with the evaluated scenarios in the year 2006, just prior to light rail beginning operation in the tunnel (worst case traffic). After construction, the DSTT would be expected to accommodate more through trips while the shorter downtown trips would most likely remain on the surface in buses. Overall, total transit trips to downtown would increase after light rail implementation. This increase in total transit boardings leads to a reduction in downtown auto vehicle trips for the preferred alternative compared to the No-build Alternative.

Table 3.3-10a
Segment C: P.M. Peak Hour Level of Service Summary 2010 and 2020 No-build and Project Conditions

Nearest Station	Intersection[1]	No-build		Alternative C1.1		Alternative C2.3		Alternative C2.4		Alternative C3	
		2010	2020	2010	2020	2010	2020	2010	2020	2010	2020
Royal Brougham	S. Jackson St. at 4th Ave. S	B (10.3)	—	B (10.2)	—	B (10.2)	—	B (10.2)	—	B (10.2)	—
	Airport Way S. at 4th Ave. S.	D (25.2)	D (28.4)	D (25.2)	D (29.1)	D (25.4)	D (29.6)	D (25.3)	D (28.8)	D (25.2)	D (29.5)
	I-90 Ramp at 4th Ave. S	C (23.0)	—	C (22.8)	—	C (22.9)	—	C (22.8)	—	C (22.8)	—
	S. Royal Brougham Way at 4th Ave. S.	C (24.1)	—	C (24.1)	—	C (24.1)	—	C (24.0)	—	C (24.1)	—
	Holgate St. at 4th Ave. S.	D (31.3)	C (23.0)*	D (31.7)	D (34.1)*	D (30.3)	C (23.3)*	D (31.6)	C (23.9)*	D (31.7)	C (23.8)*
Lander	Lander St. at 4th Ave. S	D (35.0)	E (44.1)	D (33.5)	E (47.4)	D (34.1)	E (45.5)	D (35.5)	E (47.2)	D (33.5)	E (45.4)
	Lander St. at 6th Ave. S	D (25.7)	D (26.5)	D (28.3)	D (33.8)	C (21.2)	D (26.7)	D (25.9)	D (29.4)	C (21.2)	D (26.8)
	Lander St. at Airport Way S.	C (24.5)	C (20.3)	D (25.6)	B (29.7)	C (23.0)	C (19.8)	C (24.5)	C (18.9)	C (23.0)	C (20.9)
Beacon Hill	S. McClellan St. at Beacon Ave. S.	B (6.7)	—	B (6.8)	—	B (6.7)	—	B (6.7)	—	B (6.7)	—
I-90/Rainier	Dearborn St. at Rainier Ave. S.	D (33.4)	D (34.2)	D (35.3)	D (37.1)	D (34.2)	D (39.4)	D (35.7)	D (37.1)	D (34.2)	D (37.0)
	S. Charles St. at Rainier Ave. S.	A (4.4)	—	A (4.6)	—	A (4.5)	—	A (4.6)	—	A (4.5)	—
	I-90 EB Off-Ramp at Rainier Ave. S.	B (5.1)	—	B (5.1)	—	B (6.7)	—	B (5.1)	—	B (5.1)	—
McClellan	Massachusetts St. at Rainier Ave. S.[2]	B (10.1)	—	B (10.3)	—	B (13.0)	—	B (10.3)	—	B (10.4)	—
	23rd Ave. S. at Rainier Ave. S.	D (31.1)	D (33.6)	D (31.8)	D (36.2)	D (30.2)	D (38.3)	D (30.7)	D (37.0)	D (30.2)	D (36.7)
	S. Bayview St. at Rainier Ave. S.	A (2.7)	—	A (3.1)	—	A (3.1)	—	A (3.1)	—	A (3.1)	—

Sources: 2010 LOS Calculations, Parametrix, Inc., 1998.
2020 LOS Calculations, Heffron Transportation, 1999.

Notes: Alternative C1.2 is the preferred alternative. Alternative C1.1 would result in the same LOS and delay as Alternative C1.2.
Full signal preemption was assumed for the analysis of at-grade light rail alternatives.
( ) Average intersection delay, in seconds per vehicle.
[1] 2010 level of service for these intersections does not reflect the potential downstream effects from queuing since the HCM methodology assumes that each intersection is isolated from any residual traffic congestion impacts. Therefore, the actual LOS may be worse than shown in the table; however, the relative difference between the No-build and light rail alternatives would be similar.
[2] A southbound overlap phase was added to the 120-second cycle for the No-build and Build Alternative analysis. Without this southbound overlap phase, the HCM can not calculate average delay.

Table 3.3-10b. P.M. Peak Hour Level of Service Summary 2020 No-build and Build Conditions Segment C Link Routes

	No-build		Alt C1.1		*Alt C1.2*		Alt C1.3		Alt C1.3 (w/ vacation)		Alt C1.4		Alt C1.5 (w/ vacation)	
Intersection	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay
Holgate St.at Fourth Ave S.	C	23.0	D	34.1	D	34.1	D	34.1	F[1]	(1.42)[2]	D	34.1	F[1]	(1.42)[2]
Lander St.at Fourth Ave S.	E	44.1	E	47.4	E	47.4	E	47.4	F[3]	(1.09)[2]	E	47.4	F[3]	(1.08)[2]
Royal Brougham at Sixth Ave. S	B	14.3	B	14.1	B	14.1	B	14.1	B	12.7	B	14.1	B	12.7
Holgate St. at Sixth Ave. S	C	16.2	C	16.2	C	16.2	C	16.2	C	16.3	C	16.2	C	16.3
Lander St. at Sixth Ave. S	D	26.5	D	33.8	D	28.9	D	28.1	C[4]	24.8	D	28.1	C[4]	24.2
Forest St. at Sixth Ave. S	A	4.2	A	4.2	A	4.2	A	4.2	A	4.2	A	4.2	A	4.2
Lander St. at Airport Way S	C	20.3	D	29.7	D	29.7	C	21.5	D	33.7	C	21.5	D	32.9

Source: Heffron Transportation (1999)

1 With mitigation (striping NB and SB right-turn lanes on 4th Ave. S. at S. Holgate St.) this intersection would operate at LOS D.

2 Average delay could not be calculated by Highway Capacity Software because one or more of the intersection approaches has a v/c ratio greater than 1.2. Volume-to-capacity ratios were included for intersections expected to degrade to LOS F.

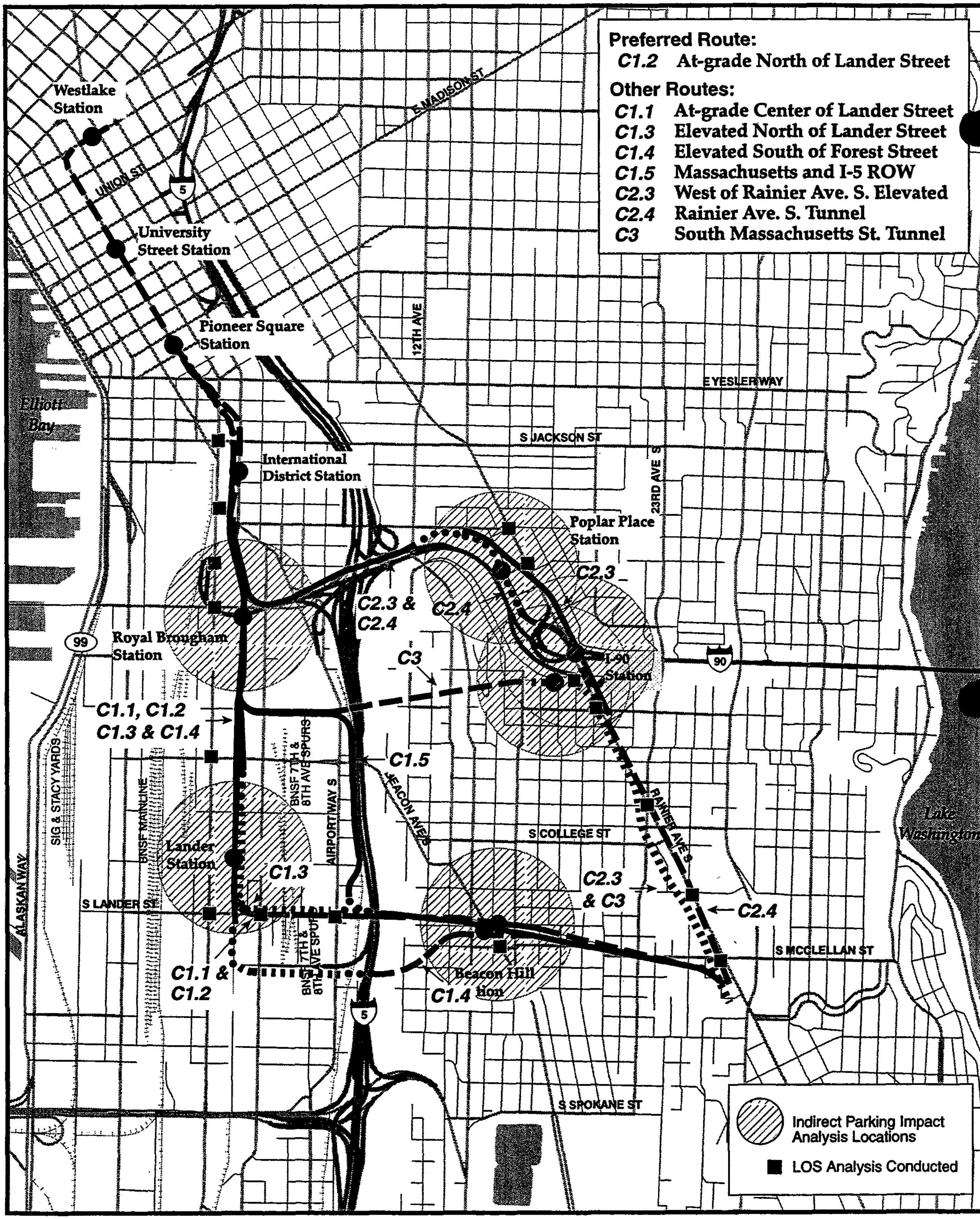
3 With mitigation (striping a SB right-turn lane on 4th Ave. S. at Lander St.) this intersection would operate at LOS E.

4 Level of service reflects signal timing modifications made to serve diverted vehicles due to vacating Sixth Avenue S, north of Holgate Street.

Stations associated with the preferred alternative are shown in italics.

Access and Circulation

The preferred alternative (C1.2) consists of an at-grade alignment on the east side of the E3 Busway, and the north side of S. Lander Street, which limits access and circulation impacts on S. Lander Street to the north side only. Access to and from unsignalized intersections and businesses located on the north side of S. Lander Street would be controlled by gated street crossings. For other light rail alternatives, access and circulation impacts for at-grade sections on S. Lander Street (C1.1), Rainier Avenue S. (C2.3), S. Massachusetts Street (C1.5 and C3) would be caused by left turn prohibitions to and from all unsignalized driveways and streets. For elevated sections (C1.3, C1.4, C2.3 and C3) left turns to and from some streets and driveways could be prohibited. For alternative C1.1, turn restrictions (right-in, right-out) would be needed on S. Lander Street, Seventh Avenue S., Seventh Place S., and Eighth Avenue S. With Alternative C1.3, the light rail line would be elevated along the north side of S. Lander Street, and Alternative C1.4 would construct an elevated light rail line along the south side of S. Forest Street. The elevated sections would not be expected to result in property access impacts. Alternative C1.5 would be at-grade along the E3 Busway and the south side of S. Massachusetts Street west of I-5. Gated crossings would be considered to control access to businesses and unsignalized streets on the south side of S. Massachusetts Street. For Alternative C2.3, the light rail route could result in property displacements and closures of S. Dean, Charles, Norman and Stevens streets. Left-turn restrictions may also be needed on Rainier Avenue S. at S. State, Grand, Holgate, and Plum streets. With Alternative C2.4, some street closures would be needed towards the south end of the route at S. Dean, Forest and Stevens streets, as the light rail transitions from a tunnel to an at-grade or elevated profile. Alternative C3 would result in turn restrictions at the S. Massachusetts Street/Eighth Avenue S. intersection, and the closure of Stevens Street.



SoundTransit

Tunnel
Elevated
At Grade
Retained Cut-Fill
Station
Potential Station

0 1,000 2,000
FEET

Figure 3.3-3 Segment C Parking and Traffic Analysis Locations

Overall, Alternative C2.3 would cause the largest overall impact to traffic access and circulation, followed by Alternatives C2.4, C3, C1.1, C1.2, C1.5, C1.3 and C1.4, (lowest access and circulation impact).

Traffic Safety

The introduction of at-grade light rail within a roadway creates the potential for new accidents, but can also result in a reduction in midblock accidents. New accidents would primarily be caused by new collisions between light rail vehicles and pedestrians and autos, and rail/bus transfer activity at station areas that require bus stops and layover zones located across the street from the rail station. If the light rail trackway is located within the center of the roadway, existing midblock left turn vehicle conflicts, midblock head-on collisions, and midblock pedestrian crossing accidents could be reduced because of mid-block left-turn prohibitions. At-grade sections in the center of a roadway in Segment C include:

- Alternative C1.1 on S. Lander Street
- Alternative C2.3 on Rainier Avenue S.
- Alternative C3 on S. Massachusetts Street

With Alternative C1.2 (preferred alternative), the light rail alignment would be located on the north side of Lander Street, with cross street traffic controlled by gated crossings. Gated crossings could also be provided on the south side of Massachusetts Streets for Alternative C1.5. Alternatives C1.1, C1.3, and C1.4 would not have gated crossings. A survey of comparable light rail systems (conducted by Korve Engineering 1999) revealed that for streets that cross light rail tracks with gates, the number of collisions were so few that a comparison with tracks controlled by traffic signals is not possible. The far lower collision rate is the result of the physical barrier provided by automatic gates, providing greater control and visibility. The number of collisions at comparable systems is so low that a quantitative estimation of traffic safety impacts for Alternative C1.2 is not valid.

Pedestrian safety and accident data have been developed in recent years as part of a nationwide program to research the causes and prevent pedestrian accidents. A review of data from prior research, safety oversight authorities and direct surveys of light rail system staff in the Western U.S. was undertaken as part of the EIS analysis. That review reveals that LRV- pedestrian accidents are divided into two general location types. The first location type, at station platforms, represents the largest percentage of total LRV-pedestrian accidents. This high percentage may be attributed to the inherent purpose of a station, where large numbers of people converge near the light rail vehicles and cross the trackway. Many accidents at stations are also the most easily preventable, through safe design, appropriate signage, and public education to encourage safe behavior.

The second location type is along the right-of-way, away from stations. This location type includes paths to stations, such as crossings at intersections where pedestrians cross over the light rail tracks, and right of way intrusion (trespassing).

Although the light rail systems differ in alignment type and length, the annual average for pedestrian incidents is between 4 and 5 per system. The average number of pedestrian accidents at crossings for these systems is two per year. The annual average number of pedestrian accidents along light rail right-of-way is 1 per system. Achieving a low number of incidents is the result of several conditions including safety oriented design, light rail operator training, trains speeds, and public education that warns pedestrians of potential hazards involved with light rail trains.

Although the low number and unique circumstances of historic pedestrian accidents do not allow a valid quantitative projection for the Link project, some trends are present in the background data of accident causes. For example, pedestrians standing too close to the edge of the platform as a light rail train approaches represent a large number of LRV-pedestrian collisions at stations. In addition, intoxicated pedestrians represent a large percentage of the collisions. Furthermore, LRV-pedestrian accidents at crossings are typically the result of pedestrians proceeding without waiting for a green signal to walk.

Left-turn prohibitions at unsignalized intersections could lead to increased traffic, including some trucks on local access streets. This could also create safety impacts for pedestrians and vehicles in these areas.

In summary, while the light rail alternatives with at-grade sections would introduce some light rail accidents with passenger vehicles or pedestrians, they would also decrease midblock and left-turn vehicle accidents.

Non-Motorized Facility Impacts

The light rail corridor alignments limit access that would complicate the use of the streets and access for bicyclists and pedestrians, both for those going to the stations and for other non-transit-related trips. Safety at existing intersections would be affected by the addition of new rail right-of-way. However, pedestrian and bicycle safety is improved by encouraging the use of well-marked crosswalks at signalized locations. Any roadway widening would result in increased pedestrian crossing distances, which could compromise safety if not properly designed. Increased pedestrian crossing distances are expected on roadways affected by at-grade and elevated sections, including S. Lander Street (C1.1), S. Forest Avenue (C1.4), Rainier Avenue S. (C2.3 and C3) and S. Massachusetts Street (C1.5 and C3). The reduced number of legal crosswalks for at-grade alternatives will require pedestrians to walk longer distances to cross streets. Table 3.3-11a summarizes the number of pedestrian trips expected and proposed pedestrian facilities. All sidewalks near light rail stations in Segment C are expected to operate at acceptable levels in the year 2020 with the project alternatives, when designed to meet the City of Seattle's minimum standards (5 ft for arterial roadways).

Table 3.3-11a
Segment C: Non-Motorized Facility Impacts

Station	2010 P.M. Peak Period Walk Trips[1]		2020 P.M. Peak Period Walk Trips[1]		Proposed Pedestrian Facilities
	Ingress	Egress	Ingress	Egress	
Royal Brougham	115-155	110	130-175	160	Planned overpass to baseball stadium
Lander	370	110	420	155	None
Beacon Hill	750	795	960	990	None
Poplar Place	0	10	0	25	None
I-90	60	245	65	310	Elevated walkway to station (Alt. C3)

Note: + The preferred alternative
[1] Walk trips are summarized for the P.M. peak 3-hour period. Range reflects different route alternatives served by station. Stations associated with the preferred alternative are shown in italics.

Bicycle route connections are lacking at most stations, particularly in the east-west direction. With the No-build, preferred, and other light rail alternatives, the proposed I-90 Greenway path would be built, which would provide a new north-south bicycle route in Segment C. In addition, with Alternatives C1 and C3, a pedestrian and bicycle overpass would be provided between the I-90 Greenway and Fourth Avenue S. at the Royal Brougham Station. A new signal is also proposed at the Beacon Avenue/Lander Street intersection with the preferred alternative, which would provide additional pedestrian crossing opportunities at the Beacon Hill Station. Table 3.3-11b shows bicycle storage facilities proposed for all stations in Segment C except for the stations in the DSTT.

Table 3.3-11b. Proposed Bicycle Facilities for Segment C

Station Name	Proposed Bicycle Facilities	Proposed Quantity	Proposed Expansion Area
Royal Brougham	Racks	Racks for 40	750 ft^2
Lander Street	Racks	None	1,200 ft^2
Beacon Hill	Racks	Racks for 20	1,250 ft^2
Poplar Place	Racks	Racks for 20	1,200 ft^2
I-90	Racks	Racks for 20	1,200 ft^2

Note: Facilities would be sheltered.
Stations associated with the preferred alternative are shown in italics.

Parking Impacts

Table 3.3-12a summarizes parking impacts for the route and station alternatives; station area parking displacements are summarized in Table 3.3-12b. For Segment C, Alternatives C1.1, C1.2, C2.4, and C3 have mostly elevated or tunnel profiles that would generate no direct route segment parking displacements. The at-grade sections of Alternative C1.1 and C1.2 would displace 27 spaces on S. Lander Street. Alternative C3 would displace 15 to 25 spaces. The at-grade section of Alternative C2.3 could displace up to 38 spaces on Dearborn Place S., Poplar Place S., and S. Norman, Charles and Dean streets. Several station areas in Segment C could be impacted by hide-and-ride activity, including Royal Brougham, Poplar, Beacon Hill, and I-90. All of these station areas have a large amount of available unrestricted on-street parking.

Table 3.3-12a
Segment C: Parking Impacts Summary[1]

Alternative	Parking Spaces Removed	
	On-Street	Off-Street
C1.1 At-grade center of Lander Street Tunnel	27	235
C1.2 At-grade north of Lander Street	11	235
C1.3 Elevated north of Lander Street	0-5	235
C1.4 Elevated south of Forest Street	0-5	235
C1.5 Massachusetts and I-5 right-of-way	15-25	15
C2.3 West of Rainier Avenue S. – Elevated	38	0
C2.4 Rainier Avenue S. Tunnel	0	200
C3 S. Massachusetts Tunnel	15 to 25	0

Note: [1] Includes impacts of route and station alternatives.
The preferred alternative is shown in italics.

Table 3.3-12b
Segment C: Parking Impacts in Station Areas

Station	Spaces Displaced	Area Affected by Displacement
Royal Brougham Station	220	Ryerson Bus Base east of busway[1]
Lander Station	27	S. Lander St.
Beacon Hill Station	15	Off-street lots at Beacon Ave., S. Lander St.
Poplar Place Station	200	Off-street lot on S. Poplar St.
I-90 Station (Alternative C2.3 only)	6	17th Ave. S.

[1] The Royal Brougham Station would eliminate this planned parking lot associated with the bus base expansion.
Stations associated with the preferred alternative are shown in italics.

Mitigation

Any effect on coordinated signal progression on Sixth Avenue S. or S. Lander Street would need to be minimized with the signal phasing improvement summarized in the Impacts section.

The Segment C non-motorized facility improvements would be consistent with the non-motorized facilility mitigation approach described for Segment A (Section 3.3.2.1).

Sound Transit is working with King County Metro to mitigate for the loss of parking at Ryerson Base, associated with Alternatives C1.1, C1.2, C1.3, and C1.4. The two options include: providing temporary parking using WSDOT right-of-way with long-term parking being accommodated in new structured parking at Central Base; or constructing a new parking lot south of Ryerson Base to accommodate displaced employee parking. Other business/property owners will also be directly compensated when a portion of their property is acquired by Sound Transit. If a portion of the area purchased was used for parking, Sound Transit will work with the property owner on a case-by-case basis to replace lost parking.

Mitigation for possible hide-and-ride parking impacts in Segment C is the same as described in Section 3.3.2.1 under Segment A. The areas surrounding the Royal Brougham, Lander, and Beacon Hill Stations currently experience low on-street parking utilization. To address the potential for Link riders to increase parking utilization, surveys will be conducted within a ¼ mile of the station between 9:30 to 3:30 P.M., the peak parking period of possible hide-and-ride impacts from Link users.

3.3.2.4 Segment D (S. McClellan Street to Boeing Access Road)

Figure 3.3-4 shows the traffic and parking analyses locations in Segment D. For this segment, the preferred alternative is D1.1e.

Congestion

Table 3.3-13 summarizes the LOS analysis results for the No-build, preferred (D1.1e) and other light rail alternatives using the highest ridership and station area trip generation estimates for all major signalized intersections impacted by light rail route alternatives and station areas.

In the northerly portion of Segment D, Alternatives D1.1c, D1.1d, D1.1e, and D1.1f would impact MLK Jr. Way S., Alternative D1.3 would have no significant impact, Alternative D3.3 would impact Rainier north of Alaska and MLK Jr. Way S. south of Alaska and Alternative D3.4 would impact Rainier Avenue S. only. South of approximately S. Graham Street, all alternatives have the same at-grade profile on MLK Jr. Way S., resulting in increased side street delay at intersections.

Full signal preemption for light rail vehicles was assumed at all at-grade intersections for both the year 2010 and 2020 LOS analysis. This results in a reallocation of green time from eastbound and westbound approaches and northbound and southbound left-turn movements to northbound and southbound through movements. Additional traffic operations analysis for the year 2020 has been conducted using TRANSYT-7F, assuming a progression-type transit priority system instead of preemption. Under a progression-type transit priority system, the traffic signals are coordinated for light rail operations; however, not every signal would need to be preempted by every light rail vehicle arrival. This approach generally results in shorter sidestreet delays and better systemwide automobile operations than the full preempt system. The TRANSYT-7F corridor-wide LOS analysis was conducted only for Alternatives D1.1c, and D1.1e to provide representative information on a different signalization strategy. Some or all of these mitigation features could also be included with other Segment D alternatives; however, the analysis for Alternatives D1.1d, D1.1f, and D1.3 did not include these new mitigation features to show the range of possible alternatives and impacts. Based on the TRANSYT-7F analysis, the S. Graham Street/MLK Jr. Way S. intersection would be expected to operate at LOS F with Alternative D1.1c and at LOS E with Alternative D1.1e in the year 2020. The Renton Avenue S./MLK Jr. Way S. intersection would also operate at LOS E with Alternative D1.1c in the year 2020. All other intersections would operate at LOS D or better with the signal progression and system optimization assumptions used for the analysis. These results are generally better than would be expected, assuming full signal preemption with Alternative D1.1c, three intersections would be expected to degrade to unacceptable levels in 2020 with full signal preemption (as compared to two intersections with the progression-type transit priority system). For Alternative D1.1e, the S. Alaska Street/MLK Jr. Way S. intersection would degrade to LOS F in the year 2020 with full signal preemption. (As compared to the S. Graham Street/MLK Jr. Way S. intersection, which would degrade to LOS E in the year 2020 with the progression-type signal priority system.

The worst case analysis assuming full signal preemption indicates that most intersections in the project area would operate at acceptable overall levels of service in the year 2010 during the P.M. peak hour with the No-build and project alternatives. The S. Othello Street/MLK Jr. Way S. intersection is expected to operate at LOS F for the No-build and all project alternatives except Alternatives D1.1e (preferred alternative) and D1.1f in the year 2010. The S. Alaska Street/MLK Jr. Way S., S. Graham Street/MLK Jr. Way S. intersections would all worsen to LOS F with Alternative D1.1d in the year 2010, due to decreases in roadway capacity. The S. Alaska Street/Rainier Avenue S. intersection would also worsen from LOS D to LOS E with Alternative D3.3, because the eastbound/westbound green time allocations would decrease with light rail signal preemption.

In the year 2020, the S. McClellan Street/Rainier Ave. S. intersection would also worsen to LOS E with Alternative D3.4; the S. Alaska Street/MLK Jr. Way S. intersection would operate at LOS F with all alternatives except D1.1f; the S. Graham Street/MLK Jr. Way S. and S. Othello Street/MLK Jr. Way S. intersections would operate at LOS F with all project alternatives except Alternatives D1.1e (preferred alternative) and D1.1f, and the S. Alaska Street/Rainier Avenue S. intersection would operate at LOS E with Alternatives D1.1d, D1.1f and D3.4. With Alternatives D1.1d and D1.1f, the S. Holly Street/Rainier Avenue S., S. Henderson Street/Rainier Ave. S., and S. Henderson Street/Renton Avenue S., and S. Othello Street/MLK Jr. Way S. intersections would all worsen to LOS E or F by the year 2020.

In addition to the overall intersection LOS impact, for the at-grade sections of each project alternative, average delay on the east-west approaches to MLK Jr. Way S. and Rainier Avenue S. would be higher than No-build. This delay increase results from the assumed light rail full signal preemption system reallocating green time from east/west to north/south movements. The LOS on eastbound and westbound approaches remains at LOS D or better at most intersections with the preferred and other light rail alternatives except for the following locations:

- <u>MLK Jr. Way S./Rainier Avenue S.</u> – In the year 2010, the eastbound approach worsens from LOS D (No-build) to LOS E (Alternatives D1.1d and D1.1f). By the year 2020, the eastbound approach worsens from LOS D (No-build) to LOS E (Alternatives D1.1d, D1.1f, D1.3, D3.3, and D3.4), and the westbound approach would worsen from LOS D (No-build) to LOS E (Alternatives D1.1d and D1.1f).
- <u>MLK Jr. Way S./Alaska Street</u> – With the preferred alternative (D1.1e), the westbound approach worsens from LOS E (No-build) to LOS F in the year 2010. In the year 2020, the eastbound approach worsens from LOS D (No-build) to LOS F, and the westbound approach worsens from LOS E (No-build) to LOS F with the preferred alternative. For the other light rail alternatives, the westbound approach worsens from LOS E (No-build) to LOS F (Alternatives D1.1c, D1.1d, D1.1e, and D3.3), and the eastbound approach worsens from LOS D to LOS E (Alternative D.1.1d) or LOS F (Alternative D1.1f) in the year 2010. By the year 2020, the eastbound approach worsens from LOS D (No-build) to LOS E (Alternatives D1.1f and D1.3) or LOS F (D1.1c, D1.1d, D1.1e), and the westbound approach would operate at LOS E (No-build and Alternative D1.1f) or LOS F (all other light rail alternatives).
- <u>MLK Jr. Way S./S. Graham Street</u> – With the preferred alternative (D1.1e), the eastbound approach operates at LOS E (same as for No-build) and the westbound approach worsen from LOS D (No-build) to LOS E in the year 2010. In the year 2020, the eastbound approach continues to operate at LOS E (same as No-build) and the westbound approach worsens from LOS E (No-build) to LOS F with the preferred alternative. For the other light rail

alternatives, the eastbound approach would operate at LOS E (No-build, D1.1d, D1.1e, D1.1f, and D1.3 alternatives) or LOS F (Alternatives D1.1c, D3.3 and D3.4), and the westbound approach worsens from LOS D to LOS E (Alternatives D1.1c, D1.1e, D3.3, and D3.4) or LOS F (Alternative D.1.1d) in the year 2010. By the year 2020, the eastbound approach would operate at LOS E (Alternative D1.1e) or LOS F (No-build, D1.1c, D1.1d, D1.1f, D1.3, D3.3, and D3.4 Alternatives), and the westbound approach worsens from LOS E (No-build) to LOS F (all other light rail alternatives).

- MLK Jr. Way S./S. Cloverdale Street – With the preferred alternative (D1.1e), the westbound approach worsens from LOS D (No-build) to LOS F in the year 2010. In the year 2020, the eastbound approach worsens from LOS C (No-build) to LOS E with the preferred alternative. For the other light rail alternatives, the eastbound approach would operate at LOS E (No-build, D1.1d and D1.1f alternatives), and the westbound approach worsens from LOS D (No-build) to LOS F (Alternatives D1.1c, D1.1e, D1.3, D3.3, and D3.4) in the year 2010. By the year 2020, the eastbound approach worsens from LOS C (No-build) to LOS E (Alternatives D1.1c, D1.1e, D1.3, D3.3, and D3.4).
- MLK Jr. Way S./S. Henderson Street – With the preferred alternative (Alternative D1.1e), the westbound approach worsens from LOS C (No-build) to LOS F in the year 2020. For the other light rail alternatives, the westbound approach worsens from LOS C to LOS F (Alternatives D1.1d and D1.1f) in the year 2010. By the year 2020, the westbound approach worsens from LOS C (No-build) to LOS E (Alternatives D1.1d and D1.1f) or LOS F (Alternatives D1.1c, D1.1e, D1.3, D3.3 or D3.4).
- Rainier Avenue S./S. Walden Street – In the year 2010, the eastbound and westbound approaches worsen from LOS C (No-build) to LOS F (Alternative D3.3 and D3.4).
- Rainier Avenue S./S. Charlestown Street – In the year 2010, the westbound approach worsens from LOS D to LOS F (Alternatives D3.3 and D3.4).
- Rainier Avenue S./S. Andover Street – In the year 2010, the westbound approach worsens from LOS D (No-build) to LOS F (Alternative D3.3) or LOS E (Alternative D3.4).
- Rainier Avenue S./S. Alaska Street – With the preferred alternative (Alternative D1.1e), the eastbound approach operates at LOS F (same as for No-build) in the year 2020. For the other light rail alternatives, the southbound approach worsens from LOS D (No-build) to LOS F (Alternative D3.3), eastbound approach worsens from LOS E to LOS F (Alternatives D3.3 and D3.4), and the westbound approach worsens from LOS E to LOS F (Alternatives D1.1d, D1.1f and D3.4) in the year 2010. By the year 2020, the eastbound approach would operate at LOS E (No-build, D1.1d, D1.1f, D1.3, D3.3, and D3.4 alternatives) or LOS F (Alternatives D1.1c and D1.1e), and the westbound approach would operate at LOS F (No-build and all light rail alternatives).

With all Segment D alternatives, new signals would be added at the Rainier Avenue S./S. Forest Street and Rainier Avenue S./S. Hanford Street intersections, to improve vehicular and pedestrian access to the McClellan Station, and on S. Henderson Street near Yukon Avenue S. (between MLK Jr. Way S. and S. Renton Avenue S.) to serve the new transit facility at the Henderson Station. These signals are expected to operate at LOS D or better in the year 2020 with all light rail alternatives. With Alternative D1.1e, additional signals would also be provided on MLK Jr. Way S. at Hanford Street, Andover Street, Dakota Street, Edmunds Street, Dawson Street, Brandon Street, and Holly Street. All of these new intersections are expected to operate at LOS C or better in the year 2020. Signals would also be added at most of these intersections (except Dakota and Brandon streets) with Alternative D1.1f and would operate at LOS C or better in the year 2020.

With S. McClellan Station Option A (at-grade), a light rail crossing on MLK Jr. Way S. would be required for Alternatives D1.1c, D1.1d, D1.1e, D1.1f, and D3.3. For Alternatives D1.1c, D1.1d, D1.1e and D1.1f, light rail tracks would cross the southbound lanes on MLK Jr. Way S. only; for Alternative D3.3, light rail tracks would cross both the northbound and southbound lanes.

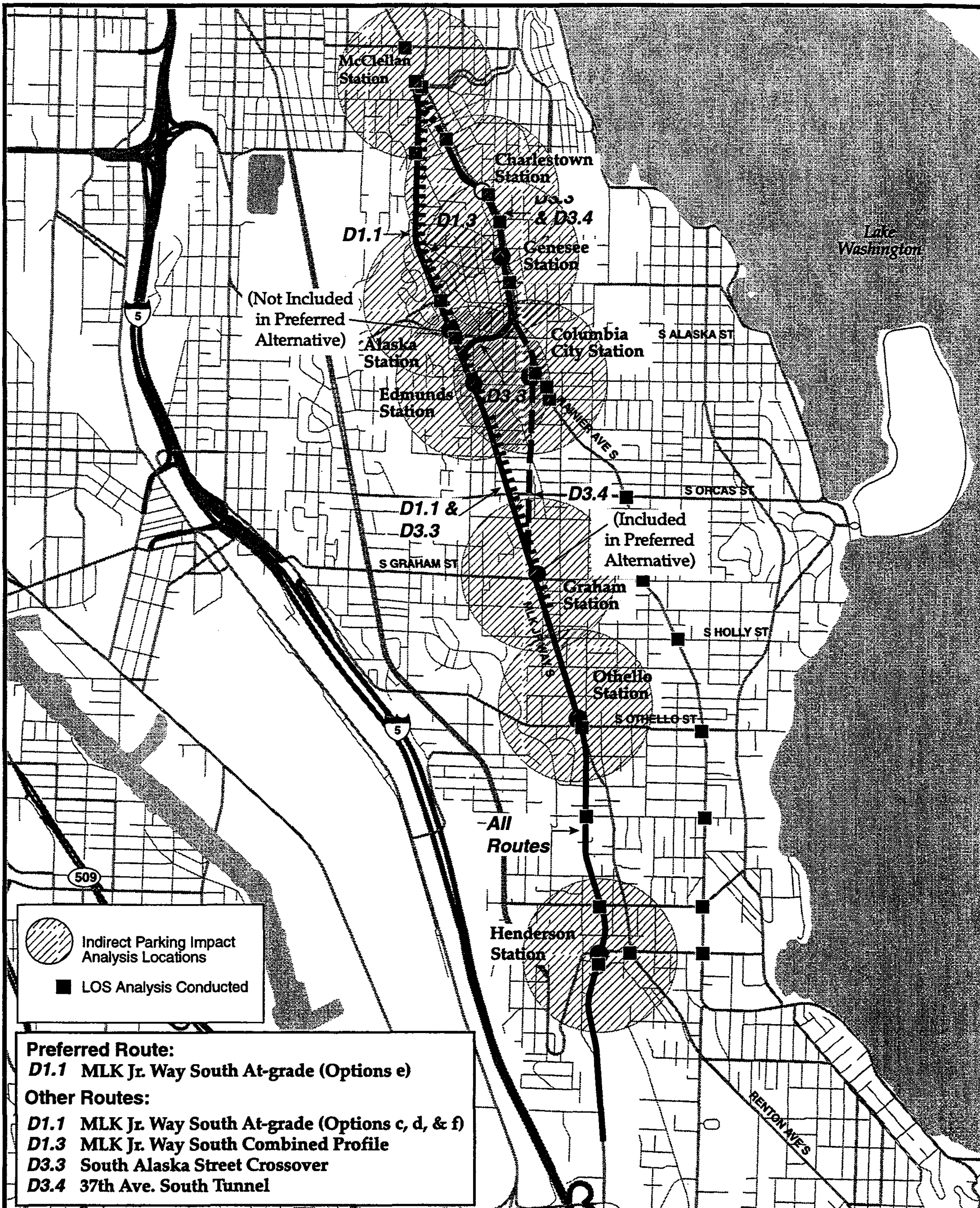


Figure 3.3-4 Segment D: Parking and Traffic Analysis Locations

Table 3.3-13
Segment D: P.M. Peak Hour Level of Service Summary 2010 and 2020 No-build and Project Conditions

Intersection[1]	No-build		Alternative D1.1c		Alternative D1.1d		*Alternative D1.1e*		Alternative D1.1f		Alternative D1.3		Alternative D3.3		Alternative D3.4	
	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020
S. McClellan St. at Rainier Ave. S.	D (26.8)	D (28.7)	D (29.0)	D (39.9)	D (29.0)	D (39.9)	D (29.0)	D (39.9)	D (29.0)	D (39.9)	D (29.4)	E (41.5)	D (28.8)	D (37.7)	D (28.8)	E (41.5)
Rainier Ave. S. at MLK Jr. Way S.	C (22.4)	D (25.9)	C (23.6)	D (30.1)	D (30.3)	D (38.3)	C (23.6)	D (30.1)	D (30.3)	D (38.3)	C (24.2)	D (30.8)	C (23.5)	D (27.2)	C (23.5)	D (27.2)
S. Walden St. at MLK Jr. Way S.	B (8.1)	—	B (9.7)	—	C (19.0)	—	B (9.7)	—	C (19.0)	---	B (8.2)	—	B (8.1)	—	B (8.1)	—
Columbian Way at MLK Jr. Way S.	B (11.6)	—	C (15.2)	—	B (13.9)	—	C (15.2)	—	B (13.9)	---	B (11.9)	—	B (11.3)	—	B (11.3)	—
S. Alaska St. at MLK Jr. Way S.	D (27.9)	D (32.4)	D (28.4)	F (1.40)*	F (0.97)*	F (1.41)*	D (28.4)	F (1.40)	D (36.8)	E (42.4)	D (28.9)	F (1.56)*	D (29.9)	F (0.90)*	D (27.9)	F (0.89)*
S. Orcas St. at MLK Jr. Way S.	C (19.5)	—	C (15.5)	—	B (12.8)	—	C (15.5)	—	B (12.8)	---	C (19.7)	—	C (16.0)	—	C (16.0)	—
S. Graham St. at MLK Jr. Way S.	D (28.4)	D (39.0)	D (30.0)	F (1.00)*	F (1.11)*	F (1.27)*	C (25.0)	D (34.7)	C (18.1)	D (39.5)	D (27.9)	F (1.01)*	D (31.4)	F (1.01)*	D (30.5)	F (1.01)*
S. Holly St. at MLK Jr. Way S.	B (7.2)	—	B (8.4)	—	B (12.0)	—	B (8.4)	—	B (12.0)	---	C (16.0)	—	B (9.9)	—	B (9.9)	—
S. Othello St. at MLK Jr. Way S.	F (1.12)*	F (1.25)*	F (1.19)*	F (1.20)*	F (1.25)*	F (1.26)*	D (25.6)	D (25.8)	C (22.6)	C (21.3)	F (1.18)*	F (1.26)*	F (1.14)*	F (1.26)*	F (1.14)*	F (1.26)*
S. Kenyon St. at MLK Jr. Way S.	B (8.7)	—	B (11.0)	—	B (8.8)	—	B (11.0)	—	B (8.8)	---	B (11.1)	—	B (10.7)	—	B (10.7)	—
S. Cloverdale St. at MLK Jr. Way S.	B (13.1)	C (19.0)	C (17.7)	C (19.6)	C (19.2)	C (21.9)	C (17.7)	C (19.6)	C (19.2)	C (21.9)	C (17.7)	C (22.3)	C (21.5)	C (22.3)*	C (21.5)	C (22.3)
S. Henderson St. at MLK Jr. Way S.	C (17.1)	C (18.5)	C (16.5)	D (25.9)	C (23.5)	C (21.0)	C (16.5)	D (25.9)	C (23.5)	C (21.0)	C (15.5)	C (21.9)	C (15.7)	C (21.9)	C (15.7)	C (21.9)
S. Walden St. at Rainier Ave. S.	B (10.0)	—	B (10.2)	—	B (11.6)	—	B (10.2)	—	B (11.6)	---	B (10.2)	—	B (12.4)	—	B (12.4)	—
S. Charlestown St. at Rainier Ave. S.	B (8.3)	—	B (8.3)	—	B (8.5)	—	B (8.3)	—	B (8.5)	---	B (8.3)	—	B (9.0)	—	B (9.0)	—
S. Andover St. at Rainier Ave. S.	A (3.9)	—	A (4.0)	—	A (4.0)	—	A (4.0)	—	A (4.0)	---	A (4.0)	—	A (3.8)	—	A (3.4)	—
S. Genesee St. at Rainier Ave. S.	D (28.6)	D (30.7)	D (26.1)	D (31.3)	D (30.5)	D (32.4)	D (26.1)	D (31.3)	D (30.5)	D (32.4)	D (25.9)	D (30.3)	C (17.8)	C (19.2)	C (17.7)	C (19.2)
S. Alaska St. at Rainier Ave. S.	D (29.2)	D (37.6)	D (31.4)	D (39.2)	D (33.8)	E (46.3)	D (31.4)	D (39.2)	D (33.8)	E (46.3)	D (31.2)	D (39.8)	E (54.5)	D (39.2)	D (32.1)	E (40.7)
S. Edmunds St. at Rainier Ave. S.	B (8.3)	—	B (8.4)	—	B (13.9)	—	B (8.4)	—	B (13.9)	---	B (8.4)	—	B (8.4)	—	B (5.5)	—
S. Ferdinand St. at Rainier Ave. S.	B (7.3)	—	B (7.4)	—	B (7.9)	—	B (7.4)	—	B (7.9)	---	B (7.4)	—	B (7.4)	—	A (4.8)	—

Table 3.3-13 Continued

Intersection[1]	No-build		Alternative D1.1c		Alternative D1.1d		*Alternative D1.1e*		Alternative D1.1f		Alternative D1.3		Alternative D3.3		Alternative D3.4	
	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020	2010	2020
S. Hudson St. at Rainier Ave. S.	B (11.3)	—	B (11.9)	—	C (15.4)	—	B (11.9)	—	C (15.4)	---	B (11.9)	—	B (11.9)	—	B (12.2)	—
S. Orcas St. at Rainier Ave. S.	B (9.4)	—	B (9.5)	—	B (12.0)	—	B (9.5)	—	B (12.0)	---	B (9.5)	—	B (9.6)	—	B (9.6)	—
S. Graham St. at Rainier Ave. S.	C (17.7)	C (18.9)	C (17.9)	C (19.3)	C (21.3)	C (21.0)	C (17.9)	C (19.3)	C (21.3)	D (31.8)	C (17.9)	C (19.2)	C (18.1)	C (19.2)	C (18.1)	C (19.2)
S. Holly St. at Rainier Ave. S.	B (10.5)	B (11.2)	B (9.3)	D (35.2)	C (24.6)	F (0.83)*	B (9.3)	D (35.2)	C (24.6)	F (0.83)*	B (9.3)	D (26.1)	B (9.5)	D (26.1)	B (9.5)	D (26.1)
S. Othello St. at Rainier Ave. S.	C (24.3)	D (30.7)	C (24.7)	D (28.2)	C (24.2)	D (31.8)	C (24.7)	D (28.2)	C (24.2)	D (31.8)	C (24.5)	D (38.0)	C (24.7)	D (38.0)	C (24.7)	C (38.0)
S. Kenyon St. at Rainier Ave. S.	B (5.6)	—	B (5.7)	—	B (8.7)	—	B (5.7)	—	B (8.7)	---	B (5.7)	—	B (5.8)	—	B (5.8)	—
S. Cloverdale St. at Rainier Ave. S.	B (8.2)	—	B (8.6)	—	B (11.5)	—	B (8.6)	—	B (11.5)	---	B (8.6)	—	B (8.6)	—	B (8.6)	—
S. Henderson St. at Rainier Ave. N.	C (24.5)	D (27.6)	D (25.4)	D (33.9)	D (32.3)	E (44.3)	D (25.4)	D (33.9)	D (32.3)	E (44.3)	D (25.6)	D (33.3)	D (25.2)	D (33.3)	D (25.2)	D (33.3)
S. Henderson St. at Renton Ave. N.	C (21.9)	C (24.1)	C (21.7)	D (32.3)	C (21.5)	E (43.2)	C (21.7)	D (32.3)	C (21.5)	E (43.2)	C (21.8)	D (29.7)	C (24.6)	D (29.7)	C (24.6)	D (29.7)

Notes: ( ) Average intersection delay, in seconds per vehicle
* Average delay could not be calculated by HCM. Volume-to-capacity ratio is shown.
Full signal preemption was assumed for all at-grade light rail alternatives on MLK Jr. Way S.
[1] Level of service for these intersections does not reflect the potential downstream effects from queuing since the HCM methodology assumes that each intersection is isolated from any residual traffic congestion impacts. Therefore, the actual LOS may be worse than shown in the table; however, the relative difference between the No-build and light rail alternatives would be similar.
The preferred alternative is shown in italics.

For all of these alternatives, an active traffic control system such as a traffic signal or flashing light signal and automatic gates coordinated by the traffic signal controller would be needed at the potential light rail crossing location, which would require vehicles to stop for a 40 to 50 second period every 4 minutes, as light rail vehicles cross MLK Jr. Way S. The existing signals at the Rainier Avenue S./MLK Jr. Way S. and Rainier Avenue S./S. McClellan Street intersections will require resequencing and coordination with light rail operation to prevent potential southbound queues through those intersections. Elevating the crossing at MLK Jr. Way S. with McClellan Station options B and C, as proposed for Alternatives D1.1 (including the preferred alternative), D1.3 and D3.4 would eliminate this impact. To improve bus access and egress to the McClellan Station, the project would add two new signals on Rainier Avenue S. at S. Hanford and S. Forest streets and may involve moving bus-transfer activity to the east-side of Rainier Avenue S.

Access and Circulation

Access and circulation impacts for at-grade and elevated sections on MLK Jr. Way S., (all alternatives) are caused by one or less street closures, and by left turn prohibitions to and from unsignalized driveways and streets. Alternative D1.1e (preferred alternative) and Alternative D1.1f would limit 34 unsignalized intersections on MLK Jr. Way S. to right-in, right-out access only, signalize seven existing unsignalized intersections, and close one side street intersection (31st Avenue S.). Alternatives D1.1c, D1.1d and D1.3 would limit 39 unsignalized intersections on MLK Jr. Way S. to right-in, right-out access only. South of approximately Graham Street, Alternatives D3.3 and D3.4 would have the same at-grade profile as D1.1c, D1.1d, D1.1e, D1.1f, and D1.3; therefore, Alternatives D3.3 and D3.4 would also result in right-in, right-out access restrictions at 16 intersections on MLK Jr. Way S. For at-grade sections west of Rainier Avenue S. (Alternatives D3.3 and D3.4), all local access streets currently intersecting with Rainier Avenue S. at an unsignalized location would be closed or have some kind of active traffic control system. These streets include S. Hanford, Byron, and Adams streets for both Alternatives D3.3 and D3.4, and S. Angeline Street for Alternative D3.3.

For at-grade sections on MLK Jr. Way S., U-turns will likely be permitted for passenger vehicles only at all signalized intersections to minimize the impact of left-turn prohibitions. In addition, the signalization of seven currently unsignalized intersections for Alternatives D1.1e (preferred alternative) and D1.1f would provide alternative routes for sidestreet access. In general, the vehicular access restrictions caused by the implementation of at-grade light rail is not expected to significantly worsen P.M. peak hour conditions, since the existing high northbound and southbound P.M. peak hour volumes on MLK Jr. Way S. and Rainier Avenue S. currently make it difficult for vehicles to turn left into and out of unsignalized driveways and sidestreets. During off-peak conditions, the left-turn prohibitions would result in some out of direction travel for motorists to reach their destinations. With the existing and new signalized intersections providing U-turn opportunities, the travel time increase could be as high as two minutes in some instances, and roughly one minute on average. This assumes that as a worst case, vehicles could be required to travel up to ¼ mile for an opportunity to make a U-turn, and that these vehicles may be delayed at a signalized intersection for up to one minute before making the U-turn.

Alternatives D1.1c, D1.1d and D1.3 would cause the largest overall impact to automobile traffic access and circulation, followed by Alternatives D1.1e and D1.1f, and Alternatives D3.4 and D3.3 (lowest access and circulation impact). Pedestrian access would be improved with Alternatives D1.1e and D1.1f due to the addition of 8 signalized pedestrian crossings.

Traffic Safety

Traffic safety impacts in Segment D would be similar to those described for Segment C and would apply to all at-grade alternatives in Segment D. This includes Alternatives D1.1c, D1.1d, D1.1e, and D1.1f from Rainier Avenue S. to Graham Street, and Alternatives D3.3 and D3.4 west of

Rainier Avenue S. between MLK Jr. Way S. and S. Alaska Street, and all alternatives south of approximately S. Graham Street.

Potential accident increases and decreases were evaluated based on the historical accidents on MLK Jr. Way S. and by examining accident rates for similar at-grade light rail systems in the U.S. Alternatives D1.1c, D1.1d, D1.1e (preferred alternative), and D1.1f were evaluated, since light rail would be located in the median through the entire MLK Jr. Way S. corridor.

Between 1994 and March 1999, 1,555 total accidents were reported along the MLK Jr. Way S. corridor, averaging approximately 296 accidents per year. The accident rate of 6.26 accidents per million vehicle miles (mvm) traveled is slightly above the rate of accidents on other similar arterial streets in Seattle. Prohibition of midblock left turns included in the Link at-grade alternatives would help make MLK Jr. Way S. a safer street by reducing collisions between motor vehicles and between pedestrians and motor vehicles. At-grade median light rail systems improve safety by separating opposing traffic, providing for safe turn movements, and providing additional signalized pedestrian crossings.

A review of the experience of other light rail transit systems indicates that motor vehicles turning left in front of light rail vehicles account for the largest percentage of collisions. Collisions involving pedestrians account for a small percent of total collisions.

To assess the potential for future motor vehicle accidents on MLK Jr. Way S., estimates were made of future collisions between motor vehicles and between motor vehicles and light rail vehicles. These estimates indicate that there would be fewer collisions involving motor vehicles with the light rail alternatives compared to a No-build Alternative.

A detailed review of accident records on MLK Jr. Way S. indicates that, of the 1,555 total accidents, an at-grade median light rail system could have prevented 233 collisions (123 involving left turning vehicles, 55 involving vehicles crossing MLK Jr. Way S., and 55 head-on or U-turn collisions) between motor vehicles from 1994 to March 1999. This would be equivalent to an average annual reduction of approximately 44 motor vehicle collisions per year. Based on collision benchmarks from a survey of western urban light rail systems (Korve Engineering 1999), new light rail vehicle accidents with motor vehicles would occur; however the number of new accidents is expected to be lower than the number of existing accidents reduced by the median light rail system. See additional discussion of traffic safety in Section 3.3.2.3.

The review of accident records on MLK Jr. Way S. also indicated that 7 collisions per year between motor vehicles and pedestrians or bicyclists occurred mid-block or at unsignalized crossings. The preferred alternative, with a raised median and additional signal-protected pedestrian crossings, would likely have prevented at least some of these collisions.

In comparison, light rail vehicle accidents with pedestrians and bicyclists are expected to be lower, based on the experience of other comparable light rail systems.

Non-Motorized Facility Impacts

The general non-motorized facility impacts described in Segment C also apply to Segment D. Increased pedestrian crossing distances are expected on MLK Jr. Way S. for all alternatives except D1.1d, due to the proposed widening of the roadway to accommodate at-grade and elevated light rail trackway, as well as traffic lanes, pedestrian, and bicycle improvements. Alternative D1.1d would have one less through lane in each direction and would primarily maintain the existing right-of-way width. With the preferred alternative (D1.1e) as well as Alternative D1.1f, new signalized pedestrian crossings would be provided on MLK Jr. Way S. at S. Hudson Street, 37th Avenue S./S. Raymond Street, S. Morgan Street, S. Willow Street, S. Holden Street, S. Elmgrove Street, S. Thistle Street, and S. Merton Way S. With these new pedestrian crossings, Alternatives D1.1e and D1.1f would result in lower pedestrian impacts than all other light rail alternatives in Segment D. The existing pedestrian signal at Tamarack Drive S. would remain in place for all Segment D alternatives.

With the added signals, distances between signalized crossings would range from 450 ft to 1,450 ft on MLK Jr. Way S. between Rainier Avenue S. and S. Henderson Street compared to 450 ft to 3,900 ft for the No-build Alternative. In all locations the distance required to walk from one side of MLK Jr. Way S. to the other is less than ¼ mile, except between S. Walden Street and S. Andover Street where the walking distance would be a maximum of 0.27 mile. With the No-build Alternative, walking distances to a "legal" crossing location are shorter (50 to 850 ft) because pedestrians are permitted to cross at any signalized or unsignalized intersection. However, the distance between protected signalized crossings for the preferred alternative is much lower than the No-build Alternative; therefore, the impact of the preferred alternative on pedestrian crossing distances is not considered to be significant. For Alternatives D1.1c and D1.1d, new pedestrian-only signals would only be provided at S. Dakota and S. Edmunds streets. Table 3.3-14a summarizes the number of pedestrian trips expected and proposed pedestrian facilities. All sidewalks near stations in Segment D are expected to operate at acceptable levels of service in the year 2020 with the project alternatives, which would be designed to meet the City of Seattle's minimum standards (5 ft minimum sidewalk width for arterial roadways).

Bicycle route connections are currently provided throughout the segment. However, new east-west bicycle routes may be needed to serve the Edmunds (to Columbia City), Graham, Othello, and Henderson (on both sides of MLK Jr. Way S. between Cloverdale and Henderson streets) stations. The McClellan Station would increase traffic on Cheasty Boulevard, which may affect bicycle travel. However, the project would include new sidewalks and streetscape improvements between MLK Jr. Way S. and just west of 27th Avenue.

Table 3.3-14a
Segment D: Non-Motorized Facility Impacts

Station	2010 Peak Walk Trips[1]		2020 Peak Walk Trips[1]		Proposed Pedestrian Facilities
	Ingress	Egress	Ingress	Egress	
McClellan[3]	150-460	330-660	210-575	380-835	New at-grade crosswalks at Rainier/MLK Jr. Way S.
Alaska[3]	340	720	440	935	Traffic Signal
Charlestown (Rainier Valley Square)*	200	315	260	410	Traffic Signal
Genesee	400	895	520	1165	Traffic Signal
Edmunds*[3]	260-375	645-790	340-510	845-1,105	Traffic Signal
Columbia City	260-460	655-895	340-520	850-1,165	Grade-separated platform under Edmunds St.
*Graham**[3]	265-280	90-665	385-400	120-910	Traffic Signal
Othello[3]	5-180	90-420	10-280	130-600	Traffic Signal
Henderson	90	195	140	255	Traffic Signal

Notes: [1] Walk trips are summarized for the P.M. peak 3-hour period.
[2] Proposed for elevated and at-grade McClellan Station options.
* Denotes potential station
[3] Range reflects differences with different route alternatives and station combinations.
Stations associated with the preferred alternative are shown in italics.

The at-grade alternatives in Segment D would impact crossings of MLK Jr. Way S. and Henderson Street for the proposed Chief Sealth Trail, extending from Beacon Hill to Renton. In addition, with the preferred alternative (D1.1e), Sound Transit would work with the City to provide a new north-south bicycle facility running parallel to MLK Jr. Way S. Alternative D1.1f could also provide additional space within the MLK Jr. Way S. roadway, which could potentially improve bicycle travel in the corridor. Table 3.3-14b shows the proposed bicycle storage facilities that would be provided in Segment D.

Table 3.3-14b. Proposed Bicycle Facilities for Segment D

Station Name	Proposed Bicycle Facilities	Proposed Quantity	Proposed Expansion Area
McClellan	Racks and lockers	Racks for 20, Lockers for 4	2,700 ft^2
Columbia City/Edmunds	Racks	Racks for 20	1,500 ft^2
Charleston/Genesee/Alaska	Racks	Racks for 20	950 ft^2
Graham	Racks	Racks for 20	1,500 ft^2
Othello	Racks	Racks for 20	1,200 ft^2
Henderson	Racks and lockers	Racks for 20, Lockers for 4	TBD

Note: Facilities would be sheltered.
Stations associated with the preferred alternative are shown in italics.

Parking Impacts

Parking displacements for Segment D are shown in Table 3.3-15a. Some loss of private, off-street parking stalls would result from the at-grade alignments. Off-street parking loss due to partial commercial property displacements is estimated to be 284 spaces for Alternatives D1.1c, 163 spaces for D1.1d, 232 spaces for Alternatives D1.1e (preferred alternative) and D1.1f, 129 spaces for D1.3, 247 spaces for D3.3, and 177 spaces for D3.4. Full property displacements would result in additional parking displacement; however, these are not considered to be a parking impact since business displacements described in Section 4.2 would be the impact from the project.

Alternatives D1.1c, D1.1d, D1.1e (preferred alternative), D1.1f, and D1.3 would be expected to displace few on-street parking spaces because the alignment would be located in the center median of MLK Jr. Way S., which generally does not provide on-street parking. Alternatives D3.3 and D3.4, which would be on Rainier Avenue S., north of S. Edmunds Street in Alternative D3.3, and north of S. Graham Street in Alternative D3.4, would displace 35 on-street parking spaces on Rainier Avenue S. All the station areas in Segment D have a large amount of available unrestricted on-street parking, and could result in hide-and-ride parking impacts within walking distance of Segment D stations. Table 3.3-15b summarizes parking impacts in station areas.

Table 3.3-15a
Segment D: Parking Impacts Summary

Alternative	Parking Spaces Removed	
	On-Street	Off-Street*
D1.1c MLK Jr. Way S., 4-lane	3	284
D1.1d MLK Jr. Way S., 2-lane	3	163
D1.1e MLK Jr. Way S., 4-lane	*3*	*232*
D1.1f MLK Jr. Way S., 2-lane	3	232
D1.3 MLK Jr. Way S., Combined Profile	3	129
D3.3 Alaska Street Crossover	68 to71	247
D3.4 37th Avenue S. Tunnel	46 to 53	177

Note: *Parking displacements resulting from partial property displacements only.
The preferred alternative is shown in italics.

Table 3.3-15b
Segment D: Parking Impacts in Station Areas

Station	Spaces Displaced	Area Affected by Displacement
McClellan Station	*24*	*Existing off-street parking*
Charlestown Potential Station	3	S. Charlestown Street (bus layover space)
Genesee Station (D3.3)	30	Rainier Ave. on-street parking allowed
Edmunds Station	*None*	*None*
Columbia City Station	8 to 12	Edmunds Street and 37th Ave. S. (bus stops)
Alaska Station	None	None
Graham Station	*None*	*None*
Othello Station	*3*	*MLK Jr. Way (bus stops)*
Henderson Station	*None*	*None*

Stations associated with the preferred alternative are shown in italics.

Mitigation

Mitigation for the preferred alternative (D1.1e) was developed using two different signal timing assumptions to bracket the range of possible impacts and mitigation options. The recommended Link traffic signal system for the preferred alternative in Segment D is a progression-based system on MLK Jr. Way S. While the analysis with the recommended progression-based system was conducted for Alternatives D1.1c and D1.1e (preferred alternative) only, this system, and the related intersection improvements described below, could be included as mitigation for all other alternatives. This system relies on the predictability of light rail vehicle arrivals, eliminating the need for light rail vehicles to fully preempt traffic signals. This type of system minimizes or eliminates impacts to eastbound/westbound movements and northbound/southbound left-turn movements compared to a light rail signal preemption system. All existing and new signalized intersections will require timing and phasing revisions. Most of the LOS impacts at intersections from at-grade light rail operations are eliminated with the progression-based signal system. However, there are six intersections where improvements have been included in the project design of the preferred alternative (D1.1e) to mitigate LOS impacts. These locations include:

- S. Columbian Way – add eastbound left-turn lane
- S. Graham Street – add eastbound right-turn lane
- S. Myrtle Street – add eastbound and westbound left-turn lanes
- S. Othello Street – add eastbound and westbound left-turn lanes and restripe the eastbound curb lane to an exclusive right-turn lane
- Renton Avenue S. – add westbound left-turn lane
- S. Cloverdale Street – add eastbound right-turn lane

To mitigate impacts of eliminating left-turn access at unsignalized locations, additional signals with northbound and/or southbound left-turn lanes were included in the preliminary project design at the following intersections:

- S. Dakota Street
- S. Edmunds Street
- S. Dawson Street
- S. Holly Street

Passenger vehicles would be allowed to make U-turns at these locations. Protected pedestrian crosswalks across MLK Jr. Way S. would also be provided. The following intersections would also be signalized with Alternative D1.1e; however, left turn lanes would not be provided on MLK Jr. Way S. at these locations:

- S. Hanford Street
- S. Andover Street
- S. Brandon Street

New traffic signals would also be added at three intersections to improve vehicular and pedestrian access to the McClellan and Henderson stations.

- Rainier Avenue S./S. Forest Street (McClellan Station)
- Rainier Avenue S./S. Hanford Street (McClellan Station)
- S. Henderson Street near Yukon Avenue S. (Henderson Station)

To provide crossing opportunities for pedestrians, pedestrian-only signals would be included with the preferred alternative at the following intersections:

- S. Tamarack Drive S. (existing and proposed)
- S. Hudson Street
- 37^{th} Avenue S./S. Raymond Street
- S. Morgan Street
- S. Willow Street
- S. Holden Street
- S. Elmgrove Street
- S. Thistle Street
- Merton Way S.

These added pedestrian signals would minimize the walking distance required to reach a protected crossing of MLK Jr. Way S. They would also enhance pedestrian safety compared to the No-build Alternative by providing additional protected pedestrian crossing opportunities.

Final design of the at-grade sections will consider safety measures such as a visual element in the center of the tracks to discourage crossing the tracks except at legal crosswalks. The visual element may consist of a 42-inch high decorative fence, bollards and chain, or other similar features. Another potential measure being considered would provide an area for pedestrians to stand on one or both sides of the rail tracks at legal crossing locations.

At some signalized intersections, east-west pedestrian movements would not have sufficient time to cross MLK Jr. Way S. in one signal cycle. This would require pedestrians to cross both the northbound and southbound travel lanes in separate signal cycles. To eliminate this impact, eastbound and westbound left-turn movements could be assigned to a single permissive left-turn phase allowing pedestrians to cross the entire street in one cycle.

The preferred alternative also includes a 6-ft sidewalk with a 4 ½-ft planting strip on MLK Jr. Way S. throughout the corridor. At station locations, the sidewalk width will be increased to 10 ft.

For all alternatives, including D1.1c and D1.1e, a worst-case signal preemption strategy was assumed for the LOS analysis. If signal preemption is implemented instead of the signal progression strategies above, the following mitigation measures would be needed.

In the year 2010, the MLK Jr. Way S./S. Alaska Street intersection would degrade from LOS D with the No-build Alternative to LOS F with Alternative D1.1d and LOS E with Alternative D1.1e. In 2020, the intersection would operate at LOS F with all project alternatives. The addition of a westbound left turn lane would improve intersection operations to LOS D.

In the year 2010, the MLK Jr. Way S./S. Graham Street intersection would degrade from LOS D with the No-build Alternative to LOS F with Alternative D1.1d. In the year 2020, the intersection would operate at LOS F with all project alternatives, except Alternatives D1.1e (preferred alternative) and D1.1f. The addition of an eastbound right turn lane would improve intersection operations to LOS C or D. This eastbound right-turn lane would be included as part of the preferred alternative (D1.1e).

By the year 2010, the MLK Jr. Way S./S. Othello Street intersection would operate at LOS F with both the No-build and all light rail alternatives, except Alternatives D1.1e (preferred alternative) and D1.1f, which would operate at LOS D or C in 2020; however, the volume-to-capacity ratios are expected to worsen slightly for all light rail alternatives due to the addition of light rail project traffic and signal phasing restrictions. The addition of a lane to both the eastbound and westbound approaches on S. Othello Street would improve intersection operations to LOS D with all light rail alternatives except Alternative D1.1d in 2010. With Alternative D1.1d, the intersection would operate at LOS F with a volume-to-capacity ratio of 1.12, which is the same as the No-build Alternative. This revised lane configuration would consist of one left turn lane, one through lane, and one right-turn lane on both the eastbound and westbound approaches. A proposed lane configuration consisting of exclusive eastbound left, through and right turn lanes, an exclusive westbound left turn lane and two westbound through lanes would be included as part of Alternatives D1.1e (preferred alternative) and D1.1f.

In 2010, the S. Alaska Street/Rainier Avenue S. intersection would degrade from LOS D with the No-build Alternative to LOS E with Alternative D3.3, due to the addition of light rail project traffic and signal phasing restrictions. In 2020, the intersection would also worsen to LOS E with Alternatives D1.1d, D1.1f and D3.4. The addition of a southbound right-turn lane to Rainier Avenue S. would improve intersection operations to LOS D.

The S. Holly Street/Rainier Avenue S., S. Henderson Street/Rainier Ave. S, and S. Henderson Street/Renton Ave. S. intersections would all operate at LOS E or F with Alternatives D1.1d and D1.1f by the year 2020. Signal timing adjustments would be needed to improve levels of service to D or better.

The Segment D non-motorized facility improvements would be consistent with the non-motorized facility mitigation approach, discussed in Section 3.3.2.1 for Segment A, would also apply to Segment D. The preferred alternative (D1.1e), and all other alternatives, would also include the development of Chief Sealth Trail crossings of MLK Jr. Way S. and Henderson Street near Henderson Station, development of a bicycle facility through the Rainier Valley parallel to the light rail corridor, and improved signage for an existing on-street bicycle route through the Rainier Valley.

Mitigation for Segment D hide-and-ride parking impacts is the same as described in Section 3.3.2.1 under Segment A. The areas surrounding the McClellan, Edmunds, Graham, Othello, and Henderson stations currently experience low parking utilization. To address the potential for Link riders to increase parking utilization, surveys would be conducted within a 1/4 mile of the station between 9:30 to 3:30 P.M., the peak parking period of possible hide-and-ride impacts from Link users.

Business/property owners will be directly compensated when a portion of their property is acquired by Sound Transit. If a portion of the area purchased was used for parking, Sound Transit will work with the property owner on a case-by-case basis to replace lost parking.

The City of Seattle has also suggested conducting early morning commute period surveys. Given the low parking utlization in this area, a mid-day survey should be adequate to capture the full parking impacts of Link users. Should the mid-day survey prior to Link opening identify greater than 90 percent parking utilization, an additional survey will also be conducted between 7:00 to 9:30 A.M.

3.3.2.5 Segment E (Tukwila)

Figure 3.3-5 shows the traffic and parking analyses locations in Segment E. For this segment, the preferred alternative is E1.1.

Congestion

Tables 3.3-16 and 3.3-17 present the 2010 and 2020 No-build and project LOS analysis results for the Segment E alternatives during the P.M. peak hour. As for Segment D, full signal preemption for light rail vehicles was assumed at all at-grade intersections for both the year 2010 and 2020 LOS. This analysis results in a reallocation of green time from eastbound and westbound approaches and northbound and southbound left-turn movements to northbound and southbound through movements. Additional traffic operations analysis for the year 2020 has been conducted using TRANSYT-7f assuming a progression-type transit signal priority system instead of preemption. The TRANSYT-7F corridor-wide LOS analysis was conducted for the No-build Alternative and Alternative E1.1 on Tukwila International Boulevard. Based on the analysis, most of the intersections would operate at LOS C or better in the year 2020, with system-wide optimization of cycle length and signal timings. The only exception is the S. 144th Street/Tukwila International Boulevard intersection, which would operate at LOS E in the year 2020.

For Alternatives E1.1 (preferred alternative) and E1.2, the worst case 2010 P.M. peak hour analyses indicate that most study intersections would operate at an acceptable LOS based on City of Tukwila LOS standards with or without the light rail system. The exceptions include the Boeing Access Road/MLK Jr. Way S./Ryan Way intersection, the S. 112th Street/Tukwila International Boulevard intersection, and S. 144th Street/Tukwila International Boulevard intersection, which all would operate at LOS F in 2010 for the No-build and Alternatives E1.1 and E1.2. Volume-to-capacity (v/c) ratios at the Boeing Access Road/MLK Jr. Way S./Ryan Way and S. 112th Street/Tukwila International Boulevard intersections are not expected to degrade significantly between the No-build and Alternatives E1.1 and E1.2. However, v/c ratios at the S. 144th Street/Tukwila International Boulevard intersection are expected to degrade from 1.10 with the No-build Alternative to 1.32 with Alternative E1.1. By the year 2020, the Boeing Access Rd./E. Marginal Way S. intersection would also worsen to LOS F with the No-build and project alternatives.

The 2010 P.M. peak hour analyses indicate that the study intersections for Alternatives E2 and E3 would be minimally affected by traffic generated from the light rail system. The West Valley Highway at S. 156th Street intersection is expected to degrade from LOS E to LOS F. By the year 2020, the Interurban Ave. S./ 42nd Ave. S./Macadam Rd. S., Interurban Ave. S./Gateway Dr., West Valley Highway/S. 156th Street, West Valley Highway/S. 158th Street, West Valley Highway/Strander Boulevard, and Baker Boulevard/Andover Park W. intersections would all worsen to LOS F with the No-build and all other light rail alternatives.

For the at-grade sections of Alternatives E1.1 and E2, average delay on the east-west approaches would be higher than No-build. This delay increases as a result of the assumed light rail full-signal preemption system reallocating green time from east-west to north/south movements. The LOS on eastbound and westbound approaches remains at LOS D or better or would not operate worse than the No-build alternative at most intersections with the preferred alternative and other light rail alternatives except for the following locations:

- MLK Jr. Way S./Boeing Access Road – With the preferred alternative (Alternative E1.1), and Alternative E1.2, the eastbound approach worsens from LOS D (No-build) to LOS F in the year 2020.
- Tukwila International Boulevard/S. 144th Street – With the preferred alternative (Alternative E1.1) and Alternative E1.2, the eastbound approach worsen from LOS E (No-build) to LOS F in the year 2020. The westbound approach also worsens from LOS E (No-build) to LOS F with the preferred alternative.

- Interurban Avenue S./42nd Avenue S./Macadam Road S. – In the year 2010, the westbound approach worsens from LOS D (No-build) to LOS E (Alternative E2). In the year 2020, both approaches would operate at LOS F with the No-build and all light rail alternatives.
- Interurban Avenue S./Gateway Drive – In the year 2010, the eastbound and westbound approaches worsen from LOS E (No-build) to LOS F (Alternative E2). In the year 2020, both approaches would operate at LOS F with the No-build and all light rail alternatives.
- West Valley Highway/S. 156th Street – In the year 2010, the eastbound approach worsens from LOS E (No-build) to LOS F (Alternatives E2 and E3). In the year 2020, the eastbound approach would operate at LOS F with the No-build and all light rail alternatives.

Access and Circulation

With the preferred alternative (E1.1), access and circulation impacts for at-grade sections on Tukwila International Boulevard (E1.1) would be caused by left turn prohibitions to and from unsignalized driveways and streets. For elevated sections (E1.1 and E1.2), left turns to and from most streets and driveways would be prohibited. The following nine locations on Tukwila International Boulevard would be restricted to right-in, right-out access only for both Alternatives E1.1 and E1.2: 35th Avenue S., 37th Avenue S., S. 133rd Street, S. 139th Street, S. 141st Street W., S. 141st Street E., S. 142nd Street, S. 146th Street, and S. 150th Street. These left turn restrictions would cause some motorists to travel longer distances to access Tukwila International Boulevard. In some cases, this additional travel would occur on residential streets. For these at-grade and elevated sections on Tukwila International Boulevard, U-turns will be permitted for passenger vehicles at all signalized intersections to minimize the impact of these left turn prohibitions. In addition, the signalization of the S. 140th Street/Tukwila International Boulevard and S. 148th Street/Tukwila International Boulevard intersections (currently unsignalized) with the No-build, preferred and other light rail alternatives would provide alternative routes for sidestreet access. In general, the vehicular access restrictions caused by the implementation of at-grade light rail is not expected to significantly worsen P.M. peak hour conditions, since the existing high northbound and southbound P.M. peak hour volumes on Tukwila International Boulevard currently make it difficult for vehicles to turn left into and out of unsignalized driveways and sidestreets. During off-peak conditions, the left-turn prohibitions would result in some out of direction travel for motorists to reach their destinations. With the existing and new signalized intersections providing U-turn opportunities, the travel time increase could be up to two minutes in some instances and considerably less in most cases. This assumes that, the worst-case, vehicles could be required to travel up to ¼ mile for an opportunity to make a U-turn, and that these vehicles may be delayed at a signalized intersection for up to one minute before making the U-turn. Alternative E2 would result in the relocation of the Foster Golf Course entrance from Interurban Avenue S. and Alternative E3 would result in the closure of 57th Avenue S. from MLK Jr. Way S. Alternative E1.1 would cause the largest overall impact to traffic access and circulation followed by Alternatives E1.2, E2, and E3 (lowest access and circulation impact).

Table 3.3-16
Segment E: P.M. Peak Hour Level of Service Summary—2010 and 2020 No-build and Project Conditions (Tukwila International Boulevard Route Alternatives)

Intersection[1]	No-build		*Alternative E1.1*		Alternative E1.2	
	2010	2020	2010	2020	2010	2020
E. Marginal Way at S. 102nd St.	C (23.7)	C (22.8)	C (23.7)	C (22.8)	C (23.7)	C (22.8)*
Boeing Access Rd. at MLK Jr. Way S. at Ryan Way	F (1.31)*	F (1.08)*	F (1.34)*	F (1.22)*	F (1.34)*	F (1.22)*
Boeing Access Rd. at light rail station	A (4.8)	B (8.3)	B (11.8)	B (9.8)	B (11.8)	B (9.8)
Boeing Access Rd. at E. Marginal Way S.	D (36.7)	F (1.00)*	D (32.5)	F (1.03)*	D (36.7)	F (1.03)*
E. Marginal Way S. at S. 112th St.	B (11.5)	—	B (11.5)	—	B (11.5)	—
S. 112th at Tukwila International Blvd.	F (1.66)*	F (1.76)*	F (1.66)*	F (1.76)*	F (1.66)*	F (1.76)*
S. 116th at Tukwila International Blvd.	C (23.0)	D (32.8)	D (27.2)	--	C (23.0)	--
S. 130th at Tukwila International Blvd.	B (6.7)	—	B (5.7)	—	B (6.7)	—
S. 132nd at Tukwila International Blvd.	B (6.5)	—	B (8.8)	—	B (6.5)	—
S. 144th at Tukwila International Blvd.	F (1.10)*	F (0.93)*	F (1.32)*	F (1.15)*	F (1.12)*	F (0.93)*

Notes: ( ) Average intersection delay, in seconds per vehicle
* Average delay could not be calculated by HCM. Volume-to-capacity ratio is shown.
Full signal preemption was assumed for the at-grade alternative (E1.1) on Tukwila International Boulevard.
[1] Level of service for these intersections does not reflect the potential downstream effects from queuing since the HCM methodology assumes that each intersection is isolated from any residual traffic congestion impacts. Therefore, the actual LOS may be worse than shown in the table; however, the relative difference between the No-build and light rail alternatives would be similar.
Level of Service at the 154th and 160th at International Blvd. intersections are included in Section 3.3.2.6, Segment F (SeaTac).
The preferred alternative is shown in italics.

Table 3.3-17
Segment E: Tukwila P.M. Peak Hour Level of Service Summary – 2010 and 2020 No-build and Project Conditions (MLK Jr. Way S. and Interurban Avenue Alternatives)

Intersection	No-build		Alternative E2 (Interurban)		Alternative E3 (MLK Jr. Way)	
	2010	2020	2010	2020	2010	2020
Interurban Ave. S. at East Marginal Way S.	B (10.5)	—	B (11.2)	—	B (10.5)	—
Interurban Ave. S. at 42nd Avenue S. at Macadam Rd. S.	E (44.8)	F (1.03)*	E (52.4)	F (0.98)*	E (44.8)	F (1.03)*
Interurban Ave. S. at Gateway Dr.	D (39.8)	F (1.11)*	E (43.4)	F (1.08)*	D (39.8)	F (1.11)*
Interurban Ave. S. at SR 599 Northbound Off-ramp	C (16.8)	—	C (16.8)	—	C (16.8)	—
Interurban Ave. S. at SR 599 Northbound On-ramp	A (4.5)	—	B (5.9)	—	A (4.5)	—
Interurban Ave. S. at 48th Ave. S.	B (7.3)	—	B (7.3)	—	B (7.3)	—
Interurban Ave. S. at I-5 Southbound Off-ramp	B (5.5)	—	B (5.5)	—	B (5.5)	—
Interurban Ave. S. at 56th Ave. S. at 52nd Ave. S.	B (5.6)	—	C (15.1)	—	B (5.6)	—
Interurban Ave. S. at 58th Ave. S. at 141st St. S.	C (17.4)	—	C (16.0)	—	C (17.4)	—
Interurban Ave. S. at Fort Dent Way	F (2.41)*	F (1.73)*	F (2.41)*	F (1.73)*	F (2.41)*	F (1.73)*
Interurban Ave. S. at S.W. Grady Way	F (2.13)*	F (2.21)*	F (2.13)*	F (2.21)*	F (2.13)*	F (2.21)*
West Valley Highway at S. 156th St.	E (57.5)	F (1.47)*	F (2.42)*	F (1.53)*	F (2.42)*	F (1.53)*
West Valley Highway at S. 158th St. (Longacres Way)	C (20.2)	F (1.55)*	C (20.5)	F (1.60)*	C (20.5)	F (1.60)*
West Valley Highway at Strander Blvd.	E (41.8)	F (0.88)*	E (45.2)	F (0.89)*	E (45.2)	F (0.89)*
Tukwila Parkway at Southcenter Mall North Driveway	C (23.6)	—	C (23.6)	—	C (23.6)	—
Tukwila Parkway at 1st Ave. S.	C (19.7)	—	C (19.7)	—	C (19.7)	—
Tukwila Parkway at Andover Park W.	C (19.9)	C (16.9)	C (21.1)	C (17.3)	C (20.6)	C (17.3)
Baker Blvd. at Andover Park W.	C (25.0)	F (60.4)	C (24.8)	F (0.73)*	D (25.9)	F (65.6)
Strander Blvd. at Andover Park W.	E (42.7)	E (43.9)	E (43.4)	E (46.3)	E (43.5)	E (44.9)

Notes: ( ) Average intersection delay, in seconds per vehicle
* Average delay could not be calculated by HCM. Volume-to-capacity ratio is shown.
Level of Service at the 154th and 160th at International Blvd. intersections are included in the section 3.3.2.6, Segment F (SeaTac).

Traffic Safety

Traffic safety impacts in Segment E would be similar to those described for Segments C and D. At-grade alternatives in Segment E, which would have the highest potential impact on traffic safety include Alternative E1.1 on Tukwila International Boulevard and Alternative E2 on Interurban Avenue S.

An analysis was made to quantify possible numbers of accident increases and decreases based on the historical accidents on Tukwila International Boulevard and by examining accident rates for at-grade light rail systems in the U.S. Alternative E1.1 (preferred alternative) was evaluated, since light rail would be located in the median through the entire Tukwila International Boulevard corridor.

Between 1994 and 1996, there were 198 accidents experienced in the 1.45-mile segment on Tukwila International Boulevard between S. 130th Street and S. 152nd Street, for an accident rate of 3.14 accidents per million vehicle miles. Approximately 130 of these accidents occurred midblock or at unsignalized locations. During the 3-year period (1994 to 1996) 11 of these midblock accidents involved left-turns, 1 involved a bicyclist, and 11 involved pedestrians.

An at-grade median light rail system on Tukwila International Boulevard could have prevented 11 midblock left-turn accidents out of the 130 total midblock accidents. This would be equivalent to an average annual reduction of approximately 3 to 4 motor vehicle collisions per year. The potential for accident reductions would be even higher in future years as traffic volumes increase. Based on collision benchmarks from a survey of western urban light rail systems (Korve Engineering 1999), new light rail vehicle accidents with motor vehicles would occur; however, the number of new accidents is expected to be lower than the number of existing accidents reduced by the median light rail system. See additional discussion of traffic safety in Section 3.3.2.3.

The light rail alternative with a raised median on Tukwila International Boulevard and additional signal-protected pedestrian crossings would likely have prevented at least some of the 12 collisions between motor vehicles and pedestrians or bicyclists – an average of 4 per year—which occurred mid-block or at unsignalized crossings. In addition, light rail vehicle accidents with pedestrians and bicyclists are expected to be lower.

With Alternatives E2 and E3, light rail trains would be expected to operate at-grade or elevated (Alternative E3) on the side of the street with cross street traffic controlled at gated crossings. A survey of comparable light rail systems (Korve Engineering 1999) revealed that for streets that cross light rail tracks with gates, the number of collisions were so few that a comparison with tracks controlled by traffic signals is not valid. The far lower collision rate is the result of the physical barrier provided by automatic gates, providing greater control and visibility. The low number of collisions at comparable systems does not allow quantitative estimation of traffic safety impacts for Alternatives E2 and E3.

Non-Motorized Facility Impacts

The general non-motorized facility impacts described in Segment C also apply to Segment E. Reduced pedestrian crossing locations are expected along at-grade and to a lesser degree, elevated sections on Tukwila International Boulevard (E1.1 and E1.2) and Interurban Avenue S. (E2). However, many currently-observed crossings are at unsafe or illegal locations. The reduction in legal crossing locations will force pedestrians to walk longer distances (approximately 600 to 1,700 ft) to cross Tukwila International Boulevard for Alternatives E1.1 and E1.2, compared to the No-build Alternative. The No-build Alternative includes a total of seven unsignalized active and passive mid-block crossings of Tukwila International Boulevard resulting in shorter pedestrian crossing distance compared to the preferred alternative. Three of these crossings are included in the preferred alternative as signalized pedestrian crossings. With the No-build and preferred alternative, new signals are also being provided at the Tukwila International Boulevard intersections with S. 140th and S. 148th streets. These would provide additional controlled and safer pedestrian crossing opportunities near the S. 144th Station. Therefore, the impact of the preferred alternative on pedestrian crossing distances is not considered to be significant. Adding a pedestrian refuge at the station and requiring pedestrians to cross in two signal phases would increase pedestrian crossing time at the S. 144th Street intersection for those crossing the street. However, the two-step pedestrian movement would decrease pedestrian wait time for those crossing Tukwila International Boulevard to the station due to a shorter overall cycle length. Table 3.3-18a summarizes the number of pedestrian trips expected and proposed pedestrian facilities.

Table 3.3-18a
Segment E: Non-Motorized Facility Impact Summary

Station	2010 Walk Trips[1]		2020 Walk Trips[1]		Proposed Pedestrian Facilities
	Ingress	Egress	Ingress	Egress	
Boeing Access Road	140	0	200	0	Traffic Signal
S. 144th Street	95	95	180	195	Traffic Signal
Longacres	0 to 120	0	0 to 130	0	Traffic Signal
Southcenter (Baker Blvd. and Strander Blvd.)	190 to 280	130 to 145	205 to 395	175 to 180	Traffic Signal

Notes: [1] Walk trips are summarized for the P.M. peak 3-hour period. Range reflects different route alternatives served by station. Stations associated with the preferred alternative are shown in italics.

The Boeing Access Road and S. 144th Street stations have little to no pedestrian facilities and bicycle routes in the area. All sidewalks near stations in Segment E would operate at acceptable levels of service (LOS B) in the year 2020 with the project alternatives, when designed to meet the City of Tukwila's minimum standards for arterial roadways (5 ft minimum effective sidewalk width). The project would provide 12-ft wide pedestrian areas (8 ft sidewalk, 4-ft landscape) for the entire length of Tukwila International Boulevard, consistent with Tukwila's proposed improvement. The Longacres Station is located in close proximity to the Green River/Interurban Trail system and sidewalks exist on S. 144th Street near the S. 144th Station. Additionally, bicycle storage facilities, summarized in Table 3.3-18b, are proposed for all stations in Segment E.

Table 3.3-18b. Proposed Bicycle Facilities for Segment E

Station Name	Proposed Bicycle Facilities	Proposed Quantity	Proposed Expansion Area
Boeing Access Road	Racks	Racks for 20	None
S. 144th	Racks	Racks for 20	450 ft^2
Longacres	As built by Sounder	As built by Sounder	As built by Sounder
Southcenter	Racks	Racks for 20	400 ft^2

Note: Facilities would be sheltered.
Stations associated with the preferred alternative are shown in italics.

Parking Impacts

Some loss of private, on-street and off-street parking stalls would result from bus pull-outs for at-grade Alternative E1.1 (preferred alternative), guideway piers for Alternatives E1.2, E2 and E3, and roadway widening for all alternatives. As shown in Table 3.3-19, parking loss from partial commercial property displacements is estimated to be 68 spaces for Alternative E1.1 (preferred alternative), 56 spaces for E1.2, 314 spaces for E2, and 260 to 460 spaces for E3. These losses due to partial displacements represent approximately 17 percent of existing parking spaces for Alternative E1.1, 14 percent for E1.2, 6 percent for E2, and 4 to 8 percent for E3, depending on the location of the Southcenter Station. With Alternatives E1.1 (preferred alternative) and E1.2, an additional 56 spaces, currently located in front of businesses and within the Tukwila International Boulevard right-of-way, would also be lost.

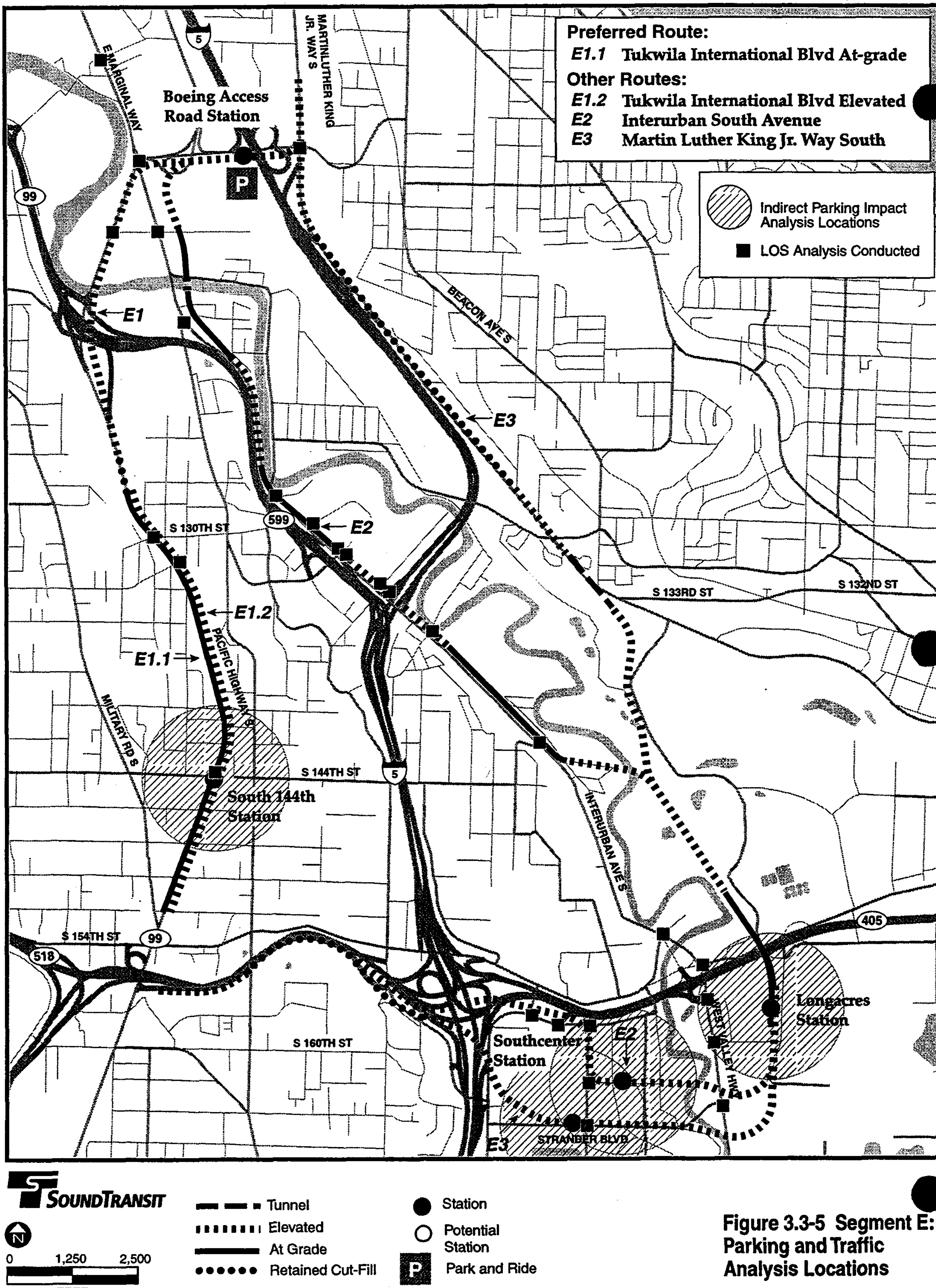


Figure 3.3-5 Segment E: Parking and Traffic Analysis Locations

An additional 146 parking spaces would be also lost due to full right-of-way purchases with the preferred alternative; however, these are not considered to be a parking impact since the business displacements described in Section 4.2 would be the impact from the project.

Roadway improvements identified in the Pacific Highway Revitalization Plan and included in the No-build Alternative would require 86 to 100 ft of right-of-way, which would result in some parking loss. However, this parking loss would be lower than the preferred alternative, which would require a 102 ft right-of-way. The total number of parking spaces lost would be higher for Alternatives E2 and E3 than for Alternatives E1.1 and E1.2; however, Alternatives E1.1 and E1.2 would impact more properties (44 parcels) than would Alternatives E2 (20 parcels) or E3 (11 parcels). With Alternatives E2 and E3, a significant number of parking spaces would be lost at Foster Golf Course, and Southcenter.

The Boeing Access Road Park-and-Ride would have capacity for 300 vehicles. In the year 2020, vehicle demand is expected to fall within the range of 180 to 195 vehicles, depending on the light rail alternative. The proposed Longacres Station would create off-street parking impacts to adjacent properties if platform access requires area currently used for parking. Light rail riders would also be expected to use the proposed commuter rail park-and-ride lot at the Longacres Station. In other station areas, the Southcenter Station at Baker Boulevard (Alternative E2) would displace approximately 15 to 20 parking spaces with both station options A and B. The Southcenter Station at Andover Park West and Strander Boulevard (Alternative E3) would displace approximately 265 Southcenter parking spaces with station Option A, and 100 parking spaces with station Option B.

The Tukwila neighborhoods served by Link have low parking utilization rates which Link service would not be expected to increase due to the presence of Link park-and-rides at the Boeing Access and S. 154th stations.

Table 3.3-19
Segment E: Parking Impacts Summary

Alternative	Parking Spaces Displaced
E1.1 Tukwila International Boulevard At-grade	124[1]
E1.2 Tukwila International Boulevard Elevated	112[2]
E2 Interurban Avenue S.	314
E3 MLK Jr. Way S. (Option A)	460
E3 MLK Jr. Way S. (Option B)	260

Note: * Parking displacements resulting from partial property acquisitions only.
The preferred alternative is shown in italics.
[1] 56 of these 124 spaces are within the Tukwila International Boulevard right-of-way.
[2] 56 of these 112 spaces are within the Tukwila International Boulevard right-of-way.

Mitigation

The E. Marginal Way S./Boeing Access Road intersection would operate at LOS F in the year 2020 with the No-build and other light rail alternatives. Volume-to-capacity ratios for Alternatives E1.1 (preferred) and E1.2 would be expected to be worse than with the No-build Alternative. An additional westbound left-turn lane and signal timing adjustments would improve traffic operations to LOS D conditions in the year 2020 with the No-build and other light rail alternatives.

To minimize or eliminate impacts to east-west movements related to the light rail signal preemption system or other signal timing strategies (such as the progression-based transit priority system approach described previously) with less impact to the east-west movements could be considered. With the signal progression approach, average delay for the eastbound and westbound approaches would be the same for all alternatives, including No-build.

Based on the TRANSYT-7F analysis, which assumes signal progression instead of signal preemption on Tukwila International Boulevard, the S. 144th Street/Tukwila International Boulevard intersection would operate at LOS E or worse with Alternative E1.1 in the year 2020. Without mitigation, severe congestion and delay would be expected at all intersection approaches. The addition of an eastbound right-turn pocket and a two-phase pedestrian crossing (with a refuge area in the center of Tukwila International Boulevard) would lower average vehicle delays. With this improvement, the S. 144th Street/Tukwila International Boulevard intersection would still operate at LOS E; however, no approaches would operate over capacity.

The Interurban Ave. S./Gateway Drive intersection would worsen from LOS D (No-Build) to LOS E in the year 2010 with Alternative E2, and operate at LOS F in the year 2020 with the No-Build and all light rail alternatives. Adding a westbound left turn and reconfiguring the eastbound approach to include an exclusive right turn lane and a shared through/left turn lane would improve intersection operations to LOS D in the year 2020 with the No-build and all other light rail alternatives.

The West Valley Highway/S. 156th Street intersection would worsen from LOS E (No-build) to LOS F (Alternatives E2 and E3) in the year 2010, and operate at LOS F in the year 2020 with the No-build and all other light rail alternatives. An additional northbound left turn lane, westbound left turn lane, and eastbound left turn lane would mitigate this impact and improve operations to LOS D in the year 2020 with the No-build and other light rail alternatives.

The Boeing Access Road Station access would be signalized, improving safety for vehicles and transit accessing the station and for pedestrians crossing Boeing Access Road.

Any effect on coordinated signal progression on streets impacted by the improvements described would need to be minimized.

The Segment E non-motorized facility improvements would be consistent with the non-motorized facility mitigation approach described for Segment A (Section 3.3.2.1). With the preferred alternative (E1.1), new signalized pedestrian crossings would also be provided on Tukwila International Boulevard 1,100 ft north of S. 130th Street, 1,250 ft south of S. 132nd Street, and 50 ft south of S. 142nd Street, to improve safety and provide additional crossing opportunities.

Additional safety measures to be considered during final design for at-grade sections are a visual element in the center of the tracks to discourage pedestrian crossings except at legal crosswalks; and an area for pedestrians to stand on one or both sides of the tracks at legal crossing locations. The visual element may consist of a decorative fence or similar feature.

Mitigation for Segment E hide-and-ride parking impacts is the same as described in Section 3.3.2.1 under Segment A Mitigation for Parking. To address the potential for overflow parking at the Longacres, and Boeing Access Road, and hide-and-ride parking at the S. 144th and Southcenter stations, surveys will be conducted within ¼ mile of the stations between 9:30 to 3:30 P.M., the peak parking period of possible hide-and-ride impacts from Link users.

Business/property owners will be directly compensated when a portion of their property is acquired by Sound Transit. If a portion of the area purchased was used for parking, Sound Transit will work with the property owner on a case-by-case basis to replace lost parking. Sound Transit would also work with businesses on Tukwila International Boulevard to replace lost parking in situations where a portion of the property is not acquired but a substantial amount of the parking serving the business is displaced.

3.3.2.6 Segment F (SeaTac)

Figure 3.3-6 shows the traffic and parking analyses locations in Segment F. For this segment the preferred alternative is F2.3.

Congestion

With the preferred alternative (F2.3), most intersections would operate at acceptable levels in the year 2020, when compared to No-build. The only exceptions include the International Boulevard/S. 154th Street, International Boulevard/160th Street, International Boulevard/170th Street, 32nd Avenue S./S. 176th Street, and International Boulevard/S. 200th Street intersections.

Tables 3.3-20a and 3.3-20b present the 2010 and 2020 worst case P.M. peak hour No-build and project level of service analysis results for the SeaTac Segment. These results represent the worst-case assumptions for each of the proposed stations and alternatives. A more detailed summary of LOS calculation results, including all station options analyzed, is included in the Transportation Technical Report. Full signal preemption for light rail vehicles was assumed at all at-grade intersections for Alternative F1.

Alternative F1, which proposes the potential North SeaTac Station at the S. 154th Street intersection, would cause LOS at the International Boulevard/S. 154th Street intersection to degrade from LOS D to LOS F in the year 2010. International Boulevard/S. 160th Street, International Boulevard/S. 170th Street, and International Boulevard/S. 188th Street intersections would also degrade to LOS F in the year 2010 as compared to the No-build conditions with Alternative F1. The intersections of International Boulevard/S. 167th Street and International Boulevard/S. 200th Street would operate at LOS F under No-build conditions and all light rail alternatives. One intersection, International Boulevard/S. 188th Street, would operate at LOS E with the No-build Alternative, but would degrade to LOS F under all F1, F2, and F3 alternatives.

Additional alternatives, including the preferred (F2.3), F3.3, and F4 alternatives, as well as multiple station options, were added to the analysis for the year 2020 as shown in Table 3.3-20b. These alternatives and station refinements were made for the year 2020 LOS analysis only, which represents a worse-case than the year 2010 analysis. Mitigation was developed based on year 2020 LOS results, to capture all potentially significant impacts that could occur in the year 2010 as well as the year 2020. Based on this analysis, the International Boulevard/S. 154th Street intersection would worsen from LOS D (No-build) to LOS E or F in the year 2020 with Alternatives F2.3 with north SeaTac Station options F or G, and F3.2 and F3.3 with North SeaTac Option B. The 32nd Ave. S./S. 176th Street intersection would worsen from LOS D (No-build) to LOS E with all light rail alternatives. The International Boulevard/S. 160th Street, International Boulevard/S. 170th Street, and International Boulevard/S. 200th Street intersections would operate at LOS F with the No-build and all light rail alternatives. Volume-to-capacity (v/c) ratios would degrade to worse than No-build conditions at the International Boulevard/S. 160th Street intersection with Alternatives F2.3 (station options F and G), F3.2, and F3.3. At the International Boulevard/S. 170th Street and International Boulevard/S. 200th Street intersections, v/c ratios would degrade to worse than No-build conditions with Alternatives F2.1, F2.2, F2.3, F3.1, F3.2, F3.3, and F4.

In addition to the overall LOS impact, average delay on the east-west approaches for Alternative F1 would be higher than for the No-build Alternative. Delays would increase because of the assumed light rail full signal preemption system reallocating green time from east-west to north-south movements. Minor approach delays would also increase at some locations for light rail alternatives other than F1 due to increased vehicle trips generated by the project. The LOS on eastbound and westbound approaches would remain at LOS D or better at most intersections except for the following locations:

- <u>International Boulevard/S. 152nd Street</u> – with the preferred alternative (Alternative F2.3), the westbound approach worsens from LOS C (No-build) to LOS E with station Option A in the years 2010 and 2020. For other light rail alternatives, the westbound approach worsens from LOS C (No-build) to LOS E (Alternatives F1 – station Option A, F2.3 – station Option A, and F4) in the year 2010 and from LOS C (No-build) to LOS E (Alternatives F1–station Option A, F2.3–station Option A, and F4) in the year 2020.
- <u>International Boulevard/S. 154th Street</u> – with the preferred alternative (Alternative F2.3), the eastbound approach worsens from LOS C (No-build) to LOS E (station Option G), and the westbound approach worsens from LOS D (No-build) to LOS E (station options F or G) or LOS F (station Option A) in the year 2020. For other light rail alternatives, the eastbound approach worsens from LOS D (No-build) to LOS F (Alternative F1) in the year 2010. In the year 2020, the westbound approach worsens from LOS D (No-build) to LOS E (Alternative

F2.3 – station options F and G) or LOS F (Alternatives F1–station Option A, F2.3–station Option A , F3.2, F3.3, and F4).

- International Boulevard/S. 160th Street – with the preferred alternative (Alternative F2.3), the eastbound approach worsens from LOS E (No-build) to LOS F in the year 2010, and from LOS E (No-build) to LOS F with Option A in the year 2020. For other light rail alternatives, the eastbound approach worsens from LOS E (No-build) to LOS F (Alternative F1), and the westbound approach worsens from LOS E (No-build) to LOS F (Alternative F1) in the year 2010. In the year 2020, the eastbound approach worsens from LOS E (No-build) to LOS F (Alternatives F1, F2.3 – station Option A , and F4).
- S. 176th Street/32nd Avenue S. – with the preferred alternative (Alternative F2.3) and all other light rail alternatives, the westbound approach worsens from LOS E (No-build) to LOS E or F in the years 2010 and 2020.
- S. 200th Street/28th Avenue S. – with the preferred alternative (Alternative F2.3), the westbound approach worsens from LOS C (No-build) to LOS F with station Option E in the year 2020. For other light rail alternatives, the westbound approach worsens from LOS C (No-build) to LOS F (Alternatives F2.1, F2.2, F2.3 – station Option E, F3.1, F3.2, and F3.3 – station Option E).

Access and Circulation

The preferred alternative (F2.3) would result in few access and circulation impacts, since the route is elevated and off-road or on the east side of 28th Avenue S. Access and circulation impacts for at-grade sections on International Boulevard (F1) and 28th Avenue S. (F2.1, F2.2, F3.1, and F3.2) are caused by left turn prohibitions to and from unsignalized driveways and streets. For elevated sections on 28th Avenue S. (F2.1, F2.2, F2.3, F3.1, F3.2, F3.3, and F4), left turns to and from most side streets and driveways would be prohibited. Alternative F1 would result in right-in, right-out turn restrictions on International Boulevard at S. 160th Street and S. 167th Street and on 28th Ave. S. at S. 200th Street. Alternative F4 could result in right-in, right-out turn restrictions on International Boulevard at S. 167th St and on 28th Avenue S. at S. 200th Street. The remaining alternatives (F2.1, F2.2, F2.3, F3.1, F3.2, and F3.3) could also result in right-in, right-out restrictions on 28th Avenue S. at S. 200th Street. Six station layouts (options A through F) are currently being considered for the South SeaTac Station. With Alternatives F1, F2.1, F2.2, F3.1, F3.2, and F4, the station layouts being considered (options A through D) would provide vehicle access via S. 200th Street and via new signalized access locations north of S. 200th Street on the proposed 24/28th arterial and International Boulevard. Station Option E, associated with Alternatives F2.3 and F3.3 would provide vehicle access via S. 200th Street only. For Alternatives F2.3 and F3.3 an additional staton layout (Option F) is being considered, which would provide vehicle access via S. 200th Street and via a new signalized access north of S. 200th Street on International Boulevard. Alternative F1 would cause the largest overall impact to traffic access and circulation, followed by Alternatives F4, F2.1, F2.2, F3.1, F3.2, F3.3, and F2.3 (lowest access and circulation impact).

Alternatives F2.1, F2.2 and F2.3 (preferred alternative) could impact some planned projects identified in the Sea-Tac Airport Master Plan including: the terminal roadway system for the proposed new North End Aviation Terminal (NEAT), and a new interchange on the Northern Airport Expressway at S. 160th Street. The proposed Intermodal Center (IMC) at the current Radisson Hotel site would also be impacted by these alternatives. Alternatives F2.1, F2.2, F2.3 (preferred alternative), F3.1, F3.2, and F3.3 could also impact the proposed "Airport Link" roadway system and the 28th Avenue S./S. 188th Street intersection. Alternatives F2.1, F2.2, F2.3 (preferred alternative), F3.1, F3.2, and F3.3 could impact planned improvements to the roadway system around the Main Terminal.

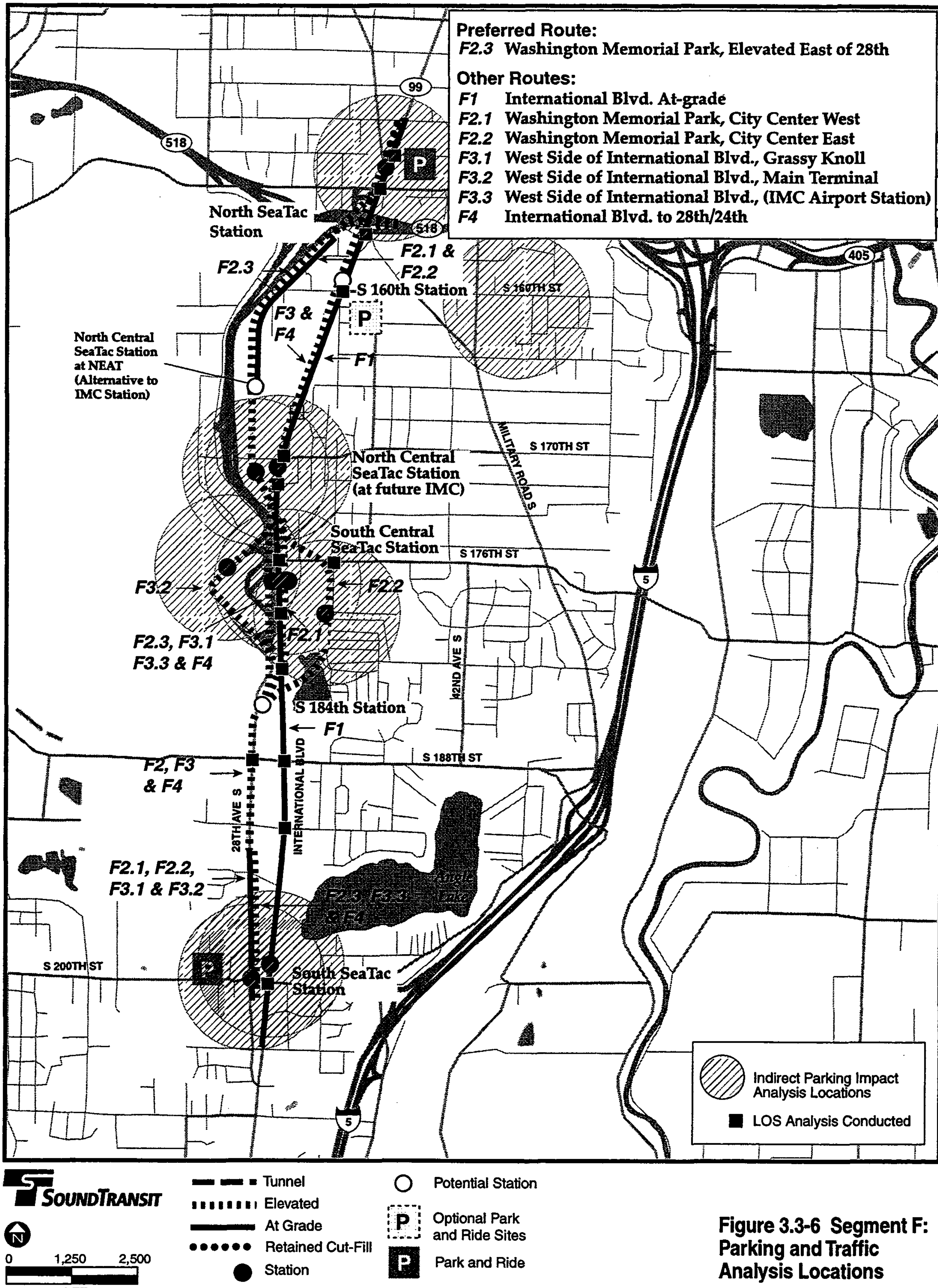


Figure 3.3-6 Segment F: Parking and Traffic Analysis Locations

Table 3.3-20a
Year 2010 P.M. Peak Hour Level of Service Summary in Segment F (SeaTac)
2010 Build and No-build Conditions

	No-build		International Boulevard F1		International Boulevard (North SeaTac Station Option C) F1 (ALT)		West of Washington Memorial and International Boulevard F2 & F3	
Intersection[3]	Avg. Delay (sec)	LOS	Avg. Delay (sec)	LOS	Avg. Delay (sec)	LOS	Avg. Delay (sec)	LOS
S. 152nd St. at Military Way	35.0[1]	E	37.0[1]	E	36.0[1]	E	36.0[1]	E
International Boulevard at S. 152nd St.	9.5	B	20.6	C	20.5	C	18.5	C
International Boulevard at S. 154th St.	33.1	D	*(1.08)	F	(1.08)[1]	E	39.1	D
International Boulevard at SR 518 EB Ramp	12.1	B	16.5	C	15.1	C	11.1	B
International Boulevard at S. 160th St.	52.9	E	*(0.98)	F	*(1.0)	F	54.3	E
International Boulevard at S. 167th St.	>45[1]	F	>45[1]	F	>45[1]	F	>45[1]	F
International Boulevard at S. 170th St.	55.1	E	*(1.23)	F	*(1.23)	F	58.2	E
International Boulevard at S. 172nd St.	10.6	B	15.8	C	15.8	C	11.4	B
International Boulevard at S. 176th St.	15.1	C	13.1	B	13.1	B	15.1	C
S. 176th St. at 32nd Ave. S.	39.1	D	41.1	E	41.1	E	39.1	D
International Boulevard at City Hall	9.4	B	10.5	B	10.5	B	10.0	B
International Boulevard at S. 182nd St.	36.6	D	38.4	D	38.4	D	39.2	D
International Boulevard at S. 184th St.	29.0	D	23.4	C	23.4	C	31.7	D
International Boulevard at S. 188th St.	46.6	E	*(1.12)	F	*(1.12)	F	1.01	F
28th Ave. S. at Air Cargo Road at S. 188th St.	33.7	D	32.8	D	32.8	D	33.6	D
International Boulevard at S. 192nd St.	36.8	D	30.7	D	30.7	D	36.6	D
International Boulevard at S. 195th St.	20.9	C	21.7	C	21.7	C	21.6	C
International Boulevard at S. 200th St.	*(1.27)	F	*(1.34)	F	*(1.34)	F	*(1.22)	F
S. 200th St. at 28th Avenue S.	>45[1]	F	14.8[2]	B	14.8[2]	B	*(1.10)[2]	F
S. 200th St. at 26th Avenue S.	9.3	B	10.7	B	10.7	B	28.5	D

Notes: [1] Unsignalized intersection
[2] A traffic signal is assumed in the future at this intersection
* Average delay could not be calculated by the HCM.
( ) Volume-to-capacity ratio included for intersections expected to degrade to LOS F.
[3] 2010 level of service for these intersections does not reflect the potential downstream effects from queuing since the HCM methodology assumes that each intersection is isolated from any residual traffic congestion impacts. Therefore, the actual LOS may be worse than shown in the table; however, the relative difference between the No-build and light rail alternatives would be similar.

Table 3.3-20b
Year 2020 P.M. Peak Hour Level of Service Summary in Segment F (SeaTac)
2020 Build and No-build Conditions

Intersection[3]	No-Build	Alt. F1	Alt. F2.1/F2.2	*Alt. F2.3*	Alt. F3.1	Alt. F3.2	Alt. F3.3	Alt. F4
S. 152nd St. at Military Way	E (40.1) [1]	E (39.2) [1]	---	E (39.2) [1]	---	E (39.2) [1]	E (39.2) [1]	E (39.2) [1]
International Boulevard at S. 152nd St.	E (55.2)	C (23.0)	---	E (59.8)	---	E (59.8)	E (59.8)	C (23.0)
International Boulevard at S. 154th St.	D (35.3)	D (36.9)	---	E (49.4)	---	E (41.5)	E (41.5)	D (36.9)
International Boulevard at S. 160th St.	F (1.03)*	F (0.91)*	---	F (1.04)*	---	F (1.04)*	F (1.04)*	F (0.91)*
International Boulevard at S. 167th St.	C (17.5)	D (22.4)	---	---	---	D (22.4)	---	---
International Boulevard at S. 170th St.	F (1.34)*	F (1.27)*	F (1.37)*	F (1.37)*	F (1.37)*	F (1.37)*	F (1.37)*	F (1.37)*
S. 176th St. at 32nd Ave. S.	D (40.0)	E (42.6)	E (42.6)	E (42.6)	E (42.6)	E (42.6)	E (42.6)	E (42.6)
International Boulevard at S. 182nd St.	C (24.2)	C (24.0)	D (25.2)	D (25.4)	D (25.4)	D (25.4)	D (25.4)	---
International Boulevard at S. 184th St.	B (12.6)	B (10.3)	B (13.1)	B (13.1)	B (13.1)	B (13.1)	B (13.1)	---
International Boulevard at S. 188th St.	D (35.3)	D (35.9)	D (37.1)	D (37.1)	D (37.1)	D (37.1)	D (37.1)	D (37.1)
28th Ave. S. at Air Cargo Road at S. 188th St.	E (45.8)	E (48.5)	E (48.5)	E (48.5)	E (48.5)	E (48.5)	E (48.5)	E (48.5)
International Boulevard at S. 192nd St.	C (22.2)	C (18.5)	C (22.8)	C (22.8)	C (22.8)	C (22.8)	C (22.8)	C (22.8)
International Boulevard at S. 195th St.	C (15.9)	C (15.8)	C (16.5)	C (16.5)	C (16.5)	C (16.5)	C (16.5)	C (16.5)
International Boulevard at S. 200th St.	F (1.40)*	F (1.39)*	F (1.44)*	F (1.46)*	F (1.44)*	F (1.44)*	F (1.46)*	F (1.45)*
S. 200th St. at 28th Avenue S. [2]	F (1.32) *	D (39.1)	F (1.31) *	F (1.30)*	F (1.31) *	F (1.31) *	F (1.30) *	D (34.6)

Notes: [1] Unsignalized intersection
[2] A traffic signal is assumed in the future at this intersection
() Average intersection delay in seconds per vehicle
* Average delay could not be calculated by HCM. Volume-to-capacity ratio included for intersections expected to degrade to LOS F.
The preferred alternative is shown in italics.

Table 3.3-21a
Segment F: Non-Motorized Facility Impact Summary

Station	2010 Walk Trips[1]		2020 Walk Trips[1]		Proposed Pedestrian Facilities
	Ingress	Egress	Ingress	Egress	
North SeaTac (S. 154th St./S. 160th St.)	5	15	5	20	Potential pedestrian overpass
North Central SeaTac	490	585	630	710	Connections to SeaTac APM, or NEAT (by others)
South Central SeaTac	20-250	80-200	40-670	105-750	Grade-separated connection to City Center
South SeaTac	30	150	45	200	Grade-separated connection over S. 200th Street

Note: [1] Walk trips are summarized for the P.M. peak 3-hour period. Range reflects different route alternatives served by station.

Table 3.3-21b. Proposed Bicycle Facilities for Segment F

Station Name	Proposed Bicycle Facilities	Proposed Quantity	Proposed Expansion Area
S. 154th (N. SeaTac)	Racks and lockers	Racks for 20, Lockers for 4	900 ft^{2*}
S. 200th	Racks and lockers	Racks for 20, Lockers for 4	450 ft^{2*}
North Central Sea-Tac Airport	TBD	TBD	TBD
South Central Sea-Tac Airport	TBD	TBD	TBD

Note: Facilities would be sheltered, except for S. 154th Street.
* Varies per station option.

Traffic Safety

Traffic safety impacts in Segment F would be similar to those described for Segment C for at-grade and/or elevated alignments. Alternatives F1 and F4 are the only light rail alternatives that would provide at-grade light rail in the median of International Blvd. and would have the greatest potential for traffic safety impacts. Since midblock left turns are already prohibited or planned to be prohibited on International Boulevard in SeaTac, however, there would likely be little to no difference in accidents between the No-build and light rail alternatives.

Non-Motorized Facility Impacts

The general non-motorized facility impacts described in Segment C also apply to Segment F. Increased pedestrian crossing distances are expected along at-grade sections on International Boulevard (F1) and 28th Avenue (F2.1, F2.2, F3.1, and F3.2). Table 3.3-21a summarizes pedestrian trip generation and proposed pedestrian facilities.

All station areas have some streets with existing sidewalks, but lack any bicycle route connections. All sidewalks near stations in Segment F would operate at acceptable levels of service in the year 2020 with all light rail alternatives, which would be designed at a minimum to meet the City of SeaTac's minimum standards of 5 ft for arterial roadways.

Additionally, bicycle storage facilities, summarized in Table 3.3-21b, are proposed for all stations in Segment F. Bicycle facilities at the North and South Central Sea-Tac Airport stations would be a multi-agency project and specific facilities have yet to be determined.

Parking Impacts

Table 3.3-22a summarizes on-street and off-street parking displacements for Segment F. With the preferred alternative, the North SeaTac Park-and-Ride lot would have an unconstrained demand of 505 vehicles in the year 2020. Parking spaces provided with seven station options at this location range from 260 to 670. The South SeaTac Park-and-Ride would have an unconstrained demand of 290 vehicles in the year 2020, which would fall below the 630-vehicle capacity by 340 vehicles. Year 2020 park-and-ride demand for the other light rail alternatives would range between 485 and 525 vehicles at the North SeaTac Station and between 290 to 525 at the South SeaTac Station. The area surrounding these stations is largely commercial, including pay lots for long-term airport parking creating the potential for airport users and area employees to use project park-and-ride lots. The SeaTac neighborhoods served by Link have low parking utilization rates which Link service would not be expected to increase due to the presence of Link park-and-rides at the S. 154th and S. 200th stations.

The location of guideway piers, roadway widening and construction of bus pull-outs would displace some existing private off-street parking. Off-street private parking loss due to partial commercial property displacements is estimated to be 711 spaces for F1, 519 spaces for F2.1, 552 spaces for F2.2, 226 spaces for F2.3 (preferred alternative), 334 spaces for F3.1, 328 spaces for F3.2, 258 spaces for F3.3, and 206 spaces for F4. Full property acquisitions would result in additional parking displacement; however, these are not considered to be a parking impact since the business displacement described in Section 4.2 is the impact from the project. Impacts in station areas are summarized in Table 3.3-22b.

Table 3.3-22a
Segment F: Parking Impacts Summary

Alternative	Parking Spaces Removed	
	On-Street	**Off-Street***
F1 International Boulevard – At-grade	0	711
F2.1 Washington Memorial Park – City Center W.	40	519
F2.2 Washington Memorial Park – City Center E.	40	552
F2.3 Washington Memorail Park, Elevated east of 28th Ave.	40	226
F3.1 West of International Boulevard, Grassy Knoll	40	334
F3.2 West of International Boulevard, Main Terminal	40	328
F3.3 West side of International Boulevard, IMC Airport Station	40	258
F4 International Boulevard to 28th/24th	40	206

Note: * Parking displacements resulting from partial property displacements only. These include impacts to commercial parking businesses associated with station options.
The preferred alternative is shown in italics.

Table 3.3-22b
Segment F: Parking Impacts in Station Areas

Station	Potential Impacts
North Sea-Tac	Available on-street parking fully occupied. Excess demand likely to convert to other travel modes or divert to other stations with park-and-ride capacity.
North Central Sea-Tac	None
South Central Sea-Tac	None
South Sea-Tac	Loss of 40 on-street spaces for all alternatives and station options

Mitigation

The intersection LOS at International Boulevard/S. 154th Street degrades to LOS E in the year 2020 with Alternatives F2.3 (options F and G), F3.2, and F3.3 as a result of the additional light rail project traffic and signal phasing restrictions. Construction of a westbound right turn pocket, and adjusted signal phasing would improve traffic operations to LOS D in the year 2020.

The International Boulevard/S. 160th Street intersection operates at LOS F in 2020 with the No-build and all light rail alternatives. V/C ratios degrade to worse than No-build conditions with Alternatives F2.3 (station options F and G), F3.2, and F3.3. Restriping the eastbound leg of the intersection to provide a left turn pocket with a shared through/right lane would improve traffic operations to LOS D/E in the year 2020.

The International Boulevard/S. 170th Street intersection operates at LOS F in 2020 with the No-build and all light rail alternatives. V/C ratios degrade to worse than No-build conditions with Alternatives F2.1, F2.2, F2.3, F3.1, F3.2, and F3.3. Providing exclusive westbound left, through, and right-turn lanes would improve traffic operations to LOS E in the year 2020.

The intersection level of service at the 32nd Avenue S./S. 176th Street intersections would worsen from LOS D (No-build) to LOS E will all light rail alternatives. Signal timing adjustments would improve traffic operations to LOS D or better in the year 2020.

The International Boulevard/S. 200th Street intersection would operate at LOS F in 2020 with the No-build and all light rail alternatives. V/C ratios would degrade to worse than No-build conditions with Alternatives F2.1, F2.2, F2.3, F3.1, F3.2, F3.3, and F4. The addition of eastbound and westbound right-turn lanes would improve v/c ratios to better than No-build conditions. To minimize or eliminate impacts to east-west movements related to the light rail signal preemption system for Alternatives F1 and F4, other signal timing strategies such as signal progression with less impact to the east-west movements could be considered. Any effect on coordinated signal progression on streets impacted by the improvements described above would also need to be minimized.

The Segment F non-motorized facility improvements would be consistent with the non-motorized facility mitigation approach described in Section 3.3.2.1 for Segment A.

Mitigation for Segment F hide-and-ride parking impacts is similar to that described in Section 3.3.2.1 under Segment A. To address the potential for overflow parking at the S. 154th Station and S. 200th Station, surveys will be conducted within a ¼ mile of the stations between 9:30 to 3:30 P.M., the peak parking period of possible hide-and-ride impacts from Link users.

Link park-and-ride facilities within the City of SeaTac are not intended to replace paid parking for airport passengers and special enforcement policies will be developed in conjunction with the City and Port to allow SeaTac park-and-ride facilities to remain available for transit users. Enforcement policies could include time restrictions or permit requirements for park-and-ride users.

3.3.2.7 Maintenance Base Sites

The peak hour traffic impacts from the seven alternative maintenance base sites would be minimal since most of the trips generated by the maintenance facility would be made during off-peak hours. A 150-space parking lot would be provided at each site to meet the peak parking demand for employees and visitors to the facility. More detailed information on impacts from street closures and property access changes is included in Section 3.4.2 and the Transportation Technical Report.

Site M1-A would require the vacation of S. Stacy Street between Sixth Avenue S. and Eighth Avenue S. Vehicles and pedestrians that now use this street to access local businesses east of Eighth Avenue S. would divert to Airport Way S.

Site M1-B would require vacation of S. Stacy Street and S. Walker Street between about Seventh Avenue S. and Airport Way S., as well as the vacation of Eighth Avenue S. between S. Lander Street and S. Stacy Street. Trucks that now use these streets to access businesses west of Seventh Avenue S. would have to access the area via Sixth Avenue S. and S. Stacy Street. Since S. Stacy Street would dead-end at the maintenance base, it is likely that a turn-around to accommodate large trucks and fire apparatus would be required.

Site M1-C would require the vacation of Sixth Avenue S and Eight Avenue S. between S. Holgate Street and S. Massachusetts Street. This option would remove businesses located between S. Massachusetts and S. Holgate streets. However, access would need to be retained to the businesses located north of S. Massachusetts Street, including the King County/Metro Transit Base. Vehicles that currently access these businesses from the south via S. Holgate Street would be diverted to Royal Brougham Way.

Site M1-D would require the vacation of S. Hanford, S. Horton, and S. Hinds streets between Seventh Avenue S. and Airport Way S. Since all three of these streets would dead-end at the maintenance base, it is likely that turn-arounds to accommodate large trucks and fire apparatus would be required at the end of the street. All truck access to businesses located west of the maintenance base would be from Sixth Avenue.

Site M1-E would require the vacation of S. Hanford Street. A turn-around on S. Hanford Street east of Sixth Avenue S. would likely be required to accommodate large trucks and fire apparatus. This base alternative would also require relocating Airport Way S. to the east between S. Forest Street and about S. Hinds Street. If this alternative is constructed, Sound Transit would own properties on both sides of the existing Airport Way S. Therefore, access to adjacent properties would not be affected by this change. As previously discussed, through traffic on Airport Way S. would be maintained during construction to maintain access to properties located elsewhere along Airport Way S.

Light rail access to Site M2 would require crossing the southbound lanes on MLK Jr. Way S. at-grade. For this alternative, traffic would be held at the MLK Jr. Way S./Norfolk Street intersection when a train is crossing into the maintenance site. An elevated access is also being considered and would eliminate these crossing conflicts.

The main entrance gate for Site M3, located south of Boeing Access Road and east of Interurban Avenue S., would be located on Interurban Avenue S., near S. 112th Street. An emergency entrance would also be provided on Interurban Avenue S., south of Boeing Access Road.

3.3.3 Significant Unavoidable Adverse Highway and Street Impacts

With the identified mitigation measures and other mitigation incorporated into the project design, all significant impacts would be avoided or reduced below a level of significance.

3.4 FREIGHT MOVEMENT

3.4.1 Affected Environment

Freeways, local roadways, and rail lines throughout the light rail study area are vital to the movement of freight and goods between major transportation hubs such as the Port of Seattle and Sea-Tac Airport, and to numerous business and customer destinations. Freight and goods movement within the study area generally comprises two transportation modes: trucks on roadways or trains on local mainline and spur tracks. The following describes the affected environment for key freight roadways and railroad mainlines and spur tracks for each of the six segments. The Transportation Technical Report includes more detail on freight roadways, truck volumes, freight-rail facilities and rail activity. In 1990, the Washington State Legislature directed its Legislative Transportation Committee to examine the use of the state highway system for truck freight transportation. The State subsequently adopted the Freight and Goods Transportation System. The system's classifications range from T-1, which includes roadways that carry over 10,000,000 tons per year, to T-5, which includes roadways that carry over 20,000 tons in 60 days (used in agricultural areas).

I-5 is the principal freight route (classified as T-1) through the Puget Sound region and is located within the study area of each light rail study segment. Other T-1 freight routes in the study vicinity include: I-90 between Fourth Avenue S. and the Seattle city limit, SR 99 between the southern Seattle city limit and N. 145th Street, I-405 between I-5 and SR 181, E. Marginal Way between Boeing Access Road and Interurban Avenue S., and Boeing Access Road between I-5 and East Marginal Way S. Over 800 large trucks per day currently travel on these roadways. Compared to north downtown, more industrial properties are located south of downtown Seattle, and the number of key freight roadways is higher through south downtown Seattle and further south to Tukwila, as well as to Sea-Tac airport, due to air freight activity. Truck traffic occasionally diverts to local routes as a result of highway congestion throughout the region.

Previous studies of truck freight within the City of Seattle and Puget Sound region have demonstrated that most truck activity occurs during the daytime hours of 9 A.M. to 4 P.M. Generally, truck volumes decline between the hours of 4 P.M. and 7 P.M. and represent a small fraction of afternoon peak commuter traffic.

S. Lander Street and Sixth Avenue S., south of downtown Seattle, currently serve local and through truck traffic. S. Lander Street is one of the few streets in the area that connects First Avenue to Airport Way S. The section of S. Lander Street between Fourth Avenue S. and Sixth Avenue S. serves area-wide trucking needs by providing the link to Sixth Avenue S. (to I-5) from elsewhere in the Duwamish area. About 1,140 trucks per day use this section of S. Lander Street. East of Sixth Avenue S., the truck volume declines to about 800 trucks per day. An estimated 25 percent of these trucks are destined to businesses along S. Lander Street or Eighth Avenue S. The remaining trucks pass through to Airport Way S. The relative importance of S. Lander Street as an east-west connector could change following construction of an overpass at S. Lander Street over the BNSF mainline as part of the FAST Corridor Phase II program. However, this overpass is not likely to substantially increase traffic east of Fourth Avenue. Sixth Avenue S. is a key route that trucks and other motorist use to access eastbound Spokane Street and I-5. Traffic and truck volumes are highest at the south end of the arterial near Spokane Street, and are also higher in the southbound direction. The truck volume on Sixth Avenue S. north of Spokane Street is approximately 1,670 trucks per day (or approximately 11 percent of all traffic on Sixth Avenue S.). North of S. Holgate Street, the daily truck volume is approximately 900 trucks per day. On the section of Sixth Avenue S. between Royal Brougham Way and S. Holgate Street, a truck following survey determined that about 70 percent of all trucks are destined to local businesses. Only about 275 trucks per day travel through between S. Holgate Street and Royal Brougham Way. About one-half of all trucks using this section of Sixth Avenue S. are small trucks; many of these are likely generated by the Federal Express facility located further south.

Two of the nation's largest railroads operate in Seattle: the Burlington Northern-Santa Fe (BNSF) and Union Pacific-Southern Pacific (UPSP). Near the Fifth Avenue S./E-3 busway, there are two primary spur tracks that branch off the BNSF mainline to the north between I-5 and Fourth Avenue. These spur tracks branch again north of Spokane Street to create approximately five separate north/south spur tracks between I-5 and Fourth Avenue. Two of the spurs are located on either side of Fifth Avenue S (E3 Busway). Two additional spurs extend across S. Lander Street at approximately S. Seventh and Eighth avenues. These spurs result in four tracks crossing at S. Lander Street between S. Seventh and Eighth avenues. Finally, one spur is located along the west side of I-5 east of Airport Way S. According to BNSF staff, the tracks along either side of the E3 Busway are relatively unused except for occasional storage by the BNSF Railroad. Also, the track on the east side of the E3 busway is BNSF's whereas the track on the west side is operated by Union Pacific. The Seventh and Eighth Avenue spurs are used regularly and serve approximately two train deliveries per day.

In the southern part of the light rail corridors, the existing BNSF and UPSP rail lines run parallel to and east of West Valley Highway and Interurban Avenue S. The tracks cross under I-5 at approximately S. 130th Street and parallel I-5 on the west through the northern part of the City of Tukwila. The BNSF line has a volume of approximately twenty-six freight trains per day, and six Amtrak passenger trains. The UPSP line has a volume of approximately twelve trains per day.

Rail activity along the mainline tracks within the study area occurs 24-hours per day, seven days per week. Although the Amtrak passenger trains have schedules, freight trains arrive and depart based on shipping needs and mainline capacity constraints. Sound Transit is planning to begin weekday commuter rail service between Seattle and Tacoma along the BNSF Railroad mainline by December 1999. Service between Seattle and Everett would begin in mid 2001. On weekend days, the number of freight train crossings may be slightly higher than weekday conditions and Amtrak train traffic would continue: however, the commuter rail trains would not operate.

3.4.2 Impacts and Mitigation

3.4.2.1 Truck Circulation Impacts

A summary of truck circulation impacts for each segment are provided below. The Transportation Technical Report contains more detailed information. Refer to Section 4.2 for information on property displacements.

Segment A (Northgate to University District)

None of the four alternatives are anticipated to significantly impact truck circulation in the Northgate to University District segment study area. The project would not impact the Freight and Goods Transportation System (FGTS) identified above.

Segment B (University District to Westlake Station)

Neither the preferred alternative (B1) nor other alternatives are anticipated to impact truck circulation in the University District to Westlake Station segment study area. None of the routes would cross any of the FGTS Roadways at-grade.

Segment C (Westlake Station to S. McClellan Street)

The at-grade section of Alternative C1.1 would impact truck circulation along S. Lander Street between the E-3 Busway and Airport Way S. Alternative C1.1 would require that left turns be prohibited to and from all driveways and unsignalized streets adjacent to the rail line. Left-turn movements would be retained at the signalized intersections of Sixth Avenue S. and Airport Way S. where traffic signals can separate vehicular and train movements. The left-turn prohibitions would make access and egress to/from properties along S. Lander Street and intersecting streets more difficult. However, because of the existing grid of streets in the area, vehicles would be able to access all directions of travel, although they may have to "loop-the-block" to do so.

In order to accommodate right-turning movements, particularly by large trucks, some corner radii would need to be increased. The light rail line in the center of S. Lander Street would have the largest effect on those businesses that rely on the street right-of-way for maneuvering into loading docks. MacDonald Meats on the south side of S. Lander Street is one business that would be affected since trucks now use much of the street to maneuver into the loading docks. The weighing scale at Phoenix Oil Company would be affected since trucks would no longer be able to access the scale or the fueling pumps from eastbound S. Lander Street. This company provides a public truck scale and diesel fuel for trucks. New at-grade light rail crossings would be constructed at approximately Sixth Avenue S. and Airport Way S. These would increase vehicular delay along this well-used truck route between the North Duwamish area and S. Spokane Street where trucks access I-5 south.

Impacts to S. Massachusetts Street for Alternative C3 would be similar to the impacts on S. Lander Street for Alternative C1.1. Left turn movements to and from S. Massachusetts Street would be prohibited and vehicular delay would increase at the new at-grade rail crossings. South Massachusetts Street is used by fewer trucks than S. Lander Street; however, it is used as a primary access route to the adjacent King County Metro Transit Bases.

Alternative C1.2 (preferred alternative) would locate the light rail alignment at-grade on the north side of S. Lander Street. This alternative would require the prohibition of all movements to and from unsignalized side streets and driveways along the north side of S. Lander Street. Field observation determined that there are seven truck loading docks/doors/gates along the north side of S. Lander Street to be purchased under this alternative. Most of these appeared to be inactive. Access to and from Eighth Avenue S. would also be affected. Businesses that currently access Eighth Avenue S. from S. Lander Street would have to access it from Airport Way S. and S. Stacy Street. Based on observations, approximately ten trucks per hour could be diverted. Since this alternative would preclude turning movements to businesses on the north side of S. Lander Street, it would likely dislocate the Phoenix Oil Company.

Alternative C1.3 would elevate the light rail line along the north side of S. Lander Street. Columns supporting the elevated structure would be along the north side of the street, which would not preclude left or right turning movements to and from adjacent businesses. Allowing full turning movements would require that the columns be located so that they do not impede side street intersections, driveways, or loading docks, and that adequate sight distance around the columns can be provided. The elevated structure will need to provide vertical clearance for trains at the Seventh and Eighth Avenue spurs (typically 23-ft minimum); therefore, the clearance would also be adequate for all trucks. One business that is likely to be affected by this rail alignment is the Phoenix Oil Company. Its scale is currently located within the right-of-way on S. Lander Street. Future columns along the north side of the street would either directly conflict with the scale, or make it inaccessible to large trucks. The columns could likely be spaced such that they would retain all or part of the access into the Phoenix Oil fueling bays; this would need to be confirmed through final design.

Alternative C1.4 would construct an elevated light rail line along the south side of S. Forest Street. Columns supporting the elevated structure would be along the south side of the street, which would not preclude left- or right-turning movements to and from adjacent businesses. Allowing full turning movements would require that the columns be located so that they do not impede side street intersections, driveways, or loading docks, and that adequate sight distance around the columns can be provided. The elevated structure will need to provide vertical clearance at the rail spur (typically 23-feet minimum); therefore, the clearance would also be adequate for all trucks. One truck loading bay on the north side of the Gai's Bakery building may be affected by this alignment. This loading dock is located at the west end of the building near the E3 Busway. An elevated alignment would turn from the E3 Busway onto S. Forest Street near this loading dock and the column spacing may make it difficult or impossible for a truck to maneuver into this dock. This building does have two other locations where large trucks can load.

East of Cornwall Place S., Alternative C2.3 and C3 would impact truck circulation along Rainier Avenue S., which is classified as a 'T-2' truck route (400 to 800 large trucks per day). This section includes the interchange at I-90 where left turn restrictions at many driveways and minor local access streets already exist. Additional turn restrictions may be required with the proposed rail line.

Telephone surveys were conducted to characterize existing truck activity and identify potential truck access impacts to businesses affected by Alternatives C2.3 and C3 on Rainier Avenue S. The survey results indicate that truck movements for some businesses on Rainier Avenue S. would be impacted by the right-in, right-out access restrictions. Information from these surveys will be used in more detailed design phases to work with specific business/property owners to develop alternate truck routes. Since many businesses would not be affected, this impact does not exceed the threshold level of significance.

Segment D (S. McClellan to Boeing Access Road)

The alternatives would vary from S. McClellan Street to S. Graham Street. Alternatives D1.1c , D1.1d, D1.1e (preferred alternative), and D1.1f would be at-grade in the center of MLK Jr. Way for its entire length. This alternative would impact truck circulation along MLK Jr. Way S., a T-4 truck route (8 to 24 large trucks per day). The location of the light-rail section, at-grade and in the center of MLK Jr. Way S., would preclude most left-turn movements from businesses and driveways along the roadway. U-turns would be permitted for passenger vehicles only at most signalized intersections to minimize the impact of mid-block, left turn prohibitions. Additional delay to trucks is anticipated due to new at-grade light rail crossings at approximately S. Hanford Street and S. Othello Street. Travel time increases for trucks would range from 0 to 4 minutes as a result of the left-turn restrictions.

Alternative D1.3 would be on elevated structure from S. McClellan Street south to S. Morgan Street. The elevated structure is anticipated to be constructed with approximately 16.5-ft of vertical clearance, would be adequate for this truck route. The elevated light-rail section in the center of MLK Jr. Way S. would preclude most left-turn movements from businesses and driveways along the roadway. Revisions to left-turn access would be required. The at-grade light-rail section in the center of MLK Jr. Way S. would impact truck movements similar to those described for Alternative D.1.1c, D1.1d, D1.1e, and D1.1f above. Most left turn movements would be prohibited which would likely increase travel time and delays for trucks due to changed routing and direction of access to area. Additional delay to trucks is anticipated due to new at-grade rail crossings at approximately S. Othello Street.

Alternative D3.3 would not adversely impact truck traffic along the northern section adjacent to Rainier Avenue S. The rail line, south of S. Alaska Street, would be located at-grade in the center of MLK Jr. Way S. This route would have similar truck impacts as described for Alternative D.1.1c above although for a shorter length of roadway. Most left-turn movements would be prohibited which would likely increase travel time and delays for trucks.

Alternative D3.4 would not adversely impact truck traffic along its northern section located along Rainier Avenue S. and 37th Avenue S. South of S. Raymond Street, at-grade sections would be constructed in the center of MLK Jr. Way S. to approximately S. Norfolk Street. This alignment would have similar truck impacts as described for Alternative D.1.1 above although for a shorter length of roadway. Most left-turn movements would be prohibited which would likely increase travel time and delays for trucks.

Telephone surveys were conducted to characterize existing truck activity and identify potential truck access impacts to businesses affected by the at-grade light rail routes on MLK Jr. Way S. and Rainier Avenue S. The survey results indicate that truck movements for some businesses on MLK Jr. Way S. would be impacted by the right-in, right-out access restrictions. Information from these surveys will be used in more detailed design phases to work with specific business/property owners to develop alternate truck routes. Since many businesses would not be affected, this impact does not exceed the threshold level of significance.

Segment E (Tukwila)

Boeing Access Road is an over-dimensional truck route in South Seattle connecting I-5 to E. Marginal Way. Consequently, at least 20 ft of vertical and horizontal clearance would be maintained at the Boeing Access Road to accommodate the over-dimensional truck movements in Alternatives E1.1, E1.2 and E2. Location of the elevated (E1.1–the preferred alternative, and E1.2) and at-grade (E1.1–the preferred alternative) light rail trackway in the center of Tukwila International Boulevard would preclude left-turn movements from businesses and driveways along the roadway. Left-turns would be restricted to signalized intersections. U-turns would be permitted for passenger vehicles only at most signalized intersections to minimize the impact of left-turn restrictions. Travel time increases for trucks would range from 0 to 4 minutes as a result of the left-turn restrictions, since some trucks would be diverted to other non-residential arterial roadways.

Telephone surveys were conducted to identify potential truck access impacts to businesses affected by the at-grade light rail routes on Tukwila International Boulevard. The survey results indicate that truck movements for some businesses on Tukwila International Boulevard would be impacted by the right-in, right-out access restrictions. Information from these surveys will be used in more detailed design phases to work with business/property owners to develop alternate truck routes. Since many businesses would not be affected, this impact does not exceed the threshold level of significance.

No significant impacts to truck circulation are anticipated for Alternatives E2 and E3.

Segment F (SeaTac)

Alternative F1, which is at-grade and in the center of International Boulevard, would preclude most left-turn movements from businesses and driveways along the roadway. U-turns for passenger vehicles only would be permitted at all signalized intersections to minimize the impact of left-turn restrictions since most trucks would be required to divert to other non-residential arterial roadways. Travel time increases for trucks would range from 0 to 4 minutes as a result of the left-turn restrictions, since some trucks would be required to divert to other non-residential arterial roadways. Alternatives F2.1, F2.2, F2.3, F3.1, and F3.2 would consist primarily of off-road elevated sections and few impacts are expected.

Maintenance Base M1-A: S. Lander Street

This option would require the vacation of S. Stacy Street between Sixth Avenue S. and Eighth Avenue S. Trucks that now use this street to access local businesses east of Eighth Avenue S. would have to divert to Airport Way S.

Maintenance Base M1-B: S. Lander Street

This base option would be located between Airport Way S., Eighth Avenue S., S. Lander Street, and S. Holgate Street. It would require vacation of S. Stacy Street and S. Walker Street between about Seventh Avenue S. and Airport Way S., as well as the vacation of Eighth Avenue S. between S. Lander Street and S. Stacy Street. Trucks that now use these streets to access businesses west of Seventh Avenue S. would have to access the area via Sixth Avenue S. and S. Stacy Street. Since S. Stacy Street would dead-end at the maintenance base, it is likely that a turn-around to accommodate large trucks and fire apparatus would be required.

Maintenance Base M1-C: Atlantic/Central

The Atlantic/Central Maintenance Base would require vacation of Sixth Avenue S. between S. Holgate Street and S. Massachusetts Street. Sixth Avenue S. is a route that trucks and other motorists use to access eastbound Spokane Street and I-5. Traffic and truck volumes are highest at the south end of the arterial near Spokane Street, and are also higher in the southbound direction. The majority of truck traffic now using Sixth Avenue S. between Royal Brougham Way and S. Holgate Street is destined to local businesses along Sixth Avenue S. and S. Massachusetts Street. About 275 trucks per day now use this street to pass through between S. Holgate Street and Royal Brougham Way. Given many of the changes proposed in the area, such as the SR 519 project, some of these through trucks are likely to divert to other routes. Therefore, only about 200 trucks per day would be diverted by the vacation of Sixth Avenue S. (about one-half of all trucks using Sixth Avenue S. are small trucks).

Maintenance Base M1-D: Rainier Brewery/Roadway Express

This base option would be located from just south of S. Forest Street to south of S. Hinds Street and from about Seventh Avenue S. to Airport Way S. It would require the vacation of S. Hanford Street, S. Horton Street, and S. Hinds Street. Since all three of these streets would dead-end at the maintenance base, it is likely that turn-arounds to accommodate large trucks and fire apparatus would be required at the end of the street. All truck access to businesses located west of the maintenance base would be from Sixth Avenue S.

Maintenance Base M1-E: Rainier Brewery/Airport Way

Alternative M1-E would require the vacation of S. Hanford Street. A turn-around on S. Hanford Street east of Sixth Avenue S. would likely be required to accommodate large trucks and fire apparatus. This base alternative would also require relocating Airport Way S. to he east between S. Forest Street and about S. Hinds Street. If this alternative is constructed, Sound Transit would own properties on both sides of the existing Airport Way S. Therefore, access to adjacent properties would not be affected by this change. As previously discussed, through traffic on Airport Way S. should be maintained throughout construction to maintain access to properties located elsewhere along Airport Way S.

3.4.2.2 Significant Unavoidable Truck Circulation Impacts

The at-grade route along the north side of S. Lander Street between the E3 Busway and Airport Way S. would preclude access to businesses from the north side of the street. Several of these businesses are already assumed to be acquired for Maintenance Base M1-A or M1-B. Alternative access could be established to remaining businesses. The elevated routes (S. Lander Street or S. Forest Street) would maintain access to most businesses, with a few exceptions.

3.4.2.3 Impacts to Railroad Mainlines and Spur Tracks

With the preferred alternative, impacts to freight rail activity or facilities are only expected in Segment C, as described below. The preferred alternative would also cross the BNSF railroad mainline in Segment E; however, the light rail operation would not impact the freight rail activity.

No adverse impacts to freight railroad activity or facilities are anticipated for Segment A connecting Northgate to the University District or for Segment B connecting the University District to Westlake Station.

The alternatives for Segment C between Westlake and S. McClellan Street pass through the eastern edge of a key industrial area of Seattle. There are numerous rail mainline tracks and spur tracks serving businesses throughout the area. Alternatives C1.1 and Alternative C1.2 (the preferred alternative) would cross several BNSF Railroad spur tracks at approximately S. Lander Street between the E-3 Busway (Fifth Avenue) and Beacon Hill. Spur tracks exist along both sides of the E-3 Busway which are occasionally used for rail car storage. The spur track located on the east side of the E-3 Busway will be removed to accommodate the separation of light rail/bus operations. Alternative C1.1 and C1.2 (the preferred alternative) would also cross four tracks that extend across S. Lander Street at approximately S. Seventh and Eighth Avenues. The Seventh and Eighth Avenue spur tracks are currently used to make deliveries twice daily. The proposed light-rail operation would have trains crossing these tracks at a 90-degree angle from 5:00 A.M. to 1:00 A.M. on four to twelve minute headways in each direction (the time between consecutive train crossings). The light rail operation would likely impact the freight delivery activity on these spur tracks. Deliveries would either need to be made in small sections that could be cleared between light rail arrivals, or the deliveries would need to be made between 1:00 A.M. and 5:00 A.M. when the light rail system is not operating. Additional rail storage and a small switch engine (which would remain captive north of the light rail alignment) may be needed on the affected section of rail line to maintain frequent service to the rail customers north of S. Lander Street. Operation of Alternative C1.1 or C1.2 (the preferred alternative) is not expected to adversely impact rail operations along the E-3 Busway (Fifth Avenue) spur tracks on the west side since freight activity is light on these spur tracks. The elevated light rail alignments along either the north side of S. Lander Street (C1.3) or the south side of S. Forest Street (C1.4) would not affect freight rail operations in the vicinity.

No adverse impacts to freight railroad activity or facilities are anticipated for Segment D between S. McClellan Street and the Boeing Access Road.

All of the alternatives would cross the BNSF Railroad mainline at least once through a portion of Tukwila. Alternative E2 would cross the tracks three times on elevated structure and would be located adjacent to the eastern most set of tracks. The light-rail operation is not expected to impact the freight rail activity since the alignments would not cross at-grade. However, some limited impacts may occur during construction of elevated and adjacent sections.

No adverse impacts to freight railroad activity or facilities are anticipated for Segment F in SeaTac.

The M-1A maintenance base option would relocate and reconfigure the freight rail lead tracks and storage tracks in the 7th Avenue Yard. This would result in the loss of approximately 3,500 lineal feet of freight rail storage: Sound Transit would work with BNSF to identify a replacement location for these storage tracks. One possible location is along an existing BNSF rail lead south of Industrial Way. The replacement lead tracks and storage north of S. Lander Street would serve businesses located north of S. Holgate Street.

3.4.2.4 Significant Unavoidable Adverse Railroad Impacts

Alternatives C1.1 and C1.2 (the preferred alternative) are the only alternatives with potentially significant unavoidable adverse impacts to existing rail operations. This impact is created from the at-grade crossing of four freight rail spur tracks across S. Lander Street. Although these spur tracks receive little use, light rail operations would likely impact the schedule of freight delivery activity on these spur tracks.

3.5 NAVIGABLE WATERWAYS

3.5.1 Affected Environment

The Ship Canal Bridge connects Puget Sound with Lake Washington and serves many water-dependent businesses and marinas in Interbay, Ballard, Fremont, Lake Union, Portage Bay, Kirkland, Kenmore and Renton. Shipping activity in the ship canal ranges from small recreational vessels to large industrial vessels. The ship canal does not accommodate container ships due to vessel size limitations at the Ballard locks. The canal is a regulated water level waterway. It is also a Federally-regulated navigable waterway with delineated combined bulkhead and pier lines, and a navigation channel defined by a vertical and horizontal clearance envelope which a new bridge structure must clear unless a modification to the navigation clearances are obtained from the responsible government agencies. The vertical clearance of the I-5 Ship Canal Bridge is 127 ft.

The Duwamish River is heavily used for tug and barge travel. Vertical navigational clearances (based on mean high water) provided by the U.S. Coast Guard for bridges crossing the Duwamish River are listed below:

- Spokane Street Bridge – 55 ft of vertical navigational clearance
- West Seattle Freeway – 140 ft of vertical navigational clearance
- Burlington Northern Bridge – 8 ft of vertical navigational clearance (this bridge is kept in the open position except during train crossings)
- First Avenue S. Bridges – 24 to 35 ft of vertical navigational clearance
- 16th Avenue S. Bridges – 20 to 30 ft of vertical navigational clearance

At the mouth of the Black River in Tukwila, the Duwamish River converges with the Green River. Use of the Green River is currently limited to small recreational boats. In general, minimum vertical clearances, as required by King County, are based on the 100-year flood elevation plus six feet of freeboard.

3.5.2 Impacts and Mitigation

The preferred and other light rail alternatives could impact navigable waterways in Segments B and E, as described below.

Navigable waterways crossed by light rail routes are limited to the Lake Washington Ship Canal and the Duwamish and Green Rivers. Primary factors affecting navigation along these waterways include horizontal and vertical clearances provided between bridge piers and between the surface of the water and the bottom of span, respectively. Navigation could also be affected by the placement of the span relative to the navigational channel and by the placement of bridge piers relative to the piers of existing spans immediately upstream and downstream of the proposed span. High, mean and low water levels can lead to changes in potential navigational impacts. Segments B and E are the only segments in the proposed light rail corridor that would cross the Lake Washington Ship Canal, Duwamish and Green rivers.

None of the Segment A, C, D, or F routes would cross navigable waterways.

In Segment B, Alternative B1 and B2.2 would tunnel under the Lake Washington Ship Canal. Alternative B2.1 would cross over the canal on a new bridge approximately parallel to, and with similar vertical clearance as the existing I-5 Ship Canal Bridge.

In Segment E, the various alternatives all require elevated light rail crossings of the Duwamish and/or Green Rivers. For Alternatives E1.1 and E1.2, the light rail would cross over the Duwamish River about 50 ft east and upstream of an existing (soon to be replaced) Tukwila International Boulevard bridge and between S. 112th Street and S. 116th Street. For Alternative E2, light rail would cross over the Duwamish River about 300 ft east of and upstream of an existing East Marginal Way S. bridge and between S. 115th Street and S. 116th Street. Along S. 142nd Street, the E2 route would rise up and cross over the Green River, a stretch of the BNSF and UP tracks and right-of-way, then over the Black River to touch down about 100 ft from the south side of the Black River. Further south, E2 would again cross over the Green River near West Valley Highway and 68th Avenue S. Alternative E3 would cross the Black River in the vicinity of S. 143rd Street. Further south, Alternative E3 would also cross over West Valley Road, the Green River and S. 164th Street.

3.5.3 Mitigation Measures

Conceptual designs avoid impacts to navigable waterways. No mitigation is required; however, Sound Transit will coordinate with the U.S. Coast Guard through the design phase and construction.

3.5.4 Significant Unavoidable Adverse Navigable Waterways Impacts

No significant unavoidable adverse impacts would occur.

CHAPTER 4
ENVIRONMENTAL IMPACTS AND MITIGATION

4. Environmental Impacts and Mitigation

4.1 LAND USE AND ECONOMIC ACTIVITY

4.1.1 Affected Environment

4.1.1.1 Existing Regional Land Use Patterns

The proposed light rail project passes through the state's most intensively developed region. Land uses in the project corridor include concentrations of retail and commercial uses, single-family and multi-family residential areas, the region's largest institutional facilities, and areas of industrial/manufacturing land uses.

All alternative routes pass through downtown Seattle, the employment hub of the city and region with approximately 2,000 businesses occupying nearly 6 million ft^2 of retail space; 30 million ft^2 of office space; 9,000 hotel rooms; and a daily employment/visitor population of over 150,000 people (Downtown Seattle Association 1998). The Washington State Convention & Trade Center, also downtown, is the largest convention facility in the Northwest. It attracts one-half million delegates/visitors each year.

The full-length light rail line alternatives would be adjacent to at least one and possibly two regional shopping/employment centers—Northgate Mall in Seattle and Southcenter Mall in Tukwila. The project would also pass through SeaTac's proposed City Center and employment hub along International Boulevard; it would potentially access a manufacturing employment center near the Boeing Access Road, and the Boeing Campus office development at the Longacres site.

Four major universities or colleges and four regional hospital campuses are adjacent to the potential routes, including the University of Washington, the largest educational facility in the Northwest. The University's daily on-campus population is 50,000 people. The University of Washington's Husky Stadium, also on campus, seats 75,000 fans.

Alternative routes would provide access to Seattle Center, a 74-acre urban park that hosts 8 million visitors annually. The route would potentially serve three professional sports facilities (completed, under construction, or permitted) and Sea-Tac Airport, which accommodates over 24 million passengers per year and more than 1,000 flights per day.

See Section 4.1.1.4 for a more detailed description of existing land use in each segment. Appendix L includes maps of existing land uses near the proposed routes and stations.

4.1.1.2 Trends in Population, Employment, and Economic Activity

Population

The Puget Sound Regional Council (PSRC) has prepared long-range population, household, and employment forecasts for the four-county Puget Sound Region (King, Kitsap, Pierce and Snohomish counties). As Table 4.1-1 shows, population in the region is expected to increase by nearly 1.2 million people between 1995 and 2020, a 25-year increase of approximately 39 percent, or 1.3 percent per year. The greatest growth is projected to occur within King County (an additional 472,673 residents), followed by Snohomish County (307,307), Pierce County (260,798) and Kitsap County (119,935). King County is forecast to have about half of the total regional population in 2020 (more than Kitsap, Pierce and Snohomish counties combined).

Households

Housing units are expected to increase region-wide by nearly 574,000 between 1995 and 2020, an increase of 49 percent or 1.6 percent per year (Table 4.1-1).

Consistent with national trends, the region's average household size is expected to decrease from 2.57 people in 1995 to 2.42 people in 2020, a drop of nearly six percent over the 25-year period.

Employment

Between 1995 and 2020, the region is expected to gain 632,000 jobs, a 25-year increase of 40 percent, or approximately 1.4 percent per year (Table 4.1-1). King County is expected to experience the greatest job growth (an additional 372,493 jobs), followed by Snohomish County (107,809), Pierce County (107,766), and Kitsap County (43,971). The greatest share of new jobs (about 59 percent) will be in King County.

Table 4.1-1
Regional Population, Household, and Employment Forecasts

County	1995	2000	2000 % of Total	2020	2020 % of Total	1995-2020 Change	1995-2020% Change
Population							
King	1,596,777	1,686,234	52.8	2,069,450	50.1	472,673	29.6
Kitsap	209,263	228,795	7.2	329,198	8.0	119,935	57.3
Pierce	639,838	693,473	21.7	900,636	21.8	260,798	40.8
Snohomish	526,354	587,065	18.4	833,661	20.2	307,307	58.4
Region	2,972,231	3,195,567	100.0	4,132,945	100.0	1,160,714	39.1
Households							
King	661,023	706,254	55.8	937,954	53.8	276,931	41.9
Kitsap	76,981	84,695	6.7	128,690	7.4	51,709	67.2
Pierce	235,434	256,215	20.2	349,365	20.1	113,931	48.4
Snohomish	195,078	218,442	17.3	326,014	18.7	130,936	67.1
Region	1,168,515	1,265,606	100.0	1,742,023	100.0	573,508	49.1
Household Size							
King	2.37	2.34	N/A	2.17	N/A	-0.20	-8.4
Kitsap	2.64	2.62	N/A	2.50	N/A	-0.14	-5.1
Pierce	2.61	2.60	N/A	2.49	N/A	-0.12	-4.6
Snohomish	2.67	2.65	N/A	2.53	N/A	-0.14	-5.1
Region	2.57	2.55	N/A	2.42	N/A	-0.15	-5.7
Employment							
King	1,048,040	1,123,512	66.0	1,420,533	64.4	372,493	35.5
Kitsap	84,444	89,621	5.3	128,415	5.8	43,971	52.1
Pierce	245,691	267,323	15.7	353,457	16.0	107,766	43.9
Snohomish	195,596	221,841	13.0	303,405	13.8	107,809	55.1
Region	1,573,770	1,702,297	100.0	2,205,810	100.0	632,040	40.2

Source: Puget Sound Regional Council, 1995 Population and Employment Forecasts for the Central Puget Sound Region. August 1995.

Income

In 1996, the most recent available year, median household income in the region was estimated to be $48,067 (Table 4.1-2). In 1996, median household income in King County was estimated to be $51,103, or 6.3 percent greater than the regional average. Snohomish County had an estimated median household income of $48,798, or 1.5 percent above the regional median. Kitsap and Pierce county households earned 12.8 percent and 11.8 percent less than the regional median, respectively.

Light Rail Project Area Demographic and Economic Trends

Population, housing, and employment trends for the light rail project area segments are shown in Table 4.1-3. Data for Seattle segments are compiled for neighborhoods. The table provides estimates for 1997 and a 2020 forecast based on PSRC regional projections. In each jurisdiction, the light rail project area is defined to be those PSRC Transportation Analysis Zones that include portions of the light rail route. Thus, the information shown will differ from the population, housing, and employment within the city boundaries of Seattle, Tukwila, and SeaTac. Project area boundaries for each segment are shown in Figure 2.1-1.

Population and housing growth are expected to be highest in the Alternative B2 area – University/Lake Union/Denny Regrade, with total growth over the 23-year forecast period of 24,790 residents and 18,346 housing units. Segments C and F would have the second and third highest population growth. Population and housing are forecast to grow the least in the Alternative E1 area – Tukwila, Tukwila International Boulevard, with 5,210 residents and 2,710 housing units over the forecast period, followed by E3 and E2.

For employment, Segment C – downtown Seattle/Duwamish, is expected to experience the most growth by 2020 with 70,322 additional jobs. Segments E1 – Tukwila, Tukwila International Boulevard, and D – Beacon Hill, Columbia City, Holly Park, Rainier Beach, are expected to grow least, adding an additional 5,486 jobs and 9,049 jobs, respectively.

The forecasts reflect implementation of a regional high-capacity transit system. However, distribution of regional population, housing, and employment growth over the period 1997-2020 is only marginally affected by high-capacity transit assumptions. The forecasts are based on extensive time-series data covering the period 1958-1993 as well as national trends and forecasts. In addition, forecasts are subject to extensive review and revision by local jurisdictions, based on their comprehensive plans and knowledge of local conditions. Implementation of a high-capacity transit system may affect the location, and possibly the timing, of new growth. PSRC's 2020 forecasts reflect the assumption of a high-capacity transit system serving the Capitol Hill area in Seattle and the Tukwila International Boulevard corridor in Tukwila as well as commuter rail servicing Longacres and light rail between Bellevue and SeaTac serving Southcenter. These assumptions would be reflected in growth forecasts developed for Alternatives B1, E1, E2, and E3 respectively. Growth estimates developed for route alternatives along South Lake Union in Seattle (B2) will not reflect location of high-capacity transit along this corridor.

Table 4.1-2
1996 Regional Household Income Estimates

County	Mean HH Income	% of Region	Median HH Income	% of Region
King	$63,874	108.4	$51,103	106.3
Kitsap	$49,835	84.6	$41,918	87.2
Pierce	$50,272	85.3	$42,394	88.2
Snohomish	$56,843	96.5	$48,798	101.5
Puget Sound Region	$58,933	100.0	$48,067	100.0

Source: 1996 Puget Sound Regional Council Household Income Preliminary Estimates, Table A1.

4.1.1.3 Trends for Office/Retail/Residential Development

Approximately 1.5 million ft^2 of low-rise office development has been added to the regional inventory within the past few years. Demand for office space remains high, and vacancy rates low at about 5 percent. In downtown Seattle, 23 projects with approximately 5 million ft^2 of office space are either under construction or planned. This would add approximately 15 percent to the existing supply. In the Northgate area, approximately 380,000 ft^2 of office development is planned. Additional office growth is also planned in the Longacres area and in SeaTac's proposed City Center.

Much of the recent retail growth occurring in the light rail corridor has been in neighborhood shopping centers (defined as less than 100,000 ft^2). However, several major development or redevelopment projects have recently been completed in downtown Seattle (840,000 ft^2) and additional development, either under construction or planned, includes approximately 411,000 ft^2 of retail development in downtown Seattle, and 1,400,000 ft^2 in the Northgate area. Significant retail growth is also occurring in Tukwila, chiefly near Southcenter Mall including a 312,000 ft^2 business park.

Table 4.1-3
Population, Housing, and Employment in Link Project Area

Alternative/Neighborhoods	1997	2020	1997-2020 Change	1997-2020 % Change
A – Northgate/Roosevelt Neighborhoods				
Population	30,076	36,637	6,561	22
Housing Units	13,979	18,142	4,163	30
Employment	17,173	29,453	12,280	72
B1 – University/Capitol Hill Neighborhoods				
Population	52,469	65,146	12,677	24
Housing Units	25,889	34,483	8,594	33
Employment	61,186	82,905	21,719	35
B2 – University/Lake Union/Denny Regrade Neighborhoods				
Population	32,762	57,552	24,790	76
Housing Units	12,934	31,280	18,346	142
Employment	81,787	105,192	23,405	29
C – Downtown/Duwamish Neighborhoods				
Population	11,635	27,913	16,278	140
Housing Units	4,697	16,969	12,272	261
Employment	169,330	239,652	70,322	42
D – Beacon Hill/Columbia City/Holly Park/Rainier Beach Neighborhoods				
Population	54,691	62,776	8,085	15
Housing Units	19,237	22,804	3,567	19
Employment	22,915	31,964	9,049	39
E1 – Tukwila International Boulevard Neighborhoods				
Population	9,010	14,220	5,210	58
Housing Units	3,860	6,570	2,710	70
Employment	7,794	13,280	5,486	70
E2 – Interurban Ave. Neighborhoods				
Population	8,400	14,300	5,900	70
Housing Units	4,030	7,390	3,360	83
Employment	25,521	43,400	17,879	70
E3 – MLK Jr. Way S. Neighborhoods				
Population	9,800	15,550	5,750	59
Housing Units	4,530	7,820	3,290	73
Employment	29,875	50,910	21,035	70
F – SeaTac Neighborhoods				
Population	22,777	36,621	13,844	61
Housing Units	9,609	17,353	7,744	81
Employment	25,336	52,477	27,141	107

Notes: [1] The light rail segment population, housing, and employment estimates for 1997 and 2020 were developed from PSRC regional forecasts and technical work by ECONorthwest, 1998; Berk & Associates, 1998; and Crandall Arambula, PC and Leland Consulting Group, 1998. It should be noted that the year 2020 regional forecasts were developed under federal guidelines and with oversight from the Regional Economic Advisory Committee to ensure a general consistency with local comprehensive plans. The forecasts were adopted in 1995 and were used in the development of the Metropolitan Transportation Plan and Vision 2020 Update.

The commercial retail market within the North Rainier Valley has been relatively healthy over the last several years. Commercial land uses are located primarily along Rainier Avenue South and generally concentrated in the commercial nodes at S. McClellan Street and S. Charlestown Street. The North Rainier Valley, including Columbia City, has experienced increased private investment and economic development. Several national retail chains have moved to the area, including Long's Drug Store, QFC, Starbucks, Eagle Hardware and Hollywood Video. Other developments include the new Rainier Mall, located on Rainier Avenue S. at S. Genesee Street. In contrast, there has been little new retail development in other Southeast communities such as Rainier Beach.

Two professional sports facilities with seating for a total of 120,000 fans have either been recently completed (July 1999) or are planned immediately south of downtown Seattle. In addition, approximately 980 new hotel rooms are currently proposed for downtown Seattle (700 hotel rooms were added within past two years). This planned growth equates to approximately 10 percent of the current supply of downtown hotel rooms. Hotel rooms planned for areas outside of downtown Seattle, include 200 at Northgate, 375 in the Southcenter vicinity, and 605 at SeaTac.

Approximately 8 million ft^2 of institutional development is either under construction or planned. This includes major additions to hospitals and colleges, new governmental buildings, and convention and cultural facilities.

The demand for housing in the study area remains strong. Much of the new housing that has occurred in the late 1990s has been multi-family or small-scale single-family development-redevelopment. Within the past two years, downtown Seattle has seen approximately 1,200 housing units built. Approximately 4,000 units are either under construction or planned. In the Northgate area, several major multi-family residential developments are planned totaling approximately 850 units. Under current zoning and its designation as an urban center, the Southcenter area is expected to see increased multi-family residential development, chiefly near water amenities. In the Rainier Valley, the 1,200-unit mixed-income Holly Park redevelopment will replace 900 units of public housing.

4.1.1.4 Existing Land Use Patterns/Major Activity Sites By Segment

The existing land use patterns, by light rail study area segment, include land uses adjacent to the proposed corridor, land uses within one-quarter mile of station locations, and land use types in the vicinity of proposed maintenance facilities. Specific percentages of land uses by segment appear in Appendix L tables; figures showing land use patterns are also included in Appendix L.

Segment A (Northgate to University District)

Land use character differentiates three areas in this segment: Northgate Station to N.E. 75th Street; N.E. 75th Street to Roosevelt Station; and the Roosevelt Station to N.E. 45th Station. The Northgate section is largely within the I-5 right-of-way. I-5 travel lanes are located immediately west of the routes, and land uses to the east are primarily single-family residential. From N.E. 75th Street to Roosevelt, land uses east of the route include single-family residential, a church, and the Roosevelt commercial area; the travel lanes of I-5 are to the west. Predominant land uses close to the south at-grade section include I-5 right-of-way to the west and single-family residential to the east. Other land uses in this area include parkland associated with Ravenna Boulevard and a church. Land uses near the proposed light rail tunnel vents include a church, residential (multi-family, duplex/triplex and single-family housing), and several surface parking lots.

Northgate Station (all routes). Two major activity sites occupy 50 percent of the land use surrounding the Northgate Station—a regional shopping center and institutional uses. Northgate Mall contains 1.1 million ft^2 of retail space and plans exist to expand by an approximate 1.1 million ft^2. Institutional uses near this station include North Seattle Community College, the Northwest Hospital Outpatient Clinic, and the North Seattle Police Precinct Station. The station area is divided by the I-5 right-of-way, which restricts access between the mall on the east and the college, clinic, and precinct station on the west. Other major land uses include neighborhood commercial areas along N.E. Northgate Way, both east and west of I-5; office buildings located west of I-5 and southeast of the proposed station; and high-density multi-family west of I-5, north of N.E. Northgate Way, and southeast of the proposed station location.

Roosevelt Station (all routes). While the most prevalent land use in the study area surrounding the three sites for this station is low-density residential (5 to 8 dwelling units/acre) and multifamily residential (14 to 18 dwelling units/acre), the character in the immediate area of the stations is neighborhood commercial. Key land uses proximate to these three sites include a mix of retail/services uses located along N.E. 65th Street and Roosevelt Way N.E. Two public schools operate within this study area-Roosevelt High School (located between 12th and 15th Avenues N.E. and north of N.E. 65th Street) and Marshall Alternative High School (located on Ravenna Boulevard west of I-5). Open space near these station locations includes Ravenna Boulevard and Cowen Park.

Segment B (University District to Westlake Station)

This segment has two possible routes-a Capitol Hill route (B1–preferred alternative) and a Seattle Center/South Lake Union route (B2.1, B2.2). The land use pattern along the Capitol Hill corridor includes retail commercial, institutional, and multi-family residential. The half-mile portion of this segment from the N.E. 45th Station to the Pacific Station is bordered primarily by the University of Washington. Other uses include multi-family and parking associated with retail located along University Way. South of the Pacific Station, the route would tunnel beneath Portage Bay, Capitol Hill, and First Hill. These areas contain one of Seattle's largest concentrations of institutional, multi-family, and commercial/retail uses. In addition to the University of Washington, eight major activity sites are located along portions of this segment, including Cornish College of the Arts, Seattle Central Community College, Seattle University, Swedish Medical Center, Virginia Mason Medical Center, St. James Cathedral, O'Dea High School, and the Washington State Convention & Trade Center.

The Seattle Center/South Lake Union route includes two Portage Bay crossing options — a bridge (B2.1) or a tunnel (B2.2). The bridge would extend west from N.E. Campus Parkway over Portage Bay. One of the University of Washington's largest residence halls (Terry-Lander) is located immediately south of the station. Land uses in the immediate bridge vicinity include residential (single-family, multi-family, and houseboats), marine-related commercial businesses, rowing clubs, and retail. The portion of this route west of I-5 includes office and medical uses and single-family residential. Uses along the Mercer Street/Seattle Center/Westlake portion include offices, general commercial, light industrial, and industrial/warehousing supply businesses. Major activity sites include the Fred Hutchinson Cancer Research Center, the former U.S. Naval Reserve Center complex, and the Seattle Center.

N.E. 45th Station (all routes, preferred alternative). This station would be located on or adjacent to the northwest corner of the University of Washington campus, the largest university in the Northwest with a campus area of about 650 acres. Campus-related land uses comprise approximately 45 percent of the area surrounding this station and include the Burke Museum; a large surface parking area; the site of the University's new 200,000 ft^2 Law School Building; and Parrington Lawn, a 6-acre open space located south of the parking lot. Other major land uses within the station area include commercial/retail businesses, residential (multi-family housing), churches/other institutions, and commercial or University-related parking. Commercial land uses, which comprise approximately 30 percent of the station area, are concentrated in a two-block-wide area west of 15th Avenue N.E. (centered around University Way) and in an 8-block area along N.E. 45th Street from west of 15th Avenue N.E.

Pacific Station (B1a (preferred alternative), B1b, and B2.2). Approximately 90 percent of the land use surrounding this proposed station is University-related and includes the University's new Physics and Astronomy Building, the health sciences complex, new buildings associated with the University's schools of Oceanography and Fisheries (under construction), and University-related parking. Commercial and retail businesses constitute roughly 5 percent of the area and multi-family residences make up another 5 percent. The Burke-Gilman trail, a regional trail that extends from the Ballard Community in Seattle to Redmond, and a small public park/viewpoint are also located adjacent to this station.

Roy/Aloha Potential Station (B1b). This potential station is located on the preferred B1 route, but is not included in Sound Transit's preferred alternative. Land use near this potential station includes residential, commercial, and institutional uses. Multi-family and single-family housing comprises approximately 75 percent of this area and is generally located north, east, and west of the potential station site. Commercial retail uses (15 percent) are located in a one-half to two-block-wide corridor that extends along Broadway south from E. Roy Street. Institutional uses (Cornish College of the Arts and Lowell Elementary School) are located near this station, together with a portion of Volunteer Park. Proposals for redevelopment in the area include an expansion of Cornish (204,000 ft^2) and construction of Broadway Plaza (a 6-story mixed-use complex) at the north end of Broadway. Much of the area north of the station is within Seattle's Harvard/Belmont Historic District.

Capitol Hill Station (B1a – preferred alternative) and B1b. Land use near this station includes commercial, institutional, residential, warehouse, and park. Retail businesses comprise roughly one-half the study area located along Broadway Avenue south and north of the station site and along several east/west streets. Multi-family housing comprises about one-third of the study area and Seattle Central Community College, limited industrial/warehousing, a reservoir, and parks make up the balance. Parks near this station comprise a 6-square-block area, which includes the existing Lincoln Reservoir. The City is considering "lidding" this reservoir and developing an 8-acre park on the lid (Cal Anderson Park).

First Hill Station (B1a – preferred alternative) and B1b. The pattern of land use in the vicinity of this station includes a mix of institutional uses, high-density multi-family housing, parking (surface and structured), and retail. Institutional uses comprise approximately one-third of the area and include Seattle University; Swedish, Virginia Mason, and Harborview medical centers; three large churches–St. James Cathedral, First Presbyterian, and Fourth Church of Christ-Scientist; O'Dea High School; and the Frye Art Museum. Multi-family housing constitutes one-quarter of the area and retail uses located along Madison Street, James Street, Union Street, Pike Street, and Broadway comprise the remainder.

Campus Parkway Station (B2.1). Most of the area surrounding this station contains University of Washington facilities. Other uses include commercial businesses/retail shops, single- and low-density multi-family housing, the Burke-Gilman trail, and churches. The area within several blocks north of N.E. Campus Parkway consists of residential and commercial uses. Land uses south of the parkway along Portage Bay include University facilities and marine-related commercial and industrial businesses.

Eastlake Station (B2.1 and B2.2). The area surrounding this station consists of single- and multi-family residential, commercial, and institutional land uses. Land uses west and southwest are mainly office and marine-related commercial uses, and marine-related industrial businesses. In this area, I-5 is cut into the steep hillside along the west side of Capitol Hill, and it divides the study area. Land uses northeast, northwest, and south of I-5 are mainly residential (single- and multi-family). St. Mark's Cathedral and St. Mark's greenbelt are east of I-5. Other land uses in the area include National Oceanographic and Atmospheric Administration's Pacific Marine Center, several churches, and the Fred Hutchinson Cancer Research Center. Southwest of the station, most land uses are commercial, including restaurants, a hotel, retail, and marinas.

South Lake Union Station (B2.1 and B2.2). The area surrounding this station is primarily commercial, industrial/warehousing, and supply. Roughly one-third of the study area is general commercial uses. Institutional uses comprise the balance. The area northwest of Mercer Street includes industrial manufacturing, auto dealerships, institutional uses (the former U.S. Naval Reserve

Center complex), several gas stations, retail uses, and general commercial/industrial/warehousing. The Reserve Center and associated property is in the process of being conveyed to the city for a future park. South of the station, the pattern of land uses consists of a mix of industrial/warehousing supply businesses, services, and general commercial uses including a large auto towing yard and auction business.

Seattle Center Station (B2.1 and B2.2). Fifty percent of the area surrounding this station consists of the 74-acre Seattle Center. Other land uses include general office/commercial uses, high-density residential buildings in the northern portion of the Denny Regrade, and a large utility substation. Immediately west of the station is the KOMO broadcast studio, which occupies nearly the entire block; the east half of this block is currently being redeveloped as the first phase of a multiple phase full-block expansion of the broadcast studio. South of the station is a mix of general commercial uses (restaurants/taverns and retail uses), high-density residential (apartment/condominium buildings) and office buildings. To the east are a variety of general commercial uses including motels, banks, restaurants, auto repair facilities, and a utility substation.

Segment C (Westlake Station to S. McClellan Street)

The pattern of land use in this segment varies widely—from dense retail and high-rise office development in the downtown area to industrial, manufacturing, and warehousing south and southeast of downtown. Residential uses combine with neighborhood commercial in the vicinity of both the Beacon Hill and McClellan stations. Within Segment C, except for Beacon Hill residential areas, commercial uses (retail, offices and hotels) comprise nearly all the land use. Major activity sites include the downtown core, the Chinatown/International and Pioneer Square districts, and the existing and planned professional sports facilities.

Commercial (retail, service) land uses are predominant along routes that extend south along Rainier Avenue S. Single-family residential is the typical land use roughly one block east and west of Rainier Ave. S.

Downtown Seattle Transit Tunnel (DSTT) stations (all alternatives). The existing DSTT is located essentially beneath Pine Street and Third Avenue. The five existing stations include Convention Place, Westlake, University Street, Pioneer Square, and the International District. The predominant land use near each of these stations is commercial, including over 50 high-rise office buildings and hotels, multi-story retail, theaters, restaurants, and commercial structure/surface parking. Other major uses include quasi-public/institutional facilities (e.g., Washington State Convention Center) and housing (approximately 20 high-rise apartment buildings). Other land uses near the International District Station include two professional sports stadiums; governmental office buildings and maintenance facilities; freeway on/off-ramps; the King Street train station; warehouses; and mixed-use multi-family housing with street-level retail and service uses.

Royal Brougham and Lander (C1.1, C1.2–preferred alternative, C1.3, C1.4, C1.5, and C3–Royal Brougham only). The predominant pattern of land use between the Royal Brougham Station and the Lander Station is industrial/manufacturing/warehousing and transit vehicle storage/maintenance facilities. New office development is changing the character of the area between the International District Station and the Royal Brougham Station.

Major developments near the Royal Brougham Station include the new Safeco Field baseball facility, the planned football stadium, and an exhibition center; Safeco Field became operational in July 1999; the football stadium is expected to be operational in Autumn 2001.

Poplar Place Station (C2.4). Much of the immediate area surrounding this station location is industrial/manufacturing/warehousing and freeway right-of-way. Commercial uses are located along both sides of Rainier Avenue S. Single-family residential uses are located in the northeast portion of Beacon Hill (above I-90) and east of Rainier Avenue S.

Beacon Hill Station (C1.1–potential, C1.2–preferred alternative, C1.3, C1.4, and C1.5). Near this station, commercial (retail and service) land uses are adjacent to Beacon Avenue. Single-family residential uses are located west and east of the commercial uses along Beacon Avenue.

I-90 Station (C2.3, C3). Commercial (retail, service) and single-family residential land uses are predominant in the area surrounding this station with commercial uses along Rainier Avenue S. and single-family residential roughly one block east and west of Rainier Avenue S. Sam Smith Park (located on the lid over I-90), Thurgood Marshall Elementary School, and the Colman Elementary School building are also located in the vicinity.

Segment D (S. McClellan Street to Boeing Access Road)

Similarities in topography and development patterns along this segment have resulted in a fairly uniform land use character throughout. Commercial development interspersed with residences is concentrated alongside MLK Jr. Way S. Significant commercial development is also located along Rainier Avenue S., which intersects with MLK Jr. Way S. at the northern end of the segment.

This segment, which includes Columbia City, contains commercial businesses that have undergone a resurgence in recent years. South along MLK Jr. Way S. and north of S. Alaska Street are several areas of undeveloped land. The Rainier Vista and Holly Park public housing developments located here create a residential atmosphere for this segment.

Between S. Alaska Street and S. Henderson Street, roadside development includes a mixture of commercial and residential uses with many small apartment complexes. This area also contains nodes of more intense commercial development in the vicinity of S. Graham, S. Othello, and S. Henderson streets. Beyond the S. Henderson Street Station area, land use is dominated by large-scale industrial and warehousing facilities. There is no residential development along MLK Jr. Way S. in this area.

Alternatives D3.3 and D3.4 would extend through the north portion of the segment one-half block west of Rainier Avenue and pass through the center of the Columbia City community commercial district. Land uses along this portion of the route include single-family residences, as well as many community and retail services, and important community facilities. This route would connect with MLK Jr. Way S., either by way of S. Alaska Street or 37th Avenue S. Land use adjacent to S. Alaska Street and 37th Avenue S. is primarily single-family residential.

McClellan Station (all routes, preferred alternative). The core of this area is a mix of commercial, office, institutional, and light industrial uses. Many of the services and retail uses, such as gas stations and fast-food restaurants, are chain franchises. A big-box home and garden center is located between MLK Jr. Way S. and Rainier Avenue S. at S. McClellan Street. On the fringe of this commercial area are small businesses, some of which are intermixed with housing and community uses. West of the MLK Jr. Way S./Rainier commercial corridor is Cheasty Greenbelt, a 35-acre wooded hillside. A single-family residential area is located west of the greenbelt. A public high school (Franklin) and two public elementary schools are in the vicinity of this station. The hillside east of the commercial corridor also contains single-family residential development.

Charlestown Potential Station (D3.3 and D3.4). The mix of land uses near this potential station reflects the revitalization that is occurring to Columbia City's independently owned businesses. Small businesses include neighborhood restaurants and retail shops. A new shopping center is located at Rainier Avenue S. and S. Andover Street. South of the shopping center is a large milk plant. Most of the residences on the outskirts of the commercial district are single-family dwellings. Development is more dispersed in the west half of the station area, where the hillside rises sharply. Small houses are located along the hillsides. The topography is more gradual in the east half of the station area and residential development is more dense. Federal funding was recently approved for a large, mixed-use development at Rainier and Charlestown.

Genesee Station (D3.3). This station area overlaps the south half of the Rainier Avenue S./S. Andover Station area and contains many of the same land uses. The south end of the station area includes several community uses including the Columbia City Cultural Center, Columbia Park (west of Rainier Avenue S.), and Rainier Community Center and playfields. Much of the development in the west half of the station area is single-family residential. This area also includes a portion of the Rainier Vista public housing development.

Alaska Station (D1.1 Options C and D, and D1.3). Land uses in the vicinity of this station are primarily residential. The Rainier Vista public housing development, which extends westward to 33rd Avenue S., occupies most of the north half of the station area. The southwestern quadrant contains some very steep, forested land with little or no development. A cluster of small businesses is located at the intersection of MLK Jr. Way S. and S. Alaska Street. East of MLK Jr. Way S. and south of S. Alaska Street are three community institutions: Zion Preparatory Academy, the Rainier Lions Insight Center (an institute for the blind), and Orca Elementary School.

Columbia City Station (D3.4). The Edmunds Station area, which centers on the heart of Columbia City, contains many community facilities such as the Columbia Branch Library, Zion Preparatory Academy, Rainier Lions Insight Center, several community and cultural centers, and two parks. Orca Elementary School and playground are located on Edmunds Street and 37th Avenue S. Businesses along Rainier Avenue S. in this area are predominantly small and independently owned, providing community-oriented retail and services. The east and south portions of this station area primarily contain single-family residences.

Edmunds Station (D1.1 Options E–preferred alternative, F, and D3.3). This station area overlaps portions of the MLK Jr. Way S./S. Alaska Station area, and the west half of the 37th Avenue S./S. Edmunds Station area. The southwest portion of this area contains a steep, heavily wooded hillside, above which are single-family residences. A variety of small commercial uses are located along MLK Jr. Way S., between S. Alaska and S. Dawson streets. Many cater to the area's ethnic communities. The Edmunds Station is a potential station for Alternative D3.3.

Graham Station (preferred alternative, potential for all other routes). The station area contains a mix of neighborhood commercial uses. The retail anchor in this commercial district is the MLK Market (grocery store). The residential portion of the station area, which surrounds the commercial district, consists mostly of single-family residences with some multi-family housing located north of the MLK Market. Several vacant lots are found in this area. Institutional uses in this area include an alternative public school east of MLK Jr. Way S. and a Washington State Department of Social and Health Services center to the west. The Graham Station is a potential station for all alternatives, except D1.1 Options E and F.

Othello Station (all routes, preferred alternative). This station is at the hub of the Holly Park neighborhood commercial district. Although a supermarket is located west of the intersection, most of the businesses in the area are small and independently owned. Many serve specific ethnic populations. A concentration of small businesses is located at the King Plaza shopping center northwest of the intersection and in the immediate vicinity of MLK Jr. Way S. Most of the west half of this station area includes Holly Park, a large multi-family public housing development. Several apartment complexes are also located along MLK Jr. Way S. in this area. East of MLK Jr. Way S. is a large, single-family residential area. The station area contains many community facilities that serve the area, including the Holly Park Community Center and neighboring Othello Playground; a Head Start Program center; a mission; and several churches. Other new community and retail facilities are under construction.

Henderson Station (all routes, preferred alternative). This station is in a small commercial area located between a large, single-family residential area to the north and the edge of the MLK Jr. Way S. industrial area to the south. Expansion in the immediate area is limited by a large overhead power transmission right-of-way, which cuts across MLK Jr. Way S. Much of the land in this station area is undeveloped. Steep slopes along both sides of the MLK Jr. Way S. corridor result in a narrow strip of buildable land along each side of the street proximate to the station area. Commercial activity also extends east along S. Henderson Street. Although several restaurants and retail shops are in the immediate area, most businesses are light industrial uses (e.g., appliance, auto repair, trucking, freight, storage). Institutional uses east of MLK Jr. Way S. include a middle school and an elementary school.

Segment E (Tukwila)

The three potential light rail routes in Segment E follow the north-south orientation of the Duwamish River valley. Alternatives E1.1 and E1.2 (along Tukwila International Boulevard) rise along the hillside to the west of the valley. At its northern end, the corridor is bordered by steep, wooded slopes interspersed with single- and multi-family residences and businesses including a new 200,000 ft^2 office development. South of approximately S. 130th Street, the corridor is bordered by a strip of businesses, mostly small-scale commercial services, with residential neighborhoods behind them on the east and west. The neighborhood hub of this commercial district is centered on S. 144th Street.

Interurban Avenue S. (Alternative E2) begins at the north in Tukwila's main manufacturing/industrial area, skirts the Riverton and Allentown residential neighborhoods, and passes Tukwila's community center and a commercial/office development area near the river at the bottom of Tukwila Hill. Southward, the corridor skirts Foster Golf Course and Fort Dent Park, two major recreation areas.

MLK Jr. Way S. (Alternative E3) runs along a bench in the hillside east of the Duwamish, with steep undeveloped slopes on either side at the north end. Farther south, near the crossing of S. 129th Street, the gradient flattens somewhat and commercial uses and apartments border the road. The route between the S. 129th Street crossing and the Black River Junction area is a steep, mostly undeveloped hillside, with industrial uses such as gravel mining and a recycling facility.

Alternatives E2 and E3 would both pass through the former Longacres racetrack site, which now contains the Federal Aviation Administration offices and the Boeing Campus office development. The latter is planned to accommodate 80 percent more employment by 2010. Also proposed for development are additional office uses and a multimodal transit station. The routes would head westward through the Southcenter Mall area (Tukwila's Urban Center). Located at the interchange of I-405 and I-5, the Urban Center is dominated by large-scale regional comparison and discount retailers. The Tukwila Urban Center includes the second largest shopping area in the region. It also contains hotel and office space (over 1,500 existing units and over 600 employees). Warehousing is also prominent in the southern portion of the planning area. The two routes that pass through Southcenter would reach SeaTac (Segment F) via a largely undeveloped, wooded slope just south of SR 518 in the north end of Tukwila's McMicken neighborhood.

Boeing Access Road Station (E1.1–preferred alternative, and E1.2). Land uses near this station are mainly industrial and commercial including a portion of the Boeing aircraft facility and a City of Seattle police training facility, part of which is used as a shooting range. Over half of the station study area is contained in transportation right-of-way, including the railroad, I-5, and associated interchanges.

S. 144th Station (E1.1–preferred alternative, and E1.2). This area contains a core of commercial uses surrounded by low-density multi-family housing. Beyond are single-family housing and community facilities including two public schools, a public library, a fire station, a regional public swimming pool, and two government administration buildings.

Longacres Station (E2 and E3). The area near this station encompasses the site of the former Longacres racetrack, which is being redeveloped by the Boeing Company as an office campus. To the west are large undeveloped areas located between and adjacent to the BNSF and UP rail lines. Further west is a commercial district (including hotels) along the West Valley Highway. The Interurban regional bike trail is located west of the UP rail line. Planned development in this area includes the Sounder commuter rail/Amtrak passenger station and associated parking facilities.

Southcenter Mall Station (E2 and E3). Two possible station locations are found near Southcenter Mall—one along Baker Boulevard and the other at Strander Boulevard. The pattern of land uses proximate to each includes Southcenter Mall, a 1.2 million ft^2 regional shopping center, and large-scale, national chain retail uses. North of I-405 are office buildings (including Tukwila City Hall and other government offices) and a residential area with mostly multi-family housing. The area surrounding the Strander Boulevard Station site contains commercial development and Tukwila Pond Park, a 24-acre urban park.

Segment F (SeaTac)

The City of SeaTac is a regional employment center with approximately 50 percent growth in jobs forecasted by 2010. Sea-Tac Airport and the Washington Memorial Park occupy about 12 mi^2 west of International Boulevard, the main commercial corridor of downtown SeaTac. Most of the other land uses along this corridor are related to the airport and serve city residents and visitors. These include uses that serve primarily air travelers (such as hotels and motels, commercial parking lots, rental car lots, fast-food restaurants and diners, gas stations, and convenience marts) and uses that serve the airline industry (airline offices, facilities related to delivery/freight services). The City Center/commercial district also contains the City's administrative offices.

As the airport and airport-related businesses have grown, single-family neighborhoods have been displaced. Presently, single-family neighborhoods are located east and south of the airport/commercial district. Some isolated houses and groups of houses are located between S. 188th and S. 200th streets, particularly along 28th Avenue S. Multi-family housing is generally located between the commercial district and single-family residential areas to the east. However, a concentration of multi-family housing is located near S. 176th Street and south of S. 200th Street. Several mobile home parks are located close to the proposed routes, including a large development that partially surrounds Bow Lake.

North SeaTac Station (154th Street: F1 Options A and B, F2.3–preferred alternative, F3.2, F3.3 and F4). This area contains a mix of land uses, including those that cater to travelers (commercial parking lots, fast-food restaurants), together with a mixed-use community business district that includes office space, small neighborhood shopping centers, light industrial uses, a post office, and state patrol and fire stations. A substantial amount of multi-family housing surrounds the commercial area, with single-family housing beyond that. The southern portion of the area is devoted to road right-of-way.

North SeaTac Station (160th Street: F1–Option C and F3.2 Option B). The north portion of this station study area contains highway right-of-way (SR 518/Tukwila International Boulevard/International Boulevard/Air Cargo Road interchange area). A variety of commercial (airport-oriented) uses are found along International Boulevard. A State Patrol office and a theater complex are located just south of SR 518. Most of the remaining portion of the east half of the study area is single-family residential, with some multi-family development to the south. Washington Memorial Park, a large cemetery, is located in the southwest portion of the area. The Port of Seattle is planning a centralized rental car facility in this vicinity.

North Central SeaTac Station (all routes, preferred alternative). Depending on the alternative, the station would be located at one of three locations west or south of Washington Memorial Park. This includes the future site of the North End Aviation Terminal (NEAT)—an airport expansion including a parking garage, which would handle long-term airport demand. The cemetery, airport roadways, parking, and cargo facilities are in the west portion of the possible station areas. The east portion of the area contains typical airport commercial uses such as hotels and commercial parking lots. To the northeast is a single-family residential area. Portions of this single-family area are planned for commercial redevelopment.

South Central SeaTac Station (F1, F2.1, F2.2, F2.3 (preferred alternative), F3.1, and F3.2). Six possible locations are being considered as the site for a station near the center of the City's commercial district. The vicinity of this station would include portions of Sea-Tac Airport near the airport parking structure, access ramps, and the main terminal. The station area also includes the commercial area east of International Boulevard, which contains several of SeaTac's largest hotels and office buildings (including SeaTac's City Hall), together with commercial parking lots. The 32nd Avenue S. station area (F2.2) would be located further east than the others. The area surrounding this site includes more hotel and office uses compared to the other alternatives, as well as a variety of residential uses (apartments, single-family housing, and a large mobile home park). The S. 184th Street Station area (potential only for F2.3–preferred alternative) would be located further south than the others. This area includes airport-related long-term parking lots, freight-handling, and hotel land uses.

South SeaTac Station (all routes, preferred alternative). All five options for this station would be located in the same area. The area of this station includes a variety of commercial uses located along International Boulevard and 28th Avenue S. Although there are plans to construct a new hotel on International Boulevard, current commercial uses near S. 200th Street cater primarily to area residents. Much of the area surrounding the commercial corridor is residential. The southeast area contains a single-family neighborhood; mobile home parks are located in the southwest and northeast portions of the station area. Institutional land uses in the area include a fire station, an elementary school, the Federal Detention Center, and a power substation.

Maintenance Base Sites

A number of land use and market issues will affect siting a maintenance base facility in the Seattle close-in industrial market that includes the Duwamish Manufacturing and Industrial Center and extends to the City of Tukwila. These issues relate primarily to the loss of industrial lands and industrial jobs, the increasing presence of non-industrial uses, increasing industrial land prices, and limitations to truck traffic and freight mobility. These issues have been triggered by several recent and planned developments, including: business relocations associated with the Port of Seattle's Terminal 18 development; construction of Safeco Field and a planned football stadium; expansion of public uses (e.g. Metro's Ryerson and Central Base); and conversion of existing industrial/warehousing facilities to non-industrial (i.e. office, retail, and institutional school district) uses.

S. Lander Street (M1-A and M1-B). These sites contain industrial warehouse and distribution facilities. Land uses that surround these sites are predominantly industrial, warehousing, and manufacturing. I-5 is located one block east, near the base of Beacon Hill.

Atlantic/Central "A" (M1-C) The east and west thirds of this site contain warehouse and distribution facilities. Land uses in the vicinity of the site include warehouse and distribution facilities, office and retail uses, and Metro's Central bus base.

Rainier Brewery (M1-D and M1-E). These sites are located in an industrial area south of the S. Forest Station and west of I-5. Land uses for these sites include equipment rental, freight services, printing, electric supply, and the Rainier Brewery.

N.E. Boeing Access Road (M2). This site contains processing and wholesale distribution uses including trailer sales, log home sales, packaging, and utility supply. The predominant land uses surrounding this site are freeway, arterial, and railroad rights-of-way. Other land uses include industrial, warehousing, and manufacturing.

S.W. Boeing Access Road (M3). The portion of the site that borders E. Marginal Way contains commercial services, together with a wholesale distributor, a processing use, a bingo hall, and a single-family residence. The remainder of the site is part of the Seattle Police training facility and is mostly undeveloped land. The predominant pattern of land uses surrounding this site is freeway, arterial, railroad, and power line rights-of-way. Other land uses include industrial, warehousing, and manufacturing. The area also contains undeveloped open space, including wetlands and steep slopes.

4.1.2 Land Use and Economic Impacts

Land use impacts can be direct and indirect. Direct impacts involve property acquisition for the project and conflicts between existing and proposed land uses. Indirect impacts could result from redevelopment of properties adjacent to the proposed light rail system and from noise, visual, and access impacts.

Economic impacts discussed include regional employment and income, local business and population, and local tax revenue.

4.1.2.1 Consistency with State and Regional Land Use Plans

Approximately 40 major comprehensive land use and development plans and implementing regulations shape the land use policy framework. The three key state and regional plans include: Washington State's Growth Management Act (GMA), PSRC's Vision 2020 (including the Metropolitan Transportation Plan [MTP]), and King County's Countywide Planning Policies. In general, these documents establish a framework for all other local land use and shoreline comprehensive plans. These plans are discussed below and in Chapter 1, Purpose and Need.

The GMA sets up a framework for managing growth and coordinating land use planning with infrastructure. It requires affected jurisdictions to adopt comprehensive plans that specifically address land use and transportation. In addition, counties must designate urban growth areas where urban growth is encouraged, and where services and facilities exist, or are planned to be available. Vision 2020, which includes the MTP, is the integrated, long-range growth management, economic, and transportation strategy for central Puget Sound (King, Kitsap, Pierce, and Snohomish counties). This regional planning document calls for steps to contain growth, to concentrate new employment into approximately 15 urbanized centers within the region, and to link the centers with a regional rapid transit system that includes bus, commuter rail, and light rail. King County's Countywide Planning Policies provide a framework for the comprehensive plans of King County and for the cities within its boundaries, including Seattle, Tukwila, SeaTac, and Renton in the project study area.

Sound Move, for which financing was approved by voters in 1996, is the Ten-Year Regional Transit System Plan that implements the goals and policies of Vision 2020 and the MTP. The plan was drafted by the Regional Transit Authority, assisted by citizens and local elected officials, to provide a balanced approach to increasing the capacity, utility, and convenience of the existing transit system by offering an integrated package of transit options. The proposed light rail system is consistent with, and is a major component of, the three different modes of high-capacity transit in the *Sound Move* Plan that will serve the region's urban centers. King County and the cities of Seattle, Tukwila, SeaTac, and Renton have each adopted comprehensive plans with light rail-related transportation provisions consistent with regional planning provisions of the GMA and King County's Countywide Planning Policies. Seven of the urban centers identified in Vision 2020 and the MTP are located along the alternative routes of the proposed light rail system. These are: Northgate, University District, Capitol Hill, Seattle Center, downtown Seattle, Southcenter, and SeaTac. The preferred light rail project would directly serve four of the seven urban centers in the study area. Alternatives to the preferred route could serve two other urban centers. The segment connecting the University District north to Roosevelt and Northgate (Segment A) will be constructed as part of the project improvements, if sufficient funding is available. Current plans call for this segment to be deferred and constructed as part of future extensions. In Segment B, the preferred alternative (B1) would pass through Capitol Hill/First Hill. The alternative routes (B2.1 and B2.2) would pass through Seattle Center. E1.1 (preferred alternative) and E1.2 would not pass through the Tukwila Urban Center, whereas Alternatives E2 and E3 would. The No-build Alternative would be inconsistent with these regional policies because the light rail project is an integral component of *Sound Move*, the proposed regional transit system. See the Land Use Impacts Technical Back-up for more detail.

4.1.2.2 Consistency with Local Land Use Plans and Zoning

Seattle, Tukwila, SeaTac, Renton, and King County have each adopted comprehensive plans, shoreline master plans, and zoning that address land use and shoreline areas within their jurisdictions. Each is consistent with the key state and regional plans. While zoning provides regulatory implementation of comprehensive plans, Washington State's GMA requires that zoning be consistent with comprehensive plans. The proposed Link light rail system is consistent with city and neighborhood plans throughout Seattle, Tukwila's International Boulevard corridor, Tukwila's Manufacturing and Industrial Center, and SeaTac's City Center. Appendix L of this Final EIS includes maps depicting local comprehensive plan designations.

Seattle's comprehensive plan focuses most future growth and development (in terms of employment, housing, and commercial uses) into areas designated as urban villages (including urban centers with urban center villages, manufacturing/industrial centers, urban centers and villages, and residential urban villages). The plan encourages the urban villages to be served by high-capacity transit. The preferred alternative would serve 25 residential urban villages and 3 urban centers in Seattle (University Community, Capitol Hill, and Downtown). The preferred route would serve 12 neighborhoods within the 3 Seattle urban centers. Future light rail service to the urban centers not selected in this phase (Northgate and Seattle Center) would not be foreclosed. The Seattle Center urban center would be served by Alternatives B2.1 and B2.2. Extension of the system to Northgate is the first priority for future expansion of the system.

The light rail system, in general, is consistent with the land use goals and objectives of all Neighborhood Plans adopted by the City. However, there are specific elements of some alternatives that conflict with elements of some neighborhood plans. The preferred alternative would not be consistent with parts of the North Rainier and Columbia City neighborhood plans, although these plans have not yet been adopted (Columbia City's plan is scheduled for an October 11, 1999, adoption date; North Rainier's plan is to be adopted on September 27, 1999). The North Rainier plan calls for an underground route throughout the neighborhood and Rainier Valley, while the Columbia City plan requests a station location within the neighborhood business center. Alternative D3.4 would feature a station in the Columbia City business district and would thus be consistent with their plan. Alternative D3.4 would also have part of its route underground, making it the most consistent with the North Rainier neighborhood plan in terms of profile. No other Segment D alternatives would have below-grade sections or stations within the Columbia City business district.

The City of Seattle's Land Use Code (Chapter 23) currently has no text that specifically identifies light rail stations as a land use. The closest matching definition is "passenger terminal", which is defined in section 23. 84.038 (SMC) as, "...a transportation facility located on a sea or land transportation line, where people transfer from one mode of vehicular transportation to another or between carriers within the same mode. Such carriers shall have regularly scheduled routes, and may include trains or other types of transportation." Conversations with the City of Seattle have indicated that the term passenger facility best fits the light rail station use (personal communication, Andy Mckim); however, additional code may be written or a code amendment passed in order to specifically accommodate light rail uses. All route alternatives and stations would pass through a variety of residential, commercial, and industrial zones. Because light rail is consistent with local comprehensive plans, and careful consideration has been given to site response during station area planning, no conflicts with zoning designations are expected. It is anticipated that zoning changes will be made as necessary to accommodate planned passenger terminals.

Tukwila's plans focus higher density land uses in areas served by mass transit, and encourage pedestrian-oriented and transit-oriented development in station areas. The Tukwila comprehensive plan includes Policy 13.4.14 requiring that "any light rail or commuter rail system shall meet the following objectives: . . . Such systems shall be located so as to allow for future extensions . . . to East King County and Southeast King County . . . and shall be located in a manner that serves the Tukwila Urban Center." The Tukwila Urban Center encompasses the Southcenter area. Service to the Southcenter Urban Center is a key element of the plan, which envisions light rail as a catalyst to support a denser, mixed-use center. While the Southcenter mall is a major regional destination, it is currently a combination of auto-oriented retail, with large areas of parking and warehouse, light industrial/suburban office uses.

Alternatives E1.1 (preferred alternative) and E1.2 would not be inconsistent with the City's plans to serve the Urban Center with light rail, as they do not preclude future service to the center, and they propose regular bus service to the Urban Center from the S. 154th Station. This interpretation is specifically supported by the Central Puget Sound Growth Management Hearings Board (Case No. 99-3-000) (Sept. 15, 1999) which found Policy 13.4.14 to be permissible under GMA. The Growth Board held that "[a]lthough this policy utilizes the mandatory word 'shall,' the policy does not obligate nor authorize the City to deny permits to light-rail route alignments that do not pass through the Tukwila Urban Center." (Decision at pp. 7-8). The Growth Board also ruled that the City's planning role is one of collaboration with Sound Transit in the decision-process. Once Sound Transit's routing decision is final, cities have a "duty to accommodate" the light rail facilities, and may impose only "reasonable" conditions and mitigations that will not preclude the facility or render it impracticable. (Decision at pp. 6-7).

The Pacific Highway Revitalization Plan promotes the improvement of the Tukwila International Boulevard corridor to a community "main street" emphasizing added pedestrian amenities and streetscape improvements. A main theme of the plan is to improve the safety, function, and appearance of the corridor. The Plan identifies the intersection of S. 144th Street and Tukwila International Boulevard as the heart of the commercial district, and notes that the area around this intersection (roughly S. 146th Street north to S. 140th Street) has particularly heavy pedestrian flow. The Tukwila International Boulevard Design Report was subsequently prepared by the city to detail plan implementation. Pedestrian and streetscape amenities featured in the Design Report have been incorporated in the preferred alternative (E1.1) since the Draft EIS was issued in order to support enhancement of the corridor's safety, function, and appearance in conjunction with light rail development. Alternative E1.1 has been revised to add new mid-block pedestrian-only crossings and two new signalized intersections have been added. The preferred alternative (as well as Alternative E1.2) would locate a station at S. 144th Street, the designated focal point of the corridor. The station would support the plan by introducing more pedestrians into the commercial area, which is now typically reached by automobile and bus.

The ultimate Plan goal of transforming the image of the highway from an undesirable, unsafe environment to one of a safe and functional corridor can be achieved by the preferred alternative, although design differences remain between Alternative E1.1 and the revitalization design. The presence of the light rail in the median would consolidate cross-traffic and pedestrian flow at signalized intersections where light rail, autos, and pedestrians could safely and efficiently interact. Left turns would be limited to signalized intersections in Alternative E1.1, reducing the number of potential accident points along the corridor. The right-of-way width for Alternative E1.1 would be 2 ft wider than the current and planned right-of-way (average of 100 ft), however the Revitalization Plan designates a narrower cross section of 87 feet. The Design Report acknowledges that in order to implement the Revitalization Plan, additional right-of-way would be required (approximately 11,100 ft^2) primarily at intersections and bus pull-out lanes.

The City of Tukwila's Land Use Code was amended in January 1999 after the Draft EIS was issued to include light rail and commuter rail facilities. All Segment E alternatives would be located in primarily commercial and industrial zones. Although some isolated residential zones would have trackway located within them, stations would only be sited in the Manufacturing/Industrial Center

Heavy, Neighborhood Commercial, and Tukwila Urban Center zones. Light rail stations would be allowed under an unclassified use permit subject to specific criteria. For an unclassified use to be approved, they must not be materially detrimental to public welfare; meet or exceed performance standards for the zone; be generally compatible with traffic and pedestrian patterns and aesthetics; be consistent with the Comprehensive Plan; and have measures to minimize any adverse impacts. Each Segment E alternative would comply with these conditions through site design and reasonable mitigation measures. Additionally, the light rail project is not inconsistent with the Comprehensive Plan and provides a public benefit. In accordance with the Growth Management Hearings Board's ruling described above, it is anticipated that the City of Tukwila would amend its Comprehensive Plan and Zoning Code as necessary to accommodate the identified light rail route and station.

None of the current alternatives would provide direct service to central Renton or to unincorporated King County. All alternatives would be compatible with those jurisdictions' land use plans.

SeaTac's Comprehensive Plan also focuses higher-density land uses in areas to be served by mass transit and encourages high-density, transit-oriented development in station areas within its Urban Center along International Boulevard. Three high-capacity transit (HCT) districts are located within the center including the city center; currently a high-intensity office, hotel, a multi-family residential area, and also the main airport terminal. In SeaTac all of the alternatives, including the preferred alternative, are generally consistent with the City's plan. Each of the draft City Center Plan alternatives include light rail routes and stations consistent with those evaluated in the EIS, and light rail service is a significant component of the City's goals, policies, and strategies for the City Center Plan. Alternatives F2.1 and F2.2 would be east of International Boulevard and would orient riders (pedestrians) directly to the SeaTac City Center, possibly providing greater support for the increased density and pedestrian-oriented development envisioned for the City Center. If no stations are located on the east side of International Boulevard, local transit service along International Boulevard can provide good access to other areas in the city center, east of the airport. The City has proposed a Comprehensive Plan amendment that states a preference for transit orientated development to occur at light rail stations at S. 154th Street, NEAT, S. 184th Street and S. 200th Street. These are the same proposed optional stations included in the preferred alternative.

Most of the proposed stations coincide with the HCT districts and all lie within the Urban Center including those served by the preferred alternative. The City has proposed a Comprehensive Plan amendment that would change the northern HCT district from S. 160th Street to S. 154th Street. North SeaTac station options located at S. 154th Street (F1a, F2.3, F4, potential at F3.2a and F3.3) would be located outside of the current north HCT district but within the proposed HCT district. Alternatives F1b, F1c, and F3.2b would have stations in the current north HCT at S. 160th Street. The North Central stations (all alternatives) and the potential South Central station at S. 184th Street (preferred alternative) would lie just outside of an HCT district, but could still aptly serve the city center with appropriate pedestrian connections. The preferred alternative's North Central SeaTac Station option at the North End Aviation Terminal (NEAT) facility would serve the airport the best, but would not serve the city HCT district as well as the Intermodal Center (IMC) options.

The stations for the preferred alternative and other alternatives would include measures to increase pedestrian safety. This would contribute to consistency between the design of the light rail station and comprehensive plan policies. Pedestrians would be discouraged from crossing at mid-block with at-grade and elevated routes on International Boulevard and 28th Avenue S.; instead, crossings would be concentrated at intersections, or mid-block pedestrian crossings, where signals and crosswalks will be provided. This could help minimize pedestrian accidents with autos as well as with light rail trains.

Light rail stations are classified by the City of SeaTac Zoning Code as Essential Public Facilities (EPF). The City has adopted new text within their land use code in part to address the unique challenges of siting the light rail system. All EPF proposals are to be reviewed through the City's established CUP-EPF (Conditional Use Permit) procedure. This mechanism will provide a structure for the city's collaboration with Sound Transit to identify reasonable conditions and mitigations for permitting the route and stations.

In addition to land use plans, the light rail system would be consistent with regional transportation considerations found in major institution master plans. Relevant major institutional master plans include the Sea-Tac Airport Master Plan and master plans associated with North Seattle Community College, the University of Washington, Seattle Central Community College, Seattle University, Swedish Hospital Medical Center, Virginia Mason Medical Center, and the Washington State Convention & Trade Center. The light rail system is consistent with, and is an implementing facility for, institutional policies directed at reducing commute trips and parking demands. The Sea-Tac Airport Master Plan Update recommends several airport improvements through the year 2020, including a new runway, expansion of passenger service areas and development of a NEAT immediately west of the cemetery. The conceptual plan shows a regional rail station either at NEAT or at International Boulevard with a connection to the main terminal. The Plan also states that all terminal improvements will allow integration with or connections to potential regional or local rail systems. Most other major institution master plans pre-date Sound Transit and do not specifically address station locations. A station or station entrance, therefore, would not have been considered in current plans of these institutions but would not be precluded.

4.1.2.3 Regional Land Use Impacts

The direct acquisitions required for the light rail system would comprise a small percentage of the commercial, industrial, and residential land uses in the corridor and would not directly alter regional land use patterns. Indirectly, however, the light rail system could affect regional land use patterns. The light rail system would fulfill part of the region's plans for high-capacity transit, as envisioned in the adopted regional transportation and land use strategies (see Section 4.1.2.1). Light rail implementation would better enable local jurisdictions to meet their planned land use and density objectives and accommodate the projected population and employment growth within the currently planned urban growth area.

Without the project (No-build Alternative), other types of transportation linkages would need to be provided, or local comprehensive plans would need to be modified. Without the HCT access that the light rail would provide, an alternative transit system would need to be developed or the current density goals and patterns would be more difficult to achieve and the resulting regional land use patterns would likely be lower density than currently planned. If the same population and employment projections are to be met, but at lower densities, then the urban growth area would need to expand and/or more open space within the existing growth area would be developed.

4.1.2.4 Local Direct and Indirect Land Use and Development Impacts

Following a discussion of direct employment impacts from displacements, this section describes the direct and indirect land use, development and business impacts for the route alternatives, station areas and maintenance base sites.

Direct Employment Impacts from Displacements

Table 4.1-4 provides estimates of the number of businesses and employees located at properties that would be acquired by the EIS alternatives. The estimates were prepared based on field verification of addresses and business names, and data from the Washington State Employment Security Department (ESD), obtained from PSRC. When ESD data were unavailable, information from a commercial data service (InfoUSA) was used. Employment was estimated using employee per square foot ratios for a small number of parcels for which information from the other sources was not available.

Table 4.1-4 **Business and Employees Displaced by Alternative** [1]

Alternative	Businesses Displaced	Employees Displaced
Segment A – Northgate to University District		
A1.1 – 12th Ave. N.E. Tunnel	12	126
A1.2 – Roosevelt Way N.E. Tunnel	25	217
A2.1 – 8th Avenue N.E. Short Elevated	11	118
A2.2 – 8th Avenue N.E. Elevated	11	118
Segment B – University District to Westlake Station		
B1 - Capitol Hill Tunnel	4	69
B2.1-Seattle Center via High- level Bridge	24	370
B2.2-Seattle Center via Portage Bay Tunnel	22	360
Segment C – Westlake Station to S. McClellan Street		
C1.1 - At-grade, Median of Lander St.	14	98
C1.2 - At-grade, North of Lander St. (MI-A)	17	248
C1.3 - Elevated, North of Lander St.	14	98
C1.4 - Forest Street (M1-D, M1-E)	16	105
C1.5 - Massachusetts/I-5 right-of-way	29	391
C2.3-West of Rainier Ave. S. Elevated	18	778
C2.4-Rainier Ave. S. Tunnel	11	670
C3 - S. Massachusetts Street Tunnel	13	184
Segment D – S. McClellan St. to Boeing Access Road		
D1.1c - MLK Jr. Way S. – At-grade 4-lane	66	505
D1.1d - MLK Jr. Way S. – At-grade 2-lane	48	400
D1.1e – MLK Jr. Way S. – At-grade 4-lane	51	377
D1.1f – MLK Jr. Way S. – At-grade, 2-lane	44	320
D1.3 - MLK Jr. Way S. Combined Profile	54	423
D3.3 - S. Alaska St. Crossover	101	1,010
D3.4 - 37th Avenue S. Tunnel	105	875
Segment E – Tukwila		
E1.1-Tukwila Int. Boulevard At-grade	13	64
E1.2-Tukwila Int. Boulevard Elevated	12	64
E2 - Interurban Avenue S.	0	0
E3 - MLK Jr. Way S.	3	26
Segment F – SeaTac		
F1 - International Blvd. With 154th Station	49	357
F2.1-Washington Memorial Park-City Ctr. West	9	97
F2.2-Washington Memorial Park-City Ctr. E.	14	233
F2.3-Wash. Mem. Park-Elevated E. of 28th	5	15
F3.1-West of International Blvd. – Grassy Knoll	30	240
F3.2-West of International Blvd.-Main Terminal	30	240
F3.3-West of International Blvd.-IMC	17	158
F4-International Blvd. to 28th/24th	12	91
Maintenance Facilities		
M1-A – S. Lander Street	48	621
M1-B – S. Lander Street	37	1,026
M1-C – Atlantic/Central A	12	581
M1-D – Rainier Brewery/Roadway Express	11	331
M1-E – Rainier Brewery/Airport Way	11	170
M2 – N.E. Boeing Access Road	20	611
M3 – S.W. Boeing Access Road	24	499
Project Total [2]		
Northgate to SeaTac Alternative		
Low	75	619
High	245	2,796
N.E. 45th Street to SeaTac Alternative		
Low	64	501
High	220	2,580
Preferred alternative	90	773
MOS A	30	419
MOS B	72	694
MOS C	15	280

[1] Estimates based on data from the Washington State Department of Employment Security, InfoUSA, and employee per square foot ratios.
[2] Low and High are the minimum and maximum possible values, respectively, Range reflects mitigation in routes and station options.
[3] Preferred alternatives appear in italics.

Some perspective on the relative magnitude of the business displacement impact can be gained by comparing the number of employees displaced to total employment in the areas surrounding the proposed rail line. A comparison of those impacts is provided in Table 4.1-5. A similar comparison for the actual number of businesses displaced cannot be performed because similar growth forecasts for businesses are not available. The second and third columns in Table 4.1-5 provide a comparison of 1997 and 2020 forecasts for neighborhoods surrounding the light rail line (from Table 4.1-3). The estimates are based on Puget Sound Regional Council (PSRC) regional projections. Data for the Seattle segments are defined as a collection of Seattle Traffic and Analysis Zones located within one-half mile of the rail line. In segments E and F, the light rail project area is defined to be those PSRC Transportation Analysis Zones that include portions of the light rail route. Columns four and five provide the cumulative annual average growth rate for each segment and the implied number of employees added in each area from 1997 to 1998, which is an estimate of one year's underlying growth in employment in the areas surrounding the light rail line. The final three columns represent estimates of the number of employees at businesses that would be displaced by the project for the segment alternative with the lowest impact, the preferred alternative, and the segment alternative with the highest impact.

Table 4.1-5
Comparison of Employment Growth and Employees Displaced by Segment [1]

			Cum. Annual Growth		Employment Displaced		
Segment	**1997**	**2020**	**Percent**	**Jobs**	**Low**	**Pref.**	**High**
Segment A – Roosevelt/Northgate	17,173	29,453	2.4	408	118	n.a.	217
Segment B							
Alternative B1– University/Capitol Hill/Downtown	61,186	82,905	1.3	813	69	69	69
Alternative B2 – University/Lake Union/Downtown	81,787	105,192	1.1	900	360	n.a.	370
Segment C - Royal Brougham/North Rainier	169,330	239,652	1.5	2,577	98	248	778
Segment D – Columbia City/Rainier Beach	22,915	31,964	1.5	334	320	377	1010
Segment E							
Alternative E1 – Tukwila, Pacific Highway	7,794	13,280	2.3	183	64	64	64
Alternative E2 – Tukwila, Interurban Ave.	25,521	43,400	2.3	596	0	0	0
Alternative E3 – Tukwila, MLK Jr. Way	29,875	50,910	2.3	700	26	26	26
Segment F – SeaTac	25,336	52,477	3.2	815	15	15	357

[1] Employment forecasts from Table 4.1-3; Employment displaced from Table 4.1-4.

As shown, in most cases, the project will displace much less employment than is typically added in one year in the areas surrounding the light rail line, and the number of employees displaced is less than one percent of total employment in the surrounding area. The only exception is Segment D, where the preferred alternative would result in the displacement of just over one year's employment growth, and the highest impact segment alternative (D3.3) would result in the displacement of about 3 years employment growth. However, as also shown in Table 4.1-5, the business displacements in Segment D represent a range of 1 to 4 percent of the project area's existing employment (2 percent for the preferred alternative). Overall, the employment impact from business displacements can therefore be described as low in all segments of the project. Furthermore, because Sound Transit would provide relocation assistance to displaced businesses and other employers, it is likely that the displaced jobs will be relocated, not lost.

In conclusion, this analysis demonstrates that the changes in employment patterns resulting from the business displacements associated with this project are expected to be relatively small. Using this change in employment as an indicator of the magnitude of the economic effect resulting from the business displacements leads to the conclusion that this economic effect is small.

Overview of Indirect Impacts

Light rail has the potential to indirectly affect property values over the long term, result in monetary losses or gains to local businesses, and support new development and redevelopment.

Light rail alternatives would increase transit access and pedestrian activity, especially in areas surrounding the stations. Improved transit access can improve the convenience and desirability of surrounding residential and commercial properties. Increased pedestrian activity can increase the patronage of adjacent retail uses. Increased access can also support higher density residential and/or commercial development, although local jurisdictions determine the actual permitted densities and types of uses. Table 4.1-6 rates the likelihood of the light rail alternatives to support development or redevelopment that would change the existing land use patterns within one-quarter mile of station areas under current plans and policies. Research on the impacts associated with light rail systems indicates that light rail is just one of many factors that can influence development (Cervero 1993; Porter 1997). Changes in development patterns depend heavily on local and national real estate market conditions, existing development patterns, supportive land use and development policies, and local community and business support. As a result, the potential for the light rail alternatives to support development and redevelopment is characterized by ratings of moderate, low, or none. In general, development and redevelopment will be relatively more likely where:

- Plans and policies are in place to encourage compact, transit-supportive development
- The land around the station has pedestrian-oriented design and pedestrian links
- The land around the station is not owned by a single institution (e.g., university or airport)
- Vacant and/or underused sites are available for development
- Developable/redevelopable parcels are large, or parcels can be assembled.

While light rail would indirectly support existing and future development in some locations, it could also adversely affect some existing uses and future development potential. Where light rail alternatives would cause significant, unmitigated environmental impacts, they could reduce the value of an area for some existing or planned uses. Factors that could reduce residential and/or commercial property values or sales include: disruptive noise levels; significant light, shadow, and view impacts; and significant reductions in auto access and parking (for residential, commercial or industrial uses that are highly dependent on easy automobile access, freight mobility, and/or rail access). The rate and timing of indirect business impacts would also depend on: the location of the business relative to the new station; changes in business activity during construction and operation of the system; business visibility; and local land use plans and development standards.

As documented in the Environmental Justice Technical Report (Appendix G), there are also indirect economic benefits associated with the preferred alternative of the Central Link system including:

- **Improved Access to Transit.** The system would provide improved access for many residents throughout the Sound Transit District. In particular, it would provide a statistically significant level of improved access to transit for the minority population and nearly a significant level of improved access to transit for the low-income population of the Sound Transit District.
- **Travel Time Savings.** The system would lower travel times for many residents within the Sound Transit District. Proportionally more of these benefits would be received by minority and low income residents.

One result of the improved access and improved travel times is improved access to employment opportunities to persons living within the Sound Transit District as the number of potential employers located within a given commute time would increase. The converse also exists for businesses as the pool of potential employees that live within a given commute distance would increase for many employers.

The following sections briefly summarize and rate potential adverse indirect impacts with each alternative. Ratings are based on environmental factors that could negatively affect residential property values or business activity. The ratings are based on the analysis presented in Section 4.4, Visual and Aesthetics, Section 4.6 Noise and Vibration, and Chapter 3, Transportation Ratings and are defined as follows:

- High impacts—presence of substantial noise and visual impacts with the potential to negatively affect business activity or residential property values; substantial loss of revenue for businesses due to access/circulation/parking impacts.
- Moderate impacts—presence of substantial noise or visual impacts with the potential to negatively affect business activity or residential property values; moderate access impacts with the potential for revenue loss for businesses.
- Low impacts—little or no substantial noise or visual impacts with the potential to negatively affect business activity or residential property values; little to no access impacts resulting in no substantial revenue loss for businesses.

For some alternatives, indirect economic impacts could result from the displacement of businesses and community services if neighboring businesses that remain find it difficult to attract and/or retain customers because part of a complementary group of businesses no longer exists. The long-term magnitude of this impact will depend on the ability to relocate displaced businesses within the community, and on the extent to which infill and redevelopment take place in those areas.

Sound Transit recognizes that the light rail system has the ability to have both positive and negative economic effects on surrounding communities. Sound Transit is actively planning how to encourage economic development in project areas to provide that the benefits that a light rail system can bring to service areas are achieved. Steps that Sound Transit has taken and will take to help ensure that the project maximizes its economic development benefits include the following: developing mitigation measures to minimize impacts on businesses that will be affected during construction project; recognizing the need to use system design and planning to maximize potential economic redevelopment benefits, including the appropriate placement of stations relative to nearby residential, retail and commercial centers, and the use of pedestrian- and business-friendly design elements such as pedestrian walkways; developing partnerships with local jurisdictions in order to encourage planning efforts that will encourage transit related development; and facilitating community involvement in and support of the project. These efforts will help to ensure that the Central Link project is an economic asset for its surrounding communities, particularly in light of the strong Puget Sound Area economy. The City of Seattle and City of SeaTac, supported by Sound Transit, are actively engaging the community in a station area planning process to provide neighborhood plans, policies and zoning around stations conducive to transit oriented development.

Segment A (Northgate to University District)

The few acquisitions that would occur would not change land use patterns in the area. The Northgate Station Options A, B, and C would include a 1,300 stall park-and-ride structure (a net increase of about 380 spaces, which could be up to 860 over existing spaces) in the southwest corner of the Northgate Mall, a regional shopping center. Options B and C would replace the existing transit center in this location. A 400,000 to 500,000 ft^2 mixed-use development (retail, cinema, parking, hotel, office, and residential) is planned on the parking lot immediately east of this site. Either station option would complement existing land uses in the area and would not likely impact currently planned projects. Either option could also support redevelopment of residential properties south of the station and east of First Avenue N.E. and Fifth Avenue N.E., and intensify residential and commercial development north of Northgate Way. There could be joint development opportunities for structured parking near the station, with pedestrian linkages to Northgate Mall and North Seattle Community College, west of I-5.

The Roosevelt Station has three options. The elevated Eighth Avenue N.E. option for Alternatives A2.1 and A2.2 would be adjacent to and above part of the existing park-and-ride lot. Station entrances associated with the Roosevelt Station under either Roosevelt Way (A1.2) or 12th Avenue N.E. (A1.1) would change several retail and office land uses to transit uses. The change in existing land uses is not expected to significantly alter overall land use character in the area. These underground station options would more directly serve the heart of the Roosevelt commercial area. Approximately 89,000 ft^2 of retail/commercial development (with the Roosevelt Square redevelopment) is proposed or under construction near these stations.

There is potential for substantial redevelopment at any one of these three sites where existing zoning allows more intensive commercial and multi-family uses. In Alternatives A1.1 and A1.2, the Roosevelt Station could quicken redevelopment of nearby underdeveloped single-family and commercial properties changing to more intensive commercial and multi-family land uses. Such actions could affect nearby residential uses (single-family, duplex, and triplex structures) and underdeveloped commercial properties. The Roosevelt Station option near Eighth Avenue N.E. (A2.1 and A2.2) could support more intensive mixed-use retail/commercial and multi-family residential uses along N.E. 65th Street. Although the station would increase the pedestrian activity, the zoning and character of much of the area is single-family residential. Without comprehensive plan/zoning changes, this station would be less likely to result in more intensive development.

A vent shaft, which is proposed north of N.E. 50th Street, would occupy a portion of the playground associated with the University Heights Community Center. No other long-term land use impacts are anticipated.

The likely indirect, adverse economic impacts would be low for all Segment A alternatives. Alternatives A2.1 and A2.2, which include elevated track and stations, would have somewhat higher visual and noise impacts than the tunnel alternatives, A1.1 and A1.2, but they are not expected to be substantial.

Segment B (University District to Westlake Station)

Alternative B1, the preferred alternative, would be located entirely underground, beneath the University District, Portage Bay, Capitol Hill, and First Hill. There are two B1 routes, Options A and B, that vary by depth but not alignment. Alternatives B2.1 (high-level bridge) and B2.2 (Portage Bay tunnel) would access downtown Seattle via Seattle Center.

Under any of the three N.E. 45th Station options, the land use pattern in this area would not be significantly altered; instead, the N.E. 45th Station would likely reinforce retail and higher-density multi-family land uses north and west of the station entrances. This could affect nearby residential uses (single-family, duplex, and triplex structures) and commercial parking lots. Of the three station options, Option C would be physically closer to the heart of the commercial center of the University community (generally located along University Way N.E., commonly known as "The Ave."), and would provide greater improvements in pedestrian access to retail, office uses, and buses on University Way N.E.

Due to the dense pedestrian and transit-oriented character of the University community, strong employment growth, limited available development sites, and the nature of the mixed-use neighborhood, all options would have similarly good redevelopment potential for vacant or underused sites near the station, including properties used temporarily for construction staging.

As a system terminus, the N.E. 45th Station could cause an increase in feeder bus service in the area, greater traffic, and a potential increase in hide-and-ride parking impacts in adjacent neighborhoods.

The underground Pacific Station (B1) also has two options. The land use pattern of the West Campus area would not be significantly altered by either option.

A potential Roy/Aloha Station at 10th Ave. N.E. and E. Roy Street (not part of the preferred alternative) is a vacant "brown field" lot that has since been proposed for private redevelopment. The proposed Roy/Aloha Station affects several multi-family buildings, but would not be expected to significantly alter area land use patterns. This station location could support greater intensification of retail and higher density multi-family land uses near the station, where existing zoning allows it. This change would increase the activity level adjacent to nearby residential uses. Since issuance of the Draft EIS, the Roy/Aloha Station is no longer included in the preferred alternative.

Table 4.1-6
Indirect Effects on Development and Redevelopment in Station Areas[1]

Stations (Alternative)	Effects	Stations (Alternative)	Effects
Segment A (Northgate to University District)		**Segment D (S. McClellan Street to Boeing Access Road)**	
Northgate (All A)	Low	*McClellan (All D)*	Low
Roosevelt – 12th/65th (A1.1)	Moderate	Charlestown (D3.3, D3.4) – Potential	Low
Roosevelt – Roosevelt Way/65th (A1.2)	Moderate	Genesee (D3.3)	Low
Roosevelt – I-5/65th (A2.1, A2.2)	Moderate	*Edmunds (D3.3, D1.1e)*	Low
		Columbia City (D3.4)	Low
Segment B (University District to Westlake Station)		Alaska Street (D1.1, D1.3)	Low
N.E. 45th (All B)	*Moderate*	*Graham (All D)*	Low
Pacific (B1, B2.2)	*None*	*Othello (All D)*	Low
Roy/Aloha (B1) – Potential	Low	*Henderson (All D)*	Low
Capitol Hill (B1)	*Low*		
First Hill (B1)	*Low*	**Segment E (Tukwila)**	
Convention Place (B2.1, B2.2)	None	*Boeing Access Road (E1.1., E1.2)*	None
Campus Parkway (B2.1)	Moderate	Longacres (E2, E3)	Low
Eastlake (B2.1, B2.2)	Low	Southcenter (E2)	Low
South Lake Union (B2.1, B2.2)	Low	Southcenter (E3)	Low
Seattle Center (B2.1, B2.2)	Low	*S. 144th (E1.1, E1.2)*	Low
Segment C (Westlake Station to S. McClellan Street)		**Segment F (SeaTac)**	
Westlake (All C)	None	*North SeaTac – 154th (F1., F2.3, F3.2, F3.3, F4)*	Low
University Street (All C)	None	North SeaTac – 160th (F1, F3.2) – Potential	Low
Pioneer Square (All C)	Low	N. Central SeaTac – Airport. (All F)	Low
		N. Central SeaTac – NEAT (F2.3)	None
International District (All C)	Low	S. Central SeaTac – Main Terminal (F3.2)	None
Royal Brougham (C1.1, C1.2, C1.3, C1.4, C1.5, and C3)	None	S. Central SeaTac – Grassy Knoll (F3.1)	Low
Lander (C1.1, C1.2, C1.3, and C1.4)	Low	S. Central SeaTac – Int. Blvd. Median (F1)	Low
Beacon Hill (C1.1, C1.2, C1.3, C1.4, and C1.5)	Low	S. Central SeaTac – City Center West (F2.1)	Low
I-90 – Rainier Ave S.(C2.3)	Low	S. Central SeaTac – City Center East (F2.2)	Moderate
Poplar Place (C2.4)	Low	S. Central SeaTac – 184th St. (F2.3)–Potential	Low
		South SeaTac – S. 200th and Int. Blvd. (F1)	Low
I-90 – 17th Avenue S.(C3)	Low	*South SeaTac – S. 200th and 28th* (F2.1, F2.2, F2.3, F3.1, F3.2, F3.3, F3.4)	Low
		South SeaTac – Thrifty Surface Lot (F4)	Low
		South SeaTac – 28th/24th Ave. Garage (F4)	Low
		South SeaTac – S. 200th St. Garage (F2.3, F3.3)	Low

Source: Ratings based primarily on analysis conducted by the cities of Seattle, Tukwila, and SeaTac (EcoNorthwest, 1998; Crandall Arambula, 1998; Berk and Associates, 1998).

Note: [1] Based on current land use plan designations.
Preferred Alternative stations appear in italics.

A vent shaft would be located on public property, near SR 520; no long-term land use impact is anticipated.

The underground Capitol Hill Station (B1) has four options. Options A, B, and C would be located below Broadway south of E. John Street with two station entrances on the west side of Broadway; Options B and C include an optional entrance on the east side of Broadway. Option D would be located below Nagle Place between E. Howell and John streets with entrances on the southeast corner of E. John Street and Broadway and on the east side of Broadway near E. Howell Street. Entrances would displace or affect several retail and commercial businesses, planned development associated with Seattle Central Community College's future Learning/Resource Center, and existing parking areas, if located on Broadway (Options A, B, and C). The entrances to the Nagle

Place Station option would displace commercial and retail buildings on the intersection of E. John and Broadway and partially close a parking lot in the middle of the block south of E. Denny (to the east of Broadway).

All of the station options would be consistent with area land use patterns, and could hasten intensification of retail and higher-density multi-family land uses near the station, where existing zoning allows it. This change would increase the activity level adjacent to nearby residential uses. Due to the dense pedestrian and transit-oriented character of Capitol Hill, strong housing demand, limited available development sites, and the nature of the intense mixed-use neighborhood, all station options would have similarly good redevelopment potential for vacant or underused sites near the station, including properties used temporarily for construction staging.

The First Hill Station (B1) entrances would result in the acquisitions of two properties that provide retail space. This station would be consistent with area land use patterns. The station could support intensification of retail and high-density multi-family land uses, particularly north of E. Madison Street, where existing zoning allows it.

A station at this location would result in substantial changes to the existing two-block Convention Place Station site under any alternative. Layover of trains is a possibility on a portion of the site, potentially reducing opportunities for transit coach layover and redevelopment to commercial uses. At least 12 major construction projects are under consideration on and in the vicinity of the station. Under Alternatives B2.1 and B2.2, a light rail station at Convention Place could affect the proposed redevelopment of the site and surrounding vicinity.

The Campus Parkway Station (B2) would be underground, beneath N.E. Campus Parkway. While the station would affect traffic flow patterns in the vicinity of the station, no significant change in land use patterns is anticipated. The University has started preparing a Campus Master Plan update and will evaluate the West Campus area for future academic and administrative buildings. A station at this location could accelerate redevelopment plans for this portion of campus and could support multi-family residential use north of the campus boundary (N.E. 41st Street) and west of University Way N.E.

The Eastlake Station (B2) would displace several single-family dwellings and a parking lot. While this station would be compatible with existing land uses, displacement of the single-family dwellings could affect local land use patterns; relatively few single-family dwellings occur in this area. Indirectly, a station at this location would likely hasten the intensification of retail and higher-density multi-family land uses.

Alternatives B2.1 and B2.2 would provide a crossing of Portage Bay by bridge or tunnel. The bridge option (B2.1) route would displace several multi-family buildings, office buildings, a branch bank and several restaurants. Other than the displaced restaurants, land use patterns along the Lake Union corridor are not expected to be significantly affected as a result of these displacements.

The Seattle Center Station (B2) entrances would change several retail stores and office and commercial parking lots; however, these changes would be compatible with existing land uses in the area and would not significantly affect land use patterns. Substantial development is already planned near the station, including, at Seattle Center, a new museum, expansion of the Pacific Science Center and IMAX theater, and a full-block development associated with the KOMO television station. More intensive retail and higher-density multi-family development east, south, and southwest of the station could occur sooner than with the No-build Alternative.

The likely indirect, adverse economic impacts would be low in all Segment B alternatives. Alternative B1, preferred alternative, would generally have fewer operational impacts than the two combined profiles, Alternatives B2.1 and B2.2. Alternative B2.1 could have slightly higher noise and visual impacts to local businesses and residents than the other alternatives due to the increased length of elevated track, but the impacts are not expected to be substantial.

Under Alternative B1, preferred alternative, and the MOS A (N.E. 45th Station to S. McClellan Station), the proposed N.E. 45th Street Station would serve as the temporary northern terminus for the light rail system. Under MOS B (Capitol Hill Station to S. Henderson Station), the proposed Capitol Hill Station would serve as the temporary northern terminus. No additional adverse land use or economic impacts are anticipated if either location is a terminus station.

Segment C (Westlake Station to S. McClellan Street)

The existing DSTT comprises roughly one-third the length of this segment. The preferred alternative would have exclusive use of the tunnel for light rail transit, and buses currently using the tunnel would move to the surface. This would not result in significant land use impacts downtown. Between the International District Station and the McClellan Station, several routes would use the existing transit-only right-of-way, resulting in limited direct land use impacts. While displacements would occur with each alternative, substantially more displacements would result from Alternatives C2.3, C2.4, and C3 than the C1 alternatives, including C1.2 – the preferred alternative. Several commercial/industrial land uses near S. Poplar Place, as well as retail/commercial uses along Rainier Avenue S., would be displaced.

The Royal Brougham and Lander stations (C1.1, C1.2 – preferred alternative, C1.3, C1.4, C1.5, and C3 – Royal Brougham only) would displace several industrial, manufacturing, and warehousing-type businesses but would not be expected to significantly alter area-wide land use patterns. If the City of Seattle retains the existing industrial zoning proximate to these station locations, no redevelopment to commercial or residential uses in the vicinity of the stations is expected. Businesses that rely on easy arterial, freeway, and rail access and circulation could be adversely affected by traffic restrictions associated with light rail operation. The stations would afford employee transit access, and could reduce auto reliance and potentially increase street capacity for trucking.

Under MOS C (N.E. 45th to Lander stations), the proposed Lander Station would serve as the temporary southern terminus for the light rail system. No impacts are anticipated to land use.

The Beacon Hill Station (C1.1 – potential, C1.2 – preferred alternative, C1.3, C1.4, and C1.5) could displace several commercial (retail/service) uses. Such displacements would not significantly alter area-wide land use patterns. Redevelopment near the station would likely be multi-family and retail/commercial land uses, where zoning allows it.

The Poplar Place Station (C2.4) would displace industrial and warehousing-type land uses west and east of S. Poplar Place. Proposed displacements could alter the localized land use patterns. Development of retail uses near the station could occur where existing zoning allows more intensive uses.

The I-90 Station (C2.3, C3) would displace several residential land uses, but would not significantly alter area-wide land use patterns. Redevelopment near the station would likely be multi-family land uses, consistent with zoning.

Indirect economic impacts for the preferred alternative would range from none to low. Alternatives C2.3 and C3 would result in greater noise and visual impacts to local businesses and residents than the C1 alternatives and Alternative C2.4 because of more extensive elevated track sections in the north Rainier Valley. Potential access impacts would also be greater. Because of extensive elevated track in the north Rainier Valley, the remaining strip of land between Rainier Avenue S. and the light rail track would likely be too narrow to redevelop and would become open space. Potential access impacts would be moderate or low. Alternative C2.4 would have low, indirect, adverse economic impacts.

Segment D (S. McClellan Street to Boeing Access Road)

Design refinements to the Segment D1.1e and D1.1f alternatives have reduced the extent of direct impacts (that were identified in the Draft EIS) to residents, local businesses, and community facilities such as churches and meeting places. Alternative D1.1e would typically have a 93-ft right-of-way between intersections and would have one of the lowest acquisitions totals for this segment. Relatively few acquisitions would occur in some portions of MLK Jr. Way S. (such as the area between Horton Street and Columbian Way, Alaska and Brandon streets and south of Henderson Street). In these locations, land use character would be largely unchanged.

Potential impacts would be lowest for Alternatives D1.3 and the D1.1 options (including the preferred alternative). Alternatives D1.1c (at-grade, 104 ft right-of-way), D1.1d (at-grade, 90 ft right-of-way), D1.1f (at grade, 93 ft right-of-way), and D1.3 (elevated) would also have lesser adverse impacts. Alternatives D3.3 and D3.4 would locate the northern portion of the route immediately west of Rainier Avenue, resulting in the acquisition of every frontage property, most of them businesses, on the west side of Rainier Avenue S. between Byron and Oregon streets (approximately 1 mile), changing the character along this side of the street from commercial to light rail trackway. Because MLK Jr. Way S. is less intensely developed, and has a wider right-of-way than Rainier Avenue, it would be less severely impacted. However, even without the project, the existing single-family residences fronting MLK Jr. Way S. and Rainier Avenue S. may be replaced eventually by commercial and/or multi-family uses, consistent with zoning.

Neighborhoods may benefit from increased visibility and patronage of community businesses, if the community businesses in this segment are successfully reestablished. However, redevelopment also could result in "gentrification," with new businesses that do not effectively serve the needs of local residents, and ultimately result in less affordable land, housing, and services. Conversely, a lack of redevelopment after project construction could reduce neighborhood vitality.

There is also a potential for benefits in Segment D to be realized as the result of the reconstruction of MLK Jr. Way S. and the areas east and west of Rainier Avenue S. This will occur both at stations and along the line segment, where landscaping and other amenities will enhance the public right-of-way. The project could support more varied, intensive, pedestrian-oriented urban nodes along these corridors consistent with their neighborhood plans. Streetscape improvements on MLK Jr. Way S. could improve land use character and promote redevelopment. This effect would be most evident where station areas coincide with existing activity centers. Greater visibility and accessibility to station areas would increase activity and could benefit businesses. Land use impacts associated with specific station areas are discussed below.

The McClellan Station (all routes including the preferred alternative) could hasten development of more dense, pedestrian-oriented retail and service uses in the underused western half of the station area. Land use may intensify in the east half of the station area too, but it may be limited by the proximity of the Rainier Avenue/MLK Jr. Way S. intersection. The at-grade station option would redirect autos across and around the station platform (across Cheasty Boulevard).

The potential Charlestown Station (D3.3, D3.4) would displace single-family residences and small businesses to the west. Indirect impacts may include redevelopment of underused parcels to more intensive, transit-supportive land uses.

The Genesee Station (D3.3) would displace several small businesses located between S. Genesee and S. Adams streets. Land immediately west of the proposed station may redevelop with multi-family and neighborhood commercial uses. Development of the Alaska Station (D1.1, Options C and D, D1.3) would remove some community services. Because the station area is walkable and contains several community destinations, the station could support new neighborhood-scale commercial uses on underused or vacant parcels.

The Columbia City Station (D3.4) would support the area's existing land use pattern, which consists of a hub of community businesses and facilities surrounded by a variety of residential and recreational land uses. Any redevelopment would likely include more dense neighborhood-commercial and multi-family residential uses.

In the Edmunds Station area (D1.1e – preferred alternative and D1.1f, D3.3), the low-density residential development interspersed with steep land toward the west would not likely experience significant development. However, the at-grade alignment would include streetscape improvements along MLK Jr. Way S., making the area more attractive and pedestrian friendly. Where land is available along MLK Jr. Way S., the project may support development of a few smaller, neighborhood-oriented commercial establishments or community services with the preferred alternative D1.1e and Alternatives D3.3, D1.3, and D1.1d.

Near the Graham Station (D1.1e – preferred alternative, D1.1f, potential in all others), the MLK Market would not be directly affected by the light rail system, but several adjacent retail and service uses would be displaced, leaving much potentially redevelopable land at this intersection. Indirect land use impacts are likely to include increased residential densities and development of more pedestrian amenities.

The Othello Station (all routes, including the preferred alternative), while displacing properties primarily to the east between S. Myrtle and Othello streets, would preserve many of the more vital area businesses. The S. Othello Street commercial area, which is surrounded by a variety of housing densities and community uses, including the Holly Park redevelopment, has potential to become more active and pedestrian-oriented. There is much underused land in the area, most of it surface parking. Indirect impacts may include redevelopment of these parcels, sooner than would otherwise occur.

The Henderson Station (all routes, including the preferred alternative) located west of the Henderson Street commercial area, would support nearby neighborhood commercial and light industrial uses. Areas immediately south and west, which contain low-density residences, industrial uses, and steep, undeveloped areas, would be less likely to experience a change in character. All alternatives propose a streetscape link between the station and the Rainier Beach commercial core. Design treatments for pedestrian crossings and improved bicycle facilities would be included in streetscape improvements and station design.

The indirect adverse economic impacts would likely be greatest for Alternatives D3.3 and D3.4, followed by D1.3, D1.1c, D1.1d, D1.1e – preferred alternative, and D1.1f. Substantial indirect impacts could occur to existing businesses following the displacement of neighboring businesses and community services and the resulting change in business environment. This potential impact is likely to be greatest for Alternative D3.3, which follows Rainier Avenue S. in the northern part of the segment before turning onto MLK Jr. Way S. Alternative D3.4 follows a similar route but would have somewhat less impact (except at the portal south of Graham Street), because part of the route would be in a tunnel instead of at-grade.

Under the MOS A, the McClellan Station would serve as the temporary southern terminus of the light rail system; under the MOS B, the Henderson Station would serve as the temporary southern terminus. No additional adverse land use or economic impacts are anticipated if either location is a terminus station.

Segment E (Tukwila)

Alternatives E1.1 (preferred alternative), and E1.2 would displace several commercial uses and two to four residential uses. These alternatives would remove some of the existing parking along this auto-oriented arterial, which could affect the economic viability of adjacent land uses dependent on easy auto access. In accordance with the Pacific Highway Revitalization Plan, Alternative E1.1 (preferred alternative) has been modified to incorporate design elements of the City's proposed improvements to Tukwila International Boulevard. These modifications would help support the planned emphasis on commercial uses, which serve multiple local neighborhoods through improved pedestrian amenities and safety. Although direct displacements would be moderate and very similar with both alternatives, Alternative E1.2, because it would be elevated the entire length of Tukwila International Boulevard, would cause higher visual impacts and potential indirect economic impacts in the commercial area south of 130th Street.

The Boeing Access Road Station (E1.1–preferred alternative; E1.2) would have little direct impact on the existing pattern of land use. Because the station would be substantially removed from any existing development, there would be little additional pedestrian activity in this area. Light rail and commuter rail service may bring more commuters to the nearby Boeing facility, but no indirect land use impacts are likely.

At the S. 144th Station (E1.1–preferred alternative; E1.2), where the area is already a neighborhood commercial hub, light rail access would support the development of denser, pedestrian-oriented commercial uses nearby. There would be few displacements near the station, limiting disruption of the functioning hub. The presence of other amenities within walking distance (including a library, schools and parks) support multi-family residential development along either side of the commercial corridor.

Along Interurban Avenue S. (E2), most of the additional right-of-way would be acquired to the east of the existing roadway and would encroach on generally larger-scale office, retail, and light industrial properties, minimizing impacts to somewhat smaller businesses and multi-family residences to the west. Impacts along MLK Jr. Way S. (Alternative E3) would be relatively low because the route travels through low-intensity industrial areas, along existing railroad and freeway rights-of-way, and adjacent to large-lot residential developments. However, several small commercial uses near S. 129th Street, including a motel, would be displaced.

The Longacres Station area (E2, E3), which would include a commuter rail station, Amtrak passenger station, a park-and-ride lot, and bus connections, would become an important transportation hub. Substantial development is proposed within ¼ mile of the station. This area will likely develop with campus-style offices and surface parking lots, like the nearby Boeing complex, rather than a more dense mix of commercial and multi-family residential uses.

The Southcenter Station (located east of the mall with E2 and just south of the mall with E3) would have low direct impacts. Although the station could support the development of more intensive uses, there are few vacant parcels, and the current land uses are predominantly auto-oriented, large-scale department stores and big-box retailers that are surrounded by large parking lots and located too far apart to be easily accessible by foot. Although there would be little potential for redevelopment of surface parking in the foreseeable future, the station could be connected to pedestrian-oriented amenities.

Indirect adverse economic impacts would likely be greater with the Tukwila International Boulevard alternatives, E1.1 (preferred alternative) and E1.2, than with Alternatives E2 and E3, although overall indirect impacts are still moderately low. The potential for adverse traffic impacts to local businesses and residents would be moderate for E1.1 and E1.2. Location of the light rail trackway in the median of Tukwila International Boulevard under the E1 alternatives could affect access to some businesses and could result in economic losses away from station areas. Businesses near station areas would benefit from better accessibility, visibility, and pedestrian activity. Impacts from decreased automobile access, circulation, and parking would be low to moderately low for Alternatives E2 and E3.

Segment F (SeaTac)

Most of the routes in Segment F would result in few direct changes to existing land use patterns. Alternative F2.3 (preferred alternative) would have few displacements and generally low impacts. Alternative F1 would have slightly more impact from greater displacements. Most displacements associated with Alternative F1 would be at the northern end of the route, where the commercial corridor is most narrow. Alternative F2.2 would feature a route through SeaTac's proposed City Center and could help facilitate planned redevelopment within the center. Alternative F2.1 would abut the City Center along International Boulevard, and could facilitate redevelopment to a lesser extent. Alternatives F3.1, F3.2, F3.3, and F4 would have up to 13 acquisitions in the northern corridor area. In the southern portion of these routes, along 28th Avenue S., there is much vacant land in transition. Some of the remaining single-family residences along this road could be acquired, which could hasten development of new office buildings and other uses.

The stations in North SeaTac would be located around either the intersection of S. 154th Street and International Boulevard or S. 160th Street at International Boulevard. The North SeaTac Station at 154th Street, (Fla, F2.3–preferred alternative, F3.2, F3.3, F4) in combination with the proposed station at Tukwila International Boulevard and S. 144th Street (E1.1 – preferred alternative, E1.2), could have indirect land use impacts, supporting development of a transit- and pedestrian-oriented district. This change may aid in revitalizing that corridor. Construction of the auxiliary park-and-ride lot (in this area of multi-family residential, retail, and park-and-fly lots) would not be consistent with the creation of a more dense urban environment, but the lot would not constitute a significant change in land use over existing conditions. Station options feature park-and-ride facilities on the southeast, northeast, and northwest corners of the intersection. Each corner location would have a similar level of impact. Option A would be at-grade north of S. 154th Street, allowing the intersection to redevelop to a greater economic potential. Some impacts associated with the S. 154th Station would occur within the City of Tukwila.

Because the area around the North SeaTac Station at 160th Street (Flb, Flc, F3.2b) contains medium- and low-density commercial uses and single-family residences, and would include a new centralized Port-planned rental car facility, it is not likely to become a more dense, mixed-use hub. This station has three options (C, D and E) located at, to the north, and to the south of the intersection at S. 160th Street and International Boulevard, respectively. The project could support new transit-oriented uses along International Boulevard. Under certain market conditions, redevelopment of vacant and underused parcels in the area could occur.

The North Central SeaTac Station (all routes) would support the use of nearby commercial land for lodging and other services catering to airport travelers. Station Option C would include a station at the Intermodal Center. This location would incorporate several modes of ground transportation including Metro buses, Link light rail, and rental car facilities for the airport. Pedestrian connections could also be established across International Boulevard to SeaTac's City Center. Station Option D would be located at the NEAT site. While this location would directly serve the airport's planned expansion, it would have the less direct pedestrian connections across International Boulevard.

The South Central SeaTac Station has multiple options. Alternative F2.3 (preferred alternative) would have a potential station at S. 184th Street on the west side of International Boulevard. This station would provide an opportunity to establish pedestrian connections to the City Center. With Alternatives F2.1 and F2.2, the station would be most accessible from SeaTac's City Center, and would therefore have the greatest potential to support more dense, pedestrian and transit-friendly land use. If the station were placed to the east of City Hall at 32nd Avenue (Alternative F2.2), it could support converting the existing mobile home park near Bow Lake to higher-density housing. However, a station east of City Hall has not been included in draft redevelopment plans for the proposed City Center. A station west of International Boulevard including the preferred alternative, may result in less additional pedestrian activity in Central SeaTac, and may be less likely to support changes in land use patterns. Stations in these areas are assumed by the Draft City Center Plan to have sufficient pedestrian access across International Boulevard. to foster City Center redevelopment. A recent market analysis of the S. 184th Station concludes that the most promising redevelopment in the City Center area are not readily accessible from that site.

Substantial development is planned near the S. 184th Station, including a 385-room hotel, a 3,500-space addition to the airport parking complex, and four major expansions to existing commercial parking facilities east of International Boulevard (roughly 6,000 spaces).

The South SeaTac Station would feature a park-and-ride lot or garage structure near S. 200th Street. Alternative F2.3 (preferred alternative) would have a garage and station location south of S. 200th Street near 28th Ave S. All other F alternatives except for F1 would have similar station locations–four different locations altogether–around the S. 200th Street/28th Avenue S. vicinity. Each of these locations, including the preferred alternatives, would encroach on properties along either side of 28th Avenue S., north or south of S. 200th Street, much of which is commercial or vacant. The station for Alternative F1 would be located north of S. 200th Street on International Boulevard. This area has more businesses that would be displaced by a station. There is some indirect development potential, although the presence of the park-and-ride lots may decrease the desirability of adjacent lots for some types of residential and small-scale commercial uses. However, SeaTac's long-term plans of transitioning this area into a business district would be compatible with the presence of park-and-ride facilities.

The indirect adverse economic impacts would likely be lower in Alternative 2.3 (preferred alternative) where impacts in all areas would be low, except in Homestead Park where they would be moderately low. Impacts from reduced access, circulation, and parking would likely be moderate/high in Alternative F1, and low to moderate in the other alternatives. The potential traffic, access, and parking impacts to businesses under the F2, F3, and F4 alternatives would generally be less than those identified for F1 because the routes are generally located to the west or east of International Boulevard or on Port of Seattle property.

Maintenance Base Sites

All seven maintenance base site alternatives are located in areas consisting primarily of industrial uses and zoning. Like many industrial uses, the proposed maintenance base requires a large site with convenient train and truck access. A maintenance base at any one of the alternative locations would replace existing private manufacturing and industrial uses with the Link maintenance base, a facility for storage, cleaning, maintenance, repair and operations of light rail transit vehicles.

While a maintenance base at any one of the alternative locations would be a public facility, it would be an industrial use consistent with the Greater Duwamish Manufacturing and Industrial Center Plan. However, the North Duwamish area has limited land area available for industrial uses and it is likely that displaced private industrial uses would need to relocate outside the area. Transit vehicle base facilities are an industrial use, and in Seattle, are classified by the Seattle Land Use Code as an Administrative Conditional Use in all industrial zones. Existing industrial uses displaced by the project would be replaced by the industrial use of the transit base. Developing a maintenance base in this area would not increase pressure for development of land uses inconsistent with the industrial nature and/or zoning of the area. Several changes to the Greater Duwamish Manufacturing and Industrial Center Plan are currently under consideration by the City of Seattle.

Location of maintenance base facilities in the North Duwamish Industrial Area would erode the tax base within the industrial area by relocating private manufacturing and industrial uses. Most jobs that would be displaced are industrial in nature. Historically low vacancy rates, small parcel size, and limited land availability downtown may make relocation of displaced firms difficult within the North Duwamish Industrial area. Existing family wage jobs could be relocated outside this industrial area, but would not be lost. Sound Transit would provide relocation assistance to displaced businesses. The use of a maintenance base would provide approximately 390 additional family wage jobs for the area. Operation and maintenance activities conducted at the maintenance base site, including running repairs, heavy maintenance, and storage of light rail vehicles, would be consistent with surrounding industrial uses.

Alternative M1-A (S. Lander Street). A maintenance base at this site would displace industrial/warehousing and distribution facilities, and certain City of Seattle offices, yet would be consistent with the pattern of existing industrial land uses in the area. No indirect land use impacts are anticipated.

This alternative would relocate and reconfigure freight rail and rail storage tracks and result in the loss of approximately 3,500 ft of rail storage. This could adversely affect local businesses relying on freight storage.

The site would require the closing of S. Stacy Street between Sixth Ave. S. and Eighth Avenue S. Access to existing businesses would be maintained along Airport Way S. The businesses displaced by Alternative M1-A provide an estimated 621 jobs.

Alternative M1-B (S. Lander Street). Like Alternative M1-A, a maintenance base at this site would displace existing warehouse and distribution facilities, and would be consistent with the pattern of surrounding land uses. Alternative M1-B would retain freight rail and rail storage yard facilities displaced in M1-A, but may result in restricted movements north of S. Lander Street, thus impacting some businesses.

Alternative M1-B would require closing S. Stacy and S. Walker streets between Seventh Avenue S. and Airport Way, and Eighth Avenue S. between S. Lander and S. Stacy streets. Access to existing businesses would be maintained along Sixth Avenue S. and S. Stacy Street.

Alternative M1-B would result in the greatest employment displacements of the North Duwamish Maintenance Base Alternatives. The businesses displaced by Alternative M1-B provide an estimated 1,026 jobs. Sound Transit would provide relocation assistance to the displaced businesses.

Alternative M1-C Atlantic/Central A. Like alternatives M1-A and M1-B, a maintenance base at this site would displace existing warehouse and distribution facilities, office buildings, and retail space. The industrial use would be consistent with the surrounding land uses pattern.

Alternative M1-C would require closing Sixth and Eighth Avenues S. between S. Massachusettes and S. Holgate streets. Access to existing businesses would be maintained along parallel streets. Use of Alternative M1-C for the Link light rail maintenance base facility would prevent King County Metro from expanding its central bus base to the south, but would allow it to expand its base to the west by vacating that portion of Sixth Avenue S.

No freight rail impacts are anticipated.

The businesses displaced by Alternative M1-C provide an estimated 581 jobs.

Alternative M1-D Rainier Brewery/Roadway Express. Like alternatives M1-A, M1-B, and M1-C, a maintenance base at this site would displace existing warehouse and distribution facilities. As an industrial use, the maintenance base would be consistent with the pattern of surrounding land uses.

Alternative M1-D would require closure of portions of S. Hanford, Horton, and Hinds streets and rerouting truck access to Sixth Avenue S. Access to local businesses would be maintained; no significant business impacts are anticipated. No freight rail impacts are anticipated.

The businesses displaced by Alternative M1-D provide an estimated 331 jobs.

Alternative M1-E Rainier Brewery/Airport Way S. Like Alternatives M1-A, M1-B, M1-C, and M1-D, a maintenance base at this site would displace existing warehouse and distribution facilities; the industrial use would be consistent with the pattern of surrounding land uses.

Alternative M1-E would require re-aligning of Airport Way S. toward I-5 to connect the main Rainier Brewery property (currently on the east side of Airport Way S.) with the Rainier Brewery property on the west side of Airport Way S. and would close portions of S. Hanford Street. Truck access would be rerouted to Sixth Avenue S. Sound Transit would maintain one lane of travel in each direction on Airport Way S. during re-alignment. Access to businesses in the area would be maintained; no significant business impacts are anticipated. No freight rail impacts are anticipated.

The businesses displaced by Alternative M1-E provide an estimated 170 jobs.

Alternative M2 (N.E. Boeing Access Road). This maintenance base would displace manufacturing, warehousing, and related office land uses and would be consistent with the existing industrial land use pattern. No indirect land use impacts are anticipated.

The businesses displaced by Alternative M2 provide an estimated 611 jobs.

Alternative M3 (SW Boeing Access Road). This maintenance base site would displace the fewest light industrial and commercial land uses. A Seattle Police Association facility, a Bingo Hall, and residence would also be displaced. The maintenance base would change the character of the site but would be generally consistent with surrounding transportation and utility rights-of-way and commercial and light industrial uses.

The businesses displaced by Alternative M3 provide an estimated 499 jobs.

4.1.2.5 Regional Employment and Income Impacts

A benefit of light rail project construction and operation is the resulting increase in regional economic activity. Expenditures on construction and operation that result in demand for construction materials and workers are referred to as direct impacts. Direct impacts lead to indirect impacts when the output of firms in other industries increases to supply the demand for inputs to the construction industry. Finally, wages paid to workers in construction trades or supporting industries are spent on other goods and services (induced impacts).

It is generally assumed that only project activities funded by out-of-region sources (net expenditures) will result in new expenditures and employment. As taxes are increased regionally to pay for the project, residents and businesses have that much less income to spend on other goods and services in the regional economy. Such expenditures do not represent new economic activity, but rather a shift in the local economy's product mix. For this project, it is assumed that net direct spending and associated economic benefits will result only from the inflow of federal funds that would have otherwise not been spent in the region (33 percent federal funding is assumed for construction).

Employment and Income Impacts from Construction Expenditures

The economic impacts from light rail system construction expenditures are presented in Table 4.1-7. As shown, total direct spending on construction is estimated to be $2.4 billion for the Northgate to SeaTac Alternative, and $2.1 billion for the preferred alternative, and $1.7 billion for the low-cost alternative, MOS C. Expenditures and impacts from MOS A and B would be within the range defined by MOS C (low end) and the preferred alternative (high end).

Table 4.1-7
Employment and Income Impacts of Light Rail Construction Expenditures

Alternative	Thousand 1995$				Jobs	
	Total Direct Spending	Net Direct Spending[1]	Output[2]	Personal Income[2]	Net Direct Person-Yrs[3]	Annual[4]
Northgate to SeaTac	$2,400,000	$349,500	$593,000	$576,000	7,137	892
Preferred Alternative	$2,063,000	$298,500	$507,000	$492,000	6,035	754
MOS C – N.E. 45th St. to Lander	$1,670,000	$270,500	$460,000	$446,000	5,168	646

Notes: [1] Assumes 58 percent in-region construction, 68 percent in-region vehicle assembly, and 100 percent in-region right-of-way.
Assumes 33 percent federal funding.
[2] 3-county multipliers from the Implan Group, Inc.
[3] Based on labor estimates by PB/KE for Regional Transit Project, 1994, adjusted for this project based on ratio of project cost estimates.
[4] Assumes 8 years for design and construction.
MOS A and MOS B would be within the range defined by the preferred alternative and MOS C.

Net direct expenditures (inflows of funds to the regional economy) are about $500 million for the Northgate to SeaTac Alternative, $299 million for the preferred alternative, and $271 million for MOS C. Total impacts to the regional economy (personal income) are $576 million for the Northgate to SeaTac Alternative, $492 million for the preferred alternative, and $446 million for MOS C. These impacts would occur over the eight years required to plan, design, and construct the project.

The results of the input-output analysis indicate that a total of approximately 7,100 new jobs will be created in the three-county region for the Northgate to SeaTac Alternative, about 6,000 new jobs will be created for the preferred alternative, and about 5,200 new jobs for MOS C in response to net new spending on construction in the region. The No-build Alternative would not create the new economic activity and jobs.

Employment and Income Impacts from Operations and Maintenance Expenditures

Annual costs and employment estimates for operating and maintaining the light rail system are shown in Table 4.1-8. As shown, operating and maintaining the system (at 2020 ridership levels) is estimated to cost about $50 million per year for the Northgate to SeaTac Alternative, $24 million per year for MOS C, and $42 million for the preferred alternative. The Northgate to SeaTac Alternative is projected to require 556 employees annually, the preferred alternative is projected to require 477 employees annually, and MOS C is projected to require 265 employees annually at 2020 ridership levels. Other benefits of operating and maintaining the light rail system include supporting a diverse employee base and providing family-wage jobs. Family-wage jobs are defined as those exceeding the average annual wage for King County, or $37,299 in 1997. It is anticipated that wages and benefits paid for most light rail operations, maintenance, and administrative jobs would meet this definition. For more discussion, see the Economic Impacts Technical Report.

Table 4.1-8
2010 Annual Operations and Maintenance Cost and Employment Estimates[1]

	Cost (1995$)	Employees
Northgate to SeaTac	$49,800,000	556
Preferred Alternative	42,000,000	477
MOS C – N.E. 45th St. to Lander	24,300,000	265

Notes: [1] Manuel Padron & Associates and Sound Transit. Assumes year 2020 ridership.
MOS A and MOS B would be within the range defined by the preferred alternative and MOS C.

If current federal funding programs remain in place in the future, and if Sound Transit successfully competes for those funds, the project may receive approximately $1.2 million annually, beginning in 2006, to pay for project operations, less than five percent of the cost for operations.

4.1.2.6 Impacts on Local Tax Bases

In each of the build alternatives, Sound Transit would need to acquire residential and commercial properties. Table 4.1-9 shows the initial property tax impacts resulting from property acquisitions and the initial property tax impacts. The table does not include potential impacts from partial acquisitions.

When referring to the property tax impacts of acquisitions, the term "initial property tax impacts" is used because the extent of the long-term fiscal impact of the system is uncertain. Initially, property taxes will no longer be collected from full acquisitions along the route. As a result the rates charged remaining taxpayers would increase slightly to recover budgeted funds, or budgets for essential government services would be reduced accordingly.

In the long run, it is likely that some of the "excess" land purchased by Sound Transit for system construction will later be released for development, and it is possible that some displaced businesses would rebuild at a new location elsewhere within the jurisdiction's boundary. This would result in new construction, which is added to the jurisdiction's tax base, thus increasing the revenue available to a jurisdiction for essential government services. These positive impacts could be offset by the absence of new construction that might have occurred on properties acquired by Sound Transit. Thus, the long-term property tax impacts are uncertain, but are likely to be less than the initial property tax impacts.

Table 4.1-9 Initial Property Tax Impacts by Alternative[1]

Alternative	Total Impact	Index Low=100[2]	Impacts to City/County Taxpayers: Primary Jurisdiction[3]	Impacts to City/County Taxpayers: Other Jurisdiction[4]
Segment A – Northgate to University District				
A1.1 – 12th Ave. N.E. Tunnel	$57,500	114	$17,300	$0
A1.2 – Roosevelt Way N.E. Tunnel	$66,400	132	$19,900	$0
A2.1 – 8th Avenue N.E. Short Elevated	$63,700	126	$19,100	$0
A2.2 – 8th Avenue N.E. Elevated	$50,500	100	$15,100	$0
Segment B – University District to Westlake Station				
B1 - Capitol Hill Tunnel	$40,000	100	$12,000	$0
B2.1-Seattle Center via High-level Bridge	$138,200	345	$41,500	$0
B2.2-Seattle Center via Portage Bay Tunnel	$117,700	294	$35,300	$0
Segment C – Westlake Station to S. McClellan Street				
C1.1 - At-grade, Median of Lander St.	$38,600	100	$11,600	$0
C1.2 - At-grade, North of Lander St. (MI-A)	$86,400	224	$25,900	$0
C1.3 - Elevated, North of Lander St.	$38,600	100	$11,600	$0
C1.4 - Forest Street (M1-D, M1-E)	$39,400	102	$11,800	$0
C1.5 - Massachusetts/I-5 right-of-way	$161,100	418	$48,300	$0
C2.3-West of Rainier Ave. S. Elevated	$147,300	382	$44,200	$0
C2.4-Rainier Ave. S. Tunnel	$85,900	223	$25,800	$0
C3 - S. Massachusetts Street Tunnel	$92,200	239	$27,700	$0
Segment D – S. McClellan St. to Boeing Access Road				
D1.1c - MLK Jr. Way S. – At-grade 4-lane	$174,700	150	$52,400	$0
D1.1d - MLK Jr. Way S. – At-grade 2-lane	$116,100	100	$34,800	$0
D1.1e – MLK Jr. Way S. – At-grade 4-lane	$141,700	122	$42,500	$0
D1.1f – MLK Jr. Way S. – At-grade, 2-lane	$117,800	101	$35,300	$0
D1.3 - MLK Jr. Way S. Combined Profile	$174,600	150	$52,400	$0
D3.3 - S. Alaska St. Crossover	$281,600	243	$84,500	$0
D3.4 - 37th Avenue S. Tunnel	$259,800	224	$78,000	$0
Segment E – Tukwila				
E1.1.-Tukwila Int. Boulevard At-grade	$51,000	2,486	$15,300	$0
E1.2-Tukwila Int. Boulevard Elevated	$27,100	1,319	$8,100	$0
E2 - Interurban Avenue S.	$2,100	100	$400	$100
E3 - MLK Jr. Way S.	$31,900	1,556	$5,400	$3,200
Segment F – SeaTac				
F1 - International Blvd. With 154th Station	$311,900	630	$59,200	$11,900
F2.1-Washington Memorial Park City Ctr. West	$89,500	181	$15,900	$4,500
F2.2-Washington Memorial Park City Ctr. E.	$313,100	632	$69,400	$2,100
F2.3 - Wash. Mem. Park-Elevated E. of 28th	$49,500	100	$8,700	$2,500
F3.1-West of International Blvd. – Grassy Knoll	$156,900	317	$21,600	$14,100
F3.2-West of International Blvd. Main Terminal	$158,200	319	$21,900	$14,100
F3.3-West of International Blvd. IMC	$114,500	231	$17,500	$8,500
F4-International Blvd. to 28th/24th	$87,200	176	$17,800	$2,100
Maintenance Facilities				
M1-A – S. Lander Street	$233,300	243	$70,000	$0
M1-B – S. Lander Street	$150,300	156	$45,100	$0
M1-C – Atlantic/Central A	$285,900	298	$85,800	$0
M1-D – Rainier Brewery/Roadway	$288,100	300	$86,400	$0
M1-E – Rainier Brewery/Airport Way	$205,600	214	$61,700	$0
M2 – N.E. Boeing Access Road	$155,800	162	$36,200	$7,900
M3 – S.W. Boeing Access Road	$96,100	100	$21,700	$0
Project Total [5]				
Northgate to SeaTac Alternative				
Low	$444,900	--	--	--
High	$1,284,500	--	--	--
N.E. 45th Street to SeaTac Alternative				
Low	$394,400	--	--	--
High	$1,218,100	--	--	--
Preferred alternative	$508,900	--	--	--
MOS A	$137,100	--	--	--
MOS B	$268,500	--	--	--
MOS C	$111,000	--	--	--

Notes: [1] 1998 Assessed values and taxes billed from King County Department of Assessments. Totals for each alternative are summary of all parcels designated as full acquisitions based on conceptual design as of August 1999. Does not include the partial acquisitions impact.
[2] The lowest 1998 tax impact for a segment is given an index value of 100. Index values for the other alternatives in that segment are calculated as ratios to the low tax impact alternative. For example, the tax Impact of Alternative 1.1 is 14 percent greater than that of Alternative A2.2.
[3] Primary jurisdiction is Seattle for Segments A-D, M1, and M2; Tukwila for Segments E1.1, E1.2, E2, M3, and F2.3; King County for Segment E3; and SeaTac for all Segment F.
[4] Secondary jurisdictions: E2 = King County, E3 = Tukwila and Renton ; F and M2 = Tukwila.
[5] Low and High are the minimum and maximum possible values, respectively.
NA means not applicable.
The preferred alternative appears in italics.

From 30 to 42 percent of the tax revenues collected by affected cities are from property taxes. The remaining revenues come from other sources, such as sales and use taxes, business and occupation taxes, utility taxes, gambling revenues (e.g., Bingo Hall in Tukwila on Site M3), and parking taxes. Similar to property tax impacts, the long run tax impacts to local jurisdictions from these other taxes are uncertain if some of these tax revenues will be affected to the extent that displaced businesses do not relocate within the same community. Businesses unable or unwilling to relocate within the same community would represent a loss of revenues to the local jurisdiction. These types of losses would be offset to the extent that existing businesses relocate and business activity increases and/or new businesses are attracted to the area. Local jurisdictions are likely to receive significant sales tax revenues from purchases related to project construction. In addition to funding local jurisdiction programs, total property tax levies include funds collected for consolidated county taxes, fire prevention, libraries, schools, and other services. Based on the conceptual designs, the initial property tax impacts from acquisitions are in all cases less than one percent of the total tax revenues collected by a jurisdiction. Mitigation for impacts during construction are discussed in Section 4.17.

4.1.3 Mitigation

The light rail project is being planned and designed to recognize problems associated with the acquisition of residential and business properties, to develop solutions, and to minimize the adverse impacts of acquisitions. Where displacements are unavoidable, Sound Transit would provide relocation services and benefit payments. Efforts would also be made to relocate the occupants of acquired properties within the same community if possible and give displaced businesses priority consideration for properties to be resold for redevelopment. See the discussion in Section 4.2 of the Final EIS.

Sound Transit would use all its own sites to demonstrate good transit-oriented design and land use mixes that are appropriate to their setting, transit mode, and market conditions by preserving development opportunities on Sound Transit property and promoting transit-oriented development. Sound Transit would designate a Community Ombudsman and develop relocation policies to minimize impacts and promote the long-term viability of the businesses and the community. Business technical assistance will be provided.

Sound Transit would work with displaced businesses, under its relocation policies, to help find suitable sites within the community and also to appropriately develop acquired property. As part of the preferred alternative, the Sound Transit Board has proposed to establish a $50 million Transit-Oriented Community Development Fund (Motion M99-14 adopted February 25, 1999) to be available to mitigate impacts of building and operating the light rail preferred alternative in southeast Seattle. The fund could be used to increase ridership and improve the community. The funds can be used to leverage local, state and federal dollars for transit-related and supportive investments. A community advisory panel would be established to set priorities and make recommendations to the Sound Transit Board for application of the fund. The Fund will be available to the community for physical and economic improvements to the southeast Seattle light rail corridor.

In addition, Sound Transit's Guiding Principles for Employment and Contracting, identify four key objectives to engage the region in the implementation of *Sound Move* as follows:

- Workforce diversity reflective of the region,
- Maximum use of local business,
- Maximum use of small businesses, and
- Maximum use of minority, women and disadvantaged businesses.

The Sound Transit Board has made further commitments through economic development policies to enhance local economic benefits to businesses and the workforce. Most recently, Sound Transit has adopted a policy for the use of project labor agreements (PLA) on Central Link Light Rail construction and Sounder commuter rail station construction. The PLA policy also includes a strong commitment to diversity in employment and apprenticeship training.

4.1.4 Significant Unavoidable Adverse Impacts

There would be no significant unavoidable adverse impacts to land use and economics.

4.2 ACQUISITIONS, DISPLACEMENTS AND RELOCATIONS

Building and operating the Central Link Light Rail System requires acquisition of property for right-of-way and other facilities, and presumes displacing and relocating some of the existing uses. This section summarizes the likely property acquisitions, based on the current conceptual designs. There are two types of property acquisitions:

- A "partial acquisition" would acquire part of a parcel but would not dislocate the existing use.
- A "full acquisition" would acquire the full parcel and displace the current use. Full acquisitions include parcels that may not fully acquired for the project but would be impacted (due to loss of parking, access or other features) such that the existing use would be substantially impaired.

The following discussion outlines the likely acquisitions in each segment, focusing on major differences among alternatives. Table 4.2-1 summarizes total partial acquisitions and full acquisitions by land use type for each route alternative. The text below indicates notable differences in impacts among the station options associated with the various route alternatives. Other effects associated with acquisitions are discussed in Section 4.3, Land Use and Economics; 4.1, Neighborhoods , and Appendix G, Environmental Justice.

4.2.1 Acquisitions, Displacements by Route Alternatives and Stations

Segment A (Northgate to University District)

Alternative A2.1 would cause the highest number of full acquisitions (10) in Segment A, followed by A1.2, A1.1 and A2.2 with the least (2). A1.2 would acquire the most commercial property (five parcels), followed by A1.1, A2.1 and A2.2 (one to three parcels each). Alternative A2.1 would be the only alternative with residential displacements, including six single-family residences and one duplex.

For the Northgate Station, there are three options (A, B and C) under consideration. Option B is reflected in Table 4.2-1 and above. Option A would affect two fewer commercial properties (one full acquisition and one partial acquisition). Option C would affect one additional commercial property (partial acquisition).

Effects would cluster near Northgate Mall for all alternatives, and around the proposed stations at N.E. 65th Street and 12th Avenue N.E. (A1.1), at N.E. 64th Street and Roosevelt Way N.E. (A1.2) and just east of I-5 between N.E. 68th Street and N.E. 66th Street (A2.1 and A2.2).

Segment B (University District to Westlake Station)

In Segment B, the preferred alternative would have thee fewest full acquisitions. Alternative B2.2 would have the highest number of full acquisitions (20), followed by B2.1 (18), and B1 (four). B2.2 would acquire the most commercial parcels (19 including one vacant lot) with B2.1 acquiring 16 commercial properties (including one vacant lot) and one private/ institutional (church) parcel.

B2.1 would acquire the most residential units, including one multi-family residential property (40 units of low-income apartments) and one single-family residential property.

For the N.E. 45th Station under consideration in Segment B, there are three Options (A, B, and C). Option B is reflected in Table 4.2-1 under effects of the locally preferred alternative. Option A would have the same impacts as Option B. Long-term impacts under Option C include acquiring two commercial parcels and permanent closure of N.E. 43rd Street to vehicular traffic east of the alley

Table 4.2-1
Summary of Central Link Baseline Acquisitions by Alternative

Alt.	Commercial/Private Institutional[1]			Public/ Institutional[2]		Residential Single Family		Residential Multi-Family		Table Totals[3]	
	Partial	Full	(Full P/I)[4]	Partial	Full	Partial	Full	Partial	Full[5]	Partial	Full
A1.1	2	3	0	1	1	0	0	0	0	3	4
A1.2	2	5	0	1	1	0	0	0	0	3	6
A2.1	2	1	0	1	2	0	6	0	1(2)	3	10
A2.2	2	1	0	2	1	0	0	0	0	4	2
B1	*0*	*4*	*0*	*4*	*0*	*0*	*0*	*0*	*0*	*4*	*4*
B2.1	10	16	1	7	0	0	0	0	1(40)	17	18
B2.2	8	19	1	4	0	0	0	0	0	12	20
C1.1	2	9	0	1	1	0	2	0	0	3	12
C1.2	*8*	*11*	*0*	*1*	*2*	*0*	*2*	*0*	*0*	*9*	*15*
C1.3	1	8	0	1	4	0	2	0	0	2	14
C1.4	4	8	0	1	4	0	2	0	0	5	14
C1.5	9	23	0	1	2	0	2	0	0	10	27
C2.3	20	29	0	0	0	1	10	0	1(2)	21	40
C2.4	0	14	0	1	0	0	1	0	0	1	15
C3	17	16	0	1	0	2	14	0	3(6)	20	33
D1.1c	85	58	9	9	1	85	28	13	14(41)	192	110
D1.1d	47	40	4	15	1	30	16	11	2(7)	103	63
D1.1e	*77*	*41*	*3*	*7*	*4*	*58*	*30*	*14*	*6(16)*	*156*	*84*
D1.1f	73	35	3	6	3	46	32	14	4(9)	139	77
D1.3	56	37	5	10	3	52	9	2	8(26)	120	62
D3.3	72	98	10	12	2	66	65	8	16(49)	158	191
D3.4	53	88	10	13	3	47	32	3	10(39)	116	143
E1.1	*49*	*10*	*0*	*1*	*2*	*15*	*3*	*9*	*1(5)*	*74*	*16*
E1.2	53	6	0	0	0	8	0	2	1(5)	63	7
E2	61	3	0	0	0	1	2	0	0	62	5
E3	52	9	0	3	0	36	7	3	0	94	16
F1	83	50	0	2	0	0	3	1	0	86	53
F2.1	52	11	0	9	0	7	2	0	0	68	13
F2.2	48	17	0	7	0	7	2	0	0	62	19
F2.3	*42*	*12*	*0*	*0*	*0*	*5*	*2*	*0*	*0*	*47*	*14*
F3.1	78	23	0	7	1	8	2	1	0	94	26
F3.2	78	26	0	4	2	7	2	0	0	89	30
F3.3	78	22	0	6	0	2	2	0	0	86	24
F4	71	11	0	4	2	7	2	0	0	82	15
M1-A	0	9	0	0	1	0	0	0	0	0	10
M1-B	6	13	0	1	1	0	0	0	0	7	14
M1-C	0	6	0	0	0	0	0	0	0	0	6
M1-D	0	12	0	0	1	0	0	0	0	0	13
M1-E	0	17	0	1	1	0	0	0	0	1	18
M2	1	13	0	0	1	0	0	0	0	1	14
M3	0	9	0	1	3	0	1	0	0	1	13
Northgate to SeaTac											
High	267	228	11	38	17	131	96	24	22 (102)	429	348
Low	140	67	3	11	2	31	12	2	2 (7)	219	103
N.E. 45th to SeaTac											
High	265	223	11	36	15	131	90	24	21 (100)	425	338
Low	138	66	3	10	1	31	12	2	2 (7)	217	101
Pref[6]	*182*	*89*	*3*	*14*	*9*	*78*	*37*	*23*	*7(21)*	*297*	*145*
MOS A	14	28	0	6	3	0	2	0	0	20	33
MOS B	91	69	3	13	7	58	32	14	6(16)	176	117
MOS C	1	6	0	4	0	0	0	0	0	5	6

[1] The Commercial property category is the broadest including commercial, industrial, mixed-use (commercial/ residential), and private institutional properties. Acquired private institutional properties are set out in column "Full P/I." Partially acquired private/ institutional properties are recorded in column "Commercial/ Industrial, Partial."

[2] Public institutional properties are those owned by public entities including federal, state, and local governments, as reflected in "Taxpayer Name" records of the King County Department of Assessments, regardless of the specific underlying use (commercial, service, or residential).

[3] Table totals reflect total parcels that would be fully or partially acquired.

[4] Private institutional properties are those owned and used by religious, fraternal, or private non-profit entities, regardless of the specific underlying use (commercial, service, or residential).

[5] Figures in (parentheses) reflect the total number of housing units affected. For example, a fully acquired five-unit apartment would be recorded "1(5)."

[6] Preferred alternative totals include maintenance base site M1-B which is the worst case scenario in conjunction with C1.2.

Preferred alternatives appear in italics.

between University and 15^{th} Avenues N.E. Once station construction is complete, most of the property surface above could be available for development.

The Capitol Hill Station, serving the second highest ridership on the entire light rail line, has four design and location options (A, B, C, and D). Long-term, Option D would acquire the highest number of parcels, requiring acquisition of 13 properties. Option C would acquire six properties, less than half the number affected under Option D. Option A would acquire the fewest properties (five).

For each of the alternatives in Segment B, partial acquisitions occur around the University of Washington campus. For Alternative B1, full acquisitions and displacements would be clustered around proposed station entrances. With B2.1 and B2.2, full acquisitions and displacements would be scattered along the segment, with clusters at the Eastlake and Seattle Center stations.

Segment C (Westlake Station to McClellan Street)

Alternatives C2.3, C3, and C1.5 would have the highest number of full acquisitions (40, 33, and 27 properties, respectively). Alternatives C1.1, C1.2 (preferred alternative), C1.3, C1.4, and C2.4 would each acquire about half that number of properties (12 to 15). C2.3 would acquire the most commercial properties (29, including eight vacant properties) and C1.5 would acquire the next highest number of commercial properties (23, including one vacant property). C3 would acquire the highest number of single- and multi-family residential properties (14 single-family and 3 multi-family affecting 6 units of housing). C2.3 would acquire the next highest number of residential properties (10 single-family and 1 duplex).

Routes C1.1, C1.2 C1.3 and C1.4 would affect a Seattle Public Utilities operations center located along Airport Way South. Route C1.4 would impact fewer functions and buildings on the operations center than the other route alternatives.

For the Westlake Station under consideration in Segment C, station Option B differs slightly from Option A, which is described in Table 4.2-1. Station Option B would have no net effect in terms of the number of properties affected; however, it would require a partial acquisition of commercial property not affected by Option A. Conversely, Option A would require the partial acquisition of a commercial property not affected in Option B.

Clusters of full acquisitions would occur at proposed stations: on Fifth Avenue S., on Beacon Hill, and near S. McClellan Street with C1; at the Jackson Place Community, immediately south of S. Dearborn Street, along the 2300 block of 24^{th} Avenue S. and along the west side of Rainier Avenue S. with C2.3; and along the west side of Rainier Avenue S. and 24^{th} Avenue S. immediately south of S. McClellan Street with C2.4 and C3.

Segment D (McClellan to Boeing Access Road)

Alternative D1.1e (preferred alternative) would have 84 full acquisitions, including four community facilities; the Holly Park Medical/Dental Clinic, two Union Gospel Mission facilities, and the Filipino Community Center. The Filipino Community Center would be acquired under all alternatives except D3.4. Alternatives D3.3 and D3.4 would result in the highest number of full acquisitions in this segment (191 and 143) followed by D1.1c (110). D1.3 and D1.1d would result in the fewest acquisitions (62 and 63, respectively), about one-third as many as D3.3. D3.3 and D3.4 would acquire the most commercial property, (98, including 19 vacant properties and 88, including 17 vacant properties, respectively), as well as 10 private institutional properties each. The preferred alternative would acquire 41 commercial properties. Alternative D1.1e and D1.1f would acquire the lowest number of private/institutional properties (three). Private institutional properties include churches, community organizations, and fraternal, charitable, or other private, non-profit entities. For this analysis, private institutional properties represent a subcategory of properties that the King County Assessor records classify as "commercial." Only those private institutional properties that would be fully acquired have been separately identified from the commercial category. Each of the other alternatives would acquire between three and nine public/institutional properties.

The number of residential properties acquired would vary widely by alternative (9 to 65 single-family residences), as would the number of dwelling units in multi-residential properties (7 to 49 units). The preferred alternative would acquire 30 residential properties and displace 46 residential units. Again, D3.3 would acquire the most (65 single-family properties and 49 housing units in 16 multi-family properties) followed by D3.4 and D1.1f, (32 to 30 single-family properties). D1.1d and D1.3 would have the fewest residential acquisitions (16 to 9 single-family properties).

Under all D1 alternatives, full and partial acquisitions would occur along MLK Jr. Way S. With D1.3, full and partial acquisitions would occur along the at-grade track (especially station locations) in the southern half of the segment. With Alternatives D3.3 and D3.4, full acquisitions would occur primarily along the west side of Rainier Avenue S., but also at some station locations along MLK Jr. Way S.

Segment E (Tukwila)

In Segment E, Alternatives E1.1 and E3 would have the highest number of full acquisitions (16, including six vacant commercial parcels with E3 and four vacant commercial parcels with E1.1). E1.2 would have seven acquisitions including one vacant commercial parcel. E2 would acquire just five parcels, including these commercial properties. E1.1 would have the highest commercial full acquisitions (10 parcels, but with zero private/institutional displacements). Residential property acquisitions would be relatively low (zero single-family parcels in E1.2 to seven in E3). E1.1 and E1.2 would both displace five apartment units. Commercial displacements under Alternatives E1.1, and E2 would be primarily manufacturing, office, and retail uses. E3 commercial displacements would be primarily motel, warehousing, office, and retail.

For Alternative E1.1's full acquisitions would be clustered near the proposed Boeing Access Road station and scattered along the rest of the segment. With E2, a small cluster of full acquisitions would occur in the 6400 block of S. 143rd Street and 143rd Place. With E3 a cluster of full acquisitions would occur near the 13000 block of Beacon Coal Mine Road S. Some full acquisitions associated with the Segment F alternatives occur in the City of Tukwila, north of approximately S. 160th Street.

Segment F (SeaTac)

In Segment F, F2.3 would affect the second fewest properties fully acquiring a total of 14, including 12 commercial properties, and 2 single-family residences. Alternative F1 would affect the most properties, fully acquiring a total of 53 properties, including 50 commercial (highest in the segment) and 3 single-family residential (also highest). These commercial acquisitions include six vacant parcels. None of the alternatives would fully acquire private institutional properties or multi-family housing. Alternatives F4 and F3.2 would each fully acquire two public properties, and F3.1 would displace one public property. F2.3 would not displace any public property.

Within Alternatives F2.3, F3.3, and F4 optional station configurations would cause slightly different effects than shown in Table 4.2-4. In addition, Alternatives F1, F2.1, F2.2, F3.1, and F3.2 each have associated sub-alternatives based on connections to routes on either SR99 or SR 518. The figure in Table 4.2-1 is based on connections to SR99 (Alternatives E.1, or E.1).

For Alternative F1, Table 4.2-1 reports the effects of Alternatives F1a and F1b. F1c (connecting to E2 or E3) would require acquisition of four additional commercial properties, one additional single-family residence, and partial acquisition of 14 additional commercial properties.

For F2.1, Table 4.2-1 reports the effects of F2.1a. F2.1b (connecting E2 or E3) would require three fewer full acquisitions and 13 fewer partial acquisitions (all commercial properties).

For F2.2, Table 4.2-1 reports the effects of F2.2a. F2.2b (connecting E2 or E3) would require one less full acquisitions and 10 fewer partial acquisitions (all commercial properties).

In F2.3, Table 4.2-1 reports effects of Option B for the Northern Station, Option C for the North Central station, and Option F for the station. Using Option F for the station would require four less full acquisitions of commercial properties and one less full acquisition of a single-family residence.

Using Option G for the station would require five fewer full acquisitions of commercial properties and one less single-family residence. Using Option E for the south Station would require an additional acquisition of a commercial property but two fewer partial acquisitions of commercial parcels.

For F3.1, Table 4.2-1 reports the effects under F3.1A. F3.1B would require one less acquisition of a commercial property, one less single-family residence, and 20 fewer partial acquisitions of commercial properties.

For F3.2, Table 4.2-1 reports the effects under F3.2A. F3.2B would require one less acquisition of a commercial property, one less single-family residence, and 23 fewer partial acquisitions of commercial properties and one less partial acquisition of a public property.

In F3.3, Table 4.2-1 reports the effects under Option F for the South station. Using Option E for the south station would require additional acquisitions of a commercial property but two fewer partial acquisitions of commercial parcels.

In F4 Table 4.2-1 reports the effects of Option C for the South station. Using Option D for the South station would require two additional acquisitions of single-family residences, one additional commercial property, and one additional partial acquisitions of a commercial parcel.

In Segment F, most commercial displacements would be motel/hotel, service, office, and retail space. No churches or other private institutional properties would be affected under any of the alternatives. Acquisitions would be dispersed at various locations along each route.

Maintenance Base Sites

Site M1-A would acquire ten properties, including nine commercial properties and a public property owned by the City of Seattle. The City of Seattle currently owns and is planning to use the affected public property for public safety support functions for the Seattle Police Department.

Site M1-B would acquire 14 properties, including 13 commercial properties and one public property owned by the City of Seattle. As mentioned above, the City of Seattle currently owns and is planning to use the affected public property for public safety support functions for the Seattle Police Department.

Site M1-C would acquire six properties, the fewest of all of the alternatives. The acquired properties would consist entirely of commercial uses that would have to be relocated.

Site M1-D would acquire 13 properties including 12 commercial parcels and one public property (City of Seattle).

Site M1-E would acquire the highest number of properties, 18, including 17 commercial properties and one public parcel (City of Seattle). Among the commercial properties, there are four parcels presently in use as railroad right of way. A public parcel owned by Seattle Public Utilities, Water Department, would be partially acquired.

Maintenance Base Sites M2 and M3 would affect 15 and 14 properties, respectively. M2 would fully acquire 13 properties (including one public use) and M3 would fully acquire 13 properties (three public).

Site M2 would acquire 13 commercial properties (including approximately 814,200 gross ft^2 of warehouse, manufacturing, and motor vehicle service space).

Site M3 would acquire nine commercial parcels (including approximately 140,500 gross ft^2 of warehouse, other storage, and office space), one residence, and three public parcels, including a five-building office and warehouse complex owned by the City of Seattle. This alternative would displace property operated by the Seattle Police Athletic League for firearms training and other uses. The shooting range is a particularly unique use, important to multiple jurisdictions, for which a relocation site could be difficult to secure. This alternative would also displace a bingo hall.

4.2.2 System-Wide Acquisitions and Displacements

The preferred alternative would acquire 145 properties. Full acquisitions would range from 103 to 348 for the Northgate to SeaTac alternatives and 101 to 338 for the N.E. 45th Street to SeaTac alternative. Each system-wide total includes the maintenance base site that would cause the greatest number of displacements and could be accessed by the respective system. MOSs B and C would have few displacements compared to MOS A.

4.2.3 Mitigation

Sound Transit will contact all property owners whose property would be directly affected to answer questions and provide additional information about relocation assistance services, payments, and reimbursement eligibility. Sound Transit's relocation assistance advisory services would include, but not be limited to, measures, facilities, or services that may be necessary or appropriate to determine the relocation needs and preferences of each household, business, and nonprofit organization to be displaced. Sound Transit would provide current information on the availability, purchase prices, and rental costs of comparable replacement dwellings.

Sound Transit is committed to working closely and proactively with families and businesses to help them plan ahead for relocation, assist them to find new homes or sites, and help solve problems as they may occur. Sound Transit has also developed a Small Business Assistance Program that offers additional means of helping businesses that are affected by the light rail project. Interpreters will be used to assist those who do not feel comfortable speaking English to ensure understanding of their choices and options. The City of Seattle and Seattle Housing Authority have committed to work with Sound Transit to help investigate a variety of housing and business choices and opportunities. While the ultimate choice of relocation site will be up to the affected family or business, Sound Transit will help with detailed investigation of possible locations. Every attempt will be made to assist those who wish to remain in their neighborhood in finding a new location close to their current site.

Owners are not required to surrender possession of property until they have been paid the agreed purchase price or an amount equal to Sound Transit's established estimate of just compensation has been deposited with the court. Owners and tenants will not be required to move their businesses without first being given at least 90 days written notice by Sound Transit.

Regarding needed improvements, it is generally recommended that property owners proceed with planned improvements to their properties or facilities as they deem necessary.

Sound Transit will compensate affected property owners according to the provisions specified in Sound Transit's adopted Real Estate Property Acquisition and Relocation Policy, Procedures, and Guidelines. These provisions are largely based on the federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 and Uniform Relocation Act Amendments of 1987 and on the State of Washington's relocation and property acquisition regulations (468-100 WAC). These benefits vary depending on the level of impact, available options, and other factors.

Property owners whose entire or partial property would be acquired by Sound Transit will receive just compensation for their land and improvements. Just compensation is an amount paid to a property owner for property acquired for public purposes which is not less than the market value of the property acquired, including damages or benefits to the remaining property. Compensation would include any measurable loss in value to the remaining property as a result of a partial acquisition.

Sound Transit would pay for all normal expenses of sale, including escrow fees, title insurance, pre-payment penalties, mortgage release fees, recording fees, and all typical costs incurred incident to conveying title. The sale, however would be exempt from real estate excise tax and no real estate commissions are involved. All funds remaining at the end of sale closing would be released to the seller.

Other benefits and compensation may include payment of residential moving expenses and replacement housing payments, nonresidential moving expenses, and reestablishment expenses.

Sound Transit's Business Acquisition and Relocation Handbook and Residential Acquisition and Relocation Handbook outline compensation and acquisition procedures in detail.

The application of regulations and statutes to individual cases will be by the spirit and intent of the law, not by the letter. Special circumstances will be recognized, and pro-active help to solve problems will be the standard required, not the exception. The timing and magnitude of purchase payments and relocation assistance payments will be adjusted to fit circumstances and fundamental concepts of fairness. Sound Transit believes the parameters required to protect the use of public funds are broad enough to allow creative solutions for real problems.

4.2.4 Significant Unavoidable Adverse Impacts

Property currently occupied by residences, businesses, and organizations would be fully or partially acquired. Relocation assistance would mitigate the displacements, but relocation could still represent an inconvenience or hardship.

4.3 NEIGHBORHOODS AND POPULATIONS

This section summarizes the characteristics of and impacts to potentially affected neighborhoods and minority and low-income populations.

4.3.1 Affected Environment

In passing through developed areas of Seattle, Tukwila, King County, Renton, and SeaTac, the light rail alternatives traverse or border more than 30 distinct residential neighborhoods. This section briefly describes each city and neighborhood along the routes. Figures 4.3-1 through 4.3-6 identify the neighborhoods located within the light rail study area; Table 4.3-1 shows demographics aggregated for each neighborhood at the census block or block group level (1990 U.S. Census data).

4.3.1.1 Seattle Neighborhoods (Segments A through D)

Seattle contains many communities or neighborhoods each identified by its unique character and focal points. The City of Seattle created the Neighborhood Planning Office (now closed) in January 1995 to help neighborhoods plan for their future. Each neighborhood completed a draft plan that has been or will be adopted by the City Council. Thirty-seven communities are currently taking part in this neighborhood planning process; elements of the plans are being implemented through the Department of Neighborhoods. The proposed light rail alternatives pass through or near approximately 20 of these neighborhoods. Where light rail stations are proposed, the City of Seattle's station area planning process continues the work from the neighborhood planning process. Each is discussed briefly below and in more detail in the Neighborhoods Technical Back-up Report.

Segment A

The **Northgate** neighborhood is a busy mix of commercial and residential uses centered around shopping areas, including the Northgate Mall. Significant landmarks and institutions include North Seattle Community College, Northwest and THC hospitals, Evergreen Washelli and Pacific Lutheran cemeteries, and Haller Lake. **Roosevelt** is a residential and commercial neighborhood developed mainly in the 1920s, primarily with single-family homes and neighborhood businesses. Notable landmarks include Roosevelt High School, built in 1922, and Ravenna Boulevard; to the west across I-5 is Green Lake Park.

Segment B

The **University District** is an intensive commercial and high-density residential area centered around the University of Washington campus. Its population and demographics are dynamic, due to the large portion of student residents. Landmarks include the Meany Tower Hotel, Safeco Insurance building, University Heights Community Center, UW Medical Center, and Husky Stadium. **Capitol Hill** is the highest-density residential area in Seattle, with intense commercial development along

Broadway, the community's main north-south thoroughfare. The neighborhood shares stately mansions and apartment blocks with vibrant nightlife and a predominance of younger residents. Landmarks and institutions on Capitol Hill include Seattle Central Community College, Cornish College, Volunteer Park, Lincoln Reservoir/Bobby Morris Playfield, Seattle Asian Art Museum, and numerous historic buildings. The **Pike/Pine** neighborhood, located immediately south of Capitol Hill, is undergoing dynamic redevelopments with commercial and retail uses and apartments. Notable landmarks include the Egyptian Theater, Northwest School, and First Covenant Church. **First Hill** is a major employment center with dense residential areas and a high concentration of elderly residents. Swedish Hospital, Virginia Mason, and Harborview medical centers are situated on First Hill. Seattle University, O'Dea High School, Frye Art Museum, and numerous churches (including St. James Cathedral and First Baptist Church) are also located here. **Eastlake,** one of Seattle's oldest neighborhoods, has mixed residential areas, commercial development, and water-dependent industries. The Pacific Marine Center, Fairview-Olmsted Park, houseboat communities, and Seward School are notable neighborhood features. **South Lake Union** mixes commercial, industrial, and water-dependent uses with a small amount of residential development, primarily in the Cascade neighborhood. Notable features include the Center for Wooden Boats, Naval Reserve Armory, The Seattle Times, and the Fred Hutchinson Cancer Research Center. **Seattle Center** is a mixed-use and commercial area with substantial employment and a venue for regional entertainment and sporting events. The Space Needle, Pacific Science Center, Opera House, Key Arena, and several theaters are located in the Seattle Center neighborhood.

Two Segment B neighborhoods are located in downtown Seattle. The **Denny Triangle** is primarily a commercial area with some apartment buildings. The Denny Triangle is currently undergoing significant commercial and residential redevelopment. The Paramount and King Cat theaters, Greyhound bus terminal, Medical/Dental and Marsh & McLennan buildings, Antioch University, Gethsemane Lutheran Church, and the new Nordstrom headquarters (under construction) are located in this neighborhood. The **Denny Regrade** is a mixed-use residential and commercial neighborhood with high-density housing, artists' studios, cafes, and music clubs. Features include the Moore Theater, Seattle and World Trade centers, Westin Hotel, and Port of Seattle headquarters.

Segment C

The **Commercial Core** is Seattle's financial, governmental, and retail center, with over 100,000 employees. The Pike Place Market, Seattle Art Museum, Seattle Public Library, city and county administration buildings, Washington State Convention and Trade Center, theaters, and churches are features of the Commercial Core. **Pioneer Square**, a historic commercial and residential district south of downtown, is a focal point for tourism. Notable features include Occidental Square, the Smith Tower, Pioneer Square Park, King Street and Union stations, and the Kingdome. The **International District** is a commercial and residential area centered around Seattle's Asian communities. Landmarks and institutions include Northwest Asian Theater, Wing Luke Museum, International Children's Park, Seattle Indian Center, and Uwajimaya Market. The **23rd and Jackson** neighborhood, also known as the Central Area, is a residential/commercial area and a hub of African-American communities and culture. Landmarks in the area include Garfield High School and Community Center, Pratt Fine Arts Center, and the Langston Hughes Cultural Arts Center. **Beacon Hill** is a diverse residential community with a large Asian-American population. Landmarks include Pacific Medical Center, Jefferson Golf Course and Community Center, El Centro de la Raza, Dr. Jose Rizal Park, and Beacon Hill Playground. The **North Rainier** neighborhood is a culturally and economically diverse residential and small-business area. Community resources include Muir Elementary and Franklin High School and numerous recreational facilities, including the Seattle Tennis Center, Colman Playground, and Dr. Martin Luther King Jr. Park.

Segment D

Columbia City is an ethnically diverse residential and commercial community with a recently revitalized historic business district. Landmarks and institutions include the historic Columbia branch library, Rainier Community Center, Rainier Playfield, and several schools. The Rainier Vista Garden Community public housing project, currently planned for redevelopment, is in this area. **MLK Jr. Way S. at S. Holly Street** is a residential neighborhood characterized by ethnic diversity and a high proportion of poverty-level households. The Holly Park Garden Community public housing project, Van Asselt community center, Filipino Community Center, and several schools, parks, and playfields are located here. A complete redevelopment of the 100-plus acre site of Holly Park is under way, with a 1,200-unit mixed-use community scheduled for completion by 2006. The **Rainier Beach** neighborhood is a multicultural, single-family residential area with many long-time residents. Landmarks include the Rainier Beach Community Center, Rainier Beach Playfield, Beer Sheva Park, Rainier Beach branch library, and several schools.

Segment E

Tukwila's neighborhoods in large part reflect the history of the city's development. Between 1987 and 1990, five major annexations took place, increasing the population from 4,780 to 14,800 and the geographic area from 2,880 to 4,143 acres. Five of the six neighborhoods in the light rail study area—Foster, Thorndyke, Riverton, McMicken, and Cascade Heights—joined the city during this time. Tukwila's Comprehensive Plan notes the following: "Tukwila's residential neighborhoods are a mix of dense, small-town residential areas and newer suburban areas. These residential neighborhoods are distinct geographic areas within an urban setting that is becoming increasingly crowded, with all the challenges of urban living."

According to letters from the City Department of Community Development, the population of Tukwila has changed in recent years, primarily as a result of immigration by a number of different ethnic groups (including African, Eastern European, and Asian) into the neighborhoods along Tukwila International Boulevard. Statistics compiled by the Tukwila School District also show that a high percentage of students throughout their district are minority. But since the school data are aggregated at a very large geographic area, they cannot show racial composition of students who live in the project area. Data from the 1990 census presented in Table 4.3-1 thus may not fully reflect Tukwila's current ethnic and income composition.

Although the city does not have a formal neighborhood planning process, the Comprehensive Plan identifies nine residential neighborhoods. Those most directly affected by the Central Link alternatives are discussed briefly below.

The **Riverton** neighborhood is a long-settled residential area developed around an early 1890s Interurban Railroad station. Landmarks and institutions include the Beth Ha Shofar synagogue, Primera Iglesia Bautista, and Delta Masonic Lodge, all of which are historic buildings. **Foster,** a residential and commercial area, extends from the Duwamish River to Tukwila International Boulevard Foster High School, Showalter Middle School, Foster Library, and Foster-Tukwila Presbyterian and St. Thomas Catholic churches are all located in Foster. **Cascade View,** a residential and commercial neighborhood developed in the 1940s, has business activity centered on Tukwila International Boulevard Notable institutions include Highline Community Hospital, Cascade View Elementary School, several churches, and the Riverton Crest Cemetery. **Thorndyke,** a residential neighborhood located north of SR 518, is similar in development history and character to Foster and Cascade View. The community is served by facilities located in Foster and by the Thorndyke Elementary School. The **Tukwila Hill** neighborhood is the historic residential center of Tukwila and former stop on the Interurban rail line. Landmarks and institutions include Tukwila Elementary School, historic Tukwila Library, a fire station, Tukwila Park, and nearby Fort Dent Park on the Duwamish River.

McMicken, a residential neighborhood located south of SR 518, is separated topographically from much of Tukwila by freeways, steep slopes, and ravines. Several parks, including the recently developed Crystal Spring Park, are located in McMicken. **Southcenter,** Tukwila's designated urban center, is dominated by the Southcenter Mall and other retail uses. The small residential population is planned to be increased in the future by mixed-use development that would include multi-family housing. Key residential amenities include Tukwila Pond, Minkler Pond, the Green River, and the regional bicycle/pedestrian path.

West Hill is a community in unincorporated King County south of Seattle, east of Tukwila, and north of Renton. An area of growing ethnic diversity, developed in the 1950s to 1970s, it is proposed for annexation to Renton. Community facilities include Skyway Park, West Hill Community Center, four elementary schools and one high school.

Segment F

SeaTac's Comprehensive Plan identifies several distinct neighborhoods, situated north or east of Sea-Tac Airport, most developed since the 1940s and densely populated. They tend to be defined by geographic features (such as the bluff at the eastern edge of the city) and by major arterial streets. Neighborhoods potentially affected by the light rail project are discussed briefly below.

Riverton Heights is a residential neighborhood developed in the 1940s with a commercial area located along International Boulevard Landmarks and institutions include North SeaTac Park and Community Center, Riverton Heights Elementary School, and a Central Washington University branch campus. The **McMicken Heights** residential neighborhood, developed mainly since the 1960s, includes McMicken Heights Elementary School, McMicken Heights Park, and a Safeway at S. 164th Street and Military Road, McMicken's only grocery store. The **Bow Lake** neighborhood is largely residential, but has a higher proportion of multi-family development than McMicken Heights, including a 400-home mobile home park. Community facilities include Valley View and Bow Lake Elementary, Chinook Middle, and Tyee High schools; City Hall; Valley View Library; and Bow Lake and Valley Ridge parks. A largely single-family residential area, **Angle Lake** has developed since the 1960s, mainly along the Angle Lake waterfront, with commercial development along International Boulevard Angle Lake Park is the only major community facility. **Madrona** is a residential neighborhood with single-family development located north of S. 204th Street and more multifamily and mobile home parks south of S. 204th Street. Madrona Elementary School and a SeaTac fire station are located in this neighborhood. **Homestead Park** is a residential neighborhood of single-family and mobile homes located adjacent to Sea-Tac Airport. This area is adjacent to the airport noise buyout area and is designated for future airport-related development in SeaTac's Comprehensive Plan. Des Moines Creek is located to the west of this community.

4.3.1.2 Neighborhood Demographics

This section summarizes the demographics of neighborhood populations along the light rail route alternatives. Table 4.3-1 provides a breakdown of each identified neighborhood population (from 1990 Census data). For each neighborhood, the route and station alternatives that would serve it are also identified.

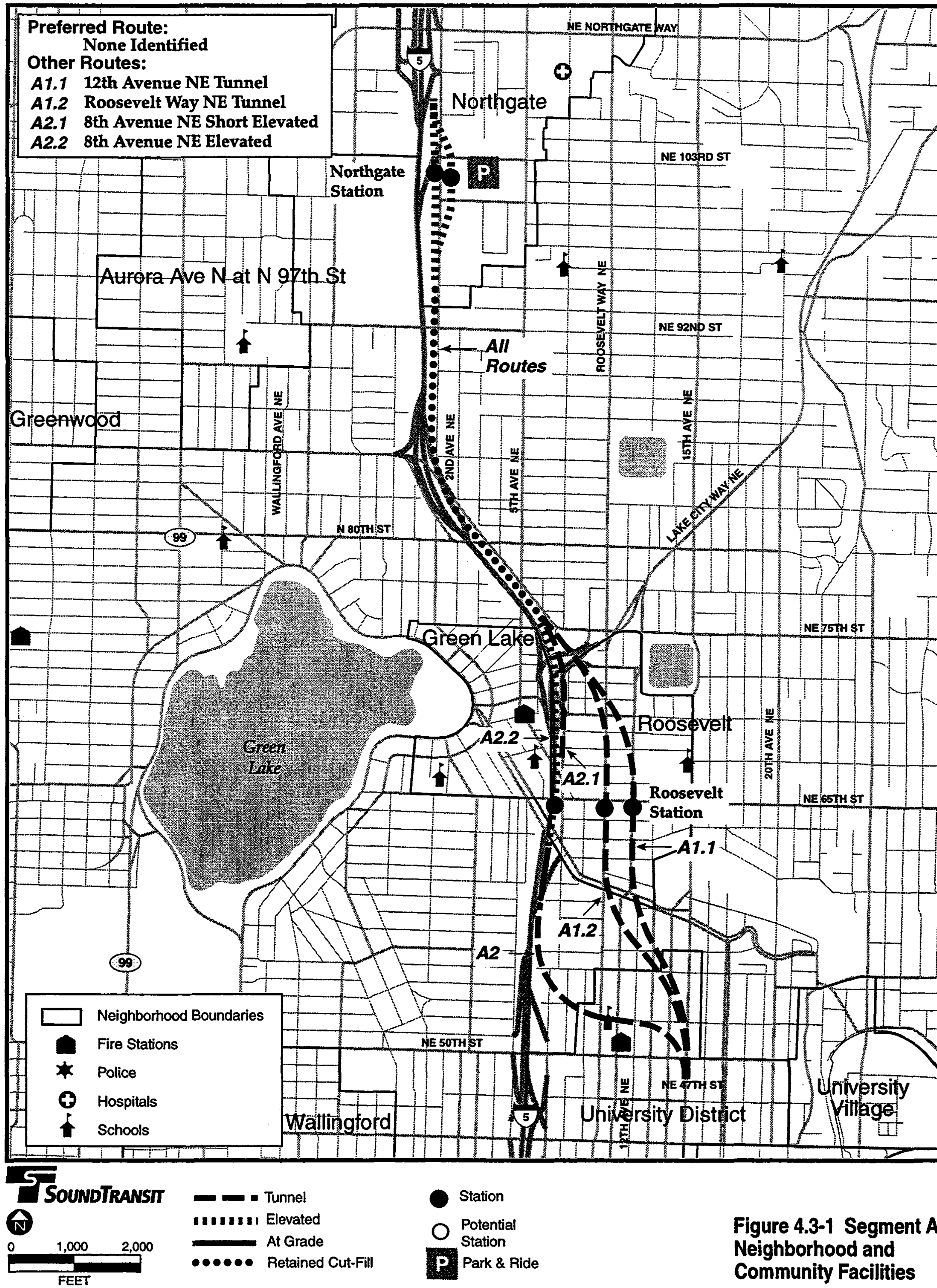
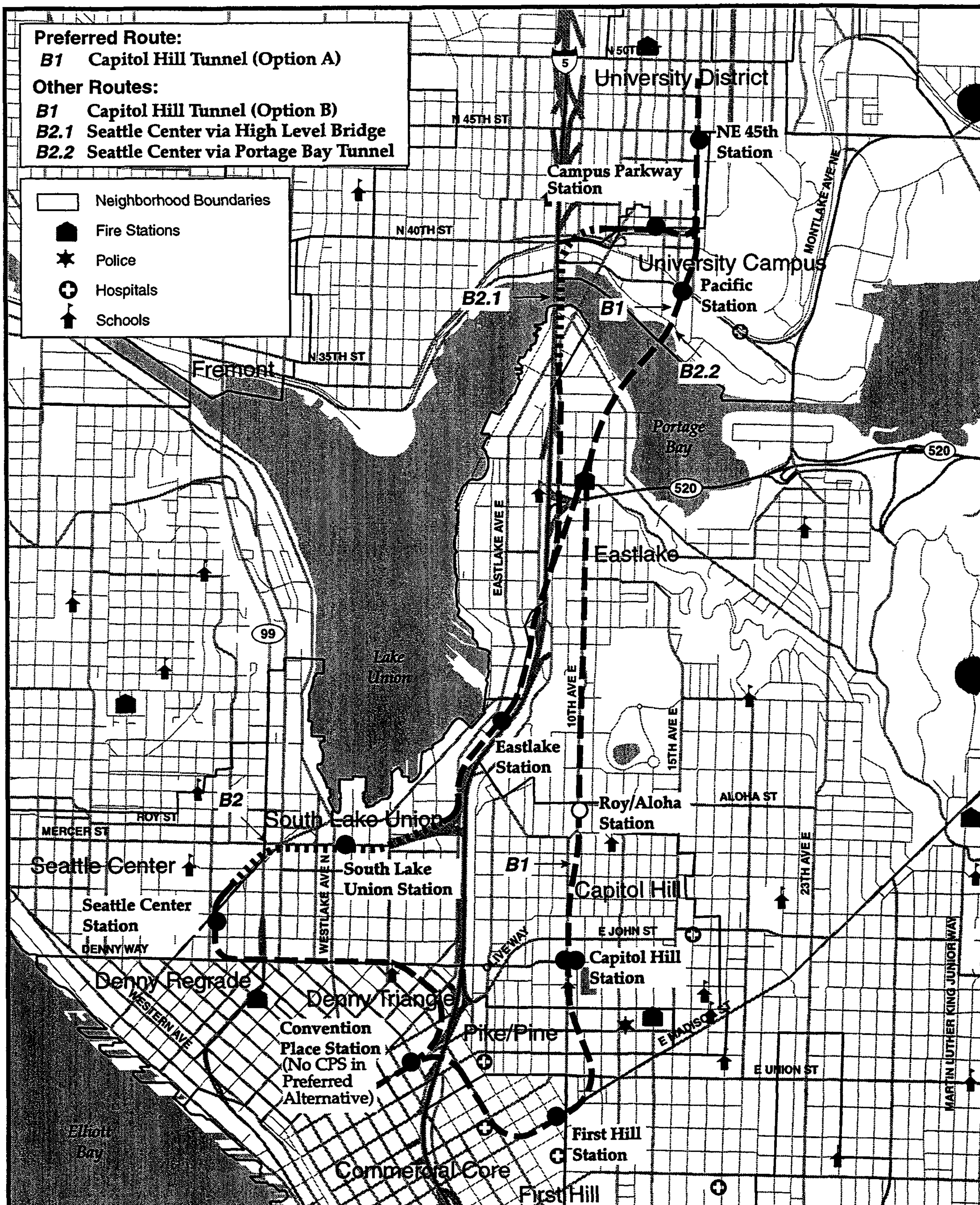


Figure 4.3-1 Segment A: Neighborhood and Community Facilities



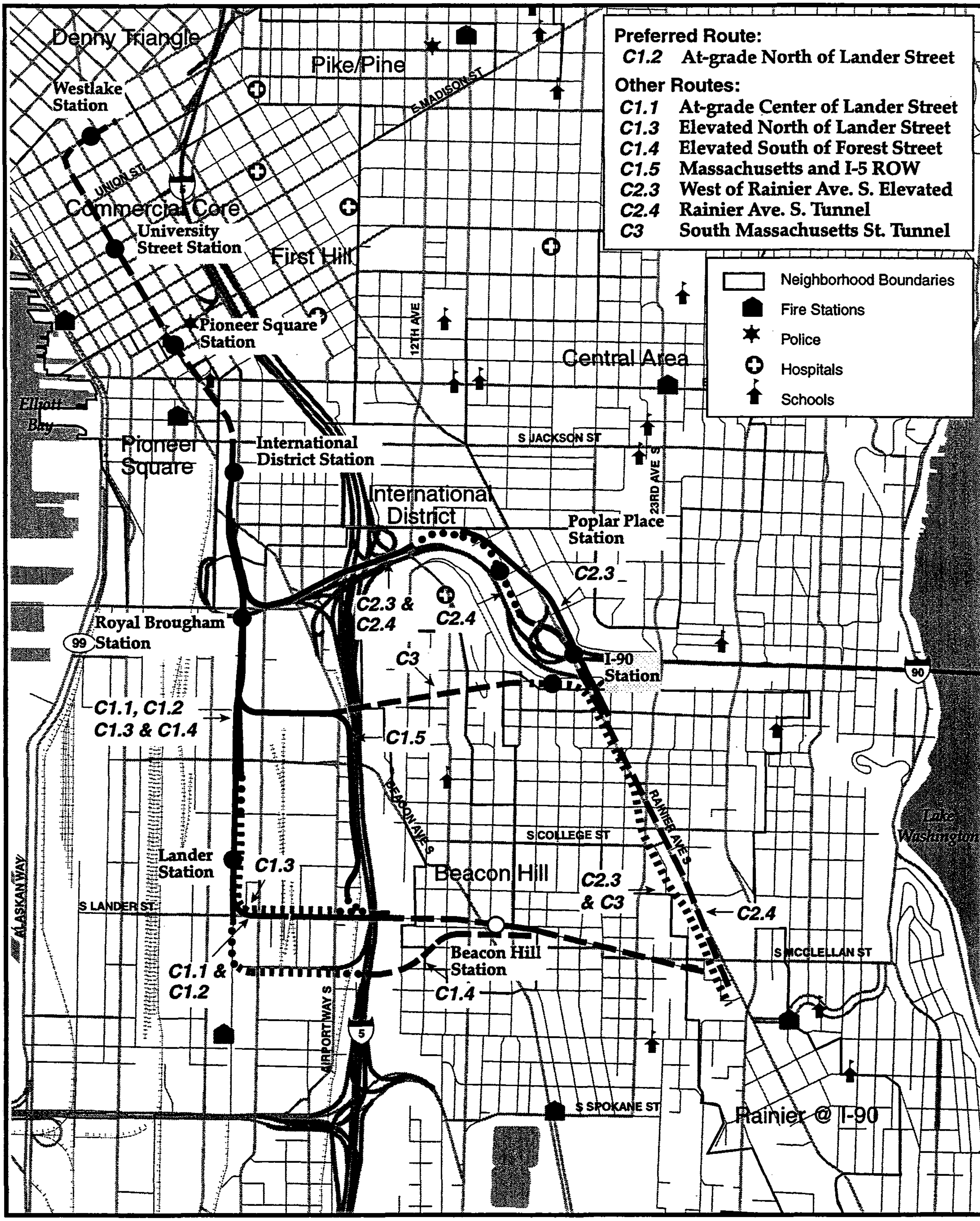
SOUND TRANSIT

0 1,000 2,000 FEET

Tunnel
Elevated
At Grade
Retained Cut-Fill

Station
Potential Station
Park & Ride

Figure 4.3-2 Segment B: Neighborhood and Community Facilities



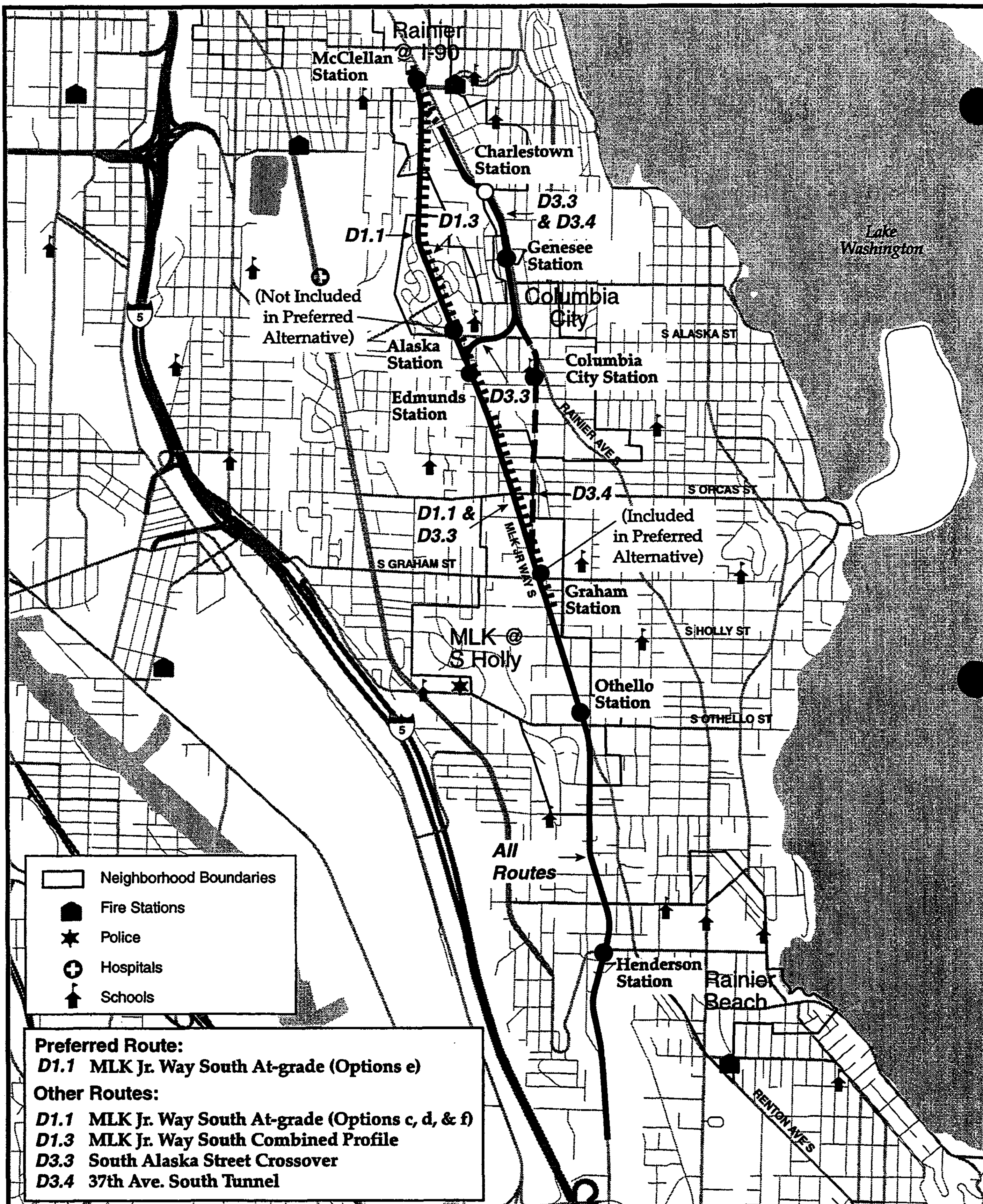
SOUNDTRANSIT

Tunnel
Elevated
At Grade
Retained Cut-Fill
Station
Potential Station

N

0 1,000 2,000
FEET

Figure 4.3-3 Segment C: Neighborhood and Community Facilities



SOUNDTRANSIT

0 1,500 3,000
FEET

Tunnel
Elevated
At Grade
Retained Cut-Fill

Station
Potential Station

Figure 4.3-4 Segment D: Neighborhood and Community Facilities

4.3.2 Impacts

The potential impacts of the light rail project on neighborhoods and populations have been evaluated following the guidance provided by the FTA. Potential impacts include the following:

- *Changes in neighborhood quality* – a subjective assessment based on the cumulative effect of residential or business displacements, and changes in traffic, parking, noise, vibration, visual character, and accessibility benefits.
- *Social interaction* – a discussion of how the proposed Link light rail corridor may affect circulation through an existing neighborhood or how people travel to and from community resources such as schools and other public facilities.
- *Safety and security* – an evaluation of potential changes that may arise from rail operations or facilities.
- *Environmental Justice* – a discussion, in accordance with Executive Order 12898, on whether the project is likely to cause disproportionately high and adverse impacts on low-income and minority populations, and the distribution of benefits to these populations.

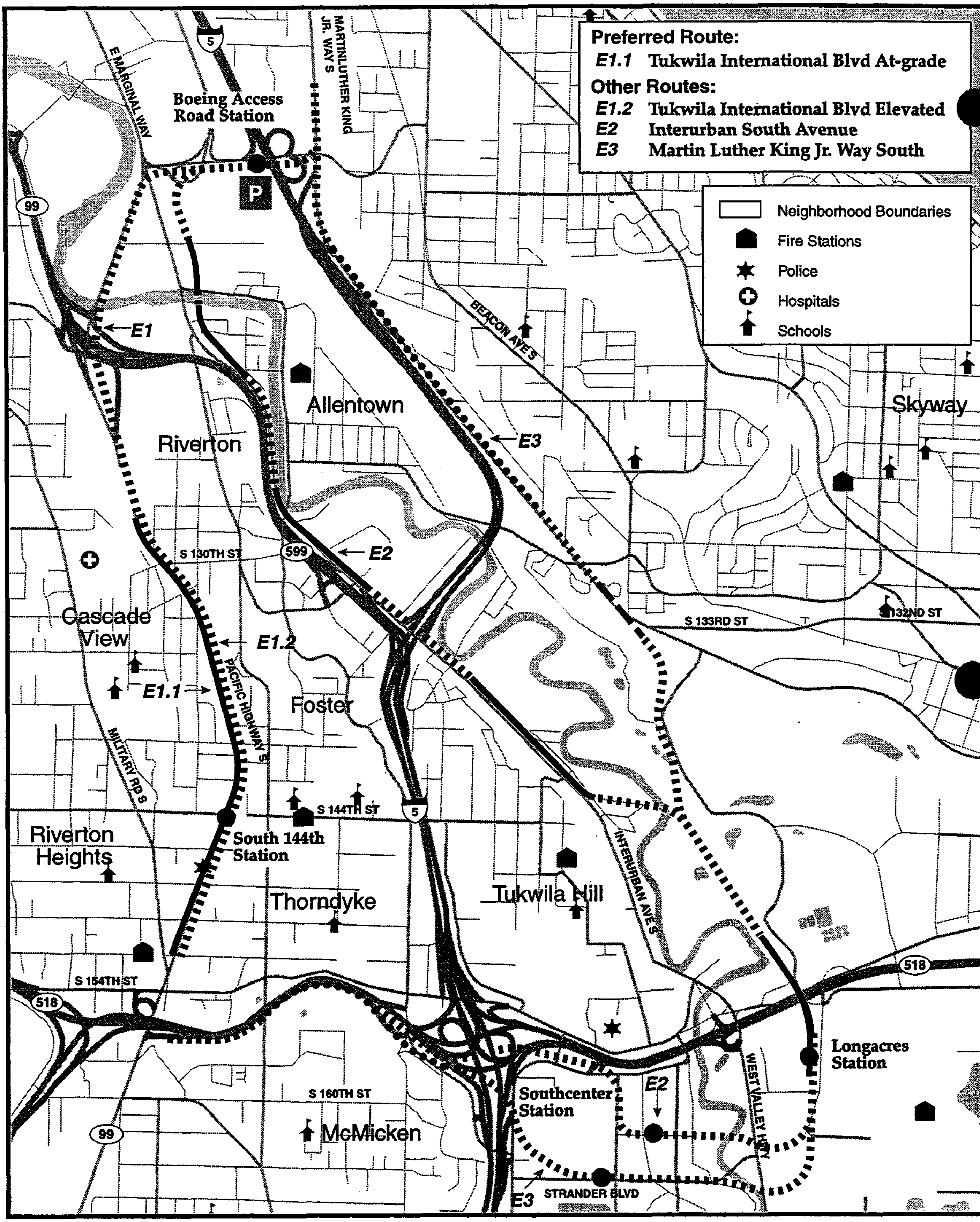
Much of the basis for the evaluation of impacts in this section comes from analyses done for other sections of this Final EIS (particularly Displacements and Relocation, Transportation, Noise and Vibration, Visual and Aesthetic, and Public Services). The intent of the Neighborhoods section is to synthesize the results of those analyses to provide a qualitative assessment of the changes that the operation of the light rail system could cause in neighborhood character and activity.

4.3.2.1 Changes In Neighborhood Quality

A new transportation mode operating on a fixed rail system has the potential for neighborhood quality effects. Although the initial impacts of the project's construction would be adverse in some neighborhoods, all neighborhoods served by light rail stations would benefit both from increased transit access and from potential development within station areas in a manner consistent with neighborhood goals and plans. To the extent that displaced residences and businesses could successfully relocate in their communities, neighborhoods (particularly those portions near station areas) may experience increased vitality in terms of improved access, residential infill, growth in employment base, and greater patronage of local businesses. Goals for regional, local, and station-area planning in all communities emphasize reducing reliance on automobiles and providing increased pedestrian access and pedestrian-oriented design, which the project would strongly support. Transit access would be of particular benefit to transit-dependent youth, elderly, and low-income populations, whose travel time to regional destinations may be shortened as a result of the new rail system.

Neighborhood quality impacts are difficult to assess quantitatively. Guidance from the FTA suggests that this analysis should be a "qualitative discussion of [the] cumulative impact of" the following four factors: property acquisitions and land use changes (including consistency of new development with existing neighborhoods); traffic and parking; noise and vibration; and the visual or physical intrusion of the new facility. Impacts are based on the following:

- Number and type of property acquisitions (Section 4.2), and the effects of their loss on the neighborhood as a whole
- Inconvenience that residents and neighborhood merchants may experience from increased traffic congestion and parking demand (Section 3.2)
- Level of noise impacts on residences (Section 4.6)
- Change in the neighborhood's visual identity (Section 4.4) that may result from the presence of the new rail line, and
- Average transit travel time savings (2020 P.M. peak hour trips to the station area) relative to No-build.

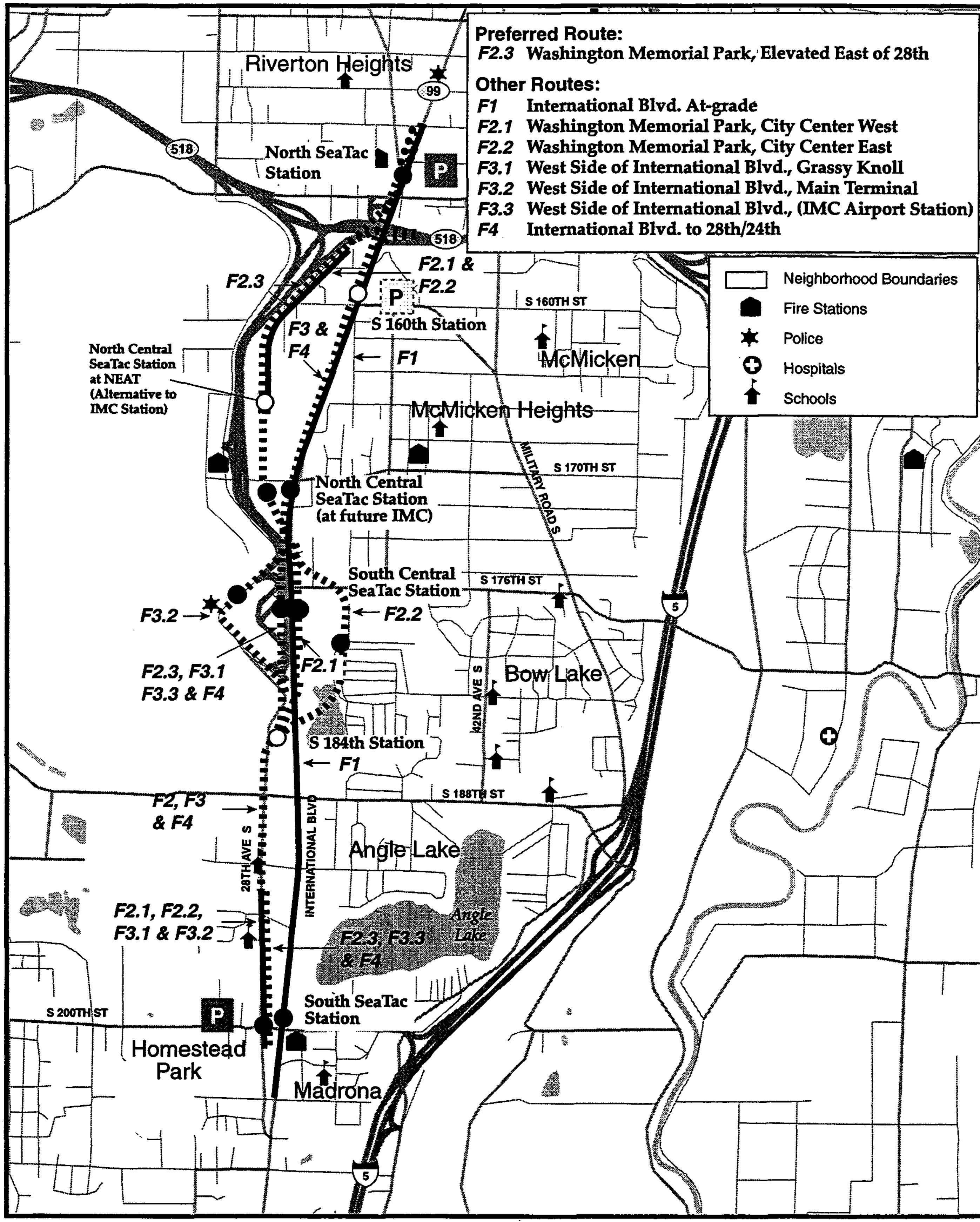


SOUND TRANSIT

Tunnel
Elevated
At Grade
Retained Cut-Fill
Station
Potential Station
Park and Ride

0 1,250 2,500
FEET

Figure 4.3-5 Segment E: Neighborhood and Community Facilities



SoundTransit

N

0 1,250 2,500 FEET

Tunnel
Elevated
At Grade
Retained Cut-Fill
Station
Potential Station
Optional Park and Ride Sites
Park and Ride

Figure 4.3-6 Segment F: Neighborhood and Community Facilities

Table 4.3-1
Summary of Neighborhood Demographics

Segment	Neighborhood	White %	Nonwhite %	Elderly %	Median Income	Below Poverty %	Own/ Rent	Route Alternatives	Link Stations
Segment A	Northgate	81	19	18	29,020	11	42/58	All A	Northgate
	Roosevelt	90	10	14	32,795	12	45/55	All A	Roosevelt
Segment B	University District	82	18	5	21,316	12	19/81	All B	NE 45th , Pacific, Campus Pkwy
	Capitol Hill	84	16	10	22,432	18	18/82	B1	Roy/Aloha, Capitol Hill, First Hill
	Pike/Pine	76	24	19	21,152	25	12/88	B1	Capitol Hill, First Hill
	First Hill	62	38	23	14,416	34	9/91	B1	First Hill
	Eastlake	92	8	8	32,636	7	31/69	B2	Eastlake
	South Lake Union	88	12	17	26,042	11	21/79	B2	South Lake Union
	Seattle Center	90	10	20	23,755	10	14/86	B2	Seattle Center
	Denny Triangle	82	18	38	18,326	22	7/93	All B	Convention Center, Westlake
	Denny Regrade	85	15	27	13,900	24	13/87	All B	Westlake
Segment C	Commercial Core	71	29	21	12,727	37	11/89	All C	Westlake, University, Pioneer Square
	Pioneer Square	64	36	7	10,541	58	2/98	All C	Pioneer Square, International District, Royal Brougham
	International District	39	61	17	11,547	44	12/88	All C	International District, Royal Brougham
	23rd & Jackson (Central Area)	25	75	16	20,919	26	39/61	C2.3 and C2.4	I-90, Poplar Place
	Beacon Hill	25	75	14	26,220	15	37/63	C1 and C2.4	Poplar Place, Beacon Hill
	Rainier Avenue at I-90 (North Rainier)	28	72	14	23,926	22	44/56	All C	McClellan
Segment D	Columbia City	27	73	13	23,998	22	51/49	All D	Charlestown, Genesee, Edmunds, Columbia City
	MLK Way S. at S. Holly Street	15	85	10	21,672	28	46/54	All D	Othello
	Rainier Beach	32	68	12	28,527	20	59/41	All D	Henderson, Boeing Access Road
Segment E	Riverton	87	13	10	29,947	4	41/59	E1 and E2	Boeing Access Road
	Foster	81	19	8	28,934	11	33/67	E1 and E2	North SeaTac
	Cascade View	82	18	9	28,069	12	38/62	E1 and E2	North SeaTac
	Thorndyke	81	19	7	29,272	10	30/70	E1 and E2	North SeaTac
	Tukwila Hill	82	18	9	31,706	8	38/62	E2	Longacres, Southcenter
	Southcenter	92	8	17	42,070	2	79/21	E2 and E3	Longacres, Southcenter
	West Hill (King Co.)	80	20	9	30,995	10	NA	E3	Boeing Access Road
	McMicken	87	13	10	36,102	6	56/44	E1	North SeaTac
Segment F	Riverton Heights	83	17	9	31,423	9	42/58	All F	North SeaTac
	McMicken Heights	87	13	11	33,287	7	56/44	All F	North SeaTac, North Central SeaTac
	Bow Lake	88	12	12	34,760	7	58/42	All F	North Central SeaTac, Central SeaTac
	Angle Lake	84	16	13	33,888	7	40/60	All F	Central SeaTac, South SeaTac
	Madrona	81	19	11	29,497	11	31/69	All F	Central SeaTac, South SeaTac
	Homestead Park	86	14	12	32,322	7	45/55	All F	South SeaTac

Source: 1990 U.S. Census Data. For purposes of this analysis, demographics were aggregated on the basis of neighborhood boundaries identified in official planning documents (for Seattle and King County) or informal boundaries identified by City planning officials (for Tukwila and SeaTac).

In neighborhoods where most or all of these factors will be substantially affected by the project, the change in neighborhood quality is considered significant. In general, the potential for negative neighborhood quality impacts is least for tunnel routes and greater for elevated and at-grade alignments. Tunnel profiles cause few long-term changes in neighborhoods except in portal and station areas. (An exception is the cut-and-cover tunnel design such as in Alternative D3.4, which involves considerable disruption of existing land uses). Elevated profiles generally have greater visual impacts and change neighborhood character more dramatically than at-grade profiles. For example, the elevated guideway, Lake City flyover, and associated overhead catenary system for Alternative A2.2 could interfere with scenic views from Rainbow Point Park. However, since less right-of-way is required, the result may be fewer property acquisitions.

Neighborhood quality benefits, over the long-term, may be higher for at-grade profiles compared to elevated and tunnel profiles. If designed as part of a comprehensive reconstruction of existing street right-of-way, light rail projects have had significant positive benefits in improving the general quality of life in neighborhoods through which they pass. Improved mobility and expanded access to areas of employment and services, as well as streetscape and other urban design improvements, are principal benefits of the light rail station. Positive neighborhood quality effects with tunnels tend to concentrate only around station locations.

Other potential changes to neighborhood character, besides changes due to construction and operation of the rail system, may result from secondary effects of the light rail project. For example, redevelopment near station areas could enhance economic activity by expanding neighborhood business districts sooner than would otherwise occur, creating economic benefits but also potentially generating more noise and traffic. Roadside property displacements necessary to allow for new or widened right-of-way could convert existing residential uses fronting the widened streets to commercial businesses. Property remainders left after acquisition of needed rights-of-way could be redeveloped with commercial uses or new homes, depending on land-use and zoning designations in the area and on other factors such as parcel size, ownership patterns, and the ability to aggregate parcels.

In Segment A, all the alternative routes would be located underground or along I-5, resulting in low impacts on neighborhood quality. Neighborhood quality impacts for the preferred alternative would be low or low/moderate in Segment B because light rail would be in tunnel except for stations, resulting in low impacts on property acquisitions, traffic/parking, noise and aesthetics. The preferred alternative in Segment C would also have low neighborhood quality impacts. Preferred route C1.2 would be located in the existing downtown transit tunnel and the E3 busway before crossing through the North Duwamish industrial area and entering a tunnel under Beacon Hill. The neighborhood quality impacts for route C3 on the North Rainier neighborhood would be moderate because of impacts it would cause where the tunnel would exit the east side of Beacon Hill (residential and commercial property acquisition, traffic/parking, and visual). In Segment D, routes have the potential for low/moderate to moderate impacts. Since the Draft EIS, additional mitigation has been added to the preferred alternative (D1.1e) and the design modified to reduce adverse impacts on neighborhoods. Mitigation measures keep these neighborhood impacts from reaching a significant level. These measures include sound mitigation, traffic revisions, and streetscape improvements, as well as benefits such as transit travel time savings. Where surplus properties could be redeveloped, neighborhoods may benefit from new uses and activity. Streetscape improvements along MLK Jr. Way S. and selected east/west corridors (for example, along S. Edmunds Street into the Columbia City business district and along S. Henderson Street into the Rainier Beach business district) would improve pedestrian facilities and amenities, enhancing pedestrian activity around neighborhood centers and aiding pedestrian safety. After changing the project design and adding mitigation measures the preferred alternative (D1.1e) would require the acquisition of 46 residential units, 41 commercial properties, and 3 public facilities in the Rainier Valley neighborhoods of North Rainier, Columbia

City, MLK at Holly St. and Rainier Beach. The project would have low noise impacts, low/moderate impacts on traffic/parking, and moderate impacts on aesthetics. The area would also benefit from high transit accessibility benefits.

For the other Segment D alternatives, displacements in the Rainier Valley neighborhoods could total up to 114 residential units and 98 commercial properties (D3.3), and one public facility in North Rainier (D3.3 and D3.4); up to 56 residential units (D3.3), 30 businesses (D3.3), and 2 public facilities in Columbia City (D3.3 and D3.4); and up to 28 residential units (D1.3), 34 businesses (D3.3), and six public facilities in MLK Jr. Way S. at S. Holly (D3.3 and D3.4). Rainier Beach would displace up to 17 residential units (D3.3 and D3.4), 9 businesses (D1.1c, D1.1d, and D3.3), and 3 public facilities (D1.1c, D1.3, D3.3, and D3.4).

The preferred alternative would displace four community facilities, all located in the MLK Jr. Way S. at Holly Street neighborhood. The Holly Park Medical/Dental Center at 7116 MLK Jr. Way S, two Union Gospel Mission facilities at 6940 MLK Jr. Way S., and the Filipino Community Center at 5748 MLK Jr. Way S. would all be displaced, and the occupants would be offered relocation assistance. These community facilities have served as focal points and gathering places for members of the Rainier Valley community, and their dislocation would be an impact on members of those communities. The Filipino Community Center in particular has historically played an important role in the community providing childcare, senior activities, recreational activities, a resource and learning center, a location for diplomacy (for visiting dignitaries and elected officials from the Philippines), and a meeting place for the diverse population of the Rainier Valley. Relocation to a site within the valley would be important in allowing these types of community activities and services to continue. The removal of community facilities can pose barriers to social interaction, if not relocated within the community.

Outside of Segment D, very few community facilities would be displaced, resulting in little impact to social interaction. No community facilities would be displaced by alternatives in Segments A, C, E, or F. In Segment B, the University Friends Meeting Hall would be displaced by Alternative B2.1. While Alternative D1.1f would displace the same community facilities as the preferred alternative, Alternatives D1.1c, D3.3, and D3.4 would displace substantially more. Each of those three alternatives would displace the Union Gospel Mission facilities, the Filipino Community Center, the Catherine Memorial AME Zion Church, the Paradise Baptist Church, the Veterans of Foreign Wars Seattle Post 6599, and the Elks Cascade Lodge #1416. As many as five churches could be displaced, depending on the alternative. These churches serve as focal points and gathering places for some members of the North Rainier, Columbia City, MLK Jr. Way S. at S. Holly Street, and Rainier Beach communities, and their relocation would be an impact on members of those communities.

If community businesses in this segment are successfully reestablished, the neighborhoods may benefit from increased visibility and patronage of these businesses. However, redevelopment also could result in "gentrification," with new businesses that do not serve the needs of local residents, and ultimately result in less affordable land, housing and services. Conversely, a lack of redevelopment after project construction could reduce neighborhood vitality. Sound Transit will work with displaced businesses under its relocation policies to help find suitable sites within the community and also to appropriately develop acquired property. There is also a potential for neighborhood quality benefits in Segment D as the result of streetscape improvements along Cheasty Boulevard, Edmunds, and Henderson streets, and the reconstruction of MLK Jr. Way S. Especially in narrower right-of-way alternatives such as D1.1d, e, and f, the reconstruction of MLK Jr. Way S. offers the potential to change the character of the street, making it more "pedestrian friendly." This will occur both at stations and along the line segment, where landscaping and other amenities will enhance the public right-of-way.

Modeling of the traffic impacts for this Final EIS (Section 3.2) generally did not show high impacts to levels of service at major intersections within neighborhoods and these can be mitigated where they do occur. The preferred alternative would mitigate all affected intersections to an acceptable level of service by using a variety of mitigation measures including right-turn lanes, revised lane configurations, signal timing adjustments, and pedestrian improvements to aid in suitable traffic flow. Other alternatives would also use similar mitigation strategies where necessary. Where congestion is increased, traffic may back up on neighborhood streets approaching the arterial where the rail line is located, or may use these streets to circumvent the arterial altogether. Design revisions and additions have been proposed that would mitigate these impacts. Loss of existing private parking along the route could result in business patrons parking in neighborhoods, and hide-and-ride parking could occur from commuters in station areas. However, these impacts are likely to be relatively low. Sound Transit would discourage hide-and-ride activity and work to find replacement parking for businesses where possible. Traffic impacts on neighborhoods are discussed further in Section 4.3.2.2.

Noise and visual impacts on neighborhoods would be lessened in areas where the route is underground or follows a major transportation corridor. The preferred alternative has a low level of potential impact for noise and a low to moderate visual impact in the neighborhoods it passes through. Neighborhoods along the preferred alternative where moderate aesthetic impacts are anticipated include North Rainier, Columbia City, MLK at Holly Street, and Rainier Beach. While other alternatives would also have low noise impacts, some neighborhoods would experience moderate/high visual impacts depending on the route. Streetscape and urban design improvements will occur at locations where the light rail system runs within a street right-of-way, around stations and station entrances, and along major pedestrian corridors on Edmunds and Henderson streets in Rainier Valley.

In Segment E, neighborhood quality impacts on Tukwila and King County neighborhoods would be low for the preferred alternative (E1.1) and low or low/moderate for all other alternatives (E1.2, E2 and E3). Very little property would have to be acquired with any of the Segment E alternatives, including the preferred alternative, which would displace a total of eight residences and acquire twelve commercial properties in the Riverton, Foster, Cascade View, and Thorndyke neighborhoods. Alternative E1.2 would displace five residences and acquire six commercial properties in the same neighborhoods. Alternative E2 would displace only two residences in Tukwila Hill, and Alternative E3 would displace seven residences and nine commercial properties in West Hill. Traffic/parking and aesthetics impacts by the preferred alternative (E1.1) would be low/moderate on the Riverton, Foster, Cascade View, and Thorndyke neighborhoods. Traffic/parking impacts would be the same for Alternative E1.2, but aesthetic impacts would be moderate due to the elevated route. The traffic/parking impacts of Alternatives E2 and E3 would be low or low/moderate except at Southcenter where they would be moderate. Aesthetic impacts for the E2 route would be moderate on Riverton and Tukwila Hill, and moderate on West Hill due to the E3 route. Noise impacts would be low in all Tukwila/King County neighborhoods for all alternatives. Accessibility benefits would be low/moderate for all neighborhoods under all Segment E alternatives except Riverton (which would be moderate under the preferred alternative-E1.1, E1.2 and E2), Cascade View (moderate for E1.1and E1.2), and Southcenter (E3).

In Segment F, neighborhood quality impacts would be low or low/moderate on all neighborhoods, with exceptions, by the preferred alternative (F2.3) and all other alternatives. Because the preferred alternative would be primarily located on airport property, displacements would be few, including one residence and seven commercial properties in the Thorndyke neighborhood; and two residences and three commercial properties in Homestead Park. Segment F alternatives would all require the acquisition of three or fewer residential properties (F1, F2.1 and F2.2 would each require three), and a range of 11 to 50 commercial properties. Commercial acquisitions would be highest in the McMicken Heights neighborhood, with 26 under F1, fifteen under F3.1, and seventeen under F3.2. Traffic/parking impacts by the preferred alternative (F2.3) and all other alternatives would be low or low/moderate in all SeaTac neighborhoods except Homestead Park where they would be moderate due to the impacts of the S. 200th Street terminus station and park-and-ride lot. Noise impacts would be low for the preferred alternative and all other alternatives. Aesthetics impacts by the preferred alternative on all neighborhoods would be low. They would also be low for all other Segment F alternatives, except McMicken Heights where they would be moderate/high under alternative F2.2, and moderate under alternatives F3.1 and F3.2. Of the SeaTac neighborhoods, McMicken Heights and Bow Lake would experience the most improved transit accessibility, from moderate under the preferred alternative to moderate/high under all other alternatives. The Angle Lake, Madrona, and Homestead Park neighborhoods would enjoy moderate accessibility benefits under all Segment F alternatives.

The preferred alternative would provide a varying degree of accessibility benefits to the neighborhoods served by the project. Seattle neighborhoods located away from the downtown core would generally experience moderate/high accessibility benefits (9 minutes saved) from the preferred alternative (2020 PM peak trips) to the station area. Tukwila and SeaTac neighborhoods would generally experience a moderate average transit travel time savings (4 to 8 minutes). The greatest time savings, approximately 18 minutes, would be experienced in the Beacon Hill/McClellan and Rainier Valley neighborhoods. It is important to note that all neighborhoods served by the light rail would experience an average transit travel time savings over the No-build Alternative. For the purposes of this analysis, neighborhood accessibility benefits have been evaluated relative to one another. Therefore, a neighborhood with "Low" accessibility benefits only has a low average time savings, relative to the other neighborhoods served by the project. The time saved is still a significant benefit compared to the No-build Alternative.

4.3.2.2 Barriers to Social Interaction

The introduction of a light rail line could both increase and decrease access through neighborhoods. Access to community services and businesses could be enhanced around stations, but may also be made slightly more difficult away from station areas where the light rail line is at-grade or elevated. There are several locations where access to community facilities and services may be more difficult after project construction. The preferred alternative would have access impacts on S. Lander street in Segment C, MLK Jr. Way S. in Segment D, and Tukwila International Boulevard in Segment E because of turning restrictions. Sound Transit would work with local jurisdictions to provide U-turn opportunities at signalized intersections.

Access issues are minimal for Segments A through C. In Segment D, Alternatives D1.1e (preferred alternative) and D1.1f would limit 34 unsignalized intersections on MLK Jr. Way S. to right-in/right-out access only. In other alternatives, residents of the North Rainier and Columbia City neighborhoods in Seattle would have some difficulty crossing Rainier Avenue S. if local access streets are closed (under D3.3 and D3.4).

Residents in the Duwamish section of Tukwila's Riverton neighborhood may have access to and from their homes impeded under Alternative E2, unless a signal is placed at one of the two access streets to this area, which is otherwise surrounded by the Duwamish River. Under Alternative E1.2, east-west vehicle and pedestrian crossings of Tukwila International Boulevard in Tukwila between the neighborhoods of Cascade View on the west and Riverton, Foster, and Thorndyke on the east may become somewhat more difficult. City planners indicate that many seniors and children cross the Tukwila International Boulevard arterial to access community services in Foster near S. 144th Street.

In Segment F, Alternative F1 along International Boulevard would have similar east/west access issues to those along Tukwila International Boulevard under Segment E. Access and circulation impacts for at-grade sections on International Boulevard (F1) and 28th Avenue S. (F2.1, F2.2, F3.1, and F3.2) would be caused by left-turn prohibitions to and from unsignalized driveways and streets. For elevated sections on 28th Avenue S. (F2.3, the preferred alternative, F2.1, F2.2, F3.1, and F3.2), left-turns to and from most side streets and driveways would be prohibited. However, most of the City's neighborhoods and services lie east of all potential routes, so there is limited existing social interaction across International Boulevard and 28th Avenue S. Under all alternatives, LOS during afternoon peak periods would be reduced to LOS E and F at the east-west approaches to intersections of International Boulevard and 160th and 188th streets. This could result in access delays for residents of the Thorndyke (Tukwila), Riverton Heights, McMicken Heights, Bow Lake, and Angle Lake neighborhoods, although these impacts can be mitigated.

Light rail routes could affect access and circulation for bicyclists and pedestrians by limiting the crossing points along the route. The preferred alternative would reduce the number of crosswalks in some segments where the route is at-grade. However, pedestrian and bicycle safety could be improved by encouraging the use of well-marked crosswalks at signalized intersections. The at-grade McClellan Station option could increase traffic on Cheasty Boulevard, which may affect bicycle travel. The project would improve sidewalks and streetscapes between MLK Jr. Way S. and just west of 27th Avenue. With the preferred alternative (D1.1e), Sound Transit would work with the City to provide a new north-south bicycle facility running parallel to MLK Jr. Way S. Alternative D1.1f could also provide additional space within the MLK Jr. Way S. roadway, which could potentially improve bicycle travel in the corridor. Station areas in Segments E and F lack adequate bicycle connection routes; however, bicycle facilities are proposed at all stations. Other alternatives also would force pedestrians to walk longer distances to crosswalks and would be lacking in bicycle connections.

To the extent that small community businesses such as shops, restaurants, and taverns function as places of social interaction, the displacement of a substantial number of those businesses under Segment D (especially D3.3 and D3.4) could also change the way some residents gather socially. These types of impacts could occur to a lesser extent in other segments where similar types of community businesses are displaced, such as in the Northgate and/or Roosevelt neighborhoods under the Segment A alternatives, Seattle Center under B2.1 and B2.2, portions of Tukwila International Boulevard under Alternatives E1.1 and E1.2, and the Thorndyke and McMicken neighborhoods under the Segment F alternatives.

Social interaction may also be improved over the long term by development of the Link project. The plans for many neighborhoods along the route, particularly in Segment D, call for enhanced economic opportunities in existing commercial corridors and nodes, and particularly in light rail station areas. Experience in other cities with fixed-guideway transit systems has shown under appropriate market and regulatory conditions, a fixed-guideway system can stimulate greater incentive for investment by property owners, especially in station areas. Transit-oriented development is typically pedestrian-friendly and concentrations of pedestrian-oriented businesses and services can increase social interaction within communities. Faster, more reliable, and more frequent transit service can also increase access to community facilities and employment opportunities, benefiting all neighborhoods along the route.

4.3.2.3 Safety and Security

Safety and security refer, respectively, to the potential for changes in accident exposure that could result from operation of the light rail line itself and the potential for criminal activity in areas near the routes, particularly station areas. Both issues are discussed in Section 4.13, Public Services, in terms of their potential impacts on emergency service providers. Transportation safety is also discussed in Chapter 3. Effects on neighborhoods are discussed below.

Safety

Light rail transit operating in-street creates the potential for accidents between light-rail vehicles and motorists, pedestrians, and bicyclists. On the other hand, increased transit use resulting from the light rail line, new signals, and the reconfiguration of the roadways may reduce other types of motor vehicle and pedestrian accidents. The potential for accidents between trains and other vehicles or pedestrians would be greatest along at-grade sections on MLK Jr. Way S. (all D alternatives, including the preferred alternative), Rainier Avenue S. at cross streets (D3.3 and D3.4), Tukwila International

Boulevard (E1.1 – preferred alternative), Interurban Avenue S. (E2), and International Boulevard (F1). Many of the safety problems associated with light rail systems result from a general lack of awareness and the failure of motorists and pedestrians to obey traffic control devices, including active rail crossing warnings. While some accidents involving vehicles, pedestrians, and light rail can be expected, design measures built into the light rail system facilities and the redesign of some roadway crossings, turning movements, and other traffic-control elements would reduce the potential for serious collisions.

Introducing at-grade light rail transit within a roadway creates a potential for a new accidents, but can also reduce mid-block and left-turn accidents. This would apply to alternative D1.1c, D1.1d, D1.1e (preferred alternative and D1.1f, Alternative E1.1 (preferred alternative) and Alternative F1. New accidents would primarily be caused by accidents between light rail vehicles and pedestrians and automobiles, and by rail/bus transfer activity at station areas that require bus stops and layover zones located across the street from the rail station. If the light rail trackway is located in the center of the roadway, several types of existing mid-block accidents may be reduced, including left-turn vehicle accidents, head-on collisions, and pedestrian crossing accidents.

Several aspects of the proposed light rail system operation would also help to reduce accidents. Allowing non-emergency vehicles to make left turns only at signalized intersections, as proposed, would reduce the risk of vehicle-light rail collisions and would also decrease the number of auto-auto collisions that would otherwise occur mid-block and at non-signalized intersections. Prohibition of midblock left turns included in the Link at-grade alternatives (including the preferred alternative) would help make affected streets safer by reducing collisions between motor vehicles and between pedestrians and motor vehicles. Midblock left-turn prohibitions would improve safety by separating opposing traffic and providing safe turn movements. In addition, pedestrians would be able to cross the roadway at more signalized intersections, or new mid-block pedestrian crossings, with signals and crosswalks. With the preferred alternative, compared to existing conditions, there would be fewer total pedestrian crossing locations, but more signal-protected pedestrian crossings on MLK Jr. Way S. and Tukwila International Boulevard.

Security

The FTA maintains crime data related to light rail operations. Most crimes appear to be thefts or auto thefts, especially near stations or parking areas (FTA 1998). Of the light rail systems reporting in 1995, 451 thefts, 128 auto thefts, 43 burglaries, and 6 arsons were reported. In Portland, Tri-Met reported 112 thefts and 48 auto thefts in 1995. Crime around the MAX stations has generally been minor, but car theft around parking areas has been a concern.

Operation of the light rail system could concentrate criminal activity in some areas, especially around parking facilities. Attempted car thefts, robberies, loitering and other crimes could be expected in these areas, particularly at night. Tukwila police have expressed particular concern about the proposed South Boeing Access Road station (E1.1 – preferred alternative and E1.2), noting that the station's isolated location, coupled with the proposed parking area at this location, could foster criminal activity. Other areas with existing high incidences of crime (based on data maintained by the Seattle Police Department) could be more prone to these types of crimes. These areas include Northgate, the University District, downtown Seattle, and some areas of the Rainier Valley neighborhoods (see also Section 4.13, Public Services).

There is a particular concern about safety and security in the deep tunnel stations in the University District, First Hill, and Beacon Hill. Increased policing or security in some areas, combined with careful planning and design of stations and parking facilities, would deter criminal activity and generally make light rail facilities safer and more secure. Sound Transit's Link Design Criteria include many principles and criteria designed to ensure safety and security throughout the light rail system. These criteria include specific design requirements for pedestrian safety, elevators and escalators, ancillary spaces, patron information centers, public telephones, call-for-aid stations, emergency management panels, electronic surveillance, lighting, materials, vandalism prevention, electrical requirements, public address systems, radio communications, alarms, and other measures. Increased policing or security, especially around stations and parking facilities, would substantially minimize criminal activity associated with the light rail system. Careful planning and design of stations and parking facilities, in association with local police departments, would also deter criminal activity. In addition, large concentrations of people and street-level activity around stations and other light rail facilities could actually decrease crime rates in some areas. The higher visibility of at-grade and elevated stations, in particular, would increase security compared to tunnel stations.

4.3.2.4 Environmental Justice

A comprehensive evaluation of the project's potential effects on minority and low-income populations is described in Appendix G - Environmental Justice, as required under Executive Order 12898 and the U.S. Department of Transportation's order on environmental justice (DOT Order 5610.2). Environmental justice in Department of Transportation decision making requires: (1) a fair process of developing and selecting the alternative to be funded that involves meaningful outreach to, participation of, and responsiveness to minority and low-income populations; and (2) non-discriminatory treatment of minority and low-income populations.

The environmental justice analysis describes the public process for the Link light rail project, and evaluates whether the project would have a disproportionately high and adverse effect on the minority and low-income populations of the Sound Transit District. Consistent with the DOT Order, offsetting benefits to the affected populations and mitigation and enhancement measures are considered. In response to concerns raised by some members of the Rainier Valley community, the environmental justice analysis compares the impacts and benefits of the preferred alternative with an alternative that would replace the at-grade alignment in the Rainier Valley with a tunnel the length of the Valley.

In evaluating the project's effects on the minority and low-income populations, Sound Transit conformed to Department of Transportation ("DOT") requirements and consulted with both the Federal Transit Administration ("FTA") and the Environmental Protection Agency ("EPA"). The primary conclusions reached are summarized below.

Public Outreach

To assure a fair process, Sound Transit engaged in public outreach from the initial project planning stages through the completion of this Final EIS. Sound Transit has used public input to identify Link light rail project alternatives, impacts, and benefits. As part of this public process, Sound Transit has also implemented meaningful outreach to minority and low-income communities to assure their active participation in the project's development. These efforts include the establishment of telephone hotlines in Chinese, Vietnamese, Spanish, and Amharic, and Tigrinya; translation of Sound Transit informational materials and distribution at numerous community events; Sound Transit presentations at community meetings; and the establishment of a Sound Transit field office in the Rainier Valley, an area with high numbers of minority and low-income residents. Southeast Seattle's participation in project development and the environmental review process demonstrates how minority and low-income populations have shaped the alternatives considered in the Final EIS and the elements of the preferred alternative.

Project Effects

Using the information presented in this Final EIS, Sound Transit has completed a comprehensive evaluation of the preferred alternative's impacts and their potential effects on the minority and low-income populations of the Sound Transit District.

A number of impacts identified in the Final EIS would not be differentially distributed among minority or low-income segments of the population. These include impacts to ecosystems, including wetlands, freight movement, water resources, and geology and soils. These impacts were not considered further for environmental justice purposes. Minor adverse impacts or beneficial impacts also were not further considered for environmental justice purposes. These include impacts relating to hazardous materials, public services, air quality, visual resources, parklands, historic and archeological resources, and electromagnetic fields.

Other impacts identified in the Final EIS, however, could be distributed differentially among minority or low-income populations. For the preferred and most other alternatives, neighborhood, noise and vibration, and transportation impacts would be minimized through design modifications and the use of mitigation measures. These modifications and mitigation measures include reducing the right-of-way for at-grade alternatives to reduce displacements; the installation of residential sound insulation and, where desired, sound walls; and additional traffic signals, pedestrian signals, parking mitigation, and streetscape improvements.

Residential and non-residential displacements, and construction impacts could have statistically greater effects on minority and low-income populations. This conclusion was reached after quantifying the effects of residential displacements identified in the Final EIS. This analysis indicated that residential displacement would unevenly affect minority and low-income populations. Most of these residential displacements would be concentrated in the Rainier Valley. Sound Transit conservatively assumed that non-residential displacements, which would also be concentrated in the Rainier Valley (although displacements in other areas such as Tukwila would also occur), and temporary construction impacts, would also unevenly affect minority and low-income populations.

The effects of the displacement and construction impacts, however, would be substantially mitigated. Displacement impacts would be mitigated through Sound Transit's provision of relocation assistance, commitment to minimize the effects of displacements, and other measures. Temporary construction impacts would be substantially mitigated through a variety of mitigation measures, including preparation of detailed construction traffic plans in close coordination with local jurisdictions, and scheduling traffic lane closures during off-peak hours to minimize delays during periods of higher traffic volumes as much as possible.

Project Benefits

Substantial benefits would accrue to minority and low-income populations through the implementation of the preferred alternative. These benefits include: improved access to transit, transit travel time savings, expanded access to employment and other amenities, streetscaping and other improvements, and the potential for increased economic development.

Improved access to transit results in transit travel time savings (discussed below) and other benefits to individuals and businesses. The analysis of demographic composition of the areas within one-half mile of the proposed stations (the area in which improved access to transit benefits would be greatest) indicates that 41 percent of residents living near proposed stations are likely to be minorities and 20 percent are likely to be low-income.

Transit users would experience substantial travel time savings with the Central Link Light Rail Project. The average savings for neighborhoods near all light rail stations is eight minutes. It is estimated that minority and low-income residents would receive 38 percent and 25 percent, respectively, of the total reduced travel time savings experienced by residents near light rail stations under the preferred alternative. Rainier Valley residents, for example, would save an average of 18 minutes of travel time, more than any other neighborhood and more than twice the system-wide average.

The Central Link Light Rail system would provide substantially better access with lower travel times to major employment and activity centers, such as downtown Seattle, Sea-Tac Airport, and the University of Washington. Minority and low-income residents would receive 47 percent and 17 percent, respectively, of the total increased employment access experienced by persons living near light rail stations. For example, after Link opens, Rainier Valley residents would have more than 195,000 additional jobs within an hour's ride by transit. When compared with today, their access to education would more than double, and access to health care services would increase by 27 percent.

Secondary benefits of light rail systems to the communities in which they are located include area beautification and other improvements and amenities provided as a result of increased investment or activity. An improvement program for existing street rights-of-way is built into the preferred alternative. These improvements generally include: upgraded pedestrian amenities, such as wider sidewalks, signage, crosswalks, and improved bicycle facilities, as well as beautification features, such as street trees and other landscaping, lighting, and public art. These improvements would be concentrated along MLK Jr. Way S., S. Edmunds Street, S. Henderson in Segment D and Tukwila International Boulevard in Segment E.

Because light rail exposes riders to new areas and businesses, and increases pedestrian activity in station areas, being located near the rail line may be economically beneficial. The benefits of transit-oriented economic development can include: improved mobility, access, and environmental conditions within communities; more affordable housing; more efficient urban form; and urban redevelopment. As with access to transit, transit travel time savings, and access to employment and other amenities, these secondary benefits would likely be provided principally to those located near stations.

Finally, Sound Transit has also proposed a local $50 million Transit Oriented Community Development Fund (Motion M99-14, adopted February 25, 1999), to benefit the Southeast Seattle light rail corridor. This fund would benefit the minority and low-income residents in that area.

Environmental Justice Conclusions

The preferred alternative would not have disproportionately high and adverse effects on the minority or low-income populations of the Sound Transit District. Many impacts associated with the preferred alternative would be eliminated or minimized. The remaining impacts are limited considering planned mitigation measures and the context of the Central Link Light Rail project. The impacts are not disproportionately high and adverse, particularly in light of the offsetting benefits to the minority and low-income populations.

Rainier Valley Tunnel Alternative

In response to concerns identified by Rainier Valley community, Sound Transit compared the impacts and benefits of the preferred alternative with an alternative that would replace the at-grade alignment in the Rainier Valley with a tunnel the length of the Rainier Valley. Sound Transit had previously evaluated the environmental impacts of the Rainier Valley Tunnel ("RVT") proposal in a separate Report and concluded that it is not a reasonable alternative. That report is included in Appendix Q of the Final EIS. The comparative analysis of the preferred alternative and the RVT proposal is set forth in Section G-7 of Appendix G. This comparison demonstrates that the RVT alternative was not included in the Draft EIS due to the planning history in Southeast Seattle and because it does not meet Sound Transit's design and engineering criteria for tunneling. In addition, the RVT alternative does not eliminate residential and non-residential displacements and construction impacts that would result from providing service to the Rainier Valley, nor would it provide the substantial streetscape and other benefits offered by the at-grade alignment. It would also result in greater construction impacts at station areas and portals, as well as greater vibration impacts. Finally, the RVT alternative would involve costs of extraordinary magnitude. For these reasons, the RVT alternative would not preclude implementation of the preferred alternative under the terms of the DOT Order.

4.3.3 Mitigation

The following measures could be implemented to reduce impacts to neighborhoods.

Changes in Neighborhood Quality

- In conjunction with identifying the preferred alternative, the Sound Transit Board has proposed to establish a $50 million Transit Oriented Community Development Fund (Motion

M99-14 adopted February 25, 1999) to be available for mitigation of impacts associated with building and operating the light rail preferred alternative in southeast Seattle. The fund could be used to increase ridership and improve the community. The funds can be used to leverage local, state and federal dollars for transit-related and supportive investments. A community advisory panel would be established to set priorities and make recommendations to the Sound Transit Board. The Fund would be available to the community for physical and economic improvements to the southeast Seattle light rail corridor.

- Sound Transit would work closely with affected residents and businesses prior to, and during, construction of the light rail line to provide replacement parking and advertising. These measures would be developed to help retain businesses and residential occupancy through the construction period.
- Implement proposed mitigation measures for displacements, traffic and parking, noise, and visual quality, to help minimize overall impacts on neighborhoods; work with communities in addressing mitigation tradeoffs (e.g., noise mitigation versus access barriers). All property acquisitions and relocations would be compensated in accordance with adopted Sound Transit and federal policies.
- Work actively with affected communities through the station area planning process to establish station area design guidelines that reflect community image and values.
- Work to control parking impacts around stations to ensure that short-term business and residential parking is not displaced by "hide-and-ride" demand.
- Work with the local community and jurisdiction to develop a program of urban design improvements, which could include streetscape, pedestrian access links, and landscaping elements designed to enhance the local neighborhood.
- Implement a program to help displaced business owners take advantage of reinvestment opportunities created along the corridor and in station areas. Any such opportunities would be carried out consistent with applicable federal and state laws. Such assistance could include: providing assistance with notification related to changes of location, including advertising in community-based publications, and working with commercial developers to ensure that displaced business owners are notified of appropriate lease opportunities in proposed new developments in the area. Any assistance beyond the relocation requirements of Sound Transit and FTA would be primarily for those businesses with special relocation needs.

Social Interaction

- Work with service providers, neighborhood groups, and others (e.g., religious congregations) to identify the most appropriate locations for relocating community facilities, such as clinics and churches, and to notify the affected community well in advance of the relocation. Provide effective interpreters and appropriately translated materials as needed for non-English-speaking populations.
- Coordinate with public works departments, school districts, and other local agencies to optimize access to critical services and facilities in at-grade or elevated segments.
- Provide relocation assistance to displaced business owners as discussed above.

Safety and Security

- Implement public education programs for neighborhood residents and motorists to increase awareness of pedestrian and traffic safety issues related to light rail system operation.
- Work with Seattle, Tukwila, SeaTac, and Port of Seattle police and fire departments, transportation divisions, and others as appropriate during preliminary and final design and operation of the Link system to maintain reliable emergency access.
- Develop a security plan and coordinate with local police departments to address security and policing efforts, especially in the vicinity of light rail stations, tunnels, and park-and-ride lots.
- Work with local police departments to implement Crime Prevention Through Environmental Design (CPTED) principles when feasible. This could include design elements such as installing appropriate lighting around the station areas, tunnels, parking facilities, and other system facilities, and following other design principles to help deter crime.
- Design and operate stations to provide patron safety and station security through architectural configuration and station design, electronic monitoring, sensing and communications, and manned surveillance.

Other

- Provide streetscape improvements and pedestrian access to amenities to assist with the integration of stations and other project facilities with existing neighborhood features.
- Provide noise and vibration mitigation to residents living near the rail lines who are severely impacted by noise and vibration associated with the project.

4.3.4 Significant Unavoidable Adverse Impacts

None of the impacts described above are significant unavoidable adverse impacts.

4.4 VISUAL RESOURCES AND AESTHETICS

This section assesses existing visual and aesthetic conditions in the light rail project area based on visual resource management (VRM) techniques. VRM techniques consider both visual resources and viewer response to the visual environment.

4.4.1 Affected Environment

Regional Visual Characteristics

The terrain encompassed by the light rail project area consists of rolling plateaus that trend north-south, bordered by parallel valleys occupied by the waters of Puget Sound, Elliott Bay, Lake Union, and Lake Washington. The flat-bottomed Duwamish/Green River valley enters Elliott Bay from the south. The plateaus generally rise 100 to 300 ft above the valley floors. Bedrock outcrops along the east side of Duwamish/Green River valley form a narrows in the vicinity of Fort Dent Park and Foster Golf Course, where the Green and Black rivers join to become the Duwamish. Elsewhere, most of the valley walls are moderately steep and many remain undeveloped.

Land use patterns (see Section 4.1) and associated structures relate to the underlying terrain. Residential, institutional, and commercial uses that are small to moderate in scale (apparent size of structures, which can differ from actual size) largely occupy the plateaus and gentler valley walls. The buildings associated with these uses typically range from one to four stories. The major valley bottoms, especially the Duwamish/Green River valley extending south from Elliott Bay, support commercial, industrial, and transportation uses that are moderate to large in scale. Outside of downtown Seattle and its high-rise structures, building heights in the valley bottoms typically range from two to six stories in height, but many buildings have large horizontal dimensions. Many of the steeper valley walls support dense greenbelts of primarily deciduous native trees.

The valley walls have also channeled major existing transportation facilities and high-voltage transmission lines into north-south corridors. Their visible features include support structures such as bridges, viaducts, retaining walls, and noise barriers; overhead structures such as towers and conductors; and right-of-way developments such as park-and-ride lots, parks, trails, public art installations, and mature landscape plantings.

To facilitate the description and analysis of the visual environment likely to be affected by the light rail alternatives, the foreground landscapes along the route alternatives are grouped into visual analysis units having similar viewing conditions, visual resources, and viewers. Visual analysis units are described more fully in the Visual and Aesthetic Impacts Technical Report. Appendix I of this Final EIS includes maps of the visual units and key viewpoints, as well as photographs and visual simulations of the light rail alternatives.

Visual Resources and Character

The light rail alternatives may affect existing visual resources at several levels. First, they may add to, alter, or remove some of the visible features that comprise the basic visual resources of the landscape. These features include landforms, water bodies, vegetation, and urban structures (including existing transportation facilities).

Second, the alternatives may change the visual character of existing resources. By assessing an area's existing visual character, it is possible to identify how the visual character of the project will contrast with the landscape or, be visually compatible with it. Some areas offer relatively high visual absorption capacity, another way of identifying project compatibility.

Existing visual resources and elements that define visual character include the following:

- landforms—types, gradients, and scale
- vegetation—types, size and maturity, and continuity
- land uses—size, scale (apparent size in relation to actual size), and character of associated buildings and ancillary site uses
- transportation facilities—types, sizes, scale, and directional orientation
- overhead utility structures, and lighting—types, sizes, and scale
- open space—types (including parks, reserves or greenbelts, and undeveloped land), extent, and continuity
- viewpoints and views to visual resources—including water features, hills and mountains, natural areas, farm landscapes, historic structures, and dramatic downtown skylines
- apparent grain or texture of visual resources comprising the visual analysis unit
- apparent upkeep and maintenance

Public concerns about visual resources often go beyond character to the issue of visual quality or value. While the interpretation and enjoyment of visual experience involves some subjective elements, general public agreement on the visual quality or value of specific views and their constituent elements supports the formal designation of such views and adoption of policies for their protection.

The City of Seattle has adopted environmental policies that designate public viewpoints from which views of scenic resources are to be considered and their obstruction minimized; these scenic resources include views of water bodies, hills and mountains, natural areas, and landmark structures, such as St. Mark's Cathedral on Capitol Hill. Seattle has also designated scenic routes along which such views (where present) are to be considered and protected. King County and the cities of Tukwila, SeaTac, and Renton have not adopted environmental policies regarding visual resources, but have identified views and scenic resources with community value in various planning documents. Each jurisdiction also reviews private development projects through design review processes that seek to ensure visual compatibility with the surrounding environment. Specific views and resources accorded public value are described in the Visual and Aesthetic Impacts Technical Report.

Viewer Characteristics and Sensitivity

Identifying the viewers who will see a project and the aspects of the visual environment to which they are most likely to respond is the key to understanding and predicting viewer response to a project's effects on visual resources. Viewer numbers and viewing conditions are grouped under the heading "viewer exposure." For example, many viewers exposed to a visual resource, such as a prominent hill or a landmark building along a major travel route, will take notice and remember the resource. Stationary or slow-moving viewers generally enjoy the greatest sharpness of vision. As viewer speed past objects increases, sight tends to be confined along the forward line of travel (FHWA 1981).

Psychological receptivity, which varies among viewer groups, is termed "viewer sensitivity." It strongly affects visual perception and the subjective evaluation of that perception. Viewer sensitivity is discussed in Impacts and Mitigation.

Sound Transit staff distributed questionnaires and cameras to citizens participating in initial community meetings on the light rail project, asking these individuals to photograph neighborhood resources, briefly explain their importance, and rate the extent to which the resource either adds to or detracts from the area's visual character. Results of this viewer-employed photography (VEP) helped to identify key views for assessing the potential project visual impacts. This analysis also helped confirm residents' concern about the visual resources and character of the communities in which they live and their heightened sensitivity to the potential visual effects of the project on these communities. Frequently sited resources are identified in the Visual and Aesthetic Impacts Technical Report. Specific visual resources among these that would be affected by the project are described in the Impacts and Mitigation section of this portion of the Final EIS.

Summary of Existing Visual Resources and Viewers

Segment A (Northgate to University District)

The rolling terrain in Segment A includes the basins occupied by the South Fork of Thornton Creek (now largely filled for Northgate Mall) and by Green Lake/Ravenna Creek, and two low ridges comprising Maple Leaf /Roosevelt and the northern portion of the University District. Urban development is almost continuous, ranging from the large-scale commercial development at and around Northgate Mall, to the dense single-family neighborhoods on the ridgetops, multi-family developments on the slopes, and moderate-scale commercial centers along Roosevelt Avenue and University Way. I-5 traverses this segment, alternating between fill, cut, and elevated profiles.

Existing overhead facilities include freeway light standards and sign structures, a high-voltage transmission line that parallels the freeway, and electrical distribution lines. Extensive mature tree plantings line the freeway, acting as visual buffers between the freeway and the adjoining residential neighborhoods. Away from the freeway, cover primarily consists of street trees, highly diverse residential plantings, and several wooded parks. Existing scale is large along the freeway and in the Northgate area, moderate in the neighborhood commercial centers and multi-family areas, and small in the single-family neighborhoods. The texture of the built environment (the size and alternation of structures and unbuilt properties or open spaces) ranges from the coarse grain of the Northgate area to the fine grain of the long-established residential neighborhoods. Viewer sensitivity is greatest in residential neighborhoods, including the Maple Leaf, Roosevelt, and North University visual analysis units, and in parks located within these units.

Scenic views of Green Lake, the downtown skyline, Elliott Bay, and the Olympics are available from viewpoints in the Maple Leaf community, along the eastern rim of the I-5 cut-slope. Ravenna

Boulevard N.E., a historic park facility, planned by the Olmsted Brothers, connects Greenlake and Cowen Parks. The Boulevard's visual resources include its broad central median and large, mature trees.

In Segment A, projects already planned by other parties would increase building size and scale. These projects include the commercial and office development associated with the pending the Northgate Mall expansion, and the multi-family redevelopment envisioned by the City of Seattle's Northgate Urban Center plan.

Segment B (University District to Westlake Station)

The terrain in this segment slopes south to the basin that contains Portage Bay and Lake Union, bordered by and including the steep-sided ridge of Capitol Hill. Urban development is quite diverse, including the moderately large buildings of the University of Washington, the industrial and office buildings along the north shore of Portage Bay and the east and south shores of Lake Union, the cultural and entertainment facilities in the campus setting of the Seattle Center, and the medical facilities and apartment towers on First Hill; the moderately small buildings of the Broadway retail business district; the small-scale but dense houseboat communities along the south shore of Portage Bay; and the single-family and multi-family neighborhoods of Eastlake and North Capitol Hill. I-5 continues across this segment, alternating between cut and elevated profiles, with major bridge and viaduct structures.

Existing overhead facilities also include freeway light standards and sign structures, a high-voltage transmission line that parallels the freeway, and electrical distribution lines. Sections of the freeway are lined by extensive tree plantings that are approaching maturity. These merge visually with greenbelts of native deciduous trees on the steep slopes along the northwest side of Capitol Hill. These wooded areas visually buffer residential neighborhoods adjoining the freeway. Away from the freeway, tree cover comprises street trees, highly diverse residential plantings, wooded parks, and greenbelts.

The visual scale of existing buildings and other physical structures is large along the freeway and in the shoreline industrial areas, moderately large in the southern portions of the University District and the Eastlake community, and moderate to small in the residential neighborhoods. The texture of the built environment ranges from the moderately coarse grain of the industrial and office areas to the moderately fine grain of the residential neighborhoods.

Scenic views of Lake Union, the Space Needle, the downtown skyline, Elliott Bay, and the Olympics are available from viewpoints in the Roanoke, Eastlake, and north Capitol Hill communities, along the western rim of Capitol Hill and the east shore of Lake Union. Other scenic views look east toward Portage Bay, Lake Washington, and the Cascades from viewpoints around the shore of Portage Bay and the eastern rim of Capitol Hill. Many attractive foreground views of historic structures are accessible throughout the segment. Viewer sensitivity is greatest in residential neighborhoods, which include the Southwest University, Eastlake, First Hill, and North Capitol Hill visual analysis units, and in parks located within these units.

In Segment B, planned developments include major new buildings on the University of Washington campus near 15th Avenue N.E. and N.E. 45th Street. Major new structures are also pending along Broadway Avenue E. and E. Madison Street for Seattle Community College Library, Seattle University Law School, a parking structure, and a large apartment project.

Segment C (Westlake Station to S. McClellan Street)

The terrain in this segment includes the southwest-facing slopes of downtown Seattle, the filled Duwamish tide flats, the northern ridge of Beacon Hill, and the manmade Dearborn Cut that leads to the northern portion of the Rainier Valley. Urban development is extremely diverse, ranging from the high-rise office buildings of downtown Seattle to the Safeco Field baseball stadium, the Kingdome (soon to be replaced by the new football stadium), the surrounding warehouse and industrial buildings of the Sodo (south of downtown) area, and the mixed single-family and multi-family neighborhoods of Beacon Hill. I-5 continues across this segment to its extensive interchange with I-90, which includes bridges, viaduct structures, retaining walls, and noise barriers.

Existing overhead facilities include freeway light standards and sign structures, high-voltage transmission lines, harbor cranes, light standards, and electrical distribution lines. I-90 is lined by extensive tree plantings that are still relatively young; I-5 south of Dearborn is bordered by undeveloped greenbelts of native deciduous trees on the steep western slopes of Beacon Hill. Away from the freeway, existing tree cover primarily consists of street trees and highly diverse residential plantings. Existing overhead facilities include streetlights and electrical distribution lines. Rainier Avenue S. north and south of I-90 is a designated scenic route oriented to provide views of Mount Rainier; hence, the City of Seattle has avoided placing overhead utilities along this route.

The visual scale of existing urban development is very large in downtown Seattle, along the freeways and in the industrial areas, moderate in the Dearborn Cut area, and moderate to small in the residential neighborhoods. The texture of the built environment ranges from the very coarse grain of the Sodo area to the moderate grain of the mixed industrial and commercial development along Rainier Avenue S. to S. McClellan Street.

Scenic views of Elliott Bay, Puget Sound, and the Olympics are available from viewpoints in downtown Seattle, First Hill, and the western rim of Beacon Hill. Scenic views toward Mount Rainier are also available from portions of Rainier Avenue S., a designated scenic route. Many attractive foreground views of historic structures are possible throughout the segment. Viewer sensitivity is greatest in residential neighborhoods, which include the downtown Seattle, International District, Judkins, North Rainier, and North Beacon Hill visual analysis units, and in parks located within these units.

In Segment C, planned projects include large-scale buildings in the Pioneer Square and International District areas; among them, the new professional football stadium, office and parking complexes at the two railroad station sites, and numerous mid-rise multi-family residential structures.

Segment D (S. McClellan Street to Boeing Access Road)

In Segment D, the terrain comprises the relatively narrow southern Rainier Valley and its gradual slope up to the low divide at Henderson Street with the narrow valley that leads south to the Duwamish River. North of the Henderson urban development alternates between one- and two-story commercial and retail buildings along the arterial streets (including the attractive and well-maintained Columbia City Historic District), with interspersed small industry and automotive-related businesses, and mixed single-family and low-rise multi-family neighborhoods. Industrial development dominates that portion of the segment south of the divide at Henderson. The existing arterial streets generally have four travel lanes, with some also having center turn lanes.

Existing overhead facilities include streetlights and electrical distribution; a major high-voltage transmission corridor traverses the southern portion of Beacon Hill and crosses MLK Jr. Way S. near S. Henderson. Existing tree cover includes street trees, highly diverse residential plantings, wooded parks, wooded vacant lands along portions of MLK Jr. Way S., and extensive greenbelts on the eastern slopes of Beacon Hill and on either side of the valley south of Henderson.

The visual scale of existing urban development ranges from moderately large in the industrial area south of Henderson, to moderately small in the commercial areas along the arterial streets, and small in the residential neighborhoods. Visual resource texture ranges from the coarse grain of the industrial area south of Henderson to the moderately fine grain of the residential areas along MLK Jr. Way S. The grain of the commercial areas along this arterial and along Rainier Avenue S. is moderate, except for Columbia City, where the grain is moderately fine.

Scenic views toward Mount Rainier are available from portions of Rainier Avenue S., designated as a scenic route. At the north end of Segment D, S. Winthrop Street is part of the Olmsted-planned Cheasty Boulevard system.. The City of Seattle has recently improved the roadside along S. Winthrop

Street by planting grass and street trees. Franklin High School is also a visually prominent historic landmark located on Mount Baker Boulevard. Viewer sensitivity is greatest in the residential neighborhoods that adjoin MLK Way Jr. S. and Rainier Avenue S., and in parks located within these neighborhoods.

Segment E (Tukwila)

In Segment E, the terrain comprises the steep-sided portion of the Duwamish Valley, rocky bluffs on the valley's east side and somewhat gentler slopes on the west. Human development on the flat valley bottom ranges from industrial development and transportation uses at the south end of Boeing Field to Southcenter Mall, with new low-rise office complexes between. Several older single-family neighborhoods are also located on the valley bottom, interspersed with parklands; newer residential neighborhoods are located on the edges of the plateaus east and west of the river valley.

Transportation corridors traverse the valley walls. One of these is the railroad corridor along the east edge of the valley floor. Starting from their intersections with the Boeing Access Road, MLK Jr. Way S. and Tukwila International Boulevard ascend the east and west valley walls, respectively, passing from office/industrial areas through steep, wooded, and relatively undeveloped slopes to mixed residential and commercial neighborhoods on the plateaus. Interurban Avenue S. threads the valley bottom from north to south along the route of an earlier light-rail system. I-90 descends the east valley wall to cross the Green River and begin its ascent of the west valley wall at Southcenter, while I-405 crosses the valley east to west and continues as SR 518 to Sea-Tac Airport by following the course of Southgate Creek.

Existing overhead facilities include freeway light standards and sign structures, as well as highway bridges and overpasses. Existing tree cover includes street trees, residential plantings, wooded parks, and extensive wooded private lands and rights-of-way along the valley walls.

The visual scale of existing urban development ranges from very large in the industrial area around the Boeing Access Road, to moderately large in the office/industrial and commercial areas and to small in the residential neighborhoods. Visual resource texture ranges from the very coarse grain of the office/industrial areas to the moderately fine grain of the residential neighborhoods. The visual grain of the commercial frontage development along MLK Jr. Way S., Tukwila International Boulevard, and Interurban Avenue S. is moderate, while the visual grain of the Southcenter commercial and office/industrial area is moderately coarse.

Scenic views northward toward the downtown Seattle skyline and Elliott Bay are available from portions of Tukwila International Boulevard, I-5, and MLK Jr. Way S. The City of Tukwila regards these as important gateway views. Scenic views toward the Cascades and Mount Rainier are also available from parks and residential areas along the crest of the wooded slopes west of the Green River, particularly in the Cascade View visual analysis unit. These east- and southwest-facing views are not available from Tukwila International Boulevard because they are blocked by adjoining terrain and development, although they may be visible from upper floors of some buildings. Other scenic views are closer in range, directed toward the Green River and some of the wooded bluffs and parks located along it, which include the Green River Trail. Several historic structures are also located along the floor of the Green River valley. Viewer sensitivity is greatest in residential neighborhoods, which include the Skyway Crest, Golf Links, North Riverton, Riverton, Cascade View, and Riverton Heights visual analysis units, and in parks located within these units.

In Segment E, planned developments include the redesign and improvement of Tukwila International Boulevard, and the anticipated redevelopment of private lands along the highway. The ongoing construction of large office buildings in the Longacres and Southcenter areas would also continue.

Segment F (SeaTac)

In this segment, the terrain comprises the gently rolling plateau west of the Duwamish Valley, with small lakes contained in shallow basins on the plateau. Urban development ranges from the airport/industrial development and associated surface transportation around Sea-Tac Airport, to new mid-rise office complexes, extensive hotel and motel complexes, and a mixture of low-rise multi-family, mobile home, and single-family neighborhoods. Visually prominent open spaces, all located along International Boulevard, include Washington Memorial Park (a cemetery), Bow Lake and its associated wetlands, and Angle Lake Park.

Existing overhead facilities include airport and freeway light standards and sign structures, highway bridges and overpasses, and electrical transmission lines and distribution lines. Existing tree cover includes extensive tree plantings along the airport access road that are approaching maturity, the recently planted median and street trees along International Boulevard, the wooded cemetery, and the highly diverse residential plantings in the neighborhoods around Bow and Angle lakes.

The visual scale of existing urban development ranges from very large in the airport area, to large in the commercial and hotel areas along Tukwila International Boulevard, and small in the residential neighborhoods. Visual resource textures range from the very coarse grain of the airport area to the moderately fine grain of the residential neighborhoods.

Scenic views toward the Cascades and Mount Rainier are available from the west and north slopes around Angle Lake. Other scenic views are closer in range, directed toward Angle Lake and Bow Lake. Angle Lake Elementary School and the Hambach Family Compound are historic resources that are also attractive visual resources. Viewer sensitivity is greatest in residential neighborhoods, which include the McMicken Heights, Bow Lake, and Angle Lake visual analysis units, and in parks located within these units.

In Segment F, future developments include the numerous highway projects, office complexes, parking structures, and mid-rise hotels along International Boulevard.

Maintenance Base Sites

Maintenance Base Site M1 is located in Segment C, in the Sodo area. Siting options have been investigated in this area, with associated light rail access variations. The site options and the adjoining area are characterized by large one- to three-story warehouse and industrial buildings. One industrial facility appears eligible for designation as a historic landmark under federal or municipal criteria; the former Great Western Smelting and Refining Co., 1922 Airport Way S. Federal and municipal regulations require consideration of project effects on the visual appearance of historic structures. Maintenance Base Site M2 is located in Segment D, immediately north of the Boeing Access Road and between I-5 and MLK Jr. Way S. Industrial development for distribution uses and construction yards currently occupies the site and adjoining properties. Maintenance Base Site M3 is located south of the Boeing Access Road, between E. Marginal Way S. and the railroad yard along I-5. Again, the site and adjoining area are used for warehouse and industrial businesses, but also included are a shooting range and bingo facility. Existing viewer exposure for all three sites is largely limited to the visitors and employees of the businesses located there, and viewer sensitivity is relatively low, although the City of Tukwila considers the M2 site area as a potential gateway to the city and hence, visually sensitive.

4.4.2 Impacts and Mitigation

The light rail guideway, overhead conductor system (OCS), stations, and other facilities would affect existing visual resources by removing or altering them, and by adding new visual elements that contrast with existing landscapes or exhibit visual compatibility. When existing visual resources and visual character are highly valued, a strong visual contrast usually constitutes an adverse visual change (although visual contrast can also be successfully employed as a design technique). If this adverse change is seen by viewers engaged in activities that require, or are enhanced by, attractive visual settings, the change is experienced as a significant adverse visual impact. This also applies to shadows that may be cast by support structures or stations for elevated portions of the project. Lighting and glare are also potentially significant environmental considerations for project environmental analysis.

Viewer response to visual change is evaluated in terms of viewer exposure and viewer sensitivity. Viewer exposure to a project or feature is measured by the number of viewers who will see the project and the length of their viewing time. Viewer sensitivity is a function of the extent to which viewer groups are seeking attractive visual resources, or to which their activity is enhanced by the presence of such resources. Persons engaged in recreation generally have the greatest viewer sensitivity, and local residents are the next most sensitive. Motorists can be considered moderate in viewer sensitivity, while persons engaged in commercial or industrial activities may be relatively insensitive to visual considerations.

Visual Simulations

Appendix I to this Final EIS includes visual simulations that illustrate the future appearance of the project, as seen from key view locations. These locations have been selected where there is a concern about impacts to the visual environment, which will help assess the impacts of the alternatives on these views. The selection process included the environmental policies of Seattle, Tukwila, and SeaTac, interviews with the cities' planning staff, analysis of viewer-employed photography, and field reconnaissance of the route alternatives. Appendix I also includes maps indicating the locations of the simulated viewpoints.

Project Design Features

Sound Transit would incorporate into the light rail project features to reduce visual impacts. These include the following actions:

- Selecting and/or modifying routes to avoid or reduce the need to acquire and clear new right-of-way. This measure has already been incorporated to a great degree in identifying route and station alternatives, and includes the use of existing transportation corridors (arterial streets and highways, limited access highways, and rail corridors), underground routes, and open-cut sections;
- Sound Transit has developed policies which pertain to design issues such as architectural expression being a balanced approach of system-wide elements and contextual elements, system-wide signage for customer ease, and a system-wide art program. The design of project elements will be completed by using interdisciplinary teams such as artists, architects, landscape architects, planners and engineers. Communities will have opportunities to comment on these designs.
- Integrating facilities with area redevelopment plans, particularly at stations;
- Minimizing the elevation or height of elevated guideways to limit their visibility generally to the extent needed by required vertical clearances;
- Minimizing clearing for construction and operation;
- Planting appropriate vegetation in and adjoining the project right-of-way to replace existing street trees, greenbelts, and/or to provide screening for sensitive visual resources and viewers;
- Replanting remainder parcels with grass or simple plantings; maintaining them, and pursuing their redevelopment for land uses that are feasible and consistent with neighborhood plans, such as residential, commercial, or open space uses;
- Using source shielding in exterior lighting at stations and ancillary facilities such as maintenance bases and park-and-ride lots, to ensure that light sources (such as bulbs) are not directly visible from residential areas, streets, and highways, and to limit spillover light and glare in residential areas.

Potential Visual Impacts and Associated Mitigation

The following discussion on the potential visual impacts of the light rail alternatives in each of the project segments discusses possible mitigation measures and their likely effectiveness. The impacts discussed here are limited to those that could be significant unless mitigated.

Segment A (Northgate to University District)

In Segment A, the visual impacts of all alternatives would be low along their common alignment in the Northgate area (Views 1-2 and 1-3). These impacts would increase along the east side of the I-5 cut section between N.E. 75th and N.E. 95th streets, where a large portion of the mature trees would be removed, and high retaining walls constructed (View 2-2). Replanting roadside vegetation and incorporating retaining wall design measures (such as steps, surface sealing and color, and surface texture) would reduce adverse visual impacts to moderate or low levels for all these alternatives.

The elevated guideway, Lake City Way flyover, and associated OCS for Alternative A2.2 would partially obstruct scenic views from Rainbow Point Park at Banner Place and N.E. 75th Street, a viewpoint designated for protection by the City of Seattle and identified as important in the analysis of viewer-employed-photography. The current design already reflects design changes made to reduce visual impacts, including lowering the trackway elevation and shifting it further west (View 3-2). Mature trees within the I-5 right-of-way would also be displaced by this alternative; these trees screen foreground views down toward the freeway while allowing scenic views toward Green Lake, downtown Seattle, and the Olympic Mountains. Replanting with appropriate species would reduce adverse visual impacts caused by this displacement to a low to moderate level. Design measures such as placement of the poles supporting the overhead contact system and increasing the height of the viewpoint would reduce the view obstruction. The elevated guideway and support structures would also be visible from residences adjacent to I-5 along Eighth Avenue N.E. (View 4-2). Mature trees along this section of I-5 were planted to screen adjoining residences from views of the freeway; their removal would expose residents to views of both the project and the freeway. These impacts could be mitigated by replanting. There are no trees in front of some homes, however, which have views across the freeway similar to those from Rainbow Point Park. The elevated guideway and support structures would obstruct these views.

Alternative A2.1 would also require removal of a number of homes along Eighth Avenue N.E.; their replacement by transportation right-of-way and facilities would be a significant visual encroachment on the adjoining Roosevelt neighborhood. However, the visual impacts of this alternative along Eighth Avenue N.E. could be mitigated to a moderate level by maintaining minimal landscape planting. Redeveloping the properties for public park or open space use, or for other uses consistent with neighborhood plans, would reduce visual impacts to a low level.

The visual impacts of Alternatives A2.1 and A2.2 on Ravenna Boulevard from removing a few trees and adding an elevated structure would not reach significance because the elevated guideway would parallel the existing I-5 viaduct, with support columns adjacent to the I-5 columns and at the same height (View 5-2). The guideway would cast shadows on a portion of Ravenna Boulevard, part of the Seattle park system, but this shading would represent a small incremental increase in the shading caused by the existing I-5 viaduct.

Segment B (University District to Westlake Station)

The N.E. 45th Station, Option B would be located on the U.W. campus, immediately east of 15th Avenue N.E. While the station entrances would largely be located outside the existing wooded buffer along the edge of the campus, the construction staging area for Option B would require removal of most trees from N.E. 45th to N.E. 43rd streets. Nevertheless, it appears possible to preserve a wooded strip approximately 30 ft wide in the middle of this frontage, for approximately half its length. The loss of mature trees in this buffer would impose a significant adverse visual impact on views toward the campus and from within it toward 15th Avenue N.E. The preservation of a portion of the buffer during construction and subsequent replanting of the remainder of the buffer would reduce the impact to a moderate level.

Option C for the N.E. 45th Station would be located on the west side of 15th Avenue N.E. Construction of this option appears likely to require clearing the half-block from N.E. 45th to N.E. 43rd streets, with the exception of the Malloy Apartments, plus the buildings at the southeast corner of the intersection of N.E. 45th Street and University Avenue N.E. The resulting visual impacts would be moderate, and would be further mitigated to a low level, where possible, by station-area redevelopment and by replanting any street trees that would be removed.

Alternative B2.1 would impose potentially significant visual impacts along Campus Parkway and immediately west, where it would require the removal of the International Grove (View 6-2), the University Friends Meeting House (eligible for historic listing), and several adjoining residential structures. The elevated guideway and OCS would also be incompatible with the visual scale and character of the adjoining residential neighborhood and would block private views toward Lake Union and Portage Bay. The adverse visual impacts of Alternative B2.1 could be reduced over time to a moderate level along Campus Parkway and immediately west, by new tree plantings to replace part of the International Grove. However, these trees would require several decades of growth until they become effective replacements for the existing mature trees. It does not appear possible to modify the route of this alternative to preserve the University Friends Meeting House, and the visual impacts of this portion of the alternative would remain. Alternative B2.1 would require a new high-level bridge across the Ship Canal, immediately adjacent to the existing I-5 Ship Canal Bridge. Because the new bridge would parallel the existing I-5 bridge, have support piers adjacent to the I-5 piers, and be at the same height, its effects on views from the Burke-Gilman Trail (View 7-2) and other public locations would not constitute significant impacts. The new bridge would increase the shadows cast on North and South Passage Point parks; however, the increase would be incremental and not likely significant. A pier for the new bridge would likely be located within each of the two parks, which already contain piers for the existing I-5 Bridge; these piers would reduce the portions of the parks from which views of the Ship Canal and Lake Union are available, but design measures for park restoration could enhance the remaining viewpoints along the shoreline.

At the south end of Lake Union, the elevated structure and station common to Alternatives B2.1 and B2.2 would obstruct views along Westlake and Fairview avenues (designated scenic routes) toward Lake Union and South Lake Union Park (8-2). These project features would also obstruct some views of the historic Ford Assembly Plant and the W.O. McKay automobile dealership building, and would alter the visual character of their settings. However, careful design of the station and elevated guideway along Mercer, together with street tree replacement, appear likely to reduce the adverse visual impacts of Alternatives B2.1 and B2.2 to a moderate level, including impacts on views of the Ford Assembly Plant and the W.O. McKay automobile dealership building.

On North Capitol Hill, Alternative B1 would require a vent shaft and traction power substation (TPSS) immediately southeast of the 10th Avenue E. bridge over SR 520. The construction of these facilities would require removal of several mature fir trees that presently help to screen the residential area from the freeway. This adverse visual impact could be reduced by replanting this area with appropriate vegetation.

Further south in this visual analysis unit, the potential Roy/Aloha Station associated with Alternative B1b could impose significant visual impacts on the setting of the historic Anhalt Apartments, particularly if a transformer building were to be associated with the station; it could also alter the character of the residential neighborhood north of E. Roy Street by replacing existing residential structures with station facilities. On the other hand, careful design of the station and its integration with area redevelopment appear likely to be effective in mitigating the visual impacts of the Aloha Station on the setting of the historic Anhalt Apartments and the residential neighborhood north of Roy Street.

In the south Capitol Hill visual analysis unit, the entrance structures for the Capitol Hill Station options would be designed to be consistent with the existing visual setting or aesthetic character of the area. However, the construction of Option D could affect the appearance of Bobby Morris Playfield and Lincoln Reservoir adjacent to Nagle Place. The City of Seattle is planning to cover the adjoining Lincoln Reservoir and develop additional park facilities over it. This action will require the removal of most of the existing trees along Nagle Place, except for a few trees at the northwest corner of the site: the construction of Option D could require removal of these remaining trees. The views of the entrance structures from the park would not constitute a significant visual impact, but the removal of the trees, if required, would be significant. The impact would eventually be mitigated by replacing the removed trees with young trees. See mitigation options discussed in Section 4.15.3.2.

The entrance buildings for the First Hill Station, within the visual analysis unit with the same name, could obstruct views of the historic Jesuit College and Church (also known as the Garrand Building) on the Seattle University campus from Broadway Avenue E. and E. Madison Street. This partial view obstruction could be mitigated by station location and design.

Segment C (Westlake Station to S. McClellan Street)

The preferred alternative or other C1 routes would not have significant visual impacts. In this segment, significant visual impacts would be primarily associated with the elevated portions of Alternatives C2.3 and C3 that would extend along Rainier Avenue S. from I-90 to its intersection with 23rd Avenue S. This portion of Rainier is a designated scenic route, and the City of Seattle has avoided constructing overhead electrical transmission and distribution facilities along this street; however, an OCS for electric trolleys is present (View 9-1). The elevated guideway and OCS would obstruct views of Mount Rainier (Views 9-2 and 9-3). The adverse visual impacts associated with both alternatives could be partially mitigated by replacement of street trees and careful urban design. However, the elevated structure would continue to obstruct scenic views toward Mount Rainier, and this visual impact would remain significant. The elevated alternatives would also obstruct views of the historic Stewart Lumber building on the west side of Rainier Avenue S.

The I-90 Station (near 17th Avenue S.) associated with Alternative C3 would require the removal of existing structures and could impose light and glare impacts on the adjoining residential neighborhood. This may contrast strongly with the park and bikeway along the south side of I-90. However, careful station-area design (including exterior lighting and open space design) and landscape maintenance appear capable of reducing the adverse visual impacts of the I-90 Station to a moderate level.

Segment D (S. McClellan Street to Boeing Access Road)

At the north end of Segment D, McClellan Station Option A would cross S. Winthrop Street, part of the Olmsted-planned Cheasty Boulevard system. All station options would reconstruct S. Winthrop Street (Cheasty Boulevard) and would include landscape improvements and tree plantings along S. Winthrop Street to enhance its visual quality as part of the boulevard system (Views 10-2, 10-3 and 10-4). Option A, a surface station, would maintain views east to historic Franklin High School (View 10-4), while Options B and C, an elevated station (preferred alternative), would partially obstruct views toward the school building, but would enhance the physical continuity of the boulevard system and could also include a central boulevard median, similar to that on Mt. Baker Boulevard. This mitigation measure could be included as part of either options B or C.

The portions of Alternatives D3.3 and D3.4 along Rainier Avenue S. between Mount Baker Boulevard and S. Alaska Street would remove several historic buildings and alter the existing visual character of the neighborhood fronting the west side of Rainier Avenue S. (Views 11-2 and 12-2). The visual character of this neighborhood was identified as important in the analysis of VEP, although residents also indicated that aspects of its visual character could be greatly improved. Several businesses, such as the Chubby and Tubby store, and structures on the west side of the street were singled out as valued neighborhood landmarks. Alternatives D3.3 and D3.4 would also require acquisition of excess right-of-way in this section; redevelopment of the remainder lots between Rainier and the trackbed along the alley to the west may also be problematic because of their small size, narrow depth, and total linear extent. To prevent land dereliction, Sound Transit has committed, after project construction, to replant these remainder parcels with grass or simple landscaping, to maintain them, and to pursue their redevelopment for land uses (including public open space) that are feasible and consistent with neighborhood plans. Given this commitment, adverse visual impacts can be expected to be moderate.

The Columbia City Business District and associated features (including the library, Columbia Park, and the playfield) were identified as important visual resources when project staff analyzed VEP. Alternative D3.4 would not impose long-term impacts on any of these features.

Because of the route's valley-bottom location, the elevated guideway and OCS for Alternative D1.3 would not obstruct distant scenic views from S. Columbia Way or S. Alaska Street, both designated as scenic routes. However, this alternative would impose high visual contrast along the east frontage of the Rainier Vista housing development, a public landscape with high design quality that constitutes an important community visual resource (Views 13-2 and 13-3), and along the residential areas between S. Alaska and S. Brandon streets, which are characterized by small-scale buildings (View 14-2). Because of the viewer sensitivity associated with these predominantly residential landscapes, visual impacts appear likely to be significant. Between S. Brandon and S. Graham streets, MLK Jr. Way S. is bordered by a mix of commercial and multi-family residential uses and buildings that are moderate in scale. The elevated profile of Alternative D1.3 would contrast less strongly with the character of the adjoining neighborhoods in this area, and redevelopment appears likely to further reduce or eliminate this contrast around station locations (View 16-3). The visual impacts of the portal for the tunnel portion of Alternative D3.4, north of Columbia City and in the vicinity of S. Graham Street would be moderate (View 16-4).

Between S. Alaska and S. Henderson streets, Alternatives D1.1c, D3.3, D3.4, and the surface portion of D1.3 would preserve the existing number of automobile travel lanes on MLK Jr. Way S. by acquiring additional right-of-way, which would create numerous small or odd-sized remainder lots and alter the existing visual character of the adjoining neighborhoods (View 16-2). Alternative D1.1e (preferred alternative) would also maintain the existing number of automobile travel lanes, but would require considerably less new right-of-way. Alternatives D1.1d and D1.1f would reduce the number of automobile travel lanes between S. Alaska and S. Henderson streets, thereby reducing the amount of right-of-way acquisition and the number of displacements and remainder lots. Most existing buildings along MLK Jr. Way S. would be undisturbed, except in the vicinity of the S. Othello and S. Henderson stations; the existing visual character of the adjoining neighborhoods would be largely unchanged. The visual character of these neighborhoods was generally not singled out as important by the Viewer Employed Photography (VEP) survey, although the mature landscapes associated with Rainier Vista and Holly Park evidence design attention and continued maintenance. To prevent land dereliction, the project is committed to replant remainder parcels with grass or simple landscaping after project construction. In addition, the parcels would be maintained, and their redevelopment for land uses (including public open space) that are feasible and consistent with neighborhood plans would be pursued. This would reduce adverse visual impacts to a moderate level for the surface portions of all alternatives (Views 15-2, 17-2, and 18-2), except for Alternative D1.1d, for which visual impacts would be moderate to low (View 15-3).

Segment E (Tukwila)

Significant localized visual impacts in Segment E are likely to be associated with elevated and flyover structures and by the resulting obstruction of views toward parks and scenic vistas.

In Alternatives E1 (preferred alternative) and E2, the elevated section running along the hill on the south side of Boeing Access Road would require the removal of naturalized vegetation (View 20-

2). This hill has traditional cultural value to local Native American peoples. Although the site presently is closed to public access, the light rail line would not be clearly visible from the top of the hill. The displacement of vegetation and elevated guideway would change the visual character of this area and impose a low to moderate adverse visual impact. Restoring areas affected by construction with native plant species originally found on the site would reduce this impact to a low level.

Visual impacts of Alternatives E1.1 (preferred alternative) and E1.2 at the Duwamish River crossing would be moderate, particularly in conjunction with the City's proposed bridge replacement (View 21-2). Impacts would be moderate where the elevated portion of Alternatives E1.1 (preferred alternative) and E1.2 (View 22-2) begin to ascend Tukwila International Boulevard. In Alternative E1.2, significant impacts appear likely where the elevated guideway and OCS would obstruct views of the Seattle skyline (View 23-2) and impose high visual contrast with existing small-scale buildings and mixed residential/business development. The elevated guideway could also adversely affect the sense of privacy of some residents by intruding into the line of sight from some residences along Tukwila International Boulevard in the Cascade View and Thorndyke neighborhoods. Shadows cast by the elevated guideway would also extend to adjacent properties, particularly during seasons when the sun is at a low angle for much of the day, but would be unlikely to affect uses of these properties because of the time of year. Streetscape improvements, and the limited extent of displacement due to the light rail project, would reduce visual contrast to low to moderate levels for the elevated configuration, and low levels for the at-grade configuration (Views 24-2 and 24-3). Street tree planting would help screen adjacent residences from views of the project and would reduce privacy impacts to a low level. In several spots, where the width of the right-of-way limits screening, these impacts would likely remain at a moderate level. If the at-grade segment of Alternative E1.1 were connected to Alternative F2.1, F2.2, or F2.3 (preferred alternative), the elevated crossing of SR 518 would require a transition section beginning at S. 150th Street; the elevated guideway would then turn southwest across the southbound lanes of Tukwila International Boulevard. at S. 154th Street. Since the highway does not afford scenic views in this area, view obstruction would not be significant.

Alternative E2 would require a bridge over the Green River and the Green River Trail east of the existing Interurban Bridge. The elevation of the new bridge would be similar to the existing bridge, and its visual impacts would be moderate. From this point, Alternative E2 would parallel the west-side of the trail to the Allentown Bridge, and the trackbed would be approximately 6 to 10 ft above the trail surface; sound barriers may be installed to reduce the effects of wheel noise on trail users, increasing the apparent height of the guideway and retaining wall (View 25-2). With careful wall design and planting, the visual impacts of this route would be moderate . Alternative E2 would require a flyover to cross I-5 at Interurban Avenue S., with one transition located at Gateway Drive (View 26-2) and another at the north end of the Foster Golf Links. The second transition would impose significant visual impacts near Lookout Mini-Park and the Foster Golf Links clubhouse. These impacts would include obstructed views toward the river, shadows cast on the mini-park, and high visual contrast. The route would return to the surface along the southern frontage of the golf course, where its visual impacts would be moderate (View 27-2). The visual and shadow impacts of the elevated portions of Alternative E2 that would cross the Green River Trail (also known as the Christensen Trail) near Baker Boulevard in the Southcenter area (View 28-2) would be incremental and not significantly adverse on trail users, because frequent underpasses are characteristic of this portion of the trail. The visual impacts of this river crossing on adjoining multi-family structures would be adverse, but could be mitigated by tree plantings and landscape development to screen project views.

Alternative E3 would require an elevated section that would transition from street level north of 57th Street, and return to grade south of 129th Street (View 29-2). The elevated structure and the transitional ramps would impose a high visual contrast with the mixed, small-scale residential and business buildings of the Skyway neighborhood, constituting a significant visual impact. The elevated guideway and sound walls would also cause moderate shadow and privacy impacts to some adjoining residences. Visual impacts of this elevated route on the hillside greenbelt east of the Foster Golf Links (View 30-2) would be moderate with care in structural design, limits on construction disturbance, and maintenance of the light rail right-of-way as a greenbelt. The visual and shadow impacts of the elevated portion of Alternative E3 that would cross the Christensen Trail at Strander Boulevard (View 31-2) would be similar to those of Alternative E2 in the Southcenter area. Visual impacts from Alternatives E2 and E3 would also be moderate or low in the Southcenter Mall area (View 32-2), where the scale of the alternatives would be consistent with the existing built environment, and no scenic views would be blocked. Shadows cast by elevated structures on adjacent commercial and retail properties would not adversely affect the use of the portions of the properties affected (primarily parking lots).

Segment F (SeaTac)

In this segment, adverse visual impacts would largely be avoided along International Boulevard Views 33-2, 33-3 and 33-4 demonstrate that the routes of Alternatives F1, F3.1, F3.2, F3.3, and F4 avoid directly affecting the Washington Memorial Park Cemetery, with the exception of a few trees that would be removed. These would be replaced with species that are appropriate to their surroundings and would enhance the visual buffer between the cemetery and International Boulevard. The project would replace all street trees along International Boulevard that it would remove. The scale of elevated Alternatives F3.1, F3.2, and F3.3 would impose a moderate level of visual contrast with existing development patterns in the McMicken Heights area north of S. 170th Street. Alternatives F2.1, F2.2, and F2.3 (preferred alternative) would have little viewer exposure on the west side of the cemetery because they remove the existing trees that provide a visual buffer between the airport access roads and visitors along the western edge of the cemetery. The station options associated with these route alternatives would also have little adverse effect on existing views because viewer sensitivity and exposure to those views are low.

In SeaTac's City Center, located in the Bow Lake area south of 170th, all of the surface and elevated route alternatives would be visually compatible with the large scale of the existing office-tower, hotel, and airport buildings (Views 34-2, 34-3, 34-4, 35-2, and 35-3). Streetscape design and replacement plantings would be effective mitigation for the visual impacts of all the alternatives along International Boulevard. Alternative F2.2 would, however, cause localized but significant obstruction of views at Bow Lake (View 36-2). Attractive foreground views of the lake are available from a private park within a mobile-home complex. It does not appear possible to reduce the view obstruction and visual contrast that would be caused by Alternative F2.2 at Bow Lake to a less-than-significant level.

At Angle Lake Park, the street widening associated with Alternative F1 would require removal of existing streetscape improvements, including street trees, and some of the recent park improvements. Mitigation of the associated adverse visual impacts would require the purchase and development of enough additional park property to replace the affected area; it is unclear whether this would be possible at Angle Lake Park itself.

Maintenance Base Sites

A number of alternatives have been investigated for Maintenance Base site M1 in the Sodo area. Each of these would be visible to employees in the adjoining industrial area, but would be visually compatible with the surrounding buildings and exterior storage yards, as would the associated light rail alignments. Maintenance Base site M2, on the east side of I-5 and adjoining MLK Jr. Way S., has been identified as a concern by the City of Tukwila because it is located at the northern entry to the city (View 19-2). However, this site has low viewer exposure because of its low elevation and screening by adjoining industrial uses, and because views from I-5 are fleeting and off the line of travel. Visual impacts would be low.

Maintenance Base Site M3, south of Boeing Access Road, would have low visual exposure, but could be seen by employees in the surrounding industrial area. Its appearance would be compatible with the adjoining buildings and exterior storage yards.

Mitigation Measures

In addition to those features incorporated in the proposed project and discussed above, the following mitigation measures would be considered: consolidating, where appropriate, the project OCS with electrical transmission and distribution systems, other overhead utilities, and street and highway lighting.

4.4.3 Significant Unavoidable Adverse Impacts

The probable significant unavoidable adverse visual impacts of the light rail alternatives, stations, and other facilities in each of the project segments are summarized below, after accounting for the effects of the possible mitigation measures.

- Alternative B2.1, from Roosevelt Way N.E. to Seventh N.E. - the elevated guideway would remove residences and the University Friends Meeting House, block private views, and be incompatible with the scale and character of existing development. Removal of the campus grove of trees would take several decades to be effectively replaced by new trees.
- Alternatives C2.3 and C3, from S. Massachusetts to 23rd Avenue S. - the transition and elevated guideway and OCS would obstruct views toward Mount Rainier from Rainier Avenue S., a designated scenic route. They would also screen the east façade of the Stewart Lumber building, a historic structure and valued neighborhood feature.
- Alternative D1.3, from S. Andover to S. Brandon streets – the elevated guideway and OCS would create high visual contrast at S. Columbia Way and S. Alaska Street (designated scenic routes), along the east frontage of the Rainier Vista housing development and along MLK Jr. Way S.
- Alternative E1.2 - the elevated guideway and OCS would obstruct scenic skyline views from Tukwila International Boulevard and impose high visual contrast within portions of the Riverton Heights and Cascade View neighborhoods.
- Alternative E2, from I-5 to S. 139th Street - the I-5 flyover and the transition section to at-grade would obstruct views, cast shadows, and impose high visual contrast on and along the Green River Trail, Lookout Mini-Park, and Foster Golf Links.
- Alternative E3, from north of 57th Avenue S. to south of 129th Street S. - the transition and elevated guideway would impose high visual contrast in the Skyway neighborhood, and cast shadows.
- Alternative F2.2, in the Bow Lake area, at approximately S. 180th Street and International Boulevard - the elevated guideway and OCS would obstruct views from the northeast shore of the lake and impose high visual contrast.
- Alternative F1 at the entry to Angle Lake Park, approximately S. 194th Street and International Boulevard.—the at-grade route would relocate park entry facilities, including parking, and remove trees and vegetation within the park.

4.5 AIR QUALITY

4.5.1 Affected Environment

4.5.1.1 Regulatory Setting

The major airborne pollutants of interest in the central Puget Sound region include carbon monoxide (CO), particulate matter, ground-level ozone, and the ozone precursors, which are hydrocarbons (HC) and oxides of nitrogen (NO_X). These regulated pollutants are among those commonly referred to as criteria pollutants. National Ambient Air Quality Standards (NAAQS) identify criteria pollutant concentrations that must not be exceeded over specified time periods.

Primary air quality standards are defined to protect public health, and secondary standards are intended to protect the natural environment. Table 4.5-1 shows the primary and secondary NAAQS for the major airborne pollutants of concern. The Washington State Department of Ecology (Ecology) and the Puget Sound Clean Air Agency have adopted state and local ambient air quality standards that are equivalent to the national standards.

The U.S. EPA revised the ozone standard in 1997 from 0.12 ppm (1-hour average) to 0.08 ppm (8-hour average). The region, an attainment maintenance area for the old ozone standard since 1996, is expected to meet the new ozone standard as well. In addition to the current PM_{10} standards, the U.S. EPA adopted new federal air quality standards for particulate matter less than 2.5 microns ($PM_{2.5}$) in diameter. Although Puget Sound Clean Air Agency's preliminary analysis indicates that the region should be able to attain the U.S. EPA's revised standards for $PM_{2.5}$, the standard was ruled invalid by a federal court in May 1999. This action results in uncertainty about the new ozone and particulate standards, including PM_{10}.

Except for the PM_{10} standard in a small area, the central Puget Sound region is now in attainment for all criteria pollutants. The U.S. EPA re-designated the region to maintenance attainment status on October 10, 1996, for CO and on November 26, 1996, for ground-level ozone. Part of Seattle's Duwamish industrial district technically retains its non-attainment designation for PM_{10} even though all required SIP demonstrations have been made, and several years of clean air monitoring data have been collected by Puget Sound Clean Air Agency. In response to the U.S. EPA's revised 24-hour PM_{10} standard, the state has recently submitted a request to U.S. EPA to withdraw application of the old standard to this area.

Table 4.5-1
National, State, and Local Ambient Air Quality Standards

Pollutant	National		Washington State	Puget Sound Region
	Primary	Secondary		
Carbon Monoxide				
8-Hour Average	9 ppm	NS	9 ppm	9 ppm
1-Hour Average	35 ppm	NS	35 ppm	35 ppm
Ozone				
8-Hour Average	0.08 ppm	0.08 ppm	0.12 ppm*	0.12 ppm*
Lead				
Maximum Arithmetic Mean (averaged over calendar quarter)	1.5μg/m³	1.5μg/m³	NS	1.5μg/m³
Particulate Matter (PM_{10})				
Annual Arithmetic Average	50 μg/m³	50 μg/m³	50 μg/m³	50 μg/m³
24-Hour Average**	150 μg/m³	150 μg/m³	150 μg/m³	150 μg/m³
Particulate Matter ($PM_{2.5}$)* **				
Annual Arithmetic Average	15 μg/m³	15 μg/m³	*	*
24-Hour Average	65 μg/m³	65 μg/m³	*	*
Particulate Matter (TSP)				
Annual Geometric Average	NS	NS	60 μg/m³	NS
24-Hour Average	NS	NS	150 μg/m³	NS

Source: Puget Sound Clean Air Agency, 1996 Data Summary
Notes: NS – No standard established
* State and Puget Sound Clean Air Agency have not yet adopted the new standard. Enforceability of new standards questioned by federal appeals court (American Trucking Associations v. U.S. EPA, No. 97-1440, 1999 WL).
** Adjusted in 1997 by changing form of standard. That change was ruled invalid by a federal appeals court in May 1999.
*** New national standard in 1997. Status unsure, pending further briefing in American Trucking case.

Conformity Requirements

In the state of Washington, transportation projects located in maintenance and non-attainment areas are subject to the following conformity requirements imposed by the federal Clean Air Act (CAA) and the Washington Clean Air Act (WCAA):

- The federal CAA requires that transportation projects located in nonattainment and maintenance areas conform with the State Implementation Plan (SIP), the state's plan for meeting and maintaining compliance with the NAAQS. U.S. EPA regulations (40 CFR Parts 51 and 93) implement the Act. Conformity to a SIP means that transportation activities would not produce new air quality violations, worsen existing violations, or delay timely attainment of the NAAQS.
- The WCAA similarly states that approval or funding of a project within, or affecting, a nonattainment area is contingent on determining that it conforms with the SIP, as required by the federal CAA. In addition, under the state's Growth Management Act (GMA), projects that are regionally significant must be included in the Regional Transportation Plan (RTP) and the Transportation Improvement Program (TIP).

4.5.1.2 Air Quality Trends–No-build Conditions

Emission projections and ongoing monitoring throughout the central Puget Sound region indicate that the ambient air pollution concentrations for CO and PM_{10} have been decreasing over the past decade. Measured ozone concentrations, in contrast, have remained fairly static. The decline of CO is due primarily to improvements made to emission controls on motor vehicles and the rate of vehicle turnover to cleaner vehicles. Over time, however, other factors have the potential to counteract this downward emission trend. For example, each year more motor vehicles travel on the region's roadways, and people in the area are making more trips of greater distance. Estimates by the Puget Sound Regional Council (PSRC 1995) indicate that emissions of CO may turn upward as early as 2010, making renewed violations of CO standards possible. This situation could result in the region's redesignation to non-attainment status, forcing more stringent constraints on travel and economic growth, and the possible loss of state transportation funds for highway expansion (PSRC 1998).

4.5.2 Impacts and Mitigation

Air quality impacts are determined by using estimates of vehicle emissions, dispersion modeling, and by evaluating possible mitigation measures. Emission estimates were used both for a regional burden analysis (total production of specific pollutants) and as input to the computer dispersion model, which was used to calculate CO concentrations at specific intersections. The emission burden analyses were performed for 1995, 2010, and 2020. CO concentrations were calculated for current conditions (represented by the base year 1995), 2010 and 2020 No-build, and 2010 and 2020 Build alternatives. The year 2010, which is also the year used for PSRC's forecasts, was chosen for the SIPs. It is a reasonable point for the conformity analysis because it is close to the light rail service start-up (2006) and it coincides with the agency's forecasted emissions inventory, or its modeled air quality. The year 2020 was chosen to reflect a foreseeable forecast year that is consistent with adopted local and regional plans.

4.5.2.1 Regional Impacts

To compare Build versus No-build contributions to the regional airshed, tailpipe emissions of CO, volatile organic compounds (VOCs), and NO_X were estimated. MOBILE5b emission factors, in grams per vehicle mile traveled, along with projected vehicle miles traveled (VMT), helped estimate the daily mass emissions for each scenario analyzed. Table 4.5-2 summarizes the results of this analysis, showing the daily estimated emissions for the base year (1995), the design year (2010), and the forecast year (2020) for both the Build and No-build alternatives.

Table 4.5-2
Burden Analysis Emissions (metric tons/day) under the Build versus No-build Alternatives

Scenario	CO	VOC	NO_X
Base Year (1995)	1,454.1	150.3	180.1
2010 No-build	1,094.6	117.4	150.3
2010–MOS A–N.E. 45th to McClellan	1,092.5	117.1	150.0
2010–MOS B–Capitol Hill to Henderson	1,092.8	117.2	150.0
2010–MOS C–N.E. 45th to Lander	1,092.9	117.2	150.0
2010–N.E. 45th Street to SeaTac	1,091.8	117.1	149.9
2010–Northgate to SeaTac	1,091.7	117.1	149.9
2020 No-build	1,177.6	125.5	153.9
2020–MOS A–N.E. 45th to McClellan	1,173.9	125.1	153.5
2020–MOS B–Capitol Hill to Henderson	1,174.3	125.1	153.5
2020–MOS C–N.E. 45th to Lander	1,174.3	125.1	153.5
2020–N.E. 45th Street to SeaTac	1,173.4	125.0	153.4
2020–Northgate to SeaTac	1,173.0	125.0	153.3

Note: The preferred alternative is shown in italics.
Based on travel forecasts by PSRC, November 1998 and May 1999 (Includes running emissions only.)

As Table 4.5-2 shows, the Northgate to SeaTac, N.E. 45th to SeaTac (preferred alternative), and MOS alternatives would result in lower mobile source pollutant emissions as compared to the No-build Alternative. The analysis shows that the preferred alternative and all of the light rail alternatives would contribute to slight reductions in regional mobile source emissions.

4.5.2.2 Segment Impacts

The segment impacts were analyzed by predicting CO concentrations at the intersection level. The first task in the CO microscale (hotspot) analysis was to select intersections from which to evaluate localized air quality impacts. Air quality specialists undertook a multiple intersection screening study to identify locations requiring microscale air quality analysis. The procedure used year 2010 estimated P.M. peak hour traffic volume and LOS to select the study area roadway intersections most likely to produce CO violations under the project's Build alternatives.

The project's transportation impact analysis supplied information used in the intersection screening process. In addition to the regional highway and transit ridership modeling results, the transportation analysis included LOS calculations for intersections potentially affected by the light rail guideways, stations, and/or maintenance base site alternatives. The intersection screening process consisted of the following steps:

- Identify and rank the top 20 intersections by year 2010 estimated traffic volumes;
- Identify and rank the top 20 intersections by year 2010 LOS and average vehicular delay; and
- Select the locations for analysis from among the highest volume and worst LOS intersections.

Both the U.S. EPA and state guidance documents recommend selecting the top three intersections for modeling, but eight were modeled to provide reasonable geographical distribution, and to address locations where the project may increase vehicular congestion and delay. Table 4.5-3 lists the modeled locations, along with forecast 2010 total intersection traffic volumes, LOS, and average vehicle delay. The data shown are for alternatives that resulted in the highest projected delay in each segment prior to the inclusion of design changes or mitigation to improve LOS.

No intersections in downtown Seattle were selected for hotspot modeling because none satisfied the screening criteria. Even the worst downtown intersections had less delay, better levels of service, and lower traffic volumes than the eight intersections that were selected for modeling. This remains true during the forecast period with increased bus volumes.

Table 4.5-3
Intersection Screening Results—2010 Worst-Case Alternative (Before Mitigation)

Intersection	Alternative	PM Peak Hour Volume[1]	LOS/Delay (sec/veh)[2]
Mercer St./Fairview Ave. N.	B2.1/B2.2	7,872	F/1.26
Interurban Ave. S./S.W. Grady Way	No-build	6,623	F/2.13
Rainier Ave. S./MLK Jr. Way S.	D1.1	5,591	D/30.3
International Blvd./S. 200th St.	F1	4,880	F/1.34
Boeing Access Rd./MLK Jr. Way S.	E1.1	4,301	F/0.97*
International Blvd./S. 170th St.	F1	4,260	F/1.23
S. Othello St./MLK Jr. Way S.	D1.1	3,811	F/1.25*
S. 144th St./Tukwila International Blvd.	E1.1	3,412	F/1.32*

Notes: The preferred alternative is in italics.
* Subsequently improved to LOS D with design improvements.
[1] Combined Year 2010 intersection approach volume.
[2] Average intersection vehicular delay.

Modeled receptors were located on either side of the road, at sites accessible to the public, generally near intersection corners and near each approach and departure link. The receptors were placed no closer than 3 meters from the edge of the road. Project-related CO concentrations were predicted by the U.S. EPA's CAL3QHC model (U.S. EPA version 95221). This model is also conservative, meaning it tends to over predict emissions.

Although NAAQS exist for both the 1- and 8-hour averaging periods, historic monitoring data show that the 8-hour NAAQS of 9.0 parts per million (ppm) is more likely to be exceeded. Therefore, for the purposes of this document, only the 8-hour model results are reported. Table 4.5-4 summarizes these results for each intersection and for each alternative modeled. Of the eight intersections analyzed, three would exceed the 8-hour CO standard under the No-build Alternative in 2010 and in 2020:

- The intersection of Mercer Street/Fairview Ave. N. would exceed the standard in both 2010 and 2020, and the preferred alternative would not change CO levels from the No-build condition, indicating it would not be impacted by the project.
- The intersection of Rainier Ave. S./MLK Jr. Way S. would slightly exceed the CO standard in 2010 (9.1 ppm) under the No-build Alternative, but would improve to below the standard in 2020 (8.5 ppm). The preferred alternative would slightly reduce the CO concentration to the standard in 2010, and would maintain a level slightly below the standard in 2020.
- The intersection of International Boulevard at S.170th Street would meet the standard in 2010 but would exceed it in 2020 under No-build conditions. The intersection of International Boulevard/S. 200th Street would exceed the standard under No-build conditions in both 2010 and 2020. In both cases the preferred alternative would reduce CO concentrations as compared to the No-build Alternative.

Table 4.5-4
8-Hour CO Concentrations (in ppm) Under Existing Conditions, Build and No-build Conditions

Segment /Intersection	1998 Existing	2010 No-build	2010 Build Alternatives				2020 No-build	2020 Build Alternatives			
Segment B (University District to Westlake Station)	1998	NB	*B1*	B2.1	B2.2		NB	*B1*	B2.1	B2.2	
Mercer St./Fairview Ave. N.	12.7	10.4	10.4[1]	10.4[1]	10.4[1]		11.3	11.3[1]	11.3[1]	11.3[1]	
Segment D (S. McClellan St. to Boeing Access Rd.)	1998	NB	*D1.1*	D1.3	D3.3	D3.4	NB	*D1.1*	D1.3	D3.3	D3.4
Rainier Ave. S./MLK Jr. Way S.	10.6	9.1	9.0	8.8	8.6	8.6	8.5	8.8	8.8	8.7	8.7
S. Othello St./MLK Jr. Way S.	9.0	8.1	8.2	8.1	8.1	8.1	8.5	7.7	7.7	8.1	8.1
Segment E (Tukwila)	1998	NB	*E1.1*	E1.2	E2	E3	NB	*E1.1*	E1.2	E2	E3
Interurban Way S./Grady Way	8.3	7.9	7.9	7.9	7.9	7.9	6.9	6.9	6.9	6.9	6.9
Boeing Access Rd./MLK Jr. Way S.	7.4	6.0	6.0	6.0	6.0	6.0	6.5	6.2	6.2	6.2	6.2
S. 144th St./Tukwila International Blvd.	8.7	7.6	8.0	7.8	7.6[1]	7.6[1]	7.0	7.9	6.9	7.0[1]	7.0[1]
Segment F (SeaTac)	1998	NB	F1	*F2*	F3	F4	NB	F1	*F2*	F3	F4
International Blvd./S. 170th St.	9.5	8.5	8.5	8.4	8.5	8.4	10.0	8.7	9.9	9.9	9.9
International Blvd./S. 200th St.	10.4	9.1	9.0	8.6	9.0	9.0	10.1	9.4	9.5	9.5	9.3

Notes: [1] Indicates that no-build concentrations are reported based on traffic analysis.
*Segments A and C had no intersections deemed likely to produce CO violations, based on the screening criteria for traffic volumes or operating conditions.
Preferred alternative is noted in italics.

For some locations, (e.g., Mercer Street/Fairview Avenue N.), the traffic analysis indicated that volumes and turning movements would be the same for all light rail alternatives as for the No-build condition, so there would be no change in air quality. Also, in most cases there would little or no difference between the alternatives. Potential CO standard exceedances were initially associated with Alternative F1 at two intersections in SeaTac. In both cases, the F1 design was changed to reduce the predicted CO concentrations to the same as or better than the No-build Alternative in both 2010 and 2020. At International Boulevard/S. 170th Street one through lane was added to both the east and west approaches, a second right-turn lane was added for the eastbound to southbound movement, and signal timing changes were included. At International Boulevard/S. 200th Street, one additional through lane was added to both the east and west approaches, resulting in two through lanes plus left- and right-turn lanes on all four approaches. These changes brought Alternative F1 into conformity.

No new violations of the federal air quality standards would occur with any of the build alternatives, and no increase in the frequency or severity of any existing violation of the standard would occur.

4.5.2.3 Mitigation

No mitigation is necessary.

4.5.2.4 Conformity Determination

Projects located in nonattainment or maintenance areas for a given pollutant must comply with provisions of the 1990 Clean Air Act Amendments. They also must comply with the promulgated state and federal rules that require a determination of conformity with the SIP. The light rail project is located in the Puget Sound region, a maintenance area for both CO and ozone.

The proposed project is included in the 1995 MTP and the 1998 TIP, both of which have been found to meet the conformity tests as identified by federal and state conformity regulations.

The results of the CO concentrations analysis at specific intersections show that neither the preferred alternative, nor other build alternatives would create a new CO violation of the NAAQS, and they would not worsen an existing violation. Therefore, the project would conform to the Washington SIP.

Currently no U.S. EPA-approved method exists for quantitatively predicting ozone concentrations at a given intersection. Photoreactive VOCs are a precursor to ozone formation in and around urban areas. Based on the emissions burden analysis performed for the project, all of the length alternatives (Northgate to SeaTac, N.E. 45th to SeaTac, and MOS A, B and C) would result in slight reductions in daily VOC emissions as compared to the No-build Alternative. These reductions can be attributed to small project-related decreases in vehicle trips and VMT. As a result, the project would also conform to the SIP for ozone.

4.5.3 Significant Unavoidable Adverse Impacts

No significant unavoidable adverse air quality impacts are anticipated as a result of the light rail project.

4.6 NOISE AND VIBRATION

4.6.1 Noise and Vibration Metrics and Standards

The Federal Transit Administration (FTA) has developed criteria for assessing noise impacts related to light rail transit projects. The standards outlined in the Transit Noise and Vibration Impact Assessment (FTA 1995) are founded on research on community reaction to noise. The standards evaluate changes in existing noise conditions using a sliding scale; thus, the higher the level of existing noise, the less allowance there is for the light rail project to contribute additional noise. The evaluation has several steps.

The first step is to determine an appropriate measurement unit. The basic unit of measurement for noise is the decibel. To better account for human sensitivity to noise, decibels are measured on the "A-scale," abbreviated dBA.

Next, the appropriate length of time to measure noise (e.g., single events versus hourly or daily averages) must be determined. FTA criteria and the Final EIS focus on average noise conditions over a 24-hour period. Noise that occurs at night (between 10:00 P.M. and 7:00 A.M.) is given a 10-dBA penalty. This is known as a Day Night Equivalent Level, abbreviated L_{dn}. A rural area with no major roads nearby would average around 45 dBA (L_{dn}), while a noisy residential area close to a major freeway would average around 70 dBA (L_{dn}). Most of the residential areas in the study corridor fall within this latter range. Figure 4.6-1 provides other typical L_{dn} values for rural and urban areas. Equivalent sound levels that are not weighted for night-time noise are expressed as L_{eq}.

The next step is to determine the types of areas being affected. Some environments, for example, are more sensitive to noise than others (parks, churches, and residences are more noise sensitive than industrial and commercial areas). The FTA Noise Impact Criteria group sensitive land uses into the following three categories:

- Category 1: Buildings or parks where quiet is essential to their purpose.
- Category 2: Residences and buildings where people normally sleep. This includes residences, hospitals, and hotels where nighttime sensitivity is assumed to be of utmost importance.
- Category 3: Institutional land uses (including schools, libraries and churches)with primarily daytime use that depend on quiet as an important part of operations.

The remaining steps, outlined in Section 4.6.3, are to choose monitoring locations, measure existing daily noise levels, and calculate the project's impacts on those levels.

In addition to light rail noise, this section evaluates traffic noise impacts that are caused by light rail-related changes in roadway alignments. Traffic noise impacts are evaluated using WSDOT and FHWA procedures. The EIS also considers the potential impacts of vibration from light rail operations. Ground-borne vibration is a small, but rapidly fluctuating motion transmitted through the ground. Although ground-borne vibration diminishes (or "attenuates") over distance, some soil types transmit the vibration quite efficiently, while others do not. The response of humans, buildings and sensitive equipment to vibration is described in this section in terms of the root-mean-square (RMS) velocity level in decibel units (VdB). As a point of reference, the average person can just barely perceive vibration velocity levels below 70 VdB. Figure 4.6-2 compares typical ground-borne vibration levels.

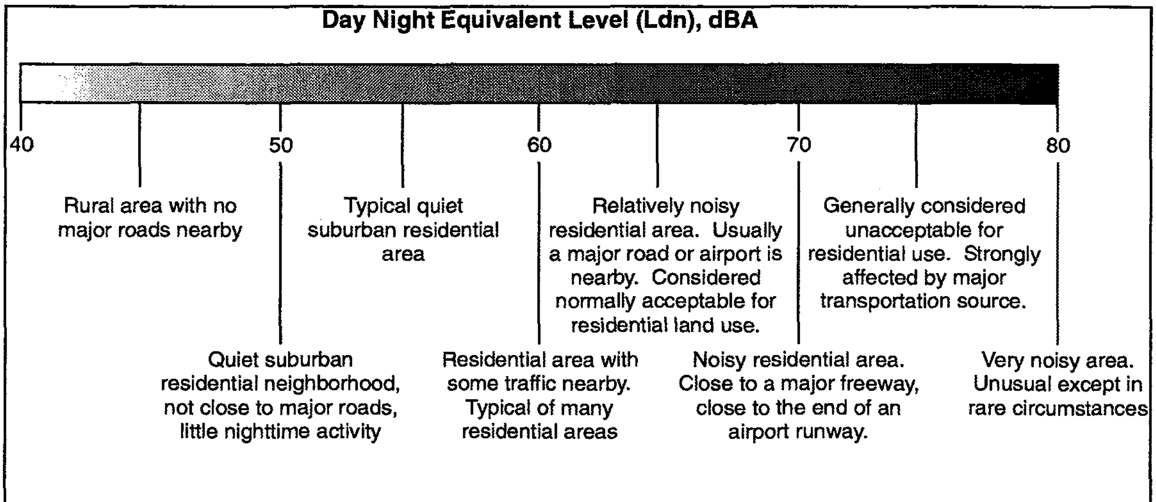
4.6.2 Existing Noise and Vibration Environment

Project staff inspected the study area for noise-sensitive and vibration-sensitive land uses, identified appropriate locations for noise and vibration monitoring, and measured noise levels at 32 locations along the route alternatives and near proposed station locations.

Figure 4.6-3 shows the monitoring locations, with the noise monitoring sites numbered NM1 to NM33. The FTA land use categories identify the types and use(s) of structures along the corridor.

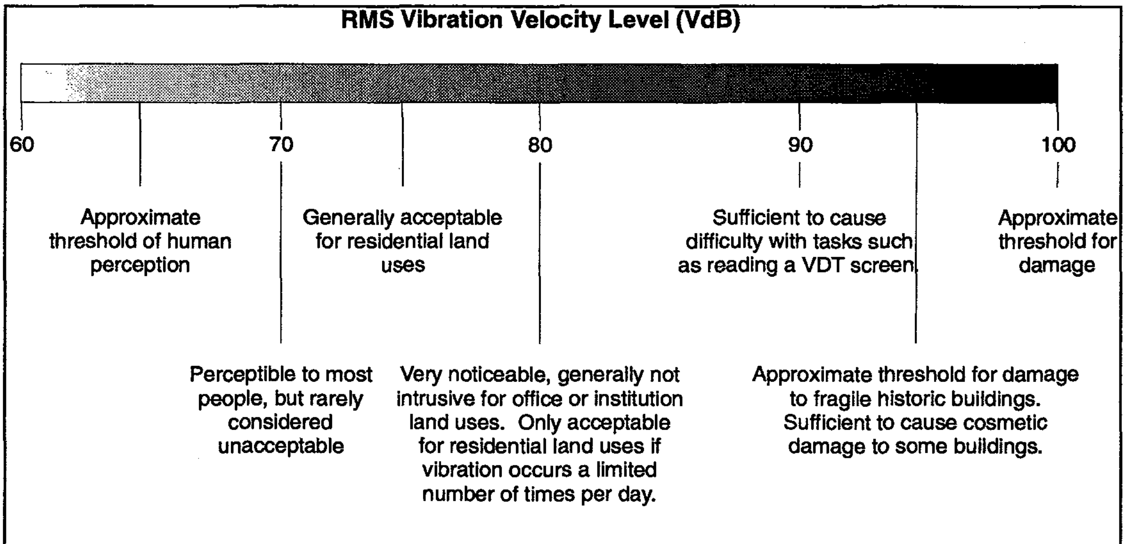
Vibration impacts for the light rail project were determined using the measured vibration propagation levels and information contained in the Transit Noise and Vibration Impact Assessment (FTA 1995). Project staff examined corridor geology and conducted vibration propagation tests at 12 representative locations to measure the efficiency of vibration propagation for the different geologic conditions along the corridor. Vibration tests were performed at the surface and at the bottom of bore holes. The surface tests were performed in areas where the alignment would be at-grade, and the bore hole tests were performed for tunnel segments. Additional tests were also performed at two locations on the existing Downtown Seattle Transit Tunnel (DSTT). The vibration test sites are numbered V1 through V11 (Figure 4.6-3). An additional test (V12), performed in the BNSF tunnel in Everett, and measurements of Portland's existing light rail system, were used to obtain a base line for the proposed Link subway operations near the University of Washington Physics and Astronomy Building.

Figure 4.6-1
Typical L_{dn} Values for Rural and Urban Areas



Source: FTA, April 1995

Figure 4.6-2
Typical Levels of Ground-borne Vibration



Source: FTA, April 1995

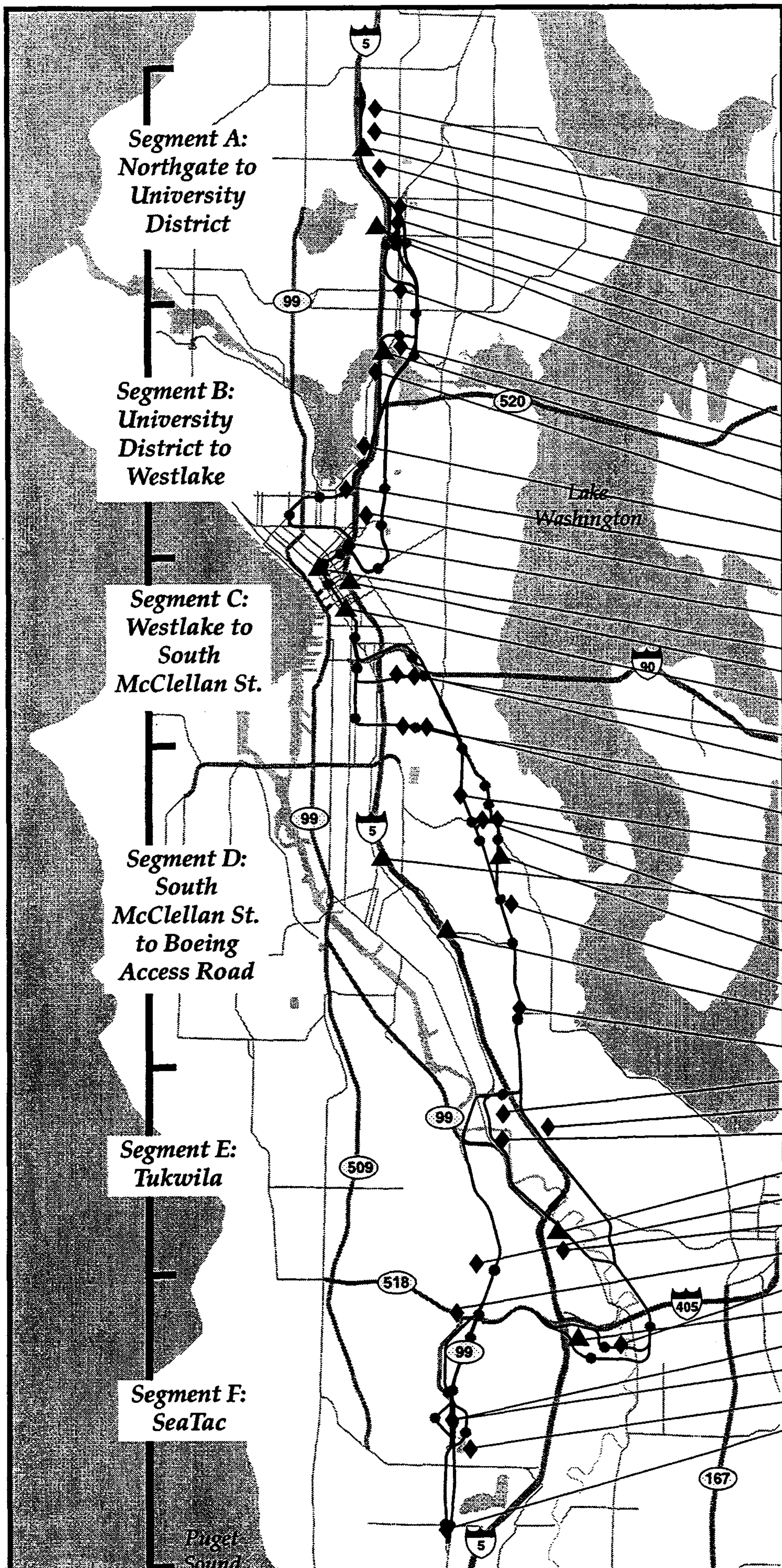


Figure 4.6-3 Noise and Vibration Monitoring Locations

Site	Ldn/Leq	Testing Methods
NM1	72/70	
NM2	76/74	
V1		Surface
NM3	72/69	
NM4	72/71	
NM5	75/73	
V2		Subsurface
NM6	72/69	
NM7	68/67	
NM8	64/62	
V3		Subsurface
NM9	71/71	
NM10	70/67	
NM11	64/61	
NM12	66/64	
NM13	67/65	
V5		Subsurface
V4		Subsurface
V6		Subsurface
NM14	66/64	
NM15	70/68	
NM16	69/67	
NM17	63/64	
NM18	71/71	
NM19	72/73	
V7		Surface
NM20	69/72	
V8		Subsurface
NM21	61/60	
V9		Surface
NM22	70/68	
NM23	63/61	
NM24	69/68	
NM25	70/69	
V10		Surface
NM26	67/64	
NM27	69/67	
NM28	71/67	
NM29	64/62	
V11		Surface
NM30	71/68	
NM31	66/64	
NM32	66/64	
NM33	68/67	

◆ Noise Monitoring Sites NM1 through NM33

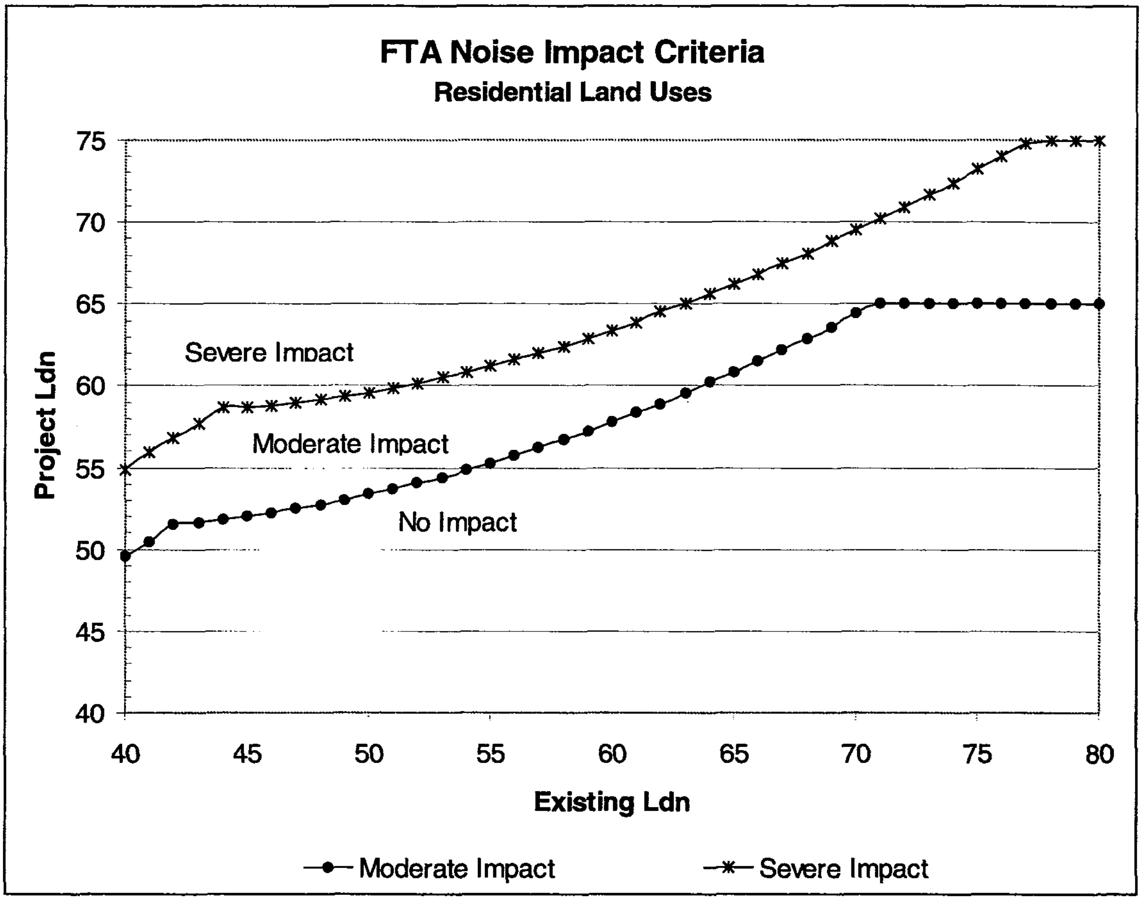
▲ Vibration Test Sites V1 through V11

Note: V12 not shown

0 1 2
MILES

SOUNDTRANSIT

Figure 4.6-4
FTA Noise Impact Criteria



The following discussion describes the existing land use, noise environment, and vibration propagation characteristics for the project corridor.

Segment A (Northgate to University District)

Land use in the Northgate Segment is predominantly single- and multi-family residential (category 2) and commercial and retail (category 3). Monitoring locations NM1 through NM4 characterize the existing noise environment for the northern end of this segment. Traffic noise from I-5 dominates area noise levels, with peak hour noise levels of 69 to 74 dBA, depending on the distance from the roadway. L_{dn} values at front-line residences near this area were measured at 72 dBA.

In the central and southern end of this segment, land use is still primarily a mixture of single- and multi-family residential, intermixed with commercial land use along local arterial and collector roadways. Monitoring locations NM4 through NM6 characterize the existing environment for these areas. Receivers located near I-5 or major arterial roadways, such as Ravenna, Lake City Way, or N.E. 12th Avenue, have existing estimated L_{dn} values of 72 dBA, and peak hour noise levels of 69 to 73 dBA L_{eq}.

In this segment, major vibration sources include heavy trucks, buses, and local construction activities.

Segment B (University District to Westlake)

Land use includes category 2 (single- and multi-family residential, hospitals, hotels), category 3 (schools), and commercial and industrial. Monitoring locations NM7 through NM10 characterize the existing noise environment. Noise-producing sources include traffic, commercial and residential activities. Project staff measured the L_{dn} at 67 dBA near the proposed alternatives in the University of Washington area, and peak hour levels registered at 67 dBA L_{eq}. Noise levels were slightly lower near Portage Bay, with an L_{dn} of 64 dBA, and a peak hour L_{eq} value of 62 dBA.

On the south side of Portage Bay, measured L_{dn} values ranged from 70 to 71 dBA. Measured peak hour values for receivers located near the proposed alternatives, stations, and tunnel portals were at 67 to 71 dBA. Land use south of Portage Bay is primarily high-density residential and commercial.

Major vibration sources in Segment B include heavy trucks, buses, and local construction activities.

Segment C (Westlake to S. McClellan Street)

Land use in this segment includes primarily commercial (downtown Seattle) and industrial uses along the west side of Interstate 5. Multi- and single- family residential, along with commercial and light industrial uses, are on the east side of Interstate 5 and along Rainer Avenue S. Monitoring locations NM11 through NM17 characterize the existing noise environment. Existing 24-hour L_{dn} values at residential areas range from 63 to 70 dBA. Measured peak hour noise levels near the commercial and industrial areas were 61 to 65 dBA L_{eq}.

Major vibration sources include freight train traffic on the existing BNSF mainline tracks, buses, heavy trucks, and ongoing construction activities.

Segment D (S. McClellan to Boeing Access Road)

Land use in the northern end of this segment supports a mixture of category 2 (high-density multi-family residential), and category 3 (commercial and industrial activities). Major noise sources include traffic on I-5 and other major arterial and collector roadways (Rainier Avenue S. and MLK Jr. Way S.), aircraft fly-overs, and activities in commercial and industrial areas. Monitoring locations NM18 through NM22 characterize the existing noise environment in this segment.

Project staff measured existing L_{dn} values at residential areas located along MLK Jr. Way S. and Rainier Avenue at levels from 69 to 72 dBA. Receivers located off these major arterial roadways indicate future estimated L_{dn} noise levels of 61 dBA. Commercial and industrial uses in this segment currently have peak-hour L_{eq} noise levels of 60 to 72 dBA.

Major vibration sources include heavy trucks, buses, and local construction activities.

Segment E (Tukwila)

Land use in the Tukwila Segment includes category 2 (single- and multi-family residential, and hotels), as well as hospitals, along with commercial and industrial areas. Noise sources in this segment include traffic on I-5 and I-405, and other major arterial and collector roadways, aircraft fly-overs, freight trains and commercial and industrial activities. Noise monitoring locations NM23 through NM29 characterize the existing noise environment in this segment.

Residences and hotels near major roadways, such as I-5, Interurban Avenue, and Tukwila International Boulevard have estimated 24-hour L_{dn} noise levels of 67 to 71 dBA. Commercial and industrial uses along the same roadways have peak-hour noise levels of 67 to 69 dBA L_{eq}. Other locations near the proposed alternatives currently have L_{dn} noise levels of 63 to 67 dBA, with peak-hour noise levels of 61 to 67 dBA L_{eq}.

Major vibration sources in the Tukwila segment include freight train tràffic, buses, heavy trucks, and ongoing construction activities. Maximum vibration near the BNSF mainline during a freight pass-by could reach 80 VdB within 100 ft of the track.

Segment F (SeaTac)

Land use in the SeaTac segment is primarily commercial, with some residential, hotels, and motels located near the proposed alternatives. Noise sources include aircraft from Sea-Tac Airport, traffic on International Boulevard and other arterial and collector roadways, and miscellaneous commercial activities. Noise monitoring locations NM30 through NM33 characterize the existing noise environment.

Project staff measured noise levels along International Boulevard at 71 dBA L_{dn} with peak hour noise levels of 68 dBA. South of the airport, L_{dn} values were lower at 66 to 68 dBA, with peak hour levels of 64 to 67 dBA. The measured 24-hour L_{dn} noise level for the Bow Lake residential area was 68 dBA. Night time (10:30 P.M.) L_{eq} was measured at 63 dBA.

Current regulations require that Sea-Tac Airport update its noise study to reflect the newer fleet of quieter airplanes and the fly quiet program. Because the noise analysis is based on the measured existing noise levels, the airports programs would have no effect on the levels of impacts related to this project.

Primary vibration sources in the SeaTac segment include buses, heavy trucks, and ongoing construction activities.

4.6.3 Impact Assessment Methods

This section summarizes the methods used to estimate noise and vibration levels, and the criteria used to assess impacts.

4.6.3.1 Light Rail Noise Assessment Method

Noise levels generated by light rail operations are a function of speed and vehicle length, track type, the number of trains operating in the daytime and nighttime hours, and the distance from the tracks to sensitive receptors. In areas where the trains would operate in a right-of-way shared with vehicular traffic, warning horns and bells may also be a noise source, but would only be used in emergencies. Steel wheels rolling on steel rails are usually the major cause of noise from light rail vehicles, although noise from the motor ventilation system may sometimes be noticeable.

To perform the noise analysis for this project, staff used the five steps listed here:

1. Inspect project area and categorize existing land use (see Section 4.6.2).
2. Measure or compute the existing area noise levels.
3. Calculate the project-related noise levels.
4. Combine the project-related noise levels with the existing noise levels, and compare the change in noise levels to FTA criteria (see below and Figure 4.6-4). The criteria are based on L_{dn}, a 24-hour average noise level with a 10 dBA penalty added to noise generated at night.
5. Identify impacts and investigate mitigation measures.

The project's noise levels were compared to the impact thresholds of the FTA criteria curves, (Figure 4.6-4), which define the range of no impact, moderate impact, and severe impact for varying existing noise and project-induced noise levels. FTA requires that mitigation be evaluated for all areas where moderate impacts are projected, although consideration of factors such as cost-effectiveness can be incorporated into the decision about whether to specify mitigation for a particular area. FTA considers severe impact to be a "significant adverse effect" under NEPA.

4.6.3.2 Light Rail Vibration Assessment Method

Vibration impacts, which resonate from the wheel/rail interface, are influenced by wheel/rail roughness, transit vehicle suspension, train speed, track construction, location of switches and crossovers, and the geologic strata underlying the track. Vibration from a passing light rail train moves through the geologic strata into building foundations, causing the building to vibrate. Ground-borne vibration is of such a low level that, for this project, there is almost no possibility of structural damage to buildings near the route. The main concern is that it can be annoying to building occupants.

The procedures used to evaluate potential impacts from ground-borne vibration and ground-borne noise follow those outlined in the Transit Noise and Vibration Impact Assessment (FTA 1995). For a complete description of the vibration analysis methods, see the Central Link Noise and Vibration Technical Report.

The vibration propagation characteristics used for the projections were based on the measurements at 12 propagation test sites (Figure 4.6-3).

The propagation results provide an estimate of vibration levels as a function of distance from the tracks. Adjustments are then used to account for train speed, mitigation measures, and building foundation. In addition, a 5-decibel safety factor has been incorporated into all of the ground-borne vibration and ground-borne noise projections, to account for the normal fluctuations in ground-borne vibration, and to ensure that the projections are not underestimated. The ground-borne vibration and ground-borne noise criteria contained in the FTA manual are summarized in Tables 4.6-1 and 4.6-2.

4.6.3.3 Traffic Noise Assessment Method

For several of the alternatives in Segments A, C, D, E, and F, light rail construction could modify the existing streets to accommodate the light rail. Where the roadway edge would be moved closer to residences, and could cause an increase in the levels of traffic noise, the potential noise impacts have been assessed using Washington State Department of Transportation (WSDOT) and Federal Highway Administration (FHWA) procedures. The future noise levels were compared to the WSDOT impact criteria shown in Table 4.6-3, which are based on the average peak hour noise level, rather than on a 24-hour average. Transportation sources in public rights-of-way are exempt from local noise ordinances. The table shows that if the future noise levels are less than 66 dBA exterior, or 51 dBA interior, there is no impact. Commercial and industrial land uses have exterior criteria of 71 dBA for impacts. In addition to the criteria given in Table 4.6-3, WSDOT also considers traffic noise impacts to occur if future traffic noise levels are 10 dBA over the existing noise levels. The traffic analysis was performed using projected year 2020 traffic volumes and speeds.

Table 4.6-1
FTA Ground-Borne Vibration Impact Criteria

Land Use Category	Ground-Borne Vibration Impact Levels (VdB re 1 inch/sec)		Ground-Borne Noise Impact Levels (dB re 20 μPa)	
	Frequent[1] Events	Infrequent[2] Events	Frequent[1] Events	Infrequent[2] Events
Category 1: Buildings where low ambient vibration is essential for interior operations.	65 VdB[3]	65 VdB[3]	–[4]	–[4]
Category 2: Residences and buildings where people normally sleep.	72 VdB	80 VdB	35 VdB	43 dBA
Category 3: Institutional land uses with primarily daytime use.	75 VdB	83 VdB	40 dBA	48 dBA

Notes: [1] Frequent Events are defined as more than 70 vibration events per day. Most rapid transit projects fall into this category.
[2] Infrequent Events are defined as fewer than 70 vibration events per day. This category includes most commuter rail systems.
[3] This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research will require detailed evaluation to define acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC system and stiffened floors.
[4] Vibration-sensitive equipment is not sensitive to ground-borne noise.

Table 4.6-2
FTA Ground-Borne Vibration Impact Criteria for Special Buildings

Type of Building or Room	Ground-Borne Vibration Impact Levels (VdB re 1 inch/sec)		Ground-Borne Noise Impact Levels (dB re 20 μPa)	
	Frequent[1] Events	Infrequent[2] Events	Frequent[1] Events	Infrequent[2] Events
Concert Halls	65 VdB	65 VdB	25 dBA	25 dBA
TV Studios	65 VdB	65 VdB	25 dBA	25 dBA
Recording Studios	65 VdB	65 VdB	25 dBA	25 dBA
Auditoriums	72 VdB	80 VdB	30 dBA	38 dBA
Theaters	72 VdB	80 VdB	35 dBA	43 dBA

Notes: [1] Frequent Events are defined as more than 70 vibration events per day. Most rapid transit projects fall into this category.
[2] Infrequent Events are defined as fewer than 70 vibration events per day. This category includes most commuter rail systems.

Table 4.6-3
WSDOT Traffic Noise Criteria

Land Use Category	Hourly Leq (dBA)
Type A: For lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose	56 (exterior)
Type B: Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, (exterior) motels, hotels, schools, churches, libraries and hospitals	66 (exterior)
Type C: Developed lands, properties or activities not included in the above categories	71 (exterior)
Type D: Undeveloped land	–
Type E: Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums	51 (interior)

Note: Impact criteria are based on the FHWA approach or exceed criteria. The WSDOT approach assumes that within one dBA of the criteria an impact occurs.

4.6.4 Impacts

Table 4.6-4 summarizes existing and projected noise levels (traffic and light rail noise) at the noise monitoring locations shown in Figure 4.6-3. Tables 4.6-5 and 4.6-6 summarize the number of impacted receivers for each alternative, both with and without potential mitigation. The impacts are grouped according to the amount that the projected noise or vibration levels would exceed the relevant impact criteria. To reduce noise impacts as discussed in Section 4.6.5, the mitigation analysis modeled different combinations of noise walls, building insulation and street and track design options.

Unless otherwise noted, impacts discussed below are moderate. Most impacted receivers are residential (Category 2 uses). A more detailed discussion of the noise and vibration impacts is given in the Noise and Vibration Technical Report.

Segment A (Northgate to University District)

A1.1 (12th Avenue N.E. Tunnel). Noise impacts are projected for four multi-family structures at N.E. 95th Street. Four additional impacts were identified at the single-family residences near First Avenue N.E. and N.E. 85th Street.

No vibration impacts are projected for the above-grade sections, although ninety-five potential vibration impacts are projected for the tunnel sections. The projected impacts would be at eight residences north of Lake City Way N.E. and 87 residences south of the station near N.E. 64th Street.

A1.2 (Roosevelt Way Tunnel). The projected noise impacts would be identical to those of Alternative A1.1. A total of 100 potential vibration impacts is projected for the tunnel section, affecting 22 residences north of Lake City Way N.E. and 78 residences south of the station at N.E. 64th Street.

A2.1 (8th Avenue N.E. Short Elevated). North of N.E. 76th Street, Alternative A2.1 has the same impacts as Alternative A1.1. In addition to the eight projected noise impacts north of N.E. 85th Street, there would be four additional impacts along the short elevated section. This alternative would also have potential traffic noise impacts to several single-family residences and a church located near N.E. 62nd Street. Three potential traffic noise impacts are projected due to the relocation of the Ravenna Boulevard off-ramp from I-5.

A total of 11 potential vibration impacts is projected for the tunnel sections, affecting four residences on the east side of the northern tunnel section and seven residences along the southern tunnel section, between N.E. 56th and N.E. 53rd streets.

A2.2 (8th Avenue N.E. Elevated). North of N.E. 76th Street, Alternative A2.2 is identical to A2.1. In addition to the eight projected noise impacts north of N.E. 76th Street, there would be 14 additional impacts along the elevated section. Potential traffic noise impacts would be the same as those in A2.1.

Vibration impacts would be similar to A2.1, but with an additional ten residences affected between N.E. 68th and N.E. 66th streets.

Segment B (University District to Westlake Station)

B1 (Capitol Hill Tunnel–preferred alternative). This alternative is entirely within a tunnel, and is deep enough so that no noise or vibration impacts are projected except as described below under "University of Washington Additional Vibration Analysis."

B2.1 (Seattle Center via High-level Bridge). A total of 23 noise impacts is projected, all near the north and south approaches to the Portage Bay Bridge. In all, 25 vibration impacts are projected at several University of Washington buildings and several residences just to the north and south of the portal at E. Gwinn Place. Vibration impacts are projected as well at seven residences scattered along the tunnel segments south of SR 520.

B2.2 (Seattle Center via Portage Bay Tunnel). No noise impacts are projected. South of SR 520, a total of seven residences scattered along the tunnel segments is projected to have vibration impacts.

University of Washington Additional Vibration Analysis. Additional analysis and ongoing design have been conducted as part of the Final EIS to evaluate the effects of light rail operations on the research activities at the University of Washington. For all Segment B alternatives, the vibration analysis indicates ground-borne vibration would not interfere with most vibration-sensitive equipment. However, some of the physics research performed in laboratories in the Physics and Astronomy Building (PAB) is uniquely sensitive to vibration and the proposed Life Sciences III Building would be located directly above the preferred alternative. Representatives of the UW Physics Department expressed concerns that vibration at frequencies below 1 Hz would interfere with gravity experiments. To provide a better understanding of the levels of light rail ground-borne vibration in the physics and life sciences laboratories, detailed evaluations of vibration levels in the physics research laboratories were performed. The goals of the analyses were to (1) determine whether ground-borne vibration from train operations would compromise use of the physics labs for vibration-sensitive experiments, and (2) evaluate mitigation measures to minimize vibration. The investigation included:

- Measurements of ambient vibration inside one of the physics labs.
- Vibration propagation measurements using a vibration wave created by an impact at the bottom of a borehole drilled near the northeast corner of 15th Avenue and Pacific Street. Vibration propagation was measured from the bottom of the hole to the ground surface and into one of the physics labs.

- Detailed measurements of ground-borne vibration and vibration propagation at the recently opened Westside tunnel on the Portland Tri-Met light rail system.
- A numerical model to estimate the static deflection of the ground that would be caused by a train in a tunnel. The static deflection was used to estimate levels of very low frequency vibration.

Details of the analysis are summarized in two reports, "Low Frequency Ground Vibration, Physics Astronomy and Life Science Buildings, University of Washington," and "High Frequency Vibration, Physics and Astronomy and Life Science Buildings, University of Washington" (PSTC 1999). The reports include seismic measurements performed by the University of Washington Geophysics Department, vibration measurement data from Tri-Met Westside Subway Tunnel in Portland, and details of the numerical model used to evaluate very low frequency vibration. The conclusions of these analyses are:

1. Mitigation of ground vibration at the Life Sciences Building III would be more effective with air spring isolated floors or equipment tables than floating slab in the tunnel. Based on the data presented in the reports, the most effective vibration mitigation for the PAB and Life Sciences III buildings is a passive air spring isolation system. This type of system can either be used for a table or workbench where individual vibration-sensitive equipment is operated or can be used to support a concrete floor slab to isolate an entire room.
2. The expected ground vibration levels at 6.3 Hz and higher, from the Sound Transit light rail vehicles, would exceed the ambient acceleration levels on the U.W. Physics laboratory's seismic pier by 5 to 7 dB in the frequency range of 8 to 10 Hz and by 6 to 14 dB in the frequency range above 31.5 Hz. The use of floating slab in the tunnel would substantially reduce the ground vibration at 20 Hz and above. At 12.5 Hz and 16 Hz the resonant frequencies of the floating slab there would be a 3 to 4 dB increase in vibration levels. The resulting mitigated vibration level would be 4 dB higher than the measured vibration at 10 Hz and would be 2 to 16 dB lower at 12.5 Hz and above. An air spring isolation system on the seismic pit, however, would substantially reduce light rail vibration levels at 6.3 Hz and above by more than 10 dB below the ambient.
3. Very low frequency vibration (below 6 Hz) would not be detectable inside the physics laboratories.
4. Very low frequency vibration (below 6 Hz) inside the planned Life Sciences III building may be higher than ambient vibration. However, most vibration-sensitive instruments that would be used in the building, including electron microscopes and other imaging instruments, are relatively insensitive to very low frequency vibration. Potential for interference from light rail-induced ground-borne vibration can be minimized through the use of standard vibration isolation mounting systems for instruments that are particularly sensitive to vibration.
5. The numerical model indicates that the following mitigation measures would result in no significant reduction of very low frequency vibration: (1) filling the utility chamber in the station platform tunnel with concrete; (2) increasing the stiffness of the running tunnel and station platform tunnel invert; and (3) constructing a concrete slurry wall along the station, between the station and the Physics Laboratory.

Segment C (Westlake Station to S. McClellan Street)

C1 (S. Lander Street, Includes C.1, C1.2, C1.3, C1.4, and C1.5 Tunnel–preferred alternative). No light rail noise, vibration or traffic impacts are projected for any of the five options of the C1 alignment alternative, because it is routed through the south Seattle industrial area and in a tunnel through Beacon Hill.

C2.3 (West of Rainier Avenue S. – Elevated). Impacts are projected at 15 single- and multi-family residences between S. Walker and S. Bayview streets. Revisions to traffic flow patterns along Rainier Avenue S. would occur only in the commercial district and are not expected to result in any traffic-related noise impacts. One potential vibration impact is projected.

C2.4 (Rainier Avenue S. Tunnel). No noise or vibration impacts are projected for this alternative.

C3 (S. Massachusetts Street). No noise impacts are projected for the south Seattle industrial or tunneled sections from either light rail or traffic. Sixteen potential residential noise impacts were identified along the elevated structure on Rainier Avenue S. A total of 13 potential vibration impacts is projected for this alternative, primarily at residences near the tunnel just north of the station at S. Atlantic Street.

Segment D (S. McClellan Street to Boeing Access Road)

D1.1e (MLK Jr. Way S. – At-grade, 4-lane 93 ft cross-section – preferred alternative). This alternative is projected to have 52 moderate light rail noise impacts. The potential noise impacts would be primarily at front-line residences bordering MLK Jr. Way S. A total of 231 traffic noise impacts are projected due to the relocation of the roadway alignment. All of the 52 receptors with potential light rail impacts would also have traffic noise impacts. Most of the front-line receivers along MLK Jr. Way S. currently have existing noise levels that meet or exceed the traffic noise abatement criteria.

No vibration impacts were identified under this alternative.

D1.1c (MLK Jr. Way S. – At-grade, 4-lane 104 ft cross section). Light rail noise impacts under this alternative are the same as given under Alternative D1.1e. The potential exists for 299 traffic-related impacts.

No potential vibration impacts are projected along MLK Jr. Way S.

D1.1d (MLK Jr. Way S. – At-grade, 2-lane 90 ft cross section). Light rail noise impacts would be similar to Alternative D1.1c, although six more impacts are projected (58 total) in D1.1d because it includes buildings that would be displaced by D1.1c. All but 14 of the 299 traffic-related noise impacts in D1.1c are eliminated under this alternative because no major widening of the roadway is planned. Furthermore, the elimination of one travel lane in each direction north of S. Henderson Street is expected to result in an overall reduction in future traffic noise levels.

Six vibration impacts were identified under this alternative displaced at structures by other D1.1 alignments.

D1.1f (MLK Jr. Way S. – At-grade, 2-lane, 90 ft cross section). Light rail noise impacts under this alternative are the same as given under alternative D1.1e. There are only 14 traffic noise impacts projected.

Six vibration impacts were identified under this alternative.

D1.3 (MLK Jr. Way S. – Combined Profile). There would be 241 light rail noise impacts with the combined profile alternative. The increase over Alternative D1.1c is primarily due to higher train speeds on the elevated structure and the inherently higher noise levels when trains operate on elevated structures. The light rail-related noise impacts on the at-grade track sections are the same as for Alternative D1.1c. There were 273 traffic noise impacts identified, again due to the widening of MLK Jr. Way S. to accommodate the light rail.

Seven potential vibration impacts are projected for this alternative, all to front line residences near S. Kenyon Street

D3.3 (S. Alaska Street Crossover). With D3.3, 129 light rail-related noise impacts are projected, four of which would be considered severe under FTA criteria. No traffic-related noise impacts are expected along the Rainier Avenue S. segment because changes are planned in the roadway alignment. However, traffic-related noise levels would increase at some receivers due to the removal of front-line blocking structures. Once the alternative transitions over to MLK Jr. Way S., realignment of the roadway to accommodate the tracks would result in the potential for 205 traffic related noise impacts.

This alternative has the potential for 58 vibration impacts, all of which would occur north of S. Hudson Street.

D3.4 (37th Avenue S. Tunnel). This alternative is projected to have 124 light rail-related noise impacts, none of which would be considered severe. There would be 139 projected traffic noise impacts along MLK Jr. S., again due to the roadway being realigned closer to the residences.

A total of 79 potential vibration impacts is projected under this alternative. Most potential impacts would occur north of the tunnel. The remainder of the potential impacts are located in two areas around the tunnel: at the beginning of the tunnel (south of S. Edmunds Street) and at the end of the tunnel (south of S. Juneau Street).

Segment E (Tukwila)

E1.1 (Tukwila International Boulevard – At-grade–preferred alternative). Fifty-six potential light rail-related noise impacts were projected in this segment. Two of the potential impacts would be considered severe under FTA guidelines. In addition to the potential light rail impacts, up to 99 potential traffic-related noise impacts were also identified. The traffic impacts would result from the travel lanes being relocated closer to the front-line receptors to accommodate the light rail tracks.

Vibration impacts are projected at 23 residences along the at-grade section.

E1.2 (Tukwila International Boulevard– Elevated). Under this alternative, there would be 109 potential light rail impacts, with 43 of them meeting the severe impact criteria. The added impacts are related to increased propagation and noise from elevated structures. There are 110 potential traffic noise impacts under this alternative.

No vibration impacts were identified under this alternative.

E2 (Interurban Avenue). Under this alternative, 26 potential light rail-related noise impacts were projected, with five falling into the severe category. There would also be the potential for 25 traffic-related noise impacts on Interurban Avenue, near 40th Avenue S., where traffic lanes would be relocated to accommodate the light rail.

Only two vibration impacts were identified for this alternative.

E3 (MLK Jr. Way S.). There would be 25 potential light rail noise impacts with this alternative, eight of which would be in the severe category. No traffic noise impacts were projected.

There are 17 projected vibration impacts identified for this alternative.

Segment F (SeaTac)

F2.3 (Washington Memorial Park – Elevated east of 28th –preferred alternative). No light rail or traffic noise impacts were identified under this alternative. Although noise from the train pass-by may be audible inside the nearest hotels, the noise levels would not cause an impact. There were no vibration impacts identified.

F1 (International Boulevard – At-grade). No traffic-related or light rail noise impacts or vibration impacts were projected. Impacts are the same under either design option.

F2.1 (Washington Memorial Park – City Center West). No light rail, traffic noise, or vibration impacts were projected under this alternative.

F2.2 (Washington Memorial Park – City Center East). Six light rail noise impacts were projected to single and multi-family residences located to the east of the tracks near the SeaTac city center. No traffic noise or vibration impacts were projected. Impacts are the same under either design option.

F3.1 (West Side of International Boulevard – Grassy Knoll). Four potential noise impacts were projected under this alternative. Impacts are the same under all the different design options. No light rail vibration or traffic noise impacts are projected under this alternative.

F3.2 (West Side of International Boulevard – Main Terminal). Noise and vibration impacts for light rail, and noise impacts for traffic are the same as for Alternative F3.1.

F3.3 (West Side of International Boulevard – IMC Airport Station). No light rail, traffic noise, or vibration impacts were projected under this alternative.

F4 (International Boulevard to 28th/24th). There are two light rail-related noise impacts projected under this alignment alternative. No traffic noise, or vibration impacts were projected under this alternative.

Maintenance Bases

Project staff analyzed potential noise and vibration impacts at each of the potential maintenance bases. The analysis used measured data from a similar maintenance facility in Portland Oregon. No impacts are projected from maintenance base operations, because land uses surrounding the maintenance base sites are primarily industrial and commercial, and because of the distance and topography between the sites and the nearest sensitive receivers

System Total Impacts

Tables 4.6-5 and 4.6-6 summarize the potential impacts for light rail noise, light rail vibration and traffic noise for each route alternative and each length alternative, both with and without mitigation. Many of the impacted structures would experience more than one type of impact. Before mitigation, 99 to 556 structures would have noise or vibration impacts under the Northgate to SeaTac Alternative. Mitigation (see Section 4.6.5) could reduce total impacts to between 0 and 30 receivers. All residual impacts would be due to vibration.

With the N.E. 45th Street to SeaTac Alternative, the total number of receivers projected to have noise or vibration impacts is between 87 and 456 before mitigation. With mitigation, (see Section 4.6.5) total impacts would be reduced to between 0 and 21 receivers, depending upon the route alternatives selected. Again, all residual impacts are due to vibration, and more extraordinary mitigation measures, as discussed in Section 4.6.5, could be used to further reduce vibration impacts.

Under the preferred alternative, there are a total of 465 impacts. Many of the structures' with impacts have a combination of light rail noise, traffic noise, and vibration impacts, so the actual number of structures is projected at 334. All of the impacts can be mitigated with the measures given in section 4.6.5. The preferred alternative will have the same before and after mitigation impacts under either MOS A or MOS B.

Under the No-build Alternative, noise and vibration levels would continue to increase due to traffic, aircraft, and commercial and industrial activities. Traffic noise levels would continue to exceed the WSDOT criteria at several locations in the corridor, including along I-5, Rainier Avenue S., MLK Jr. Way S., Interurban Avenue, Tukwila International Boulevard and International Boulevard.

4.6.5 Mitigation

The following sections describe the mitigation measures used in the analysis. With the proposed noise mitigation measures, all light rail and traffic noise impacts, based on interior noise levels, could be eliminated. Due to existing driveways and pedestrian access, and because of urban design and safety concerns, noise walls are proposed only in certain areas along the routes. For those areas where noise walls are not desirable or feasible, mitigation in the form of sound insulation on the affected residences would be used to ensure that the interior noise levels are below the HUD and FHWA interior noise level criteria. In these areas, the exterior noise levels may exceed one or more of the exterior noise criteria. However, most of these exterior areas currently exceed the exterior noise criteria and/or do not have highly sensitive outdoor use.

Currently, all but a few vibration impacts can also be eliminated using the modeled mitigation measures described in Section 4.6.5.2. Details on the type(s) of mitigation measure used for impacted receivers are given in the Noise and Vibration Technical Report.

4.6.5.1 Light Rail Noise Mitigation Measures

The following noise mitigation measures could be used to reduce or eliminate light rail noise impacts:

- Sound walls, considered the most effective noise control measure, are widely used to control traffic noise. To be effective, the walls must block the direct view of the noise source and must be solid with minimal openings. Sound walls would be used to mitigate any light rail noise impacts where the alignment is on an elevated structure. For the at-grade segments, a combination of sound walls and sound insulation (described below) could eliminate all noise impacts. No sound walls are proposed adjacent to at-grade, in-street trackway.
- Provide sound insulation. Insulating affected structures can reduce noise levels inside homes that would be noise impacted. This technique does not reduce exterior noise levels.
- Properly maintain wheels and rails. An important part of controlling noise from light rail systems is keeping the wheels and rails in good condition. Sound Transit would implement a regular wheel truing program, intermittent rail grinding and optimization of the wheel and rail profiles. Lubrication and friction modifiers on the rail and wheel surfaces can help maintain the optimum profiles and keep noise to the minimum levels.
- Extend headways. Extending headways (time between trains) or using shorter trains during late night and early morning hours reduces noise levels.

For this analysis, several noise mitigation measures were explored. The two used most often were sound walls and building insulation. On elevated trackway, sound walls were evaluated as the primary type of mitigation for light rail noise impacts. The installation of 4-ft sound walls on elevated trackway could eliminate all severe impacts and almost all moderate impacts (Table 4.6-5). Sound walls between 6 and 8 ft high adjacent to the affected property and parallel to at-grade trackway could also be used to reduce impacts; however, the walls are not appropriate in most areas. When located parallel to at-grade, sections of the project, sound walls could adversely impact neighborhood character and urban design, reduce auto accessibility, and restrict emergency vehicle access. Sound walls would be designed so that the noise levels at the affected structure would meet the appropriate criteria, either FTA criteria, FHWA criteria, or in some cases both. All at-grade sound walls would be coordinated with the affected property owners.

For those areas where sound walls are not a feasible and reasonable form of noise mitigation, building insulation would be used to eliminate noise impacts. The sound insulation would use the Housing and Urban Development (HUD) interior 45 dBA L_{dn} as the reference value for noise reduction for light rail impacts, and the WSDOT 51 dBA peak-hour L_{eq} criteria would be used for traffic noise impacts. For those locations where both light rail and traffic noise impacts are identified, the interior levels would be required to meet the more stringent criteria (requiring the greatest level of noise reduction).

Wheel squeal, one source of light rail noise, can occur when rail vehicles traverse tight radius curves. The basic mechanism causing the squeal is slip-stick between the wheels and rail caused by the inside wheels traversing a smaller radius curve than the outside wheels. Without maintenance and treatment, wheel squeal is likely to occur on any curve with a radius of less than about 400 ft.

Mitigation for wheel squeal could be performed using wayside lubricators (similar to these currently in use on the Portland East/West light rail system.) During the initial testing of the Link system, any curve with wheel squeal could be fitted with the lubricators, thereby eliminating the squeal and any potential for impact.

Table 4.6-4
Summary of Future Noise Levels at Noise Monitoring Locations[1]

Noise Monitoring # and Location[2]		Alt.	Land Use	Distance to Center of Tracks	Existing		LRT Noise		Traffic Noise	Future Noise		Change	
					Ldn	Leq	Ldn	Leq	Leq[3]	Ldn[4]	Leq[4]	Ldn[5]	Leq[5]
NM1	9104 N.E. 1st St.	All A	R	110	72	70	66.3	63.7		73.0	70.9	1.0	0.9
NM2	Northgate Condos N.E. 95th & 1st Ave. N.E.	All A	R	125	76	74	65.2	62.6		76.3	74.3	0.3	0.3
NM3	N.E. 85th & 1st Ave. N.E.	All A	R	80	72	69	65.5	62.9		72.9	70.0	0.9	1.0
NM4	N.E. 82nd St. & 2nd Ave.	All A	R/C	130	72	71	60.5	57.9		72.3	71.2	0.3	0.2
NM5	6616 8th Ave. N.E.	A2.1, A2.2	R	40	75	73	65.8	63.2		75.5	73.4	0.5	0.4
NM6	Ravenna & 8th Ave. N.E.	A2.1, A2.2	R/C	70	72	69	65.0	62.4		72.8	69.9	0.8	0.9
NM7	8th Ave. N.E. & N.E. 40th	B2.1	R	120	68	67	65.2	62.6		69.8	68.3	1.8	1.3
NM8	Boat Rd.	All B	R/C	Tunnel	64	62	0.0	0		64.0	62.0	0.0	0.0
NM9	3221 Franklin	B2.1	R	60	71	71	71.1	68.5		74.1	72.9	3.1	1.9
NM10	E. Galer St. & Eastlake	B2.1	R	130	70	67	60.9	58.3		70.5	67.5	0.5	0.5
NM11	Howell & Harvard St. (parking lot)	B2.1, B2.2	C	Tunnel	64	61	0.0	0		64.0	61.0	0.0	0.0
NM12	Tower Apts. 801 Pine St.	B1	R	Tunnel	66	64	0.0	0		66.0	64.0	0.0	0.0
NM13	Corner of Marion & Minor	All B	R/C	Tunnel	67	65	0.0	0		67.0	65.0	0.0	0.0
NM14	1541 Massachusetts St.	C3	R	70	66	64	58.5	55.9		66.7	64.6	0.7	0.6
NM15	S. Massachusetts & 20th Ave. S.	C3	R	40	70	68	71.0	68.4		73.5	71.2	3.5	3.2
NM16	S. McClellan & 15th Ave.	C1	R	Tunnel	69	67	0.0	0		69.0	67.0	0.0	0.0
NM17	2314 McClellan	C1	R	Tunnel	63	64	0.0	0		63.0	64.0	0.0	0.0
NM18	4114 Locust Ct. S.	D1.1, D1.3	R	73	71	71	72.3	69.7	72.2	74.7	74.1	3.7	3.1
NM19	4431 Rainier	D3.3, D3.4	R/C	60	72	73	67.1	64.5		73.2	73.6	1.2	0.6
NM20	4567 35th Ave.	D3.3, D3.4	R/C	70	69	72	68.2	65.6		71.6	72.9	2.6	0.9
NM21	5033 37th St.	D3.4	R/C	Tunnel	61	60	0.0	0		61.0	60.0	0.0	0.0
NM22	8324 MLK Jr. Way S.	All D	R/C	63	70	68	65.6	63	74.3	71.3	74.6	1.3	6.6
NM23	3906 113th St.	Maintenance	R/C	N/A	63	61	0.0	0		63.0	61.0	0.0	0.0
NM24	MLK Jr. Way S. & S. 129th St.	E3	R	30	69	68	69.4	66.8		72.2	70.5	3.2	2.5
NM25	11823 40th Ave. S.	E2	R/C	50	70	69	66.2	63.6		71.5	70.1	1.5	1.1
NM26	13808 S. 38th St.	E1.1, E1.2	R/C	65	67	64	66.6	64	73.0	69.8	73.5	2.8	9.5
NM27	Foster Green Apts. 13865 Interurban	E3	R	40	69	67	66.7	64.1		71.0	68.8	2.0	1.8
NM28	Grande Terrace Apts. 15708 158th St.	E2	R/C	165	71	67	58.3	55.7		71.2	67.3	0.2	0.3
NM29	Residence Inn Strander Blvd. & West Valley	E3	R	50	64	62	67.8	65.2		69.3	66.9	5.3	4.9
NM30	Holiday Inn Pacific Coast Highway	All F	R/C	70	71	68	64.7	62.1		71.9	69.0	0.9	1.0
NM31	SeaTac Hilton International Blvd.	All F	R	70	66	64	64.7	62.1		68.4	66.2	2.4	2.2
NM32	Bow Lake Residents at 31st Ave. S.	F2.2	R	40	66	64	65.6	63		68.8	66.5	2.8	2.5
NM33	20229 28th Ave. S.	All F	R	110	68	67	55.7	53.1		68.2	67.2	0.2	0.2

Notes: R=Residential C=Commercial The levels given are the highest projected levels for each of the alignment alternatives.
[1] Noise levels shown in table are without mitigation.
[2] Locations of noise monitoring sites are shown on Figure 4.6-3.
[3] Traffic noise is only projected in areas with roadway modifications.
[4] Future noise is the existing plus the light rail noise for L_{dn} and either existing or traffic (whichever is higher) plus the light rail noise for peak-hour L_{eq}
[5] Future projected noise levels minus the existing noise levels.

4.6.5.2 Traffic Noise Mitigation Measures

For traffic noise analysis, sound walls are normally used as the primary form of noise mitigation. The basic wall design is the same as for light rail mitigation, but walls are typically taller (8 to 10 ft high) because they are located further from the noise source. As with the light rail, for those areas where sound walls are not reasonable or feasible, and no other form of mitigation reduces impacts, building insulation could be used. The interior noise level criteria for residential land use is 51 dBA during the peak traffic noise hour (Table 4.6-3).

Sound walls are very effective at reducing traffic noise impacts, but they have limitations and can create adverse effects. Short sections of sound wall interspersed with openings for driveways and other access are typically ineffective. Because of these limitations, sound walls for traffic noise are considered feasible in only a few locations. In locations where sound walls are not feasible, the use of building sound insulation is planned. The combination of sound walls and sound insulation could result in no interior noise impacts and a reduced number of exterior impacts.

Besides using sound walls, traffic noise impacts can be reduced by modifying traffic speed limits, and restricting truck traffic, or impacts can be avoided by designing the project so that the roadway is not moved at all. For example, the City of Tukwila has proposed to reduce speed limits along Tukwila International Boulevard, which could help reduce traffic noise levels.

Finally, new development and redevelopment along the alignment can incorporate sound considerations into site planning and building design. The planned redevelopment of two large public housing projects in Segment D — Rainier Vista and Holly Park — provides opportunities to design these facilities so as to reduce traffic noise impacts and still enhance community character and access. Redevelopment could include creating a buffer zone between the road and new residences, incorporating a sound barrier, or constructing new homes so that interior noise levels meet HUD criteria. This process would eliminate all noise impacts at both of these developments.

4.6.5.3 Ground-borne Vibration Mitigation Measures

Potential measures to mitigate vibration impacts include the following actions:

- Reduce train speed.
- Set LRV performance specifications.
- Optimize the wheel and rail profiles in conjunction with regular wheel truing and rail grinding.
- Install ballast mats. Ballast mats, which have been used on a number of transit systems, are effective at attenuating vibration at frequencies greater than about 30 Hz.
- Use high-resilience direct fixation fasteners. This approach can provide a 5 dB or greater vibration attenuation at frequencies greater than 30 Hz.
- Use resiliently supported ties. Measurements of these tie installations in Atlanta and other cities indicate that they can provide 8 dB attenuation at frequencies greater than about 25 Hz.
- Install floating slabs. A 16 Hz floating slab would reduce light rail ground-borne vibration by 10 to 15 dB. This mitigation, however, is very expensive and typically not cost-effective.

Where this Final EIS analysis has projected vibration impacts, the following mitigation measures have been modeled:

- A ballast mat on top of a concrete pad in ballast and tie track
- Mitigation for embedded track with the same attenuation as a ballast mat
- High resilience direct fixation fasteners on elevated structures
- Resiliently supported ties in tunnels.

Table 4.6-5
Summary of Light Rail Noise and Vibration Impacts by Segment and Route Alternative

Segment—Route Alternatives and Options	No. of Structures Exceeding Noise Impact Threshold[1]						No. of Structures Exceeding Vibration or Ground-Borne Noise Impact Threshold					
	Without Mitigation			With Mitigation[3]			Without Mitigation			With Mitigation		
	0-2 dB	2-5 dB	>5 dB	0-2 dB	2-5 dB	>5 dB	0-2 VdB	2-5 VdB	>5 VdB	0-2 VdB	2-5 VdB	>5 VdB
Segment A (Northgate to University District)												
A1.1 12th Ave. N.E. Tunnel	8	0	0	0	0	0	25	58	12	0	4	0
A1.2 Roosevelt Way Tunnel	8	0	0	0	0	0	14	69	17	0	9	0
A2.1 8th Ave.–Short Elevated	12	0	0	0	0	0	0	10	1	0	1	0
A2.2 8th Ave.–Elevated	13	9	0	0	0	0	18	3	0	0	0	0
Segment B (University District to Westlake Station)												
B1 Capitol Hill Tunnel	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*3*	*0*	*0*	*0*
B2.1 Seattle Center via High-level Bridge	10	4	9	0	0	0	9	3	13	1	0	1
B2.2 Seattle Center via Portage Bay Tunnel	0	0	0	0	0	0	2	3	2	0	0	0
Segment C (Westlake Station to S. McClellan Street)												
C1 S. Lander Street Tunnel	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
C1.1, through C1.5 all have the same impacts	0	0	0	0	0	0	0	0	0	0	0	0
C2.3 W. of Rainer Ave. S.–Elevated	8	0	7	0	0	0	0	1	0	0	0	0
C2.4 Rainier Ave. S. Tunnel	0	0	0	0	0	0	0	0	0	0	0	0
C 3 S. Massachusetts Street	0	15	1	0	0	0	1	9	3	0	0	0
Segment D (S. McClellan Street to Boeing Access Road)												
D1.1c MLK Jr. Way S.–At-grade, 4-lane, 104'	35	17	0	0	0	0	0	0	0	0	0	0
D1.1d MLK Jr. Way S.–At-grade, 2-lane, 90'	36	22	0	0	0	0	4	2	0	4	2	0
D1.1e MLK Jr. Way S. – At-grade, 4-lane 93'	*35*	*17*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
D1.1f MLK Jr. Way S.–At-grade, 2-lane, 93'	35	17	0	0	0	0	0	0	0	0	0	0
D1.3 MLK Jr. Way S.–Combined Profile	105	76	60	0	0	0	7	0	0	7	0	0
D3.3 Alaska St. Crossover–At-grade	73	52	4	0	0	0	24	30	4	15	0	2
D3.4 37th Ave. S Tunnel	68	56	0	0	0	0	26	51	2	7	1	0
Segment E (Tukwila)												
E1.1 Tukwila International Blvd.–Combined Profile	*21*	*33*	*2*	*0*	*0*	*0*	*20*	*3*	*0*	*0*	*0*	*0*
E1.2 Tukwila International Blvd.–Elevated Profile	23	35	51	0	0	0	0	0	0	0	0	0
E2 Interurban Ave.	12	9	5	0	0	0	2	0	0	2	0	0
E3 MLK Jr. Way S.	8	6	11	0	0	0	2	4	11	0	0	0
Segment F (SeaTac)												
F1 International Blvd.–In median	0	0	0	0	0	0	0	0	0	0	0	0
F2.1 Washington Memorial Park–City Center West	0	0	0	0	0	0	0	0	0	0	0	0
F2.2 Washington Memorial Park–City Center East	1	5	0	0	0	0	0	0	0	0	0	0
F2.3 Washington Memorial Park	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
F3.1 W. of International Blvd–Grassy Knoll	3	1	0	0	0	0	0	0	0	0	0	0
F3.2 W. of International Blvd–Main terminal	3	1	0	0	0	0	0	0	0	0	0	0
F3.3 W. of International Blvd–IMC Station	0	2	0	0	0	0	0	0	0	0	0	0
F4 International Boulevard to 28th/24th	0	2	0	0	0	0	0	0	0	0	0	0
Maintenance Base Sites												
M1-A S. Lander Street	0	0	0	0	0	0	0	0	0	0	0	0
M1-B S. Lander Street	0	0	0	0	0	0	0	0	0	0	0	0
M1-C S. Lander Street	0	0	0	0	0	0	0	0	0	0	0	0
M1-D S. Lander Street	0	0	0	0	0	0	0	0	0	0	0	0
M2 N.E. Boeing Field	0	0	0	0	0	0	0	0	0	0	0	0
M3 Boeing Access Road	0	0	0	0	0	0	0	0	0	0	0	0
Systems Total												
SeaTac to 45th St.	43-149	23-135	2-127	0	0	0	1-81	0-67	2-31	0 – 18	0 - 2	0 - 3
SeaTac to Northgate	51-162	23-144	2-127	0	0	0	1-106	3-136	2-48	0 – 18	0 - 11	0 - 3
Preferred Alternative	56	50	2	0	0	0	21	3	3	0	0	0
MOS A 45th to McClellan St.	0	0	0	0	0	0	1	0	3	0	0	0
MOS B Capitol Hill to Henderson St.	35	17	0	0	0	0	1	0	3	0	0	0
MOS C 45th to S. Lander St.	0	0	0	0	0	0	1	0	3	0	0	0

Note:[1] Not including noise impacts from traffic noise.
[2] Under Design Option B, south of SR 518, this impact would not occur.
[3] Mitigation evaluated includes sound walls and residential sound insulation.

As shown in Table 4.6-5, preliminary projections indicate that most vibration impacts could be mitigated using standard mitigation. Where standard mitigation would not eliminate all impacts, additional mitigation, such as floating slabs, could likely eliminate the remaining impacts but may not be reasonable because of the excessive cost. Specific mitigation, including the need for non-standard measures, will be further evaluated and defined as design progresses.

Potential mitigation for U.W. Physics and Astronomy and Life Sciences buildings is discussed above in Section 4.6.4.

Table 4.6-6
Summary of Traffic Noise Impacts by Segment and Route Alternative

Segment—Route Alternatives and Options	No. of Structures Exceeding Traffic Noise Impact Threshold[1]					
	Without Mitigation			With Mitigation[2]		
	0-2 dB	2-5 dB	>5 dB	0-2 dB	2-5 dB	>5 dB
Segment A						
A2.1 8th Ave. – Short Elevated	0	3	0	0	0	0
A2.2 8th Ave. – Elevated	0	3	0	0	0	0
Segment D						
D1.1c MLK Jr. Way S. – At-grade 4-lane	21	129	149	0	0	0
D1.1d MLK Jr. Way S. – At-grade 2-lane	2	12	0	0		0
D1.1e MLK Jr. Way S. – At-grade 4-lane	49	104	78	0	0	0
D1.3 MLK Jr. Way S. – Combined Profile	44	159	70	0	0	0
D3.3 Alaska St. Crossover – At-grade	12	59	134	0	0	0
D3.4 37th Ave. S. Tunnel	11	27	101	0	0	0
Segment E[2]						
E1.1 Tukwila Intl Blvd. – Combined Profile	13	11	75	0	0	0
E1.2 Tukwila Intl Blvd. – Elevated Profile	4	20	86	0	0	0
E2 Interurban Ave.	0	4	21	0	0	0
System Totals						
SeaTac to 45th St.	2 – 62	12 – 179	0 – 235	0	0	0
SeaTac to Northgate	2 – 62	12 – 182	0 – 235	0	0	0
Preferred Alternative	62	115	153	0	0	0
MOS A 45th St. to McClellan	0	0	0	0	0	0
MOS B Capitol Hill to Henderson St.	49	104	78	0	0	0
MOS C 45th St. to Lander St.	0	0	0	0	0	0

Notes: [1] Not including noise impacts from light rail noise.
[2] Traffic noise mitigation includes noise walls and sound insulation. This combination would eliminate all interior impacts; however, there are locations where the outside sound levels exceed the exterior criteria and exterior mitigation is not feasible.

4.6.6 Significant Unavoidable Adverse Impacts

The FTA criteria for transit-related noise define two levels of impacts, moderate and severe. Any light rail noise impacts in the severe category would be considered significant. There is no severe impact category for light rail vibration or traffic noise.

Light Rail Noise: With the modeled mitigation measures, which include a combination of sound walls and residential sound insulation, all significant light rail noise impacts would be eliminated.

Traffic Noise: With the modeled mitigation measures, which include a combination of sound insulation and sound walls, all significant traffic noise impacts would be eliminated.

Light Rail Vibration: After mitigation there are no projected residual vibration impacts for the preferred alternative. Residual vibration impacts are projected at four structures with Alternative A1.1, nine structures with A1.2, and one structure with A2.1. In Segment B, there would be two residual vibration impacts under Alternative B2.1. Segment D would have six residual vibration impacts under Alternative D1.1d and D1.1f, seven with D1.3, 17 under D3.3 and eight under D3.4. Segment E would have two residual vibration impacts under Alternative E2. All of these residual vibration impacts could potentially be mitigated using more advanced vibration mitigation methods.

See the Noise and Vibration Technical Report for details on more advanced vibration mitigation measures.

4.7 ECOSYSTEMS

4.7.1 Affected Environment

4.7.1.1 Regulations

Federal, state, and local natural resource regulations govern activities associated with development of the light rail project. At the federal level, the Endangered Species Act (ESA) is implemented by the FTA in consultation with the National Marine Fisheries Service (NMFS) and U.S. Fish & Wildlife Service (U.S. FWS). The U.S. FWS also oversees bird species covered by the Federal Migratory Bird Treaty Act. All waters of the U.S., including wetlands, fall under Clean Water Act regulations, which the U.S. Army Corps of Engineers enforces.

In Washington State, the Department of Ecology and local governments regulate shorelines as mandated by the Shoreline Management Act. Washington's Department of Fish and Wildlife (WDFW) implements Hydraulic Project Approval regulations, which govern activities within those state waters below the ordinary high water mark.

Local sensitive areas ordinances and other municipal regulations and policies, including Seattle's Urban Wildlife and Habitat Management Plan, govern lands that are especially subject to natural hazards or those that support unique, fragile or valuable natural features. In many cases, these ordinances and policies supplement national and state regulations. Needed permits for this project are listed in the Fact Sheet of this Final EIS.

4.7.1.2 Vegetation and Wildlife Habitat

Project staff used field study, literature review, and aerial mapping to identify wildlife habitat and vegetation types in the light rail study area. The study area incorporates 100 ft on either side of the centerline of the alignment, and the area within 100 ft of other proposed improvements. Next, the area was classified into seven major vegetation types: (1) urban, sparsely vegetated; (2) urban, moderately vegetated; (3) urban, mostly vegetated; (4) deciduous forest; (5) wetlands; (6) riparian; and (7) open water. The Ecosystems Technical Back-up describes each vegetation type, its wildlife value, and expected and observed species.

The light rail study area lies in an urban environment, which influences the diversity of habitat and wildlife (Adams 1994). The majority of light rail occurs in commercial, industrial, and residential areas that offer habitat for adaptable species such as doves, sparrows, finches, rats, mice, and squirrels. In the urban environment, habitats such as city parks, wetlands, rivers, riparian vegetation areas, and deciduous forests often contain a greater diversity of vegetation and structural layers. These habitats provide beneficial habitat in the urban environment and increase the diversity of wildlife present (Adams 1994). Several such beneficial habitats exist in the light rail study area (described below and shown in Figures 4.7-1 through 4.7-6).

Beneficial habitats

Several wetlands in Segments E and F contain multiple plant communities or are connected to other habitat. These sites offer valuable nesting and foraging habitat for songbirds and small mammals. In addition, wetlands with open water provide habitat for some amphibians.

In Segment B, Lake Union/Portage Bay is part of an extensive waterway connecting Lake Washington to Puget Sound. Open water in the vicinity of the project area is used by migratory and resident waterfowl. In addition, peregrine falcons (*Falco peregrinus*) use the I-5 bridge over Portage Bay for winter roosting and as a hunting site (Anderson 1998 personal communication).

Patches of deciduous forest, in Segments C, D, and E between Beacon Hill and SeaTac, provide habitat for forest-associated resident and migratory songbirds and hawks, reptiles, amphibians, and small mammals. Several hawk nest sites are located in these forests (Swope-Moody 1998 personal communication).

The Duwamish and Green rivers in Segment E are bordered by a narrow riparian corridor and extensive urban development in some areas. However, a variety of wildlife species use these sites including resident small mammals, amphibians, waterfowl, songbirds, and birds-of-prey. Wintering bald eagles (*Haliaeetus leucocephalus*) are expected to use sites where large trees are present. A great blue heron (*Ardea herodius*) rookery is located approximately one-half mile east of the confluence of the Green and Black rivers, but outside the study area.

Fort Dent in Segment E and Washington Memorial Park in Segment F are open space areas dominated by mowed lawns bordered by large trees. Although these sites are mostly used by common urban species, the large trees provide nesting and perching sites for hawks and owls. In addition, these open space areas contain some dense patches of vegetation, which offer foraging habitat for migrating and resident songbirds. Reptiles and a variety of small mammals may also occur in these areas.

Bow Lake in Segment F is an open-water lake bordered by patches of dense shrubs and riparian wetland, especially along its southeast shore. This site provides habitat for small mammals, amphibians, migratory songbirds, and waterfowl, as well as for foraging eagles, hawks, and owls.

Threatened and endangered wildlife species (including species of concern)

Project staff contacted the USFWS to identify any listed threatened and endangered wildlife species and habitat(s) that the project could potentially affect. The WDFW and the Washington Department of Natural Resources (WDNR) were also asked to identify sensitive plants, habitats, and wildlife species that could be affected. Federally listed threatened and endangered species known to occur within the study corridor include the bald eagle and peregrine falcon (now delisted). An Endangered Species Evaluation, assessing impacts to these species, is included in the Ecosystems Technical Report. This analysis is being concurrently used to prepare a Biological Assessment (BA) as required by the Endangered Species Act .

Three bald eagle nests have been identified one to two miles from the project area. Two active bald eagle nests occur in Seward Park on Lake Washington, approximately 1.5 miles from the light rail route in Segment D. Another bald eagle nest is located on Angle Lake in Segment F, approximately 0.7 mile from the light rail route. Bald eagles occur at this site each year; however, the nest has not been used since 1996. Bald eagles commonly winter in the Puget Sound area (WDFW 1989). Wintering bald eagles use the open water along the Duwamish River in Segment E and may perch in large trees along the riverbank (Negri 1998 personal communication).

An active peregrine falcon nest is located in Segment C at the Washington Mutual Tower in downtown Seattle (USFWS 1998). Winter roosting activity has also been documented at the I-5 bridge over Portage Bay in Segment B. Over the past five years, the same bird has been observed perching and hunting from the bridge and transmission towers near the western shoreline of Portage Bay, using this site primarily in the winter. Other peregrine falcons have been observed at this location at other times in the year (Anderson 1998 personal communication). The peregrine falcon was delisted on August 25, 1999. As a result, the peregrine falcon is no longer protected by the Endangered Species Act. Because the peregrine falcon was a listed species when this project was initiated, it is addressed in this EIS and is being addressed in a Biological Assessment.

Other federal species of concern potentially found within the study area include the olive-sided flycatcher (*Contopus borealis*), northwestern pond turtle (*Clemmys marmorata marmorata*), Oregon spotted frog (*Rana pretiosa*), Pacific Townsend's big-eared bat (*Corynorhinus townsendii townsendii*), long-legged myotis (*Myotis volans*), long-eared myotis (*Myotis evotis*), and the white-top aster (*Aster curtus*). Washington State lists the northwestern pond turtle and the Oregon spotted frog as endangered species. However, researchers found no suitable habitat for any of these species within the study corridor (Swope-Moody 1998 personal communication; Dvornich et al. 1997; Smith et al. 1997; Pojar and Mackinnon 1994; Leonard et al. 1993; Nagorsen and Bringham 1993; Rodrick and Milner 1991). Other Federally listed species that could be impacted by the project include the humpback whale, the stellar sea lion, and the leatherback sea turtle. These species are discussed in the BA being prepared for the NMFS. All of the listed species are discussed in the Endangered Species Evaluations which are attached to the Central Link Ecosystems Technical Back-up.

4.7.1.3 Aquatic resources

Regulated aquatic resources, waters of the U.S. as defined by the Code of Federal Regulations (CFR 328.3a), include lakes, rivers, streams, and wetlands. Using existing information from previous studies and site reconnaissance, project staff mapped and characterized each aquatic resource in the study area (Figures 4.7-1 through 4.7-6). Using criteria established in the U.S. Army Corps of Engineers Wetland Delineation Manual (1987), project staff, in 1998, classified wetlands according to the Washington State Wetlands Rating System (Ecology 1993) and local jurisdictional regulations (King County and the cities of Seattle, Tukwila, Renton, and SeaTac). Using the same criteria, project staff delineated three wetlands (in 1999) along the preferred alignments where property access was granted. Table 4.7-1 lists 44 potentially affected aquatic resource areas (AR-1 through AR-44) identified along the routes. Most aquatic resources occur in Segment E (38 out of 44). Potentially affected aquatic resource sites can be divided into the following categories: (1) lakes, rivers, streams—water bodies with no associated wetland; (2) riparian wetlands—wetlands immediately adjacent to lakes, rivers, or streams that are the primary source of hydrology in these wetlands; (3) hydrologically connected wetlands—wetlands with surface hydrological connections to other water bodies such as lakes, rivers, and streams that are some distance away and are not the dominant source of hydrology in these wetlands; and (4) isolated wetlands—wetlands with no surface hydrological connections to other aquatic resources due to their position in the landscape or substantial human alteration to hydrology (e.g., diverting flow with roadway placement or sidecast material berms, or culverting flow away form the wetland). The following paragraphs describe, by category, the aquatic resources mapped along the study corridor.

Lakes, rivers, and streams lacking associated wetlands

Lakes, rivers, and streams with no associated wetland in the vicinity of the light rail alternatives include Lake Union/Portage Bay in Segment B; and the Duwamish River, Southgate Creek, Black River, Green River, Riverton Creek, and an unnamed creek in Segment E. Lake Union (AR-2 in table 4.7-1) is surrounded by urban development and lacks naturally vegetated shorelines at locations near the light rail project.

Route alternatives over the Duwamish River (AR-10, 11, 26, 27), Southgate Creek at its confluence with the Duwamish River (AR-19), Black River (AR-28), and Green River (AR-34, 35) are riprap-lined channels with no associated riparian wetland. At these crossings, reed canary grass (*Phalaris arundinacea*), Himalayan blackberry (*Rubus discolor*), and occasional black cottonwood trees (*Populus balsamifera*) predominate along the channel banks. The primary ecological function at these sites is fish passage and habitat. The North and Middle Forks of Southgate Creek (AR-21, 22) and East Fork Riverton Creek (AR-20) are cement-lined channels near the light rail project. Non-wetland vegetation adjacent to these channels is suitable habitat for small birds and mammals. An unnamed creek in Segment E (AR-24) flows down the forested hillside between MLK Jr. Way S. and Beacon Hill Coal Mine Road. The potentially affected area on the hillside is forested but no riparian wetland is present. The forested hillside provides habitat for birds and mammals.

Riparian wetlands

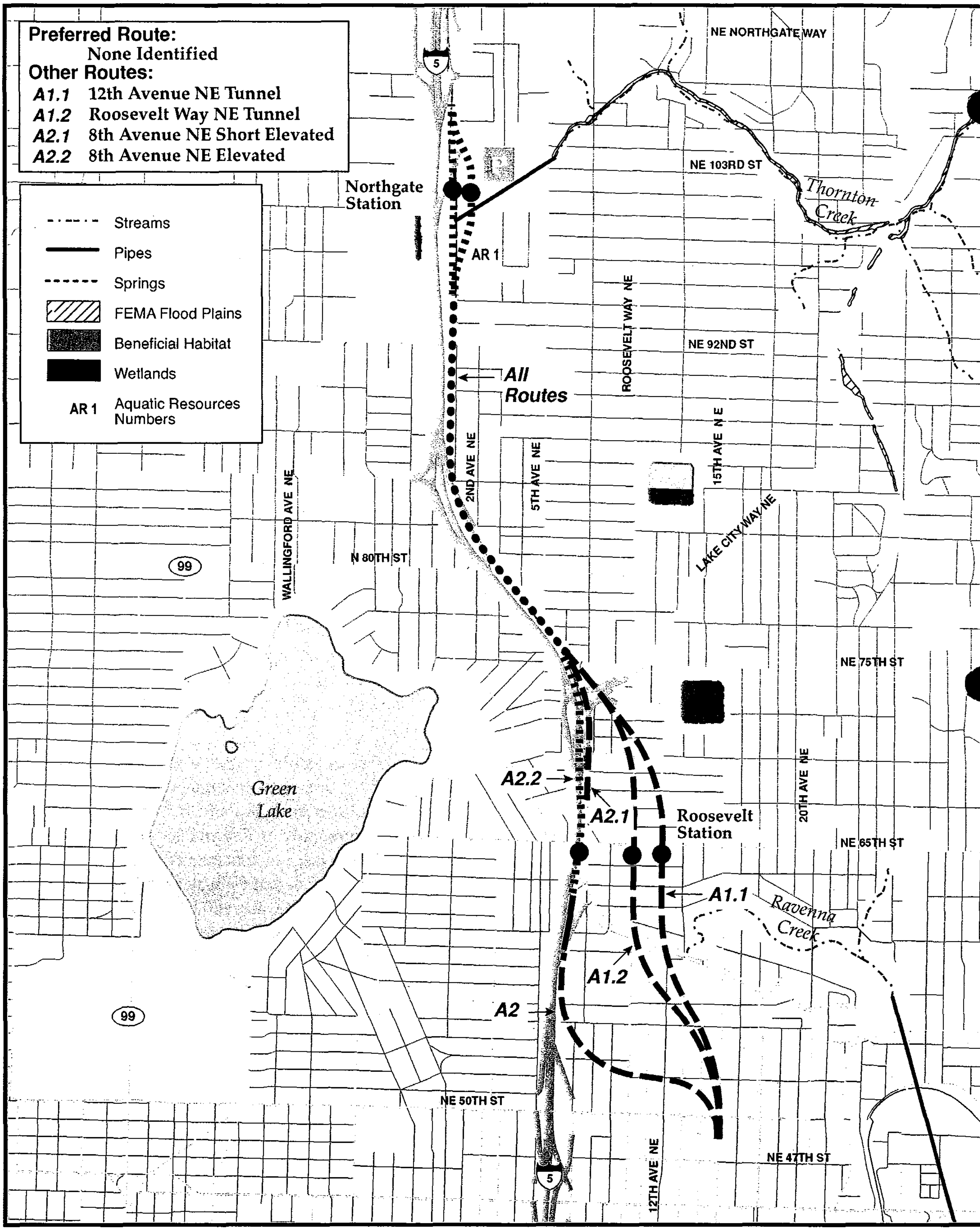
Lakes, rivers, and streams with associated wetlands include the headwaters of South Fork Thornton Creek in Segment A (AR-1); West Fork Riverton Creek (AR-18), inventoried watercourse 3-1 (AR-23) and Gilliam Creek at both SR 518 and Southcenter (AR-41, 36) in Segment E; and Bow Lake (AR-44) in Segment F. The riparian wetland associated with South Fork Thornton Creek in Segment A is surrounded by a park-and-ride lot and situated on fill material. The creek has been channelized and culverted in two locations, between I-5 and First Avenue N.E., and structured to collect and detain storm water runoff. The wetland contains a diversity of planted vegetation that lines the channel; but provides little biological support. It does detain storm water to reduce flooding and offers baseflow support for Thornton Creek. In Segment E, a riparian wetland (AR-23) is associated with Watercourse 3-1 in the Fire District #1 drainage basin, according to a City of Tukwila inventory. This wetland, which comprises a herbaceous layer within the floodplain of the creek, is surrounded by forested, non-wetland slopes. The creek and associated wetland provide flood control and wildlife habitat. West Fork Riverton Creek (AR-18) in Segment E is in a culvert under Tukwila International Boulevard in its potentially affected area; elsewhere, the creek flows through a forested riparian corridor with a 100 ft buffer. Upstream and downstream of the crossing, the riparian wetland is within the floodplain of the creek and may serve to aid in the control of erosion, flooding, and storm water. The stream and forested buffer provide habitat for birds, mammals, macroinvertebrates, and amphibians. The headwaters of Gilliam Creek (AR-41) are located next to SR 518 near Tukwila International Boulevard The natural channel is culverted and piped at several locations, including SR 518, I-5, and I-405, until it discharges into the Green River northeast of Southcenter Mall in Segment E. The riparian wetlands adjacent to SR 518 (AR-41) and Southcenter Mall (AR-36) offer limited habitat yet serve as a local wildlife corridor. They also provide storm water and erosion control functions. Bow Lake (AR-44) in Segment F collects runoff from SeaTac's downtown area and has a piped outlet to Des Moines Creek. The lake provides habitat for a variety of waterfowl and resident fish species. The wetland fringe surrounding the lake supplies additional habitat for small birds, mammals, and amphibians. These wetlands function to control erosion and improve water quality.

Hydrologically connected wetlands

Wetlands with hydrological connections include those that are not immediately adjacent to a water body, but which have a surface connection to a lake, river, or stream. All the potentially affected wetlands classified as hydrologically connected are located in Segment E. The Norfolk drainage (AR-12) and aquatic resources associated with the intersection of Tukwila International Boulevard and SR 599 (AR-14, 15, 16) drain to the Duwamish River. An unnamed seep (AR-40) adjacent to SR 518 and Crystal Springs (AR-38, 37) along SR 518, I-5, and I-405 drain to Gilliam Creek. These drainages offer limited wildlife habitat and convey storm water and baseflow that hydrologically support the Green River drainage basin. The hillside seep (AR-25) at the toe of the slope between MLK Jr. Way S. and Beacon Hill Coal Mine Road drains through a constructed channel to AR-24. The densely forested hillside supplies a valuable wildlife habitat and travel corridor.

Isolated wetlands

Seventeen of the 44 potentially affected aquatic resources are isolated wetlands, of which 14 are located in Segment E. Most of these aquatic resources are remnants of the Green River, Duwamish River, or Black River floodplains. In these areas, urbanization and placement of fill have eliminated the historic watershed hydrological connections, including connections to the floodplains. Other than storm water detention and minimal wildlife habitat, these wetlands offer little hydrological or biological support. One exception is the isolated wetland at the northeast corner of the Washington Memorial Cemetery (AR-42) in Segment F. Wetland AR-42, which has peat soils, functions as a recharge area for Gilliam Creek and provides storm water detention for runoff from adjacent property.

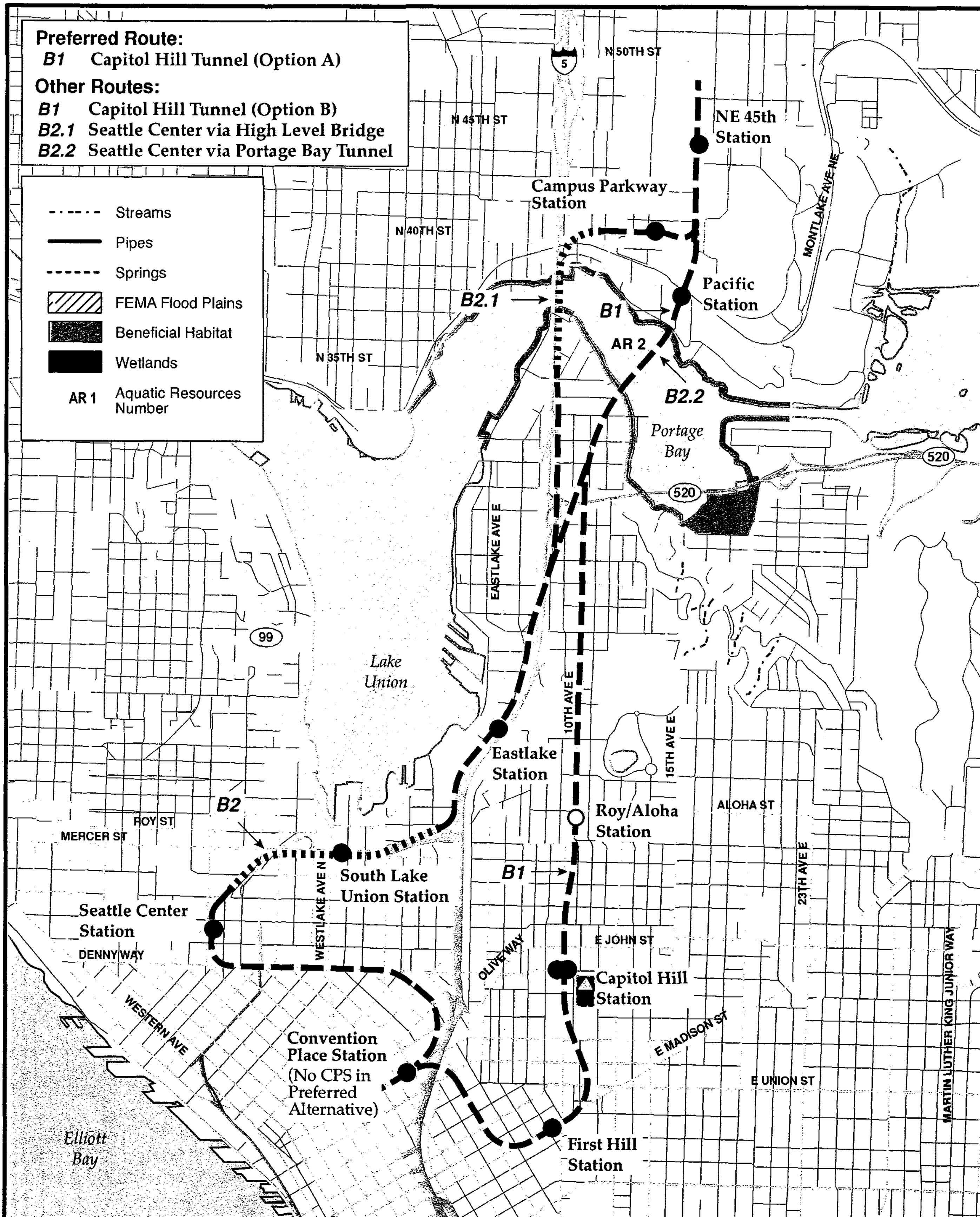


SOUNDTRANSIT

0 1,000 2,000 FEET

Tunnel
Elevated
At Grade
Retained Cut-Fill
Station
Potential Station
Park & Ride

Figure 4.7-1 Segment A: Aquatic Resources, Beneficial Habitat and Floodplains



SOUNDTRANSIT

0 1,000 2,000
FEET

Tunnel
Elevated
At Grade
Retained Cut-Fill

Station
Potential Station
Park & Ride

Figure 4.7-2 Segment B: Aquatic Resources, Beneficial Habitat and Floodplains

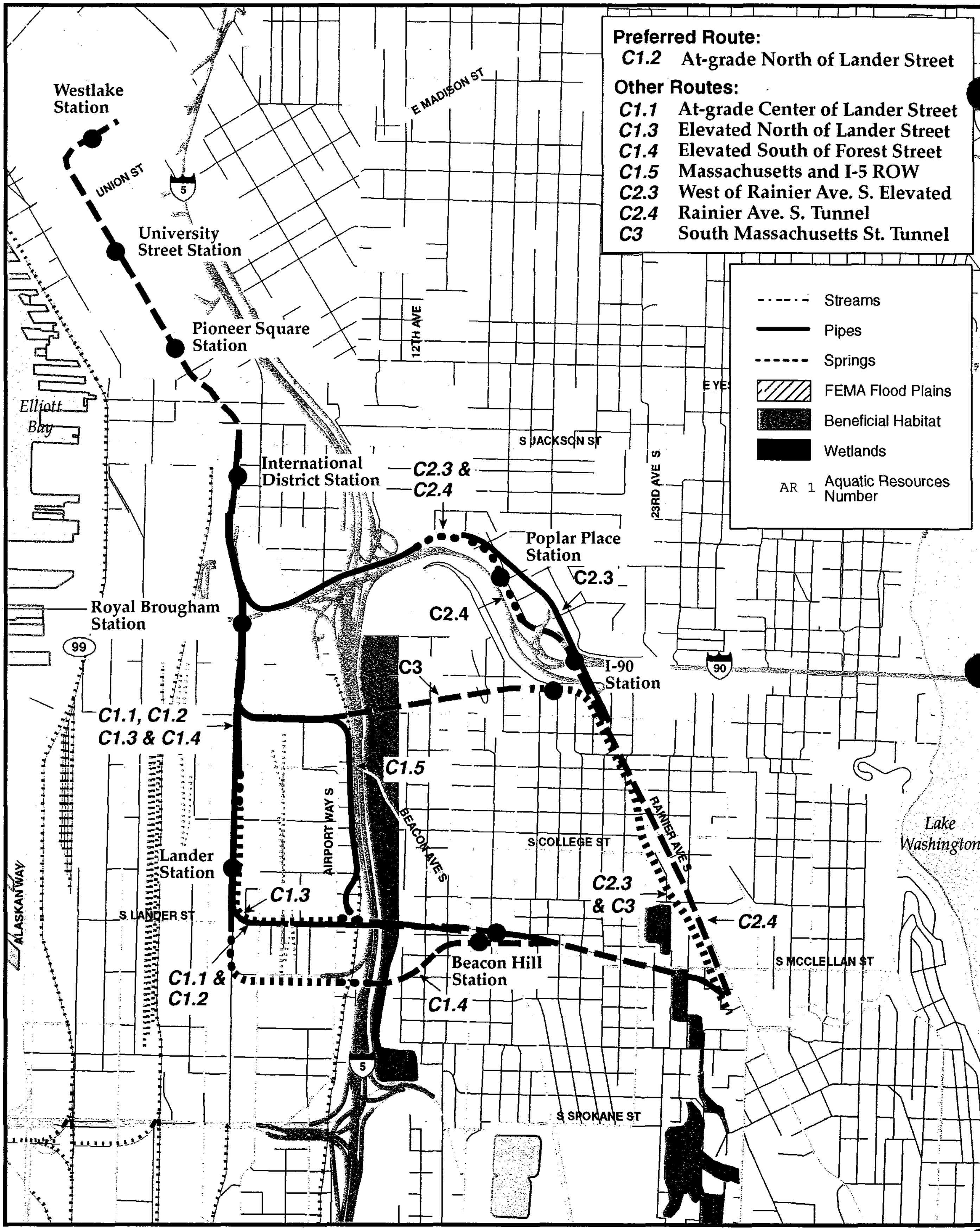
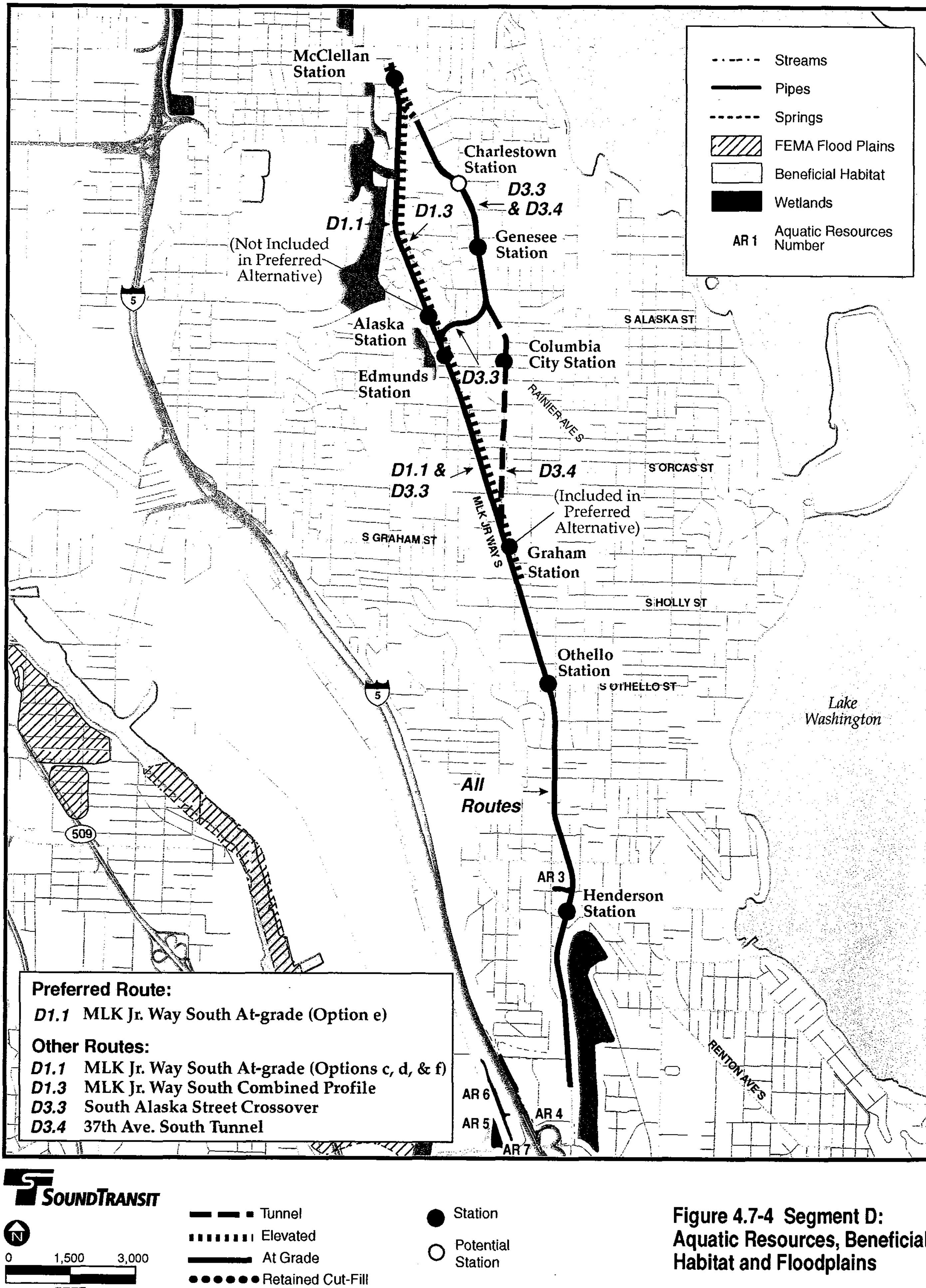
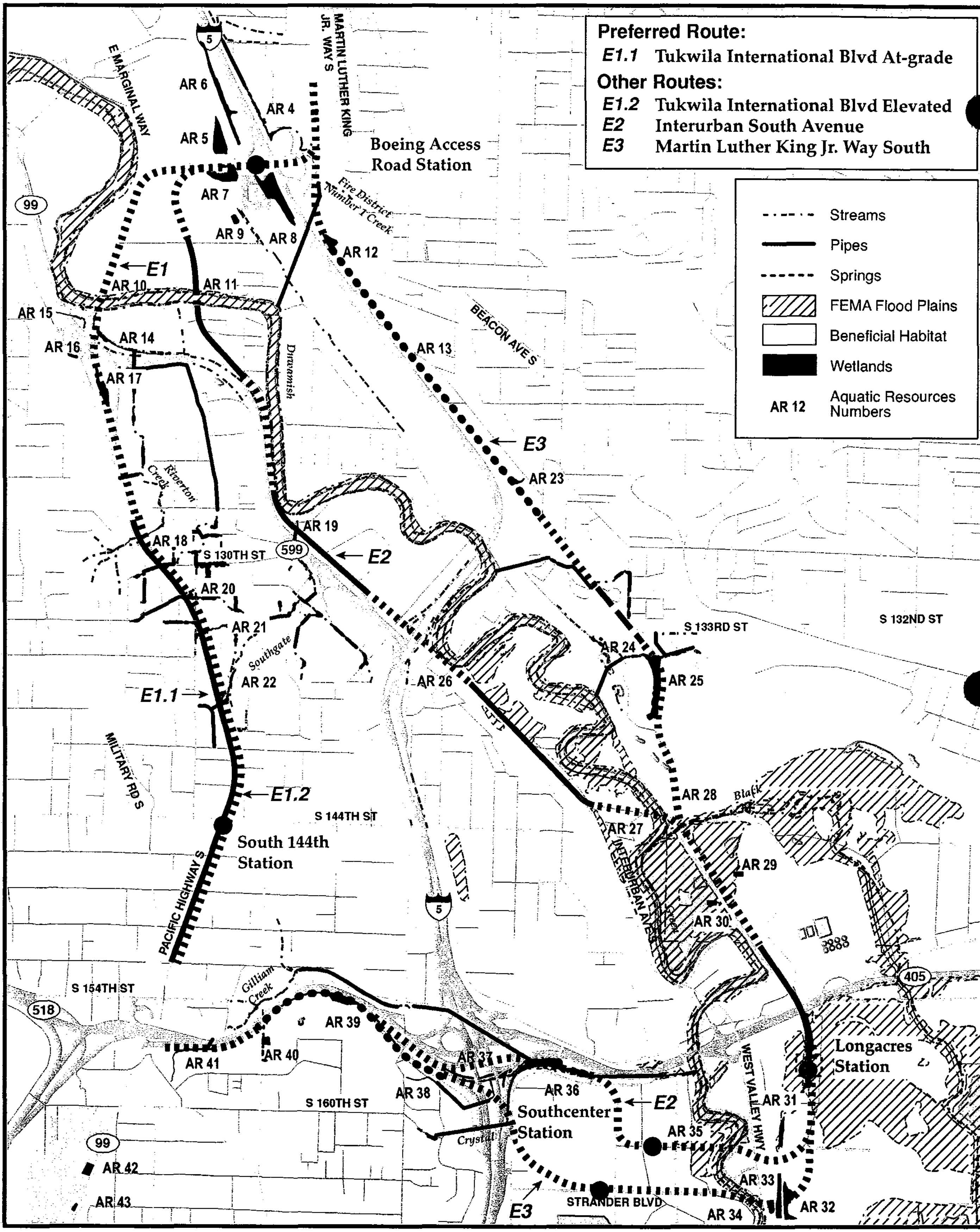


Figure 4.7-3 Segment C: Aquatic Resources, Beneficial Habitat and Floodplains



SoundTransit

Figure 4.7-4 Segment D: Aquatic Resources, Beneficial Habitat and Floodplains



SOUNDTRANSIT

0 1,250 2,500
FEET

Tunnel
Elevated
At Grade
Retained Cut-Fill

Station
Potential Station
Park and Ride

Figure 4.7-5 Segment E: Aquatic Resources, Beneficial Habitat and Floodplains

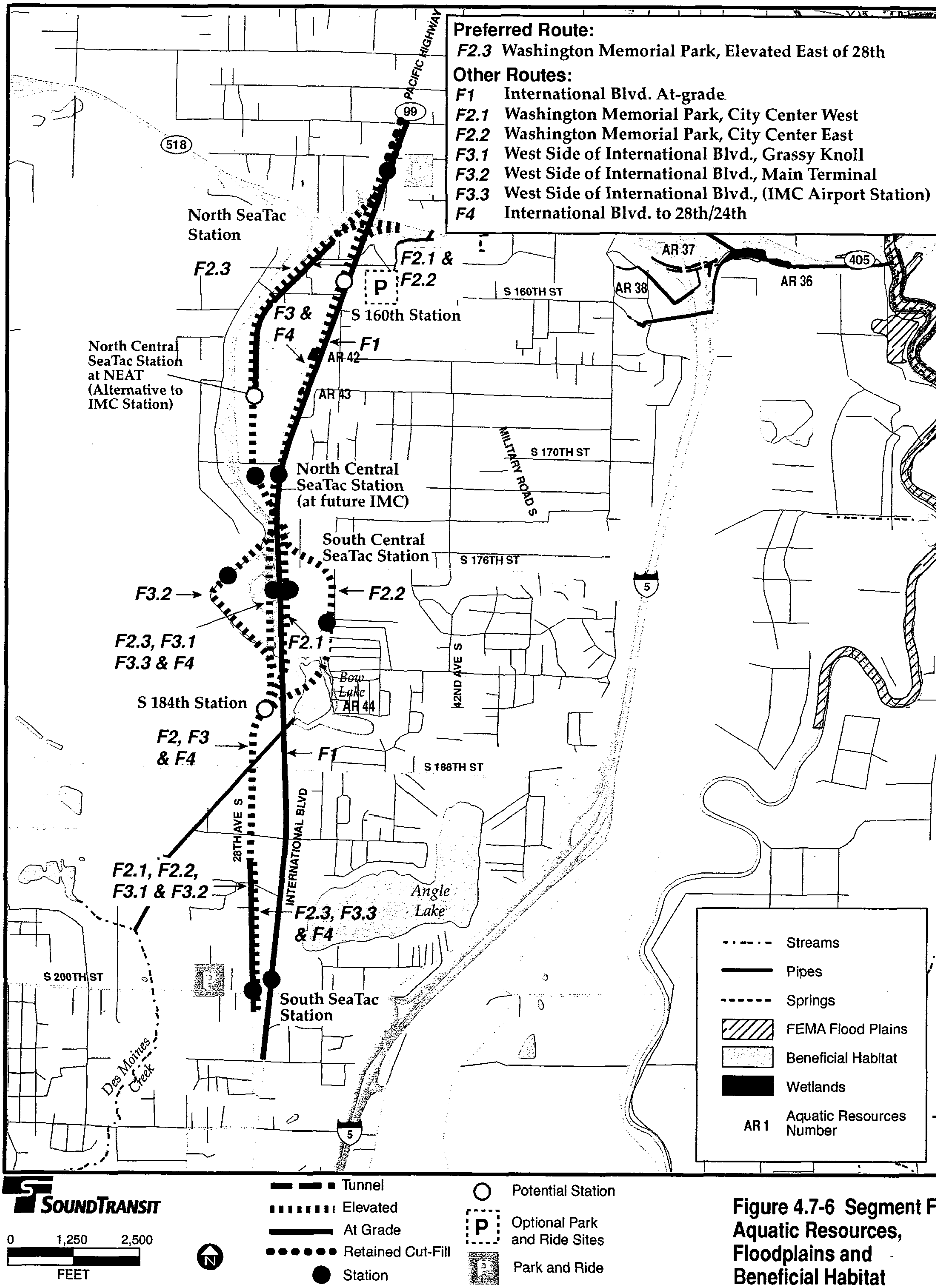


Figure 4.7-6 Segment F: Aquatic Resources, Floodplains and Beneficial Habitat

(KCM 1993). Water level fluctuations of over 3 ft are evident, and the wetland, no longer dominated by sphagnum moss, has become a scrub-shrub/forested wetland that furnishes good songbird habitat.

4.7.1.4 Fisheries

The light rail study area lies in the lower reaches of the Lake Washington and Green River drainage basins, and crosses the Lake Washington Ship Canal (Portage Bay and Lake Union) and the Duwamish/Green River, respectively. These major water bodies and their tributaries provide habitat for both anadromous and resident fish.

Description of Fish Habitat

Eight anadromous and 23 resident fish species are expected to occur within the study area. The Ecosystems Technical Back-up identifies these species and describes their occurrence in the Lake Washington and/or Green River drainage basins, their seasons of use, and habitat requirements (Eschmeyer et al. 1983; Wydoski and Whitney 1979).

Figures 4.7-1 through 4.7-6 illustrate the lakes, rivers, and streams that provide fisheries habitat within the study area. Major water bodies in the vicinity of the study area include Lake Union/Portage Bay in Segment B, and the Duwamish/Green River corridor in Segment E. Other smaller water bodies that provide fish habitat include South Fork Thornton Creek in Segment A; Riverton Creek, Southgate Creek, the Black River, and Gilliam Creek in Segment E; and Bow Lake and Angle Lake in Segment F.

Segment A in the northern end of the study area includes the headwaters of South Fork Thornton Creek, which drains into Lake Washington. The fish habitat in this creek downstream of the project corridor, is suitable for resident fish such as cutthroat trout, western brook lamprey, and sculpins. In addition, rainbow trout and a small number of coho and chinook salmon enter South Fork Thornton Creek from Lake Washington (Schneider 1999 personal communication).

Fish habitat in Portage Bay and Lake Union (Segment B) consists of freshwater lake habitat with a highly developed shoreline containing marinas, houseboats, boat maintenance facilities, and other water-dependent businesses. This development, dominated by pilings and docks, shades the bottom and limits aquatic vegetation growth. Historical discharges of industrial pollution and storm water runoff have contaminated much of the bottom sediments, although the surface water quality is rated "good," resident fish typically use this habitat including bass, crappie, pumpkinseed, perch, three-spine stickleback, catfish, and sculpins. Adult anadromous salmon and trout use this area for in-migration, while juveniles use it for out-migration.

The project may affect fish habitat in a portion of the Duwamish/Green River corridor lying in Segment E, consisting of a riverine environment lined by levee embankments. A portion of the Duwamish River in Segment E (from river mile 6.5 to 10) has fluctuating estuarine conditions created by the saltwater wedge that extends upstream from Elliott Bay along the river bottom. The saltwater wedge influences the fish distribution in the Duwamish River based on their salinity tolerance. During the spring out-migration of juvenile salmonids, the salinity gradients created by this saltwater wedge provide conditions that fish prefer for acclimating to the estuarine conditions and completing their metamorphoses. The portion of the Duwamish River near Riverton Creek could be especially important for acclimation of juvenile salmonids, but it currently lacks off-channel rearing habitat. Industrial and commercial facilities, parking lots, a golf course, railroad tracks, and bridge crossings border the shoreline of the Duwamish River in Segment E, and riparian vegetation occurs sporadically along the banks of the Duwamish/Green River in this segment. Site visits revealed a tree canopy of black cottonwood, big leaf maple, and red alder; a shrub layer dominated by Himalayan blackberry and Scot's broom; and herbaceous species such as reed canary grass and Japanese knot weed. These features provide streambank stabilization, shading, recruitment of large woody debris, and habitat for invertebrate food sources for aquatic species – all of which are beneficial to fish. The bottom sediments are mostly fine-grained materials (silt and sand) that are inadequate for spawning but will support benthic invertebrates as a food source for rearing juvenile fish. The channel lacks large woody debris as cover for juveniles. Classes of resident fish that typically use this habitat include flounder, lamprey, whitefish, minnow, sucker, perch, stickleback, sculpin, smelt, and prickle back (Muckleshoot 1995). Anadromous salmon and trout mainly use this portion of the Duwamish River in Segment E as a migration corridor, while juveniles may feed along the shorelines during their acclimation to estuarine conditions.

Segment E tributary streams (Riverton Creek, Southgate Creek, Black River, and Gilliam Creek) to the Duwamish/Green River are mainly used by resident fish, including cutthroat trout. Migration barriers, such as culverts with flap gates, limit anadromous fish passage to these small streams. These streams have been fragmented by development, are culverted under roads and parking lots, and receive stormwater runoff that causes high peak flows and low base flows. A few adult salmonids spawn in these tributaries, but there is limited off-channel rearing habitat for juvenile salmonids during their out-migration. Ongoing efforts by the City of Tukwila to increase the number of coho salmon using the Riverton and Southgate Creeks includes incubation and planting of eggs and restoration of spawning and rearing habitat. Resident fish expected to inhabit these streams include lamprey, carp, pea mouth, sucker, three-spine stickleback, and sculpins. Cutthroat trout have also been identified in Riverton Creek downstream of its crossing underneath Tukwila International Boulevard (Schneider 1999 personal communication).

Fish habitat in Bow and Angle lakes in Segment F consists primarily of freshwater lake habitat with a shoreline bordered by residential development and boat docks. Both lakes are shallow and have aquatic vegetation that supports resident fish such as rainbow trout, largemouth bass, black crappie, pumpkinseed, yellow perch, three-spine stickleback, catfish, and sculpins (Des Moines 1997). Bow Lake serves as the headwaters of Des Moines Creek. Within the study area, the stream is piped underneath International Boulevard and offers no fish habitat. Portions of Des Moines Creek downstream of the study area do provide habitat for pumpkinseed fish, largemouth bass, resident and sea-run cutthroat trout, coho salmon, and steelhead (King County 1997). Angle Lake has an outlet on the eastern side of the lake, but the drainage basin for this lake is outside the study area.

Threatened and endangered fish species (including species of concern)

The NMFS recognizes two federally listed and candidate anadromous fish species occurring within the light rail project corridor. Chinook salmon (*Oncorhynchus tshawytscha* – Puget Sound stock, a threatened species), and coho salmon (*O. kisutch* – Puget Sound/Strait of Georgia stock, a candidate species), are present in the Lake Washington and Green River drainage basins and migrate through the project area. Adult coho salmon spawn in some of the tributaries to the Green River within the project area and juvenile coho and chinook may rear in these streams.

The USFWS recognizes several non-anadromous federally listed fish species as potentially occurring within the light rail project corridor. Bull trout (*Salvelinus confluentus* – Coastal Puget Sound stock) is proposed for listing. Two other species of concern may also be present: River lamprey (*Lampetra ayresi*) and Pacific lamprey (*L. tridentata*) (USFWS 1998). Bull trout are not expected to occur in the project area based on their habitat preference for cold, well-oxygenated mountain streams (WDFW 1997). The two lamprey species may be present in the project area during adult migration to upstream spawning areas and as juveniles rearing in the bottom sediments. As species of concern, neither Lamprey species were required nor recommended to be considered in a BA.

Table 4.7-1
Potentially affected aquatic resources in the Link project

Aquatic Resource (AR) Number	Name	Segment/ Alternative	Local Jurisdiction	Classification Local	Classification State	Affected Area Type
AR-1	S. Fork Thornton Creek and riparian wetland	All A	City of Seattle	-	III	Riparian wetland
AR-2	Lake Union/Portage Bay	All B	City of Seattle	NA	NA	Lake
AR-3	Trenton Street S./MLK Jr. Way S. wetland	All D	City of Seattle	-	III	Isolated wetland
AR-4	Industrial Park Maintenance Site wetland	All E	City of Seattle/City of Tukwila	Type 3	III	Isolated wetland
AR-5	Boeing Access N.W. wetland	E1/E2	City of Tukwila	Type 2	III	Isolated wetland
AR-6	Boeing Access N.E. wetland	E1/E2	City of Tukwila	Type 2	III	Isolated wetland
AR-7	Boeing Access S.W. wetland	E1/E2	City of Tukwila	Type 2	III	Isolated wetland
AR-8	Boeing Access S.E. wetland	E1/E2	City of Tukwila	Type 2	II	Isolated wetland
AR-9	Seattle Police Gun Range Maintenance Site wetland	E1	City of Tukwila	Type 3	III	Isolated wetland
AR-10	Duwamish River crossing at SR 599/Tukwila International Blvd.	E1	City of Tukwila	NA	NA	River
AR-11	Duwamish River crossing at E. Marginal Way /115th ST	E2	City of Tukwila	NA	NA	River
AR-12	Norfolk drainage wetland	E3	City of Tukwila	Type 2	III	Hydrologically connected wetland
AR-13	MLK Jr. Way S. seep	E3	City of Tukwila	Type 3	IV	Isolated wetland
AR-14	Tukwila International Blvd./SR 599 interchange stream	E1	City of Tukwila	Type 3	III	Hydrologically connected wetland
AR-15	Riverton Creek at Tukwila International Blvd./SR 599	E1	City of Tukwila	Type 3	III	Riparian wetland
AR-16	Tukwila International Blvd./SR 599 interchange seep	E1	City of Tukwila	Type 3	III	Hydrologically connected wetland
AR-17	Tukwila International Blvd./SR 599 interchange wetland	E1	City of Tukwila	Type 3	III	Isolated wetland
AR-18	West Fork Riverton Creek and riparian wetland	E1	City of Tukwila	Type 2	II	Riparian wetland
AR-19	Southgate Creek at Duwamish River	E2	City of Tukwila	NA	NA	Stream
AR-20	East Fork Riverton Creek	E1	City of Tukwila	NA	NA	Stream
AR-21	North Fork Southgate Creek	E1	City of Tukwila	NA	NA	Stream
AR-22	Middle Fork Southgate Creek	E1	City of Tukwila	NA	NA	Stream
AR-23	Inventoried water resource 3-1 and riparian wetland	E3	City of Tukwila	Type 2	III	Riparian wetland
AR-24	Beacon Hill Coal Mine Road unnamed creek	E3	King County	NA	NA	Stream
AR-25	Beacon Hill Coal Mine Road hillside seep	E3	King County	Class 2	II	Hydrologically connected wetland
AR-26	Duwamish River Pinch at Interurban	E2	City of Tukwila	NA	NA	River
AR-27	Duwamish River Crossing at Monster Road	E3	City of Tukwila	NA	NA	River
AR-28	Black River Crossing	E3	City of Renton	NA	NA	River
AR-29	Pipefitter's Union wetlands	E2/E3	City of Renton	Category 2	III	Isolated wetland
AR-30	Fort Dent wetland	E2/E3	City of Tukwila	Type 2	IV	Isolated wetland
AR-31	Longacres 3 wetland	E2	City of Tukwila	Type 2	III	Isolated wetland
AR-32	Longacres 1 wetland	E3	City of Tukwila	Type 1	III	Isolated wetland
AR-33	Longacres 2 wetland	E3	City of Tukwila	Type 1	III	Isolated wetland
AR-34	Green River Crossing at Strander	E3	City of Tukwila	NA	NA	River
AR-35	Green River Crossing at Baker	E2	City of Tukwila	NA	NA	River
AR-36	Gilliam Creek and riparian wetlands at Southcenter	E2	City of Tukwila	Type 2	II	Riparian wetland
AR-37	I-5/I-405 Crystal Springs and riparian wetland	E2/E3	City of Tukwila	Type 3	III	Riparian wetland
AR-38	Crystal Springs and riparian wetland	E2/E3	City of Tukwila	Type 3	III	Riparian wetland
AR-39	SR 518 seep	E2/E3	City of Tukwila	Type 2	III	Isolated wetland
AR-40	SR 518/42nd Avenue S. seep	E2/E3	City of Tukwila	Type 3	III	Hydrologically connected wetland
AR-41	North Gilliam Creek and riparian wetlands at SR 518	E2/E3	City of Tukwila	Type 2	III	Riparian wetland
AR-42	U-Save wetland	All F except F2.1, F2.2 and F2.3	City of SeaTac	Class 2	II	Isolated wetland
AR-43	Washington Memorial Cemetery irrigation pond	All F except F2.1, F2.2 and F2.3	City of SeaTac	Class 3	IV	Isolated wetland
AR-44	Bow Lake and riparian wetland	F2.2	City of SeaTac	Class 2	II	Riparian wetland

Notes: 1 Aquatic resource (AR) numbers correspond to numbers indicated on Figures 4.7-1 through 4.7-6.

Endangered Species Evaluations are included in the Ecosystems Technical Report, covering chinook salmon and coho salmon, as well as bull trout. This analysis is also being used to concurrently prepare Biological Assessments as required by the Endangered Species Act. Section 7 of the Endangered Species Act requires all federal agencies (in this case, FTA) to consult with the U.S. FWS and the NMFS if they determine that any action they fund, authorize, or carry out may affect a listed species or designated critical habitat. Federal agencies are required to prepare a Biological Assessment (BA) for major construction projects. Major construction projects include any major federal action, which significantly affects the quality of the human environment (requiring an EIS). The purpose of a BA is to identify any proposed or listed species, which are likely to be affected by the proposed construction project. The BA evaluates the potential effects of the proposed action on listed and proposed species or habitats and proposes conservation measures to minimize those impacts.

4.7.2 Impacts

4.7.2.1 Impacts from Route Alternatives

Potential long-term ecosystem impacts include the amount and type of wetland filled, the amount and type of vegetation removed, and the amount and type of wildlife and fish habitat affected. Table 4.7-2 summarizes the long-term impacts on wetlands, wildlife, and fish for each route alternative, station options, and the maintenance base sites. Construction impacts are discussed in Section 4.17.7. Potential long-term project impacts on wetlands include loss of wetland acreage and reductions in wetland functions and values. These wetland impacts may occur directly from excavation and filling or indirectly from clearing vegetation, changing surface water drainage patterns, or reducing groundwater recharge. Excavating or filling wetlands would be considered a significant impact and would require permits and mitigation. Shading from elevated structures would affect wetland vegetation similar to a dense tree canopy, and in most instances it can be considered a minor impact. Potential vegetation and wildlife impacts include loss of habitat caused by altering or eliminating plant communities, fragmenting wildlife corridors, and displacing wildlife due to increased human disturbances. The magnitude of these impacts on wildlife differs depending on the species and their tolerance of human disturbance. Loss of unique habitat types or habitats used by threatened and endangered wildlife species would be considered a significant impact. Potential long-term impacts on fish habitat could include incremental increases in water temperatures and reduction in large woody debris recruitment resulting from loss of riparian vegetation, localized bank scouring caused by placing piers in river channels, potential increases in predation on juvenile fish in riprap areas underneath bridges, and incremental changes in water quality due to stormwater runoff. Impacts on habitat for threatened and endangered fish species would be considered significant and would require mitigation.

Segment A (Northgate to University District)

All four alternatives for Segment A lie in a sparsely vegetated urban environment. Long-term impacts on ecosystems are expected to be minor. The alternative locations for the Northgate Station (Options A, B and C) would have slightly different impacts on South Fork Thornton Creek and its associated wetland (AR-1). Station Option A would shade a larger portion of wetland habitat associated with Thornton Creek than Station Option B and C, which both shade the same amount of wetland area. All station options could increase pollutant runoff to Thornton Creek, but storm water detention and treatment facilities would minimize this impact. Elevated tracks from the Roosevelt Station under Alternatives A2.1 and A2.2 would remove several mature trees on Ravenna Boulevard. No long-term impacts on threatened or endangered wildlife or fish species would result from these alternatives, as long as additional stormwater runoff generated from new impervious surfaces would be detained and treated as required (see Section 4.8 Water Resources).

Segment B (University District to Westlake Station)

Long-term impacts on vegetation and wildlife habitat within Segment B are expected to be minor. For the most part, this segment is moderately vegetated by ornamental and native species, which provide limited value to wildlife. The permanent loss of mature trees used by songbirds as nesting and foraging habitat would occur under all alternatives for station entrances at N.E. 45th Street and for a vent shaft on the south side of SR 520. Alternative B2.1 would also remove mature trees on Campus Parkway. Replacement habitat would likely be provided by ornamental plantings surrounding the new station entrances and elevated tracks.

Alternative B2.1 crosses Portage Bay adjacent to a peregrine falcon roosting site on the I-5 ship canal bridge. Rail operations are not expected to adversely affect the peregrines, because noise levels would likely not increase more than 1 decibel (dBA) from existing noise levels of 72 to 76 dBA.

Operation of the light rail on a bridge over the ship canal under Alternative B2.1 is not expected to have any long-term impacts on Chinook salmon or other sensitive fish species. Shading would not impact fish habitat. The operation of Alternatives B1 (preferred alternative) and B2.2 are not expected to have any impacts on fish or falcon habitat.

Segment C (Westlake Station to S. McClellan Street)

Segment C alternatives are located in a sparsely vegetated urban environment. No long-term impacts on wetlands and fish would occur under any of the Segment C alternatives. Relatively minor impacts on wildlife habitat would occur under Alternatives C1.1, C1.2, C1.3, C1,4, C1.5, or C3. Under Alternatives C1.1, C1.2, C1.3, C1.4, and C1.5, cut-and-cover construction for tunnel portals would replace 10,150 ft^2 of deciduous forest on the East Duwamish and Cheasty Greenbelts with shrubs and trees. Under Alternative C3, cut-and-cover construction for the western tunnel portals would replace 6,400 ft^2 of deciduous forest on the East Duwamish Greenbelt with shrubs and trees. This change in vegetation may cause some wildlife to relocate or perish. Other wildlife would be expected to return to these sites once the vegetation is established.

An active peregrine falcon nest sits atop the Washington Mutual Tower on Third Avenue in downtown Seattle. Operation of the light rail system at this location would occur in the existing Downtown Seattle Transit Tunnel (DSTT) below Third Avenue. No impacts on nesting peregrine falcons or any other threatened or endangered species would be expected.

Segment D (S. McClellan Street to Boeing Access Road)

Each of the Segment D alternatives, with the exception of D1.1c, would permanently fill 0.11 acre of wetland and 0.03 acre of wetland buffer (AR-3) (Table 4.7-1). Alternative D1.1c would fill 0.15 acre of wetland and 0.03 acre of wetland buffer (AR-3). Wetland AR-3 is located in a powerline right-of-way at the northwest corner of Trenton Street S. and MLK Jr. Way S. This wetland is periodically mowed by the Power Company, and provides limited wildlife habitat and stormwater control functions. No long-term impacts on fish habitat would occur in Segment D. Some additional minor impacts on wildlife could occur under Alternatives D1.1c, D1.1d, D1.1e, D1.1f, D1.3, and D3.3 as a result of vegetation disturbance at the edge of two deciduous forest patches along MLK Jr. Way S. Songbirds and small mammals using these trees would be permanently displaced and some may perish. Alternative D3.4 does not require the removal of any deciduous trees, and no additional impacts on urban wildlife habitat are expected. Two active bald eagle nests are located in Seward Park on Lake Washington, approximately 1.5 miles from the light rail alternative routes. Due to the distance from the light rail routes and the density of large trees buffering the eagle nesting sites, no disruption of nesting activities is expected from light rail operation under any of the segment alternatives.

Segment E (Tukwila)

Ecosystem impacts under Alternatives E1.1 (preferred alternative) and E1.2 would include loss of approximately 2.02 acres of wetland and 1.57 acres of associated wetland buffer, loss of approximately 1.57 acres of deciduous forest used by urban songbirds. Potential impacts on fisheries habitat are also possible due to loss of riparian vegetation and incremental changes in water quality from stormwater and pollutant runoff (Table 4.7-2). These impacts would result from new elevated track over the Duwamish River and Riverton Creek and its riparian wetlands; placement of tracks in wetlands and on forested slopes; and filling for the Boeing Access Road Park-and-Ride lot. Alternatives E1.1 (preferred alternative) and E1.2 would also affect the planned Riverton Side Channel Project, which is designed to increase juvenile salmonid access to off-channel rearing habitat in Riverton Creek and add habitat features to the creek channel to improve the available habitat (Watershed Restoration Group 1998). Preliminary designs for the elevated track spanning this area indicate that the light rail tracks would parallel the eastern side of the Riverton Creek Side Channel project for 200 ft from its confluence with the Duwamish River. The tracks would then cross Riverton Creek as the tracks continue south and Riverton Creek continues east. The bottom of the structure in this area would be approximately 50 ft above the 100 year flood elevation. While trees could not be planted within 30 ft of the centerline of the tracks, other shrub and emergent species that provide important riparian functions could be planted below the tracks to mitigate this impact on the Riverton Creek Side Channel project.

The potential impacts on fish habitat from the Alternative E1.1 (preferred alternative) and E1.2 bridge depend on the locations of foundations and piers. Current designs indicate that piers for the Tukwila International Boulevard bridge over the Duwamish River can be located landward of the river's 100-year floodway boundaries. This would avoid waterway constriction and streambank scour, thereby eliminating any potential long-term impacts on fish habitat. Proper collection, detention, and disposal of stormwater runoff from the elevated structure would minimize long-term impacts on fish habitat in the Duwamish River resulting from the additional impervious surface. The proposed bridge structure would require clearing riparian trees within 30 feet of the centerline of the tracks. However, the bridge span would be approximately 40 ft above ground level at this location and riparian plantings with native shrubs and herbs would mitigate this impact. Culvert extensions on Tukwila International Boulevard, at the Riverton and Southgate Creek crossings, would not affect salmonid habitat. Some resident fish habitat may be lost due to the culvert extension at Riverton Creek. Detention and treatment of stormwater runoff from new impervious surfaces in the Riverton and Southgate basins would minimize long-term impacts on fish using these systems.

Ecosystem impacts under Alternative E2 would include filling 1.54 acres of wetland area and 1.43 acres of wetland buffer, loss of approximately 5.0 acres of deciduous forest along I-405 and SR 518, removal of 20 or more mature trees along the Duwamish/Green River, and potential disturbance of fish habitat through the loss of riparian vegetation and incremental changes in water quality (Table 4.7-1). These impacts would result from three bridges over the Duwamish River and one bridge over the Black River; placement of tracks in wetlands and on forested slopes; and placement of tracks in the floodplain of Gilliam Creek (Table 4.7-1). Loss of deciduous forest permanently displaces forest-associated wildlife including hawks, warblers, woodpeckers, and small mammals. A few of these animals would move to other areas, but others would perish if nearby habitats are fully occupied. Light rail operations near the Black River would not be expected to affect the heron rookery located one-half mile from Alternatives E2 and E3 (Thompson 1998 personal communication).

The potential impacts on fish habitat under Alternative E2 would be greater than under Alternatives E1.1, E1.2, or E3 because E2 adds more new bridges over major and minor fish-bearing water bodies. In addition, the extent of at-grade and elevated track to be constructed near surface waters for E2 would require extensive vegetation removal and create new impervious surface areas.

Alternative E2 would cross the Duwamish/Green River three times (at S. 115th Street, S. 143rd Street, and Baker Boulevard) in addition to one crossing over the Black River. Preliminary designs indicate that the S. 143rd Street crossing of the Green River would require one pier in the 100-year floodway. The S. 115th Street crossing would require either four piers in the 100-year floodway (including two within the normal-stage waterway of the Duwamish River, or no piers in the 100-year floodway, depending on the selected bridge design. In-water piers would be circular or elliptical in section to minimize potential fish habitat impacts, such as increased stream bank erosion resulting from altered flow patterns around the piers. Piers within the 100-year floodway could increase erosion and scour during high-flow events, leading to increased turbidity and nutrient loading. Alternative E2 would also affect salmonid habitat in Gilliam Creek at Southcenter Boulevard through both vegetation removal and the potential placement of piers in the creek channel or its floodplain. Piers in the channel or floodway of Gilliam Creek, along with vegetation removal, would increase erosion and scour during high-flow events, leading to increased turbidity and nutrient loading. The headwaters of Gilliam Creek along SR 518 would also be affected through extensive vegetation removal on the forested slopes.

Alternative E3 impacts would include loss of 1.61 acres of wetland area and 2.57 acres of wetland buffer; loss of approximately 12.0 acres of deciduous forest habitat along MLK Jr. Way S. and SR 518; removal of 3 to 4 large trees along the Green River; potential impacts on fish habitat caused by removal of riparian vegetation; and increases in new impervious surface areas, and the resulting incremental increases in pollutant and sediment loading (Table 4.7-2). Wetland and wildlife impacts associated with this alternative would be similar to those described for Alternative E2; however, Alternative E3 would displace a greater amount of wildlife due to the greater area of forest removed.

Potential impacts on fish habitat associated with Alternative E3 would be greater than with Alternatives E1.1 (the preferred alternative) and E1.2, because Alternative E3 proposes a greater number of bridge crossings, and a greater amount of vegetation removal and new impervious surface area in the Duwamish River basin. Alternative E3 includes two new bridges over major and minor fish-bearing water (Green River at Strander Boulevard and Black River), with no track construction immediately adjacent to fish-bearing waters. Alternative E3 would result in the placement of four piers in the 100-year floodway of the Black River; however, no piers would be placed within the normal-stage waterway for either bridge. Impacts on water quality and fish habitat at these proposed crossings would be similar to the impacts described for the bridge's crossing under Alternative E1.1 (preferred alternative) and E1.2. Alternative E3 would also affect the headwaters of Gilliam Creek along SR 518 through extensive vegetation removal on the forested slopes.

The USFWS and the WDFW have identified the vicinity of the Duwamish/Green River as potential bald eagle habitat. Despite the proximity of this area to other nesting territories and wintering areas, the WDFW has identified no communal roosts, regularly occupied roost trees, or nesting territories along the Duwamish/Green River (Negri 1998 personal communication). The removal of a few mature trees along the river to accommodate bridge crossings, as required under Alternatives E1.1 (preferred alternative), E1.2, and E3, is not likely to adversely affect bald eagles because the area is not currently used by eagles. However, the extensive removal of mature trees to accommodate bridge crossings and tracks under Alternative E2 could adversely affect bald eagles by precluding their use of the area.

Impacts on Chinook salmon in Segment E vary among the three alternatives, depending on the water bodies involved, the number of bridge crossings, and the amount of new impervious surface area (see Section 4.8 Water Resources). Alternative E2 would have the greatest potential impact, followed by Alternative E3. Alternatives E1.1 (preferred alternative) and E1.2 would have the least impact. The light rail bridge crossings could have long-term impacts on Chinook salmon habitat because they would remove vegetation in riparian areas, reducing large woody debris recruitment and increasing bank erosion. Additionally, piers in river channels could cause localized bank scouring. If riprap is used around piers beneath bridges it could provide desirable cover for species that prey upon juvenile fish (Bauman 1999 personal communication).

Riprap placement and potential changes in water quality from increased sedimentation could result in potential long-term impacts on protected salmonids. Other anadromous fish species in the Duwamish River and its tributaries that may be affected include coho salmon, sea-run cutthroat trout, river lamprey, and pacific lamprey. Bull trout are not expected to use habitat within the project area.

Segment F (SeaTac)

Alternatives F3.1, F3.2, F3.3, and F4 would require 0.60 acre of tree removal along the eastern edge of Washington Memorial Park and the loss of 0.12 acre of forested and palustrine emergent wetland (AR-42 and AR-43) and 0.21 acre of wetland buffer. Alternative F2.2 would affect Bow Lake (AR-44) through the loss of less than 0.01 acre of scrub/shrub wetland and 0.06 acre of wetland buffer, loss of some riparian vegetation that provides wildlife habitat and water quality functions, and incremental degradation of fish habitat from in-water piers and clearing of littoral vegetation. South SeaTac Station Option A would remove 5.0 acres and station options B and C would remove 4.0 acres of trees and dense shrubs. Most raptors, songbirds, and small mammals would be permanently displaced and some may perish. South SeaTac Station options D, E, and F would remove 0.60 acre of urban songbird habitat, resulting in the permanent displacement of these species. No long-term impact on wetlands or fish habitat is expected under the other alternatives in Segment F.

None of these alternatives would be expected to affect the bald eagle nesting territory at Angle Lake. No impacts on threatened and endangered fish species are expected to result from any of the alternatives in this segment.

Maintenance Base Sites

Maintenance Base sites M1-A, M1-B, M1-C, M1-D, and M1-E would not affect wetlands, wildlife, or fish resources. Potential impacts on wetlands at site M2 include a reduction of the buffer surrounding wetland AR-4. No long-term impacts on fish and wildlife would occur at site M2. Maintenance Base site M3 would cause impacts on the buffer of wetland AR-9. Increased runoff from additional impervious surface could potentially affect wetland AR-9. Site M3 would have no impacts on fish resources.

4.7.2.2 System-wide Ecosystem Impacts

Depending on the alternatives selected, the N.E. 45th Street to SeaTac alignment could fill up to 2.29 acres of wetland and 2.81 acres of wetland buffer, remove between 8 and 17 acres of other wildlife habitat, including riparian habitat, and impact fisheries in up to six locations on major rivers or water bodies. The preferred alternative would fill 2.13 acres of wetland and 1.60 acres of wetland buffer, remove up to 2.0 acres of wildlife habitat, and impact fisheries at 4 locations including Portage Bay, the Duwamish River, and tributaries to the Duwamish River. Under MOS A, no impacts on wetlands or fish habitat would occur. Approximately 0.34 acre of deciduous forest would be removed. MOS B would fill up to 0.15 acre of wetland. No impacts on fish habitat would occur under MOS B or MOS C. Approximately 0.34 acre of deciduous forest would be removed. In addition, some urban songbird habitat would be lost. MOS C would have no impacts on wetlands or wildlife.

Total ecosystem impacts for the Northgate to SeaTac system would be similar to those described for the N.E. 45th Street to SeaTac Alternative. The only additional impacts would be minor effects to Thornton Creek and associated wetlands near Northgate.

The No-build Alternative would avoid the impacts associated with light rail construction and operation. However, because the regional and local land use and transportation plans are dependent on increased high-capacity transit, No-build could result in the need to revise those plans. No-build would likely reduce the region's ability to meet residential and employment density goals, thereby requiring greater land area to accommodate regional population and employment growth. This would result in ecosystem impacts in other locations. No-build would result in higher automobile use (measured in VMT) which would increase impacts to surface water quality in wetlands and other aquatic resources.

4.7.3 Mitigation

Recommended mitigation for ecosystem impacts is based on a hierarchy of avoiding, minimizing, and compensating for unavoidable adverse impacts.

At the very beginning of the project, avoidance of impacts on ecosystems is an important component of alternative development and design. Alignment alternatives were developed based on numerous constructability issues, including the presence of sensitive areas. Where possible, sensitive areas were avoided. Where avoidance was not possible, designs were modified to minimize impacts on ecosystems. Preliminary designs for the light rail project incorporate several design features intended to reduce or avoid impacts on ecosystems. Some of the design modifications made specifically to reduce impacts on sensitive areas include: placing piers outside the river floodway channel (most crossings); using pre-cast girders for the bridge spans; using elevated tracks vs. at-grade tracks to reduce wetland impacts, using a central pier design for elevated tracks, which has a smaller footprint and can be placed right or left of center to avoid placement in wetlands, and installing stormwater collection facilities along the tracks.

Impact minimization would be achieved by implementing best management practices (BMPs) and monitoring these practices to make sure they are in place and functioning effectively. Impact minimization could also be achieved by: selecting an alternative or station with fewer ecosystem impacts; reducing the footprint of a facility; performing work in and around wetlands from an existing roadway or upland site; and providing stormwater detention and treatment for all new impervious surface areas.

Some impacts may be unavoidable and would require compensatory mitigation for the resulting permanent loss of habitat, especially in Segment E, where the greatest impacts on ecosystems would occur. Where impacts are unavoidable, mitigation could be provided by creating, enhancing, and/or restoring aquatic resource habitat similar to what was lost. This may occur at the same location as the impact or in the same localized drainage basin as the affected wetland or resource. Sites in the immediate vicinity are preferred over sites upstream or downstream or within other drainage systems. These criteria may be difficult to meet in the portion of Duwamish/Green drainage basin affected by the light rail project, because the river corridor in this area is highly developed, has few natural open spaces, and is tightly constrained by transportation and utility corridors. Suggested mitigation in Segment E is discussed below. Mitigation for unavoidable aquatic resource impacts can also include off-site improvements or mitigation banks.

Within all segments of the light rail corridor, trees removed from street-rights-of-way or city parks would require permits and replacement. Further, stormwater detention and treatment for all new impervious surfaces would minimize impacts on streams, wetlands, and fish habitat. Within the City of Seattle, all city stormwater requirements would be met for new impervious surfaces. Outside of Seattle, KCSWM Level 2 requirements will be met for stormwater detention and treatment for new polluting impervious surfaces.

Compensation requirements for wetland impacts in Segment D could be partially accomplished on site by removing invasive non-native shrubs and planting with native wetland species. Remaining requirements could be met at another location identified by permitting agencies. Because many of the wetlands potentially affected by the light rail in Segment E have been disturbed and encroached by development, on-site enhancement and restoration may provide suitable mitigation. Within the vicinity of AR-8, which would be affected by the proposed Boeing Access Road park-and-ride, wetlands such as AR-7, directly to the west of AR-8, could be restored. For example within AR-7, fill from previous activities could be removed and replanted with native wetlands species. Large areas of the wetland also contain garbage that could be removed from the site. Invasive species such as Himalayan blackberry, which are encroaching the wetland, could also be removed and these areas could be planted with native wetland species.

Mitigation should take into consideration of the Federal Aviation Administration (FAA) Advisory Circular – Hazardous Wildlife On or Near Airports (1997). The guidance advocates limiting activities that attract wildlife, especially birds, within 10,000 ft of an airport with turbine-powered aircraft. The limited activities include wetland mitigation. Wetland AR-7 is directly in the flight path of Boeing Field and only 3,700 ft from the end of the runway. When choosing specific wetland attributes, care should be taken to restore or enhance the wetland in manner that does not attract birds, particularly migratory waterfowl.

Remaining mitigation requirements for wetland impacts could be met in conjunction with compensation requirements for impacts, if any, on fisheries habitat in the Duwamish/Green River and its tributaries. Mitigation may include riparian plantings, stream channel habitat improvements, wetland restoration, or riparian restoration within the following systems: Duwamish/Green River, Riverton Creek, Southgate Creek, or Gilliam Creek. Impacts from bridge crossings could be mitigated by planting native species in the riparian corridor in the vicinity of the crossing. Impacts on fish habitat from culvert extensions could be mitigated by conducting in-stream habitat improvements. Impacts on threatened and candidate fish species could be mitigated by funding a habitat restoration project in the same basin as the impact. Many priority salmonid habitat restoration projects have already been identified by federal, state, and local agencies such as those identified by the Watershed Restoration Group (1998) and the U.S. Army Corps of Engineers.

4.7.4 Significant Unavoidable Adverse Impacts

Significant unavoidable adverse impacts on ecosystems include filling between 1.65 and 2.29 acres of wetland and 1.46 and 2.81 acres of wetland buffer, and removing mature trees within riparian habitat along the Duwamish River (depending upon the route alternative). The total wetland impacts under the preferred alternative are estimated to be 2.13 acres of wetland fill and 1.60 acres of wetland buffer impact. None of the alternatives can completely avoid wetland impacts. However, identified mitigation measures could replace, and possibly increase, the functional values these wetlands and buffers provide.

Table 4.7-2
Summary of long-term impacts to wetlands, wildlife, and fish resources by route alternative.

Segment Alternative	Wetlands[1]	Wildlife/Vegetation[2]	Fisheries
Northgate to University District			
A1.1	Option A shades a greater portion of riparian wetland (AR-1) than Option B	No impact	Small loss of riparian vegetation in headwaters of South Fork Thornton Creek. Incremental changes in water quality due to storm water and pollutant runoff at station sites.
A1.2	Same as Alternative A1.1	No impact	Same as Alternative A1.1
A2.1	Same as Alternative A1.1	Loss of mature trees on Ravenna Blvd.	Same as Alternative A1.1
A2.2	Same as Alternative A1.1	Same as Alternative A2.1	Same as Alternative A1.1
University District to Westlake Station			
B1 (pref.)	No impact	Incremental loss of urban songbird habitat caused by removal of up to 10 mature trees at N.E. 45th Street Station (all options). Removal of 5 to 6 fir trees for vent shaft site at SR 520 and 10th Ave. N.E.	No impact
B2.1	No impact	In addition to B1 impacts, loss of mature trees along Campus Way	Incremental changes in water quality due to stormwater and pollutant runoff at one bridge crossing over Portage Bay
B2.2	No impact	Same as Alternative B1	No impact
Westlake to S. McClellan Street			
C1.1, C1.2, C1.3, C1.4, C1.5	No impact	Replacement of 10,150 ft^2 of deciduous forest with shallow-rooted trees and shrubs.	No impact
C2.3	No impact	No additional impact to wildlife or vegetation	No impact
C2.4	No impact	No additional impact to wildlife or vegetation	No impact
C3	No impact	Replacement of 6,400 ft^2 of deciduous forest with shallow-rooted trees and shrubs.	No impact
S. McClellan Street to Boeing Access Road			
D1.1, (D1.1d, D1.1e, D1.1f) (pref.)	Fill = 0.11 acre (AR-3) Buffer loss = 0.03 acre	Incremental loss of urban deciduous forest habitat near Beacon Hill greenspace Fragmentation of powerline migration corridor by bus staging area at S. Henderson Station	No impact
D1.1c	Fill = 0.15 acre (AR-3) Buffer loss = 0.03 acre		
D1.3	Same as Alternative D1.1	Same as Alternative D1.1	No impact
D3.3	Same as Alternative D1.1	Same as Alternative D1.1	No impact
D3.4	Same as Alternative D1.1	Same as Alternative D1.1	No impact

Table 4.7-2 continued

Segment Alternative	Wetlands[1]	Wildlife/Vegetation[2]	Fisheries
Tukwila			
E1.1 (pref.)	Fill = 2.02 acres < 0.02 acre PEM (AR-7, AR-8) 2.0 acres PFO/PSS (AR-8, AR-17) < 0.01 acre riparian (AR-8) Buffer loss = 1.57 acres (AR-7, AR-8, AR-17, AR-18), Placement of Piers in AR-14 would result in loss of 10 ft diameter of wetland.	Loss of 1.5 acres of urban deciduous forest habitat along Tukwila International Blvd. near Southgate Creek	Minor loss of riparian vegetation could result in minor increases in turbidity and nutrient loading resulting from scouring and sedimentation during flood events Shading of Riverton Creek Side Channel Project and restrictions on riparian tree plantings due to the proximity of elevated tracks.
E1.2	Same as Alternative E1.1	Same as Alternative E1.1	Same as Alternative E1.1
E2	Fill = 1.54 acres 1.54 acres PEM (AR-7, AR-29, AR-36, AR-37, AR-39, AR-40) Buffer loss = 1.43 acres Vegetation shading	Removal of 20 or more mature trees at four sites along the Duwamish/Green River resulting in the loss of potential perch sites for wintering bald eagles, and foraging and nesting sites for hawks and songbirds Loss of 3.3 acres of deciduous forest in retained cut-segment along SR 518 Replacement of 1.8 acres of forest vegetation by shrub/herbaceous species in elevated segment along SR 518 and I-405.	Removal of 20 or more mature trees along Duwamish / Green River, resulting in a reduction in large woody debris recruitment and increased bank erosion Loss of riparian vegetation could result in minor increases in turbidity and nutrient loading resulting from scouring and sedimentation Potential increase in predation on juvenile fish in areas with riprap-lined banks and in the vicinity of two piers in the water Up to 5 piers in the 100-year floodway of the Duwamish/Green River resulting in localized bank scouring Support piers in channel or floodplain of Gilliam Creek at Southcenter Blvd would result in increased scour and erosion during high-flow events causing turbidity and nutrient loading
E3	Fill = 1.61 <0.01 acre riparian (AR-23) 1.57 acres PEM (AR-13, AR-29, AR-32, AR-39, AR-40) <0.01 acre PSS (AR-12) 0.02 acre PFO (AR-25, AR-33) Buffer loss = 2.57 acres Vegetation shading	Removal of 3 to 4 large trees at one crossing of the Duwamish/Green River resulting in loss of potential perch sites for wintering bald eagles, and foraging and nesting sites for hawks and songbirds Loss of 8.0 acres of deciduous forest in retained cut segment along MLK Jr. Way S. and SR 518 Replacement of 4.2 acres of forest vegetation by shrub/herbaceous species in elevated segment along Monster Road and SR 518	Removal of 3 to 4 large trees along Duwamish/Green River resulting in a reduction in large woody debris recruitment and insect production Loss of riparian vegetation could result in minor increases in turbidity and nutrient loading resulting from scouring and sedimentation Support piers in channel or floodplain of Gilliam Creek at Southcenter Blvd would result in increased scour and erosion during high-flow events causing turbidity and nutrient loading. Four piers in the 100-year floodway of the Black River resulting in localized scouring.
SeaTac			
F1	Buffer loss = up to 0.21 acre (AR-42, AR-43)	Loss of 5.0 acres of forest and shrub cover and foraging habitat for wildlife under S. SeaTac Station option A.	No impact
F2.1	No impact	Loss of 4.0 acres of forest and shrub cover and foraging habitat for wildlife under S. SeaTac Station option B.	No impact
F2.2	Fill = < 0.01 acre (AR-44) Buffer loss = 0.06 acre Vegetation shading	Same as Alternative F2.1	Fish in Bow Lake affected by loss of habitat from clearing of riparian and littoral vegetation, and placement of piers in water. A slight increase of pollutant runoff may change water quality.
F2.3	No impact	Loss of 0.60 acre urban songbird habitat at S. SeaTac Station option E or F.	No impact

Table 4.7-2 continued

Segment Alternative	Wetlands[1]	Wildlife/Vegetation[2]	Fisheries
F3.1	Fill = 0.12 acre (AR-42, AR-43) Buffer = 0.21 acre (AR-42, AR-43)	In addition to Alternative F2.1 impacts, loss of 0.60 acre urban songbird habitat along eastern edge of Washington Memorial Park	No impact
F3.2	Same as Alternative F3.1	Same as Alternative F3.1	No impact
F3.3	Same as Alternative F3.1	In addition to Alternative F2.3 impacts, loss of 0.60 acre urban songbird habitat along eastern edge of Washington Memorial Park	No impact
F4	Same as Alternative F3.1	Loss of 4.0 acres of forest and shrub cover and foraging habitat for wildlife or loss of 0.60 acre urban songbird habitat under S. SeaTac Station option C or D, respectively. Loss of 0.60 acre urban songbird habitat along eastern edge of Washington Memorial Park	No impact
Maintenance Base Sites			
M1 (M1-A, M1-B, M1-C, M1-D)	No impact	No impact	No impact
M2	Buffer reduction in (AR-4)	No impact	No impact
M3	Buffer reduction in (AR-9)	No impact	No impact

Notes: Calculations of the acres of impact are based on conceptual design.
[1]Classes of wetland include palustrine emergent (PEM), palustrine scrub/shrub (PSS), and palustrine forested (PFO). Individual wetlands named in parentheses are described in Section 4.7, Table 4.7-2.
[2]Displacement of common urban wildlife species due to removal of non-native and ornamental vegetation is common to all segments and alternatives.

4.8 WATER RESOURCES

4.8.1 Affected Environment

Project staff assessed the general conditions, land uses, hydrology, flooding, and water quality conditions for the major drainages and surface water bodies potentially affected by the light rail alternatives. These water bodies and associated floodplains appear in Figures 4.7-1 through 4.7-6.

4.8.1.1 Thornton Creek

Segment A routes cross the Thornton Creek basin, which drains into Lake Washington. The headwaters of the south branch of Thornton Creek lie within the area affected by all Segment A alternatives on the east side of I-5. Wetlands near North Seattle Community College are hydrologically connected with Thornton Creek through a pipe that conveys water under I-5 to the project area. The project area is almost completely covered with impervious surfaces. In this area, Thornton Creek is conveyed – through ditches, swales, and detention ponds – to a storm pipe that conveys flows under Northgate Mall to an open channel. Localized flooding problems occur along First Avenue N.E. during the 25-year and larger storm events (Seattle Engineering Dept. 1995). Thornton Creek is classified as Class AA "extraordinary" by Ecology (WAC 173-210A). Thornton Creek is not included on the proposed 1998 Ecology 303(d) list of impaired and threatened water bodies, although it has exceeded fecal coliform criteria. Additional data indicate that downstream of the study area Thornton Creek has depressed dissolved oxygen (DO) levels during summer low-flow conditions (Ecology 1998).

4.8.1.2 Ravenna Creek

Ravenna Creek basin drains east into Lake Washington just north of Lake Union. The proposed routes in Segment A would cross through the Ravenna Creek watershed. However, historic development of the basin has altered watershed drainage patterns so that some runoff that once was directed to the creek is now conveyed to Lake Union after being collected in storm drains and combined sewer overflows (CSOs), which, at times, overflow. Flows in Ravenna Creek now mostly consist of seepage from springs within Ravenna Park (SvR 1997).

4.8.1.3 Lake Union

All route alternatives in Segment B cross Portage Bay within Lake Union, which receives water from Lake Washington and drains into Puget Sound. The lake also receives water from adjacent upland areas via storm drains and CSOs. Land use in this area consists mainly of commercial development and docks on the lake's northern shore, and residential development and a few small parks on the southern shore.

Ecology classifies Lake Union as "Lake Class." Currently, Lake Union provides freshwater ports, maintenance facilities, and navigation routes for recreational and commercial boats. Ecology has also placed Portage Bay, within the study area, on the 1998 303(d) list as a threatened or impaired water body because it exceeds sediment bioassay criteria.

4.8.1.4 Elliott Bay

The area within Segment C that lies northwest of I-90 drains into Elliott Bay, a marine environment and part of Puget Sound, through local drainage systems and CSOs. Although Elliott Bay will not be crossed by any of the alternatives, it receives runoff from the study area. Elliott Bay is a major port and an important migratory route for salmonids; it also provides habitat for other fish and shellfish species.

4.8.1.5 Lake Washington

The area within Segment D along Rainier Avenue S. drains into Lake Washington through local drainage systems and CSOs (Metro 1995). Although it receives runoff generated within the study area, Lake Washington is not crossed by any of the proposed alternatives. Areas draining to the lake are mostly developed. Lake Washington is on Ecology's 1998 303(d) list for exceeding fecal coliform criteria. The lake, part of the Cedar River system, provides important habitat for salmonids and other fish species. It also supports many recreational activities such as boating, swimming, and fishing.

4.8.1.6 Duwamish River

The Duwamish River, the largest river system within the project area, includes two major tributaries, the Green and Black rivers. Several smaller tributaries are also located in the system: Norfolk Drainage Basin, Riverton Creek, Southgate Creek, Watercourse 3-1, and Gilliam Creek. The Duwamish River also receives flow from numerous unnamed springs, seeps, and stormwater channels within the study area. The confluence of the Green and Black rivers forms the Duwamish River, which drains into Elliott Bay and creates an estuary at the bay's south end. Land uses within the Duwamish River system include large commercial sites and areas of residential and rural development.

The Duwamish River receives stormwater through CSOs from the area affected by Segment D north of Beacon Avenue (Metro 1995). Ecology has classified the Duwamish as a Class B river from its mouth to the Black River confluence (WAC 173-201A). Ecology has placed the Duwamish River on the 303(d) list for exceeding numerous sediment quality standards and for exceeding DO, fecal coliform, and pH criteria. The Duwamish River supports commercial and recreational navigation and salmon fishing (King County 1995). An extensive trail and park system lies adjacent to the river within the study area.

Within the study area, upstream regulation, levees, and tidal fluctuation influence local flooding in the Duwamish Basin.

Norfolk Drainage. Areas affected by alternatives in Segment D are in the Norfolk Drainage, which carries runoff from urban areas along MLK Jr. Way S. Local flooding has been observed about twice a year in a closed depression, along S. Norfolk Street, between MLK Jr. Way S. and 42nd Avenue S. Flooding has also been observed along MLK Jr. Way S. at the Seattle-Tukwila border, where drainage ditches overflow (Seattle Engineering Dept. 1995).

Riverton Creek. In Segment E, Riverton Creek drains into the Duwamish southeast of the Tukwila International Boulevard Bridge. The west fork lies in a natural channel with riparian vegetation; the east fork is culverted and flows through a roadside ditch. All forks of the creek drain an area of residential development near the headwaters and commercial development near the mouth. Portions of the creek flow through roadside ditches, culverts, and pipes. Water quality monitoring indicates that Riverton Creek has had high levels of fecal coliform, total phosphorus, turbidity, and total suspended solids (Tukwila 1997). Runoff from SR 599 and Tukwila International Boulevard, which drains into Riverton Creek, has exceeded chronic standards for copper (Tukwila 1997). In addition, sedimentation is a problem primarily downstream of Tukwila International Boulevard. because sediment eroded in the upper reaches is deposited in the Duwamish Valley (Tukwila 1997). Riverton Creek's water quality does, however, support salmonids, and a Riverton Creek Restoration Project, which could improve water quality and provide salmonid habitat near the mouth of the creek is in the planning stage. The creek's floodplain has been filled, and steep banks extending from SR 599 to the creek's mouth confine high flows to the channel, thereby protecting adjacent areas from flooding. Local flooding problems downstream of Tukwila International Boulevard are due to undersized or partially blocked culverts (Tukwila 1997).

Southgate Creek. In Segment E, Southgate Creek drains northwest Tukwila and empties into the Duwamish River southeast of the intersection of Interurban Avenue S. and 42nd Avenue S. All five branches drain areas developed with residential and commercial uses. The north, middle, and south forks and central drain of Southgate Creek drain through steep narrow ravines east of Tukwila International Boulevard. These ravines have significant erosion and incision as a result of increased peak flows due to urban development in the upper basin. Downstream reaches have water quality problems associated with deposition of eroded sediment (Tukwila 1997). Water quality in Southgate Creek was assumed to be characteristic of urbanized basins, which typically have high levels of nutrients, hydrocarbons, and metals (Bellevue 1984, 1996). However, the City of Tukwila's Fostoria Stormwater Quality Management Plan indicated that water quality in Southgate Creek is adequate to support aquatic life, and salmonids have been identified in the stream (Tukwila 1996). The floodplain along Interurban Avenue S. has been filled and developed; steep banks confine the channel in this area. The north, middle, and south forks of Southgate Creek are confined in pipes under Tukwila International Boulevard and drain into roadside ditches or natural channels east of Tukwila International Boulevard.

Black River. The Black River drains southwest Renton, an area developed with dense commercial and residential land uses. Water quality in the pump station pond and locations upstream has been found impaired (Renton 1995; Ecology 1998). Although water quality within the areas potentially affected by light rail has not been documented, project staff assumed water quality problems such as temperature, metals, and fecal coliform. Local flooding does not occur in the area because the Black River pump station regulates discharges.

Green River. The Green River watershed has the largest drainage area of the Duwamish River tributaries potentially affected by the project. In this reach, Ecology has classified the Green River as a Class A river. This section of the Green River has also been included on the Ecology 303(d) list due to exceedances of criteria for dissolved oxygen, fecal coliform, temperature, and mercury.

Extensive areas of the historic Green River floodplain have been filled and developed, and residential and commercial developments are adjacent to the river. Green River flows are regulated by a dam, levees, and pump stations. Local flooding that occurs in the Green River Valley is associated with backups behind pump stations, and not from flows over levees.

Gilliam Creek. Gilliam Creek begins near Tukwila International Boulevard, drains east along SR 518, and empties into the Green River at the I-405 crossing. The creek is in a natural channel in some locations; but large reaches of the creek are in pipes both upstream and downstream of the project area. Gilliam Creek primarily receives water from urbanized areas, including Southcenter Mall, and from seeps and springs on the hillslope south of SR 518. The creek's water quality has not been measured, but streams in urbanized watersheds typically have water quality problems from due to hydrocarbons, temperature, biological oxygen demand, and turbidity (Bellevue 1984). Within the study area located south of I-405 and north of Southcenter Mall, a FEMA-designated floodplain is associated with Gilliam Creek. This area has a vegetated riparian zone and the capacity to store overbank flows, thereby reducing local flooding problems.

Inventoried Watercourse 3-1 drains the northern portion of Tukwila east of I-5 and discharges into the Duwamish south of I-5. The floodplain of Watercourse 3-1 supports riparian vegetation and wetlands along the channel. Evidence of overbank deposits of sediment and debris indicate that local flooding occurs.

4.8.1.7 Des Moines Creek

Segment F alternatives are in the Des Moines Creek drainage basin, which conveys flows to Puget Sound. Bow Lake, which forms the headwaters of the east fork of Des Moines Creek, receives stormwater from the surrounding basin, which is heavily developed. Historically the lake was a peat bog; however, peat was extracted for many years and the lake was partially filled during the 1950s and 1960s for commercial development. Bow Lake is on the proposed Ecology 303(d) list of impaired and threatened water bodies, because of depressed dissolved oxygen due to summer algal blooms (Parametrix 1992). Des Moines Creek enters a pipe at the outlet of the lake and is conveyed in a pipe through the entire area affected by the project. Downstream of the study area, Ecology has classified Des Moines Creek waters as Class A; the creek is also on the Ecology 303(d) list because of elevated levels of fecal coliform. Local flooding in a low area along 28th Avenue, south of 188th Street, along the proposed alignment has been reported due to undersized pipes in the local drainage system (SeaTac 1997).

4.8.2 Impacts

4.8.2.1 Impacts from Route Alternatives

Potential impacts include: (1) changes in the rate and volume of stormwater that result from adding or removing impervious surfaces within a drainage basin; (2) any increases in the pollutant levels in receiving waters that would impact beneficial uses; and (3) changes to floodplains or local drainage systems. Table 4.8-2 summarizes the new impervious surface area and floodplain fill for each alternative. Track segments would not be considered a pollutant-generating source. Pollutants such as detergents and cleaning fluids would be used at stations; road grime, oils and cleaning solution would be associated with maintenance facilities; diesel fuel and battery acid would be used at traction power sub-stations and conventional pollutants associated with automobile use would be generated at park-and-ride and bus-layover facilities. Measures to minimize or avoid most impacts are discussed in Section 4.8.3.

Segment A (Northgate to University District)

All of the Segment A alternatives would increase runoff; however, this increase would not contribute to new or existing water quality or flooding problems in the Lake Union or Thornton Creek basins.

Construction of Alternatives A1.1 and A1.2 would increase non-pollutant-generating impervious surfaces in the upper Thornton Creek basin by approximately 240,000 ft^2 with Northgate Station Option A, and 235,000 ft^2 with station options B and C. Runoff from these sites would drain into the headwaters of Thornton Creek.

Alternative A2.1 would be expected to have similar although slightly greater impacts than Alternatives A1.1 and A1.2 in the Thornton Creek basin. A station located at 65th Street would increase impervious surfaces within the Lake Union basin by an additional 10,000 ft^2. Runoff from new impervious surface areas would drain to existing storm sewers and CSOs. Impacts are not anticipated to be significant.

Alternative A2.2 has slightly greater runoff but would be expected to have impacts similar to Alternative A2.1 in the Thornton Creek and Lake Union basins.

Segment B (University District to Westlake Station)

Alternatives B1 (preferred alternative), B2.1, and B2.2 are not expected to increase runoff or contribute to new or existing flooding problems because they are largely in tunnel or elevated over existing impervious surfaces. Alternative B1 would create approximately 12,000 ft^2 of new pollutant-generating impervious surface at the SR 520 vent shaft and access road.

Segment C (Westlake Station to S. McClellan Street)

Alternatives C1.1 and C1.2 (preferred alternative) would create 223,000 ft^2 of new impervious surface along the track; Alternatives C1.3, C1.4, C1.5, C2.3, C2.4, and C3 would create 158,000 ft^2, 300,000 ft^2, 234,500 ft^2, 345,000 ft^2, 220,000 ft^2 and 249,000 ft^2 of new impervious surface, respectively. Runoff from this segment would drain to existing storm systems or CSOs. Additional runoff is not expected to affect hydrology, water quality, or flooding under any of the alternatives in Segment C. Tunnel portals associated with Alternatives C1.1, C1.2, C1.3, C1.4, C1.5, and C3 would increase impervious surfaces by 4,000 ft^2.

Table 4.8-1
Water Bodies Potentially Affected by the Central Link Alternatives

Segment/ Alternatives	Water Body Name	Total Drain Area (sq. mi.)	Receiving water	Water Quality Designations[1, 2]	Flooding Potential
Segment A	Thornton Creek	12	Lake Washington	Class AA	Local flooding (Seattle 1995)
Segment A	Ravenna Creek	0.08	Lake Washington	Class A	None noted or observed
Segment B	Lake Union	N/A	Puget Sound	Lake Class; 303 (d)[1]	None noted or observed
Segment B	Elliott Bay	N/A	Puget Sound	Marine	NA
Segment C	Lake Washington	608	Puget Sound	Lake Class; 303 (d)	None noted or observed
E1.1, E1.2, E2	Duwamish River	48	Puget Sound	Class B; 303 (d)	High flows confined to channel by levees; controlled by dam
Segment D	Norfolk Drainage Basin	1	Duwamish River	Class A	Local flooding due to drainage ditch overflows (Seattle)
E3	Inventoried Watercourse 3-1	0.5	Duwamish River	Class A	Evidence of local flooding west of Marginal Way due to undersized culvert
E1.1, E1.2	Riverton Creek	0.7	Duwamish River	Class A	Local flooding downstream of SR 99, outside the project area (Tukwila 1997)
E1, E2	Southgate Creek	1	Duwamish River	Class A	Local flooding downstream of SR 99, outside the project area (Tukwila 1996)
E2, E3	Black River	24	Duwamish River	Class A	None noted or observed
E2, E3	Green River	435	Duwamish River	Class A; 303 (d)	High flows confined to channel by levees; controlled by dam
E2, E3	Gilliam Creek	3	Green River	Class A	None noted or observed
Segment F	Des Moines Creek	6	Puget Sound	Class A; 303 (d)	Local flooding along 28th Street due to excess storm runoff (SeaTac 1997)
F2.2	Bow Lake	0.6	Des Moines Creek	Lake Class; 303 (d)[1]	None noted or observed

Notes: [1] On proposed 1998 Washington State Department of Ecology 303 (d) list of impaired and threatened water bodies.
[2] WAC 173-201A-120(6).
N/A = Not applicable

Segment D (S. McClellan Street to Boeing Access Road)

There would be little notable difference in impacts among the Segment D alternatives, and none of the impacts would be significant. Widening MLK Jr. Way S. for Alternative D1.1 (preferred alternative) would create approximately 138,000 ft^2 of new impervious surface area. Runoff along MLK Jr. Way S. would drain to existing storm systems or CSOs. However, the actual area supporting automobile traffic would not increase significantly. The Henderson Station and bus layover facility (all Segment D routes) would add 41,000 ft^2 of impervious surface area within the Duwamish drainage basin, most of which would support automobile use. Impacts from increased runoff or water quality degradation at the Henderson Station and bus layover area could be reduced through mitigation.

Segment E (Tukwila)

Alternatives E1.1 (preferred alternative) and E1.2 would add approximately 217,000 ft^2 and 64,500 ft^2 of new impervious surface, respectively, which is non-pollutant-generating surface, to the Duwamish River basin. Runoff from the track would not be concentrated at a single location.

Detention facilities will be provided to mitigate impacts of the increased impervious surface, according to the King County Surface Water Design Manual Level 2 requirements. The proposed park-and-ride facility at the Boeing Access Road would add 154,000 ft^2 of impervious surface. With detention and treatment, hydrologic and water quality impacts on the Duwamish River would be minor.

Current preferred alternative designs of the Duwamish River Bridge indicate that piers would be located outside the floodplain and outside the floodway. Culvert extensions, which could be required at the two proposed crossings of the east and west branches of Riverton Creek and the three proposed crossings of Southgate Creek, could have an effect on local flooding by changing flow patterns near the culvert. However, this is not expected to affect hydrology or flooding outside the project area.

Alternative E2 would not result in significant increases in stormwater runoff or pollutants in the Green or Duwamish river basins. Approximately 800,000 ft^2 of the 815,00 ft^2 of new impervious surface would be from elevated track that would be spread out over several miles, located in several drainage basins, and discharging runoff at many different locations. Runoff from these areas would not be expected to affect the water quality of these rivers.

Floodplain impacts could occur along Alternative E2 at bridges spanning the Duwamish, Green, and Black rivers. The route would be located parallel to Gilliam Creek along Southcenter Parkway and south of SR 518 between 42nd Avenue S. and Tukwila International Boulevard North of Southcenter Parkway, the alignment would be located on an elevated structure, parallel to the stream corridor, for approximately 1,000 ft. In this reach, the FEMA floodplain extends approximately from the I-405 right-of-way to the Southcenter Parkway right-of-way; therefore, locating piers outside the floodplain would be difficult. Piers placed in the floodplain could reduce flood storage and impact local flooding.

The Alternative E2 bridge proposed to cross the Duwamish River has two design options under the current conceptual design; both would require piers within the FEMA regulatory floodplains. One option would locate piers in the river, which could cause water quality impacts due to scour and bank erosion within the affected reach. The other option would locate piers on the over bank, which could result in minor scour and erosion during high-flow events. Pier located in the channel or overbank could increase local water surface elevations; however, they would not affect water surface elevations in the Duwamish River outside the project area. However, local flooding would not be affected because flows are controlled at the upstream pump station.

The Alternative E2 bridge proposed to span both the Green and Black rivers would have one pier located within the 100-year floodway on the east bank of the Green River, but outside the normal low-flow channel. This could impact conveyance during flood flows. Alternative E2 would also place approximately 150 yd^3 of fill in the FEMA floodplain south of the Black River; this floodplain currently provides dead storage of flood flows and the fill would not impact conveyance. The bridge proposed to cross the Green River parallel to Baker Boulevard would require columns at the edge of the 100-year floodway and a possible approach pier on the west bank within the 100-year floodplain. The floodplain is located west of the Green River levee and provides storage for local flooding; therefore the pier would not impact conveyance in the Green River, and is not expected to effect local flooding behind the levee. A retained cut located south of SR 518, between I-5 and 42nd Avenue S., could impact the hydrology of numerous seeps originating on the hill slope south of the alignment. Construction of the retaining wall could block interflow and overland flow routes.

As a result, runoff that is currently dispersed across the hillside could be concentrated at a single downstream discharge point resulting in flooding and conveyance impacts downstream.

Table 4.8-2
New Impervious Surface and Floodplain Fill by Alternative

Segment by Alternative	Non-Pollutant Generating			New Impervious Surface (ft²)	
	Track	Station/ Buildings[1]	Pollutant Generating[2]	Total	Displaced Flood storage (ft³)
Segment A (Northgate to University District)					
A1	230,000	5,000[3]	0	235,000[1]	N/A
A1.2	237,000	5,000[3]	0	242,000[1]	N/A
A2.1	267,000	15,000[3]	0	282,000[1]	N/A
A2.2	348,000	15,000[3]	0	363,000[1]	N/A
Segment B (University District to Westlake Station)					
B1.1	0	0	12,000[4]	12,000	N/A
B2.1	0	0	0	0	N/A
B2.2	0	0	0	0	N/A
Segment C (Westlake Station to S. McClellan Street)					
C1.1	223,000	4,000[5]	0	227,000	N/A
C1.2	223,000	4,000[5]	0	227,000	N/A
C1.3	158,000	4,000[5]	0	162,000	N/A
C1.4	300,000	4,000[5]	0	304,000	N/A
C1.5	234,500	4,000[5]	0	238,500	N/A
C2.3	345,000	0	0	345,000	N/A
C2.4	220,000	0	0	220,000	N/A
C 3	249,000	4,000[5]	0	253,000	N/A
Segment D (S. McClellan Street to Boeing Access Road)					
D1.1a	20,000	5,000	41,000	66,000	N/A
D1.1b	6,000	5,000	41,000	52,000	N/A
D1.1c	138,000	5,000	225,000	368,000	N/A
D1.1d	0	5,000	41,000	46,000	N/A
D1.1e and f	138,000	5,000	41,000	184,000	N/A
D1.3	110,000	5,000	41,000	156,000	N/A
D3.3	145,000	7,000	41,000	193,000	N/A
D3.4	115,000	5,000	41,000	161,000	N/A
Segment E (Tukwila)					
E1.1	217,000[6]	0	154,000	371,000	24[9]
E1.2	64,500	0	154,000	218,500	24[9]
E2	800,000	15,000	0	815,000	332[10]
E3	700,000	30,000	0	730,000	4,255[11]
Segment F (SeaTac)					
F1a, b, c	120,000	0	148,600	268,600	N/A
F2.1	119,000	0	137,800	256,800	N/A
F2.2	136,000	0	137,800	273,800	63[9]
F2.3	80,000	0	137,800	217,800	N/A
F3.1	100,000	0	137,800	237,800	N/A
F3.2a	202,000	0	138,600	340,600	N/A
F3.2b	198,000	0	138,600	336,600	N/A
F3.3	100,000	0	138,600	238,600	N/A
F4	146,000	0	138,600	284,600	N/A
Maintenance Facilities					
M1-A Holgate St. to Lander St	0	0[7]	187,300	187,300	N/A
M1-B Holgate St. to Lander St	0	0[7]	154,000	154,000	N/A
M1-C Massachusetts St. to Holgate St.	0	0[7]	133,100	133,100	N/A
M1-D Rainier Brewery/Roadway Express	0	0[7]	156,800	156,800	N/A
M1-E Rainer Brewery/Airport Way	0	0[7]	188,200	188,200	N/A

Table 4.8-2 Continued

Segment by Alternative	Non-Pollutant Generating		New Impervious Surface (ft²)		
	Track	Station/ Buildings[1]	Pollutant Generating[2]	Total	Displaced Flood storage (ft³)
System Totals					
Northgate to SeaTac (max)	1,840,000	68,000	727,800	2,431,800	24 to 4,318
Northgate to SeaTac (min)	532,500	10,000	311,900	1,012,400	
N.E. 45th St. to SeaTac (max)	1,492,000	41,000	727,800	2,068,800	24 to 4,318
N.E. 45th St. to SeaTac (min)	302,500	5,000	311,900	727,400	
MOS A 45th St. to McClellan (max)	345,000	4,000	200,200	545,200	--
MOS A 45th St. to McClellan (min)	158,000	0	133,100	295,100	
MOS B Capitol Hill to Henderson St. (max)	490,000	11,000	413,200	901,200	--
MOS B Capitol Hill to Henderson St. (min)	158,000	5,000	174,100	341,100	
MOS C 45th St. to Lander St. (max)	0	0	200,200	200,200	--
MOS C 45th St. to Lander St. (min)	0	0	133,100	133,100	
Total Preferred Alternative[8] (45th St. to Lander St.)	658,000	9,000	533,000	1,200,000	24

Notes:
[1] Other non-pollutant-generating surfaces include buildings, tunnel portals.
[2] Pollutant-generating surfaces include park-and-ride facilities, bus layover lots, and parking lots.
[3] Calculations based on Northgate Station Option A.
[4] New impervious surface associated with SR 520 vent shaft.
[5] New impervious surface associated with tunnel portals.
[6] 217,000 = new impervious surface due to additional road widening after the Tukwila Improvement Project.
[7] Maintenance facilities result in a net reduction in total impervious surface area.
[8] Totals for the preferred alternative were calculated assuming Maintenance Facility M1-E; it represents the worst case scenario.
[9] This fill would be located in floodplain that is not mapped by FEMA.
[10] This fill would be located in FEMA-mapped floodplain.
[11] 1,475 ft³ would be located in FEMA-mapped floodplain.
N/A = Not applicable

Alternative E3 would add approximately 730,000 ft² of impervious surface, including 700,000 ft² in trackage, in the Duwamish basin. Stormwater would not be conveyed to a single discharge point or basin, and would be detained. Runoff rates and volumes would increase at discharge locations but would not measurably affect hydrology or flooding in the Duwamish River.

Extending the Watercourse 3-1 culvert would alter flow patterns at the culvert, but would not affect flooding outside the project area. Under the current conceptual design, the bridge spanning the Black River would have riverside piers located outside the waterway but within the floodplain and floodway. The piers and pilings could cause minor scour and erosion during high flows. Under the current conceptual design, the Green River crossing at Strander Boulevard would result in minor flood storage loss due to one interior pier on each side of the river at the edge of the FEMA floodplain; however, local flooding would not be affected because flows are controlled at the upstream pump station. The Longacres Station would displace approximately 4,000 yd³ of FEMA floodplain storage, which could impact local flooding behind the levee. Alternative E3 would be expected to have the same impacts as Alternative E2 on the FEMA floodplain south of the Black River, the seeps located south of SR 518, and Gilliam Creek between 42nd Avenue S. and Tukwila International Boulevard.

Segment F (SeaTac)

Alternative F1, Options A, B and C would create 120,000 ft² of new impervious surface from trackage, 18,000 ft² from road improvements, and 130,600 ft² at the S. 200th Street park-and-ride, if the 950 proposed stalls are constructed. Increases in impervious surface associated with the proposed

S. 200th Street park-and-ride facility could impact local drainage systems and water quality by increasing runoff; however, the project is not expected to have significant impacts on the East Fork of Des Moines Creek, which lies downstream of the project. Park-and-ride facilities at S. 154th and S. 160th streets are proposed at existing developed sites with 100 percent impervious surface and would decrease the total amount of impervious surface area within the Des Moines Creek watershed although the amount of pollutant generating impervious surface would increase.

Under Alternative F2.1 stations would be located at the IMC (Radisson site), City Center West, S. 200th Street, and 28th Avenue. Track associated with this alternative would create 119,000 ft^2 of new impervious surface; 7,200 ft^2 would be created for road improvements and the proposed park-and-ride at 28th Avenue S. The S. 200th Street park-and-ride would increase the impervious surface area in the Des Moines Creek basin by up to 130,600 ft^2, if all 850 stalls are constructed. Impacts from this park-and-ride would be similar to Alternative F1.

Alternative F2.2 would have stations at IMC (Radisson site), City Center East, and S. 200th Street and would be expected to have impacts similar to those described above for Alternative F2.1. In addition, this alternative would impact Bow Lake. Alternative F2.2 would cross 500 to 600 ft of Bow Lake on an elevated structure. No change in runoff would result from this improvement (because the lake surface is considered 100 percent impervious). Support piers required for the crossing would displace approximately 63 yd^3 of flood storage. The loss of this storage would not measurably change water surface elevation or discharge rates to Des Moines Creek. Road widening and the S. 200th Street park-and-ride would create the same amount of impervious surface as Alternative F2.1.

Alternative F2.3 (preferred alternative) would have stations at S. 154th Street, IMC or NEAT, S. 184th Street (potential station), and south of S. 200th Street. The stations at S. 154th Street, IMC or NEAT, and S. 184th Street would decrease impervious surface. The proposed park-and-ride facility at S. 200th Street would add 130,600 ft^2 of impervious surface area if the proposed 630 stalls are constructed. Trackage associated with this alternative would add an additional 80,000 ft^2 of new impervious surface along International Boulevard S., and road widening would add 7,200 ft^2 of new impervious surface.

Alternative F3.1 would have stations at 170th, the Grassy Knoll, and S. 200th Street. This alternative would have increases in impervious surface and similar impacts to Alternative F2.1.

Alternative F3.2 would have a park-and-ride facility located at either S. 154th Street (Option A) or at S. 160th Street (Option B), the same as the park-and-rides proposed under Alternative F1, options A, B, or C. Alternative F3.2 would have a park-and-ride at 28th Avenue S. and S. 200th Street. Both options A and B would increase in impervious surface area of 130,600 ft^2. Approximately 200,000 ft^2 of new impervious surface would be created by track and 8,000 ft^2 for road improvements.

Alternative F3.3 would have the same amounts of new impervious area and impacts as Alternative F2.3 (preferred alternative).

Alternative F4 would have the same amounts of new impervious area and impacts as Alternative F2.3 (preferred alternative).

Maintenance Base Sites

Sites M1-A (S. Lander), M1-B (S. Lander), M1-C (Atlantic Central A), M1-D (Rainier Brewery/Roadway Express), and M1-E (Rainier Brewery/Airport Way) would decrease impervious surface areas in the Duwamish River Basin by 8.0 ac, 16.6 ac, 10.7 ac, 12.0 ac, and 14.4 ac, respectively. Estimates of impervious surface at the maintenance facility sites assume that only buildings, roads, sidewalks and parking lots would be impervious, the remainder of the site, including open and light rail vehicle storage, would be pervious tie and ballast. Stormwater runoff from each site would discharge to CSOs and would be expected to decrease and would not adversely impact existing drainage patterns or runoff amounts. Potential pollutants generated at these sites include oil, grease, roadway grime, detergents, cleaning agents, paint, solvents, and other automotive-related pollutants. BMPs – including source controls such as covered work areas, closed drainage systems, and secondary containment – would be used to minimize the pollution potential of stormwater from these sites. All remaining stormwater would be contained and treated prior to discharge. The sites would not span any water bodies and would not impact flooding.

4.8.2.2 System Total Impacts

The range of impacts for the Northgate to SeaTac and the N.E. 45th to SeaTac alternatives (see Table 4.8-2) represents the potential minimum and maximum impacts that would result from a combination of the route and station alternatives. The primary difference between the length alternatives would be that the 45th to SeaTac would avoid all impacts in the Thornton Creek basin. Three minimum operating segments (MOS) have also been identified for this project. MOS A refers to the project between N.E. 45th Street and S. McClellan Street, MOS B includes portions of the proposed project from Capitol Hill to S. Lander Street, and MOS C includes portions of the proposed project from N.E. 45th Street to S. Lander Street. All of the MOS options would include a maintenance facility.

4.8.2.3 No-build Alternative

Without the proposed action, potential indirect improvements in water quality conditions associated with projected reductions in automobile use, decreases in emissions and pollutant generation, and achievement of regional land use and urban growth area (UGA) strategies would not be achieved.

4.8.3 Mitigation

Mitigation for each of the project alternatives would be required to meet the applicable standards for the local jurisdiction(s) in which the individual project improvements are located. Stormwater, water quality, and flood control requirements have been established by the cities of Seattle, SeaTac, Tukwila, and Renton, by King County, and by state and federal agencies such as Ecology, the WSDOT, and FEMA. Additional mitigation, if required to comply with the Endangered Species Act (ESA), would be provided at specific sites.

Water quality impacts are generally regulated by federal and state guidelines, usually through standards for receiving water quality and limitations on the generation and release of pollutants. Ecology has established regulations to protect water quality from point and non-point source pollution. A National Pollutant Discharge Elimination System (NPDES) permit would be required for operation of this project. If a general permit is obtained, Storm Water Pollution Prevention plans, monitoring, and data reporting would be applicable to individual project sites including maintenance facilities. Specific water quality mitigation and treatment methods include: bioswales, grit traps, and oil/water separators (used at stations and tunnel discharge points to treat road grime oil and cleaning solutions generated on-site); double-wall diesel fuel tanks; non-draining sumps; and acid-resistant flooring and other containment BMPs (used at traction power substations to meet state and local regulations).

Additional mitigation to detain and treat stormwater runoff includes: (1) wet ponds, (2) underground vaults, (3) constructed wetlands, and (4) infiltration basins. Wet ponds and constructed wetlands could be used to remove conventional pollutants such as total suspended solids, metals, oils, and grease. Filtration in constructed wetlands or bioswales could be used to remove nutrient pollutants, such as phosphorus and nitrogen. Flood impacts would be mitigated based on local regulations, either by providing compensatory storage at the impact location, or by improving or replacing downstream conveyance systems, when necessary, to alleviate local flooding at existing culverts, road crossings, or stormwater ditches. The regulations and mitigation techniques discussed in this document reflect the regulations at the time of project approval.

Segment A (Northgate to University District)

The City of Seattle requires that new development must mitigate stormwater impacts to meet specific discharge rates. Under these regulations, stated in the City of Seattle Stormwater, Grading, and Drainage Code, on-site stormwater detention would be required for the Northgate Station Option A and the Roosevelt Station associated with Alternatives A2.1 and A2.2. No mitigation is expected to be required for the Northgate Station Option B. Stormwater detention would be provided where runoff from track segments (that create new impervious surface) discharges. These facilities would be constructed to meet City of Seattle regulations.

Segment B (University District to Westlake Station)

Stormwater runoff would not increase because these alternatives would not create new impervious surfaces. However, detention and treatment may be required to meet City of Seattle regulations for runoff from the approximately 12,000 ft^2 of impervious surface associated with the SR 520 vent shaft and access road (Alternative B1–the preferred alternative) and for runoff from the bridge over Portage Bay (Alternative B2.1). Detention for the 12,000 ft^2 impact may occur at a different location, according to direction from the City of Seattle.

Segment C (Westlake Station to S. McClellan Street)

Stormwater detention would be provided at locations where runoff from new impervious surface associated with the track of Segment C would discharge. However, if the storm drainage system has adequate capacity, detention requirements may be waived. Alternatives C2.3 and C2.4 would not create additional impervious surface, and stormwater mitigation would not be required.

Segment D (S. McClellan Street to Boeing Access Road)

Segment D alternatives would require widening MLK Jr. Way S. between the tunnel portal and S. Norfolk Street, which would create new impervious surfaces. Runoff from this area generally drains to the City of Seattle's storm drainage system, except for areas between S. Hanford Street and S. Columbian Way and between S. Trenton Street and Barton Avenue S., where it drains to a CSO. A new stormwater collection system, will be constructed on MLK Jr. Way S. This collection system will convey storm runoff from the project area to the existing storm drain system. Stormwater runoff along MLK Jr. Way S. will be separated from the existing combined sewer for approximately 4,000 ft between Hanford Street and Columbian Way, will reduce CSO events and existing impacts to receiving waters.

Segment E (Tukwila)

Alternatives E1.1 (preferred alternative) and E1.2 would be located within the City of Tukwila, which has adopted the King County Surface Water Manual (1998). The manual defines requirements for stormwater discharge rates, water quality treatment, and mitigation of potential floodplain impacts. Stormwater detention facilities would be constructed at discharge points to detain runoff from additional impervious surface areas generated by elevated track segments. These facilities would be designed to meet local regulations and would be constructed in locations that would minimize impacts to streams and wetlands. The bridge crossing the Duwamish River would not impact FEMA floodplains. Water quality and quantity facilities would be required at the Boeing Access Road park-and-ride facility. The mitigation standards used to design this facility will be based on King County Level 2 standards. Mitigation would be required to minimize impacts on local flooding in Riverton and Southgate creek basins.

Alternative E2 would be located largely within the city of Tukwila and partially within the city of Renton. Both cities have adopted the King County Surface Water Design Manual; therefore, mitigation would be similar to that discussed above under Alternative E1.1 (preferred alternative). Stormwater detention and treatment would be required at the Longacres and Southcenter stations to meet local regulations. Stormwater facilities would also be provided at discharge locations to detain runoff from sections of the track that creates new impervious surface area. Mitigation would be provided for the elevated section over Gilliam Creek to minimize hydrologic and water quality impacts that the support columns could cause if located in or near the channel. Mitigation could include a design that places the support columns out of the channel and floodplain. Mitigation for lost floodplain storage could be required at the Duwamish, Green, and Black river bridges and at the floodplain located south of the Black River and the Green River crossing. Mitigation would require 1:1 compensation storage to be provided for all fill within regulatory floodplain limits and below the 100-year floodplain elevation. In addition, mitigation to meet the no-net-rise regulation would be required for piers or fill in the Duwamish and Green river floodways.

Alternative E3 would be located largely in the city of Tukwila, and partially in King County and the City of Renton. These jurisdictions follow the King County Surface Water Design Manual (1998); therefore, mitigation requirements would be similar to E1.1 (preferred alternative). Stormwater detention and water quality treatment would be required in the same locations as Alternative E2. Mitigation for lost floodplain storage could be required for the Black River bridge crossing, the floodplain located south of the Black River, the Green River bridge, and the Longacres Station, as discussed above under Alternative E2.

Segment F (SeaTac)

City of SeaTac regulations, which are based on the King County Surface Water Design Manual (1998), govern the area that would be impacted by all the alternatives in Segment F. Stormwater detention and water quality treatment would be provided at the proposed park-and-ride at International Boulevard and S. 200th Street, and at 28th Avenue S. and S. 200th Street, to meet KCSWM Level 2 requirements. No other mitigation would be required. Water quality treatment would be provided at the S. 154th Street park-and-ride facility.

Maintenance Base Sites

Maintenance base sites would reduce existing impervious surfaces at each site. For all maintenance base sites, stormwater runoff would be collected and conveyed to storm sewers. On-site water quality mitigation would include: bioswales or other treatment for runoff from parking lots, treating and recycling wash water, using filters and oil/water separators prior to discharge, requiring spill control in paint shops, and recycling grease.

4.8.4 Significant Unavoidable Adverse Impacts

Alternative E2 would significantly impact Gilliam Creek and the adjacent FEMA floodplain north of Southcenter Boulevard, if the required piers for the elevated structure are placed in the creek channel or floodplain. These impacts could include increased erosion and scour during high-flow events.

4.9 ENERGY

4.9.1 Affected Environment

The affected environment for energy includes the types, sources, and rates of use for various energy resources and focuses on existing transportation-related energy use in the Sound Transit service area. The transportation energy analysis identifies energy consumed by automobiles, trucks, and motorcycles (not boats and planes).

The main energy types used in the state include petroleum, electricity, natural gas, and wood. Petroleum use accounts for 51 percent of total energy use in Washington. Electricity, natural gas, and wood provide 24, 13, and 11 percent of total energy used, respectively. These types are mostly derived domestically and include: oil from Alaska; electricity from hydropower and natural gas-fired electrical plants in Washington and California; natural gas from Canada, the Southwest, and Rocky Mountain regions; and wood from Washington.

Total energy use in Washington increased 51 percent from 1970 to 1993. Most of this growth was due to transportation energy use largely related to population growth and increases in per capita travel. From 1970 to 1993, transportation use rose from 38 percent of total energy use to 51 percent (Washington State Energy Office 1996).

Existing motor vehicle energy consumption in the Sound Transit service area includes energy used for fuel and vehicle maintenance. Table 4.9-1 summarizes the average daily energy consumption for these activities. The daily VMT in the region in 1995 consumed 441.260 x 10^9 Btu (British Thermal Units) of energy. Energy is also consumed to maintain and repair vehicles (oil, tires, and general maintenance and repair), adding 12.119 x 10^9 Btu, accounting for 3 percent of the total energy consumed daily by motor vehicles.

4.9.2 Impacts

The operational impact analysis examines the two length alternatives, including the preferred alternative, and the three MOS alternatives. As the individual route alternatives would not significantly differ in their impacts on regional energy consumption, they were not analyzed in detail. However, some longer alternatives (B2.1, B2.2, E2, and E3) would consume slightly more energy than the shorter alternatives (B1, E1.1, and E1.2).

Direct impacts are characterized by the energy that would be consumed by the light rail system. Indirect impacts include changes in energy use in the regional transportation system (including automobiles, buses, trucks, and motorcycles) that would be caused by light rail operation. The energy consumed by light rail includes operation of the light rail vehicles, lighting for park-and-ride facilities, and lighting and heating energy for maintenance facilities.

Table 4.9-2 summarizes the projected daily operational energy demand in the year 2010 for the No–build and Link alternatives. For the No-build Alternative, 568.552 x 10^9 Btu are predicted to be consumed by vehicles in the Sound Transit service area.

The Northgate to SeaTac Alternative would consume 0.640 x 10^9 Btu of energy. This is a relatively small amount of energy when compared to the total system energy consumption (approximately 1/10th of a percent of the total system energy use). To put the energy consumption figure in perspective, Btu's of energy can be converted to gallons of gasoline (125,000 Btu = 1 gallon of gasoline). Therefore, the Northgate to SeaTac daily energy consumption figure of 0.640 x 109 Btu is equivalent to 5,120 gallons of gasoline. While the light railway would consume additional electrical energy, it would also reduce the total energy consumed by other transportation modes (mostly petroleum use). The overall 2010 energy consumption with the Northgate to SeaTac Alternative is estimated at 567.693 x 10^9 Btu. This alternative is predicted to save 0.859 x 10^9 Btu of energy per day (or 6,872 gallons of gas per day) over the No-build Alternative.

The N.E. 45th to SeaTac Alternative, including the preferred alternative, is estimated to consume 0.483 x 10^9 Btu. The overall energy demand with this alternative is predicted to be 567.618 x 10^9 Btu. This alternative is estimated to save 0.934 x 10^9 Btu of energy over the No-build Alternative.

MOS A would use approximately 0.182 x 10^9 Btu. Total energy demand under MOS A is estimated at 567.651 x 10^9 Btu. This alternative is predicted to consume 0.901 x 10^9 Btu less than the No-build Alternative.

MOS B is estimated to use 0.198 x 10^9 Btu. Total energy demand under this alternative is 567.833 x 10^9 Btu. MOS B is predicted to save 0.719 x 10^9 Btu over the No-build Alternative.

It is predicted that MOS C would use 0.154 x 10^9 Btu of energy. The total energy demand would be 567.830 x 10^9 Btu. This alternative would save 0.722 x 10^9 Btu as compared to the No-build Alternative.

Table 4.9-1
Existing motor vehicle energy consumption for the region.

Vehicle Type	Percent of VMT[1]	Daily VMT[2]	Average Fuel Consumption (MPG)[3]	Daily Fuel Consumption (Gallons)	Daily Energy Consumption (Btu x 10^9)
Light-Duty Gas Autos	62.9	30,575,406	22.68	1,348,419	168.552
Light-Duty Gas Trucks 1	18.0	8,749,719	19.32	452,790	56.599
Light-Duty Gas Trucks 2	9.0	4,374,859	12.44	351,762	43.970
Heavy-Duty Gas Vehicles	2.7	1,312,458	5.81	225,896	28.237
Light-Duty Diesel Autos	0.3	145,829	26.10	5,588	0.699
Light-Duty Diesel Trucks	0.1	48,610	21.80	2,230	0.279
Heavy-Duty Diesel Vehicles	6.5	3,159,621	6.16	512,925	64.116
Motorcycles	0.5	243,048	50.00	4,861	0.608
Subtotal		48,609,548		2,904,471	363.060
Vehicle Maintenance					12.119
Total					411.260

Source: Parametrix, Inc. 1998; PSRC 1998
Notes: Btu/gallon of gasoline = 125,000; Btu/gallon of diesel = 138,700; Light-Duty Trucks 1 = Trucks up to 6,000 lbs. gross vehicle weight (gvw); Light-Duty Trucks 2 = Trucks from 6,000 to 8,500 lbs. gvw; Heavy-Duty Trucks = Trucks over 8,500 lbs. gvw.
[1] Share of vehicle miles traveled by vehicle type is from Ecology 1998.
[2] VMT 1995 (PSRC 1998).
[3] California Department of Transportation/U.S. Department of Transportation, Federal Highway Administration 1993.

Table 4.9-2
Daily Operational Energy Demand in the Sound Transit Service Area for the Year 2010 (10^9 Btu)

Type of Energy Use	No-build	Northgate to SeaTac	N.E. 45th to SeaTac	MOS A: 45th to McClellan St.	MOS B: Capitol Hill to Henderson	MOS C: 45th to Lander
Total Vehicle Energy Use	568.552	567.053	567.135	567.469	567.635	567.676
Link Light Rail Vehicles	—	0.608	0.451	0.150	0.166	0.122
Link Maintenance Facility	—	0.027	0.027	0.027	0.027	0.027
Link Park-and-Ride Lots	—	0.005	0.005	0.005	0.005	0.005
Total Link Energy Use	—	0.640	0.483	0.182	0.198	0.154
Total Energy Demand	568.552	567.693	567.618	567.651	567.833	567.830

Source: Parametrix, Inc. 1998; PSRC 1998; Puget Sound Transit Consultants 1998

4.9.3 Mitigation

- Incorporate relevant city, county, and Washington State energy code requirements into design aspects of the light rail system, stations, maintenance facility, and parking areas.
- Work with Seattle City Light and Puget Sound Energy to design facilities to conserve electricity and to help ensure that electrical system specifications for supply are workable and safe.

4.9.4 Significant Unavoidable Adverse Impacts

There would be no significant unavoidable adverse energy impacts.

4.10 GEOLOGY AND SOILS

4.10.1 Affected Environment

This section describes the existing geologic conditions (topography, soils, groundwater, and hazards) that may affect or be affected by the proposed light rail facilities. The Geology Technical Back-up includes maps of surficial geology and a table summarizing the existing geologic conditions for each of the light rail segments and alternatives. Maps of geologic hazards are presented in Figures 4.10-1 and 4.10-2.

4.10.1.1 Topography and Regional Geology

The proposed light rail project corridor is located in the central to southern portion of the Puget Sound Basin, an elongated, north–south trending depression situated between the Olympic Mountains and the Cascade Range in western Washington State. The existing topography, surficial geology, and hydrogeology in the project area are heavily influenced by past glacial activity. The topography is dominated by a series of north–south trending ridges and large troughs formed by glacial activity. The major troughs are now occupied by Puget Sound, Hood Canal, Lake Washington, and other large water bodies. Geology in the region includes a thick sequence of glacially consolidated soils overlying bedrock. Between periods of glaciation, the valleys and low-lying areas filled with river and lake sediments.

The light rail corridor traverses variable topographic and geologic conditions, including upland areas such as Northgate, Capitol Hill, Beacon Hill, and the Sea-Tac Airport plateau. The elevation of these topographic high points is up to 400 ft with several valleys and low-lying areas at sea level to an elevation of about 75 ft. The low areas include Portage Bay and the Rainier and Green/Duwamish River valleys. To traverse the extreme elevation differences along the corridor, several of the light rail alternatives include tunnels below Portage Bay, through Capitol Hill and Beacon Hill, and under 37th Avenue S.

The Uniform Building Code (ICBO 1997) defines the Puget Sound region as Seismic Zone 3, which represents an area susceptible to moderately high seismic activity. For comparison, much of Alaska and California are within Seismic Zone 4 and are susceptible to greater seismic activity. Since the 1850s, over 25 earthquakes of Magnitude 5.0 or greater have occurred in the Puget Sound region. In addition to the recorded historic earthquakes, evidence suggests that a major earthquake occurred about 1,100 years ago on the Seattle Fault, which roughly parallels I-90 and passes below downtown Seattle near the Pioneer Square area. Evidence also suggests that large subduction zone earthquakes (Magnitude 8 to 9) can occur along the Washington coast. The geologic record suggests five or six subduction zone events may have occurred over the last 3,500 years; the most recent was about 300 years ago.

4.10.1.2 Soils and Groundwater

Subsurface soils throughout most of the light rail corridor, and surficial soils on many of the ridges and plateaus, are predominantly glacial till (locally known as hardpan) or other glacial deposits. Surface soils in the valleys and troughs are typically alluvium (deposited by streams and creeks), lacustrine (deposited by lakes), or landslide deposits overlying subsurface glacial deposits. Bedrock is also exposed or near the surface in some locations. The Geology Technical Back-up includes maps of surficial geology in the corridor.

4.10.1.3 Hazards

Geologically hazardous areas are defined as areas that, because of their susceptibility to erosion, sliding, earthquake, or other geologic events, are not suited for development – consistent with public health and safety concerns. Washington State's GMA (Chapter 36.70A RCW) requires all cities and counties to identify critical areas within their jurisdictions and to formulate development regulations for their protection.

The cities of Seattle, Tukwila, Renton, and SeaTac, along with King County, have each developed Geologically Hazardous Areas Ordinances and accompanying maps or folios. In general, these ordinances require that detailed geotechnical studies be prepared to address specific standards relating to site geology and soils, seismic hazards, and facility design.

Figures 4.10-1 and 4.10-2 show the approximate locations of the identified geologic hazard areas relative to the light rail alternatives. The most notable hazard areas include steep slope and landslide hazards in Segments C and E and potential liquefaction areas in Segments B through F. Section 4.10.2 describes the significance of the hazard areas relative to the light rail alternatives.

4.10.2 Impacts

In the following discussion, Section 4.10.2.1 describes the types of long-term geologic impacts that could occur throughout the corridor, Section 4.10.2.2 summarizes notable or potentially significant impacts for each alternative, and Section 4.10.2.3 describes the mitigation that would or could be implemented to avoid and reduce impacts. Short-term construction impacts and mitigation are described in Section 4.17.10.

4.10.2.1 Geologic and Soils Impacts in the Corridor

Seismic Hazard Areas. The entire corridor may be subjected to earthquake shaking and is considered to have a moderate to high seismic risk. In addition, soil liquefaction could result in a loss of strength, settlement, and lateral displacement of soils supporting the light rail system. At-grade routes would be more susceptible to liquefaction-induced damage than elevated and underground routes, because elevated trackway is typically supported on piles that are founded below the liquefaction-prone soils, and tunnels are typically deep and tend to be lower in elevation than the liquefaction-prone soils. The magnitude of soil movement and loss of strength is a function of many factors including: soil thickness, soil quality, groundwater level, and the magnitude and location of the seismic event.

Landsliding/Steep Slopes. Existing steep, landslide-prone slopes are at risk. Landslides can either be triggered by a seismic event, the natural stabilization process whereby a steep slope evolves to a flatter profile, an increase in pore water pressure from excessive rainfall that could destabilize the slope, or project construction that traverses or cuts into a steep slope.

Erosion. The King County Soil Survey rates soils in the area as having slight inherent erosion potential; however, much of the area is classified as urban development and is not rated. Soils disturbed during construction would be re-vegetated and would not experience long-term erosion impacts. Run-off from permanent facilities would be managed so as not to result in long-term erosion impacts.

Coal Mine Hazards. Coal mine hazard areas are those areas directly underlain by, adjacent to, or affected by underground mine workings. Most underground coal mines in the area (near Fort Dent Park) have been abandoned and can create hazardous conditions. For example, as the roof and sides of an underground mine gradually fail, the area over the mine may subside. More dramatically, a shallow mine may collapse. Structures located above subsurface mines could sustain damage during seismic events. Based upon information obtained from the Washington Department of Natural Resources (WDNR), coal mines were situated near the Black River Junction and on the west side of Interurban Avenue near Foster Golf Course (Segment E). However, the WDNR maps indicate the previous coal mine workings would not underlie any of the light rail alternatives. Alternatives E2 and E3, which pass nearest the hazard areas, appear to be at least 400 ft from the nearest mapped mine shaft.

Operational Vibration Impacts. Long-term environmental impacts associated with light rail system operation include vibrations from the railcars that could possibly trigger slope movements and settlement of loose soils. However, there are few case histories of slides actually being triggered by heavy freight trains, let alone light rail type vehicles.

4.10.2.2 Potential Impacts of the Alternatives

Potentially significant or notable long-term impacts, by alternative, are outlined below.

Segment A (Northgate to University District). The potential long-term geologic impacts are low for all alternatives in Segment A.

Segment B (University District to Westlake Station). The alternative under Capitol Hill (B1, the preferred alternative) has low potential, long-term, geologic impacts. Alternative B2.1 (Seattle Center via High-level Bridge) has a high identified potential for liquefaction (near Portage Bay and Lake Union) and a low potential for landslide impacts. Alternative B2.2 (Seattle Center via Portage Bay Tunnel) has a moderate potential for liquefaction along the southern shore of Lake Union and a low potential for landslide impacts. The potential for settlement of overlying and adjacent structures is greatest near the tunnel shafts and vents. In Segment B, the tunnels are very deep and will be constructed in dense, hard glacially consolidated soils, so the potential for settlement along the tunnel alignment is relatively low.

Segment C (Westlake Station to S. McClellan Street). The C1 alternatives (C1.1, C1.2 – preferred alternative, C1.3, C1.4, and C1.5) all have moderate potential for liquefaction (west of I-5) and landslide impacts (at the Beacon Hill Tunnel portals). Alternative C3 (S. Massachusetts Street Tunnel) has a high potential for liquefaction (west of I-5 and through the Rainier Valley) and a moderate potential for landslide impacts (Beacon Hill Tunnel portals). Alternatives C2.3 and C2.4 have a similarly high potential for liquefaction (west of I-5 and through Rainier Valley) and a lower potential for landslide impacts.

Segment D (S. McClellan Street to Boeing Access Road). Alternatives D1.1 (A through F) and D1.3 have a low potential for liquefaction and landslide impacts. The two alternatives aligned with Rainier Avenue in the northern part of this segment (D3.3 and D3.4) have a moderate potential for liquefaction (along Rainier Avenue), a low potential for landslide impacts, and traverse a mapped landfill (north of the Columbia City Station).

Segment E (Tukwila). Both Tukwila International Boulevard alternatives (E1.1—preferred alternative and E1.2) cross the Duwamish River Valley parallel to the Boeing Access Road at the north end of the segment. This area is mapped as liquefaction hazard area; however, these alternatives (E1.1 and E1.2) have a low liquefaction hazard rating when compared to Alternatives E2 and E3. Alternative E2 is situated primarily within the Duwamish/Green River Valley and has a high potential for liquefaction impacts. Both E1.1, (preferred alternative) and E1.2 have a moderate potential for landslide impacts associated with steep slopes mapped along SR 99 between SR 599 and S. 138th Street. Alternative E2 has a moderate potential for landslide hazards near the I-5/SR 518 Interchange and a low potential for coal mine impacts. Alternative E3 traverses steep slope and landslide hazard areas along the east side of the valley between Boeing Access Road and Fort Dent and also near I-5/SR 518; thus, E3 has the highest potential for landslide/steep slope hazard impacts of the Segment E alternatives. Just east and south of Fort Dent, Alternative E3 follows nearly the same path as E2 and has moderate potential for liquefaction and low potential for coal mine hazards.

Segment F (SeaTac). Alternatives F2.3, F1 and F4 (the preferred alternative, International Boulevard–At-grade and Elevated) have low liquefaction potential. Alternative F2.1 (Washington Memorial Park City Center West) has a moderate potential for liquefaction near the north end of the segment and where it crosses International Boulevard. Alternative F2.2 (Washington Memorial Park City Center East) has a high potential for liquefaction where it crosses Bow Lake. The three alternatives west of International Boulevard (F3.1, F3.2, and F3.3) all have low potential for liquefaction. All of the Segment F alternatives have little or no potential for landslide or inherent soil erosion hazards.

Maintenance Facility Sites. Each of the seven maintenance facility sites have high inherent potential for liquefaction, low inherent erosion potential, and no known coal mine hazards. Site M3 has a moderate landslide hazard associated with the slopes adjacent to the site. Sites M1-D and M1-E, the two Rainier Brewery sites, have moderate potential for settlement due to unmapped landfill that has been reported to underlie portions of the site. Although not indicated on the jurisdictions' sensitive area maps, a landfill is reported to underlie the Rainier Brewery sites (M1-D and M1-E).
System Total. Impacts from the total light rail system (either N.E. 45th to SeaTac, Northgate to SeaTac, or the preferred alternative) would result in a combination of the impacts described above for each segment and alternative. There would be no significant differences between these length alternatives. The MOSs would have fewer impacts then the longer "length alternatives" because of their much shorter alignments. There would be no significant differences between the MOS alternatives.
No-build. The geologic impacts associated with building and operating the light rail alternatives would be avoided with the No-build Alternative.

4.10.3 Mitigation

The measures described below would avoid and/or reduce potential long-term geologic impacts.

Mitigation for Seismic Hazards. Appropriate seismic parameters will be used for design of the light rail systems and facilities. Measures to reduce impacts from liquefaction-prone soils include: densifying potentially liquefiable materials; placing the light rail system on a raft of non-liquefiable soils; founding the facilities on piles; and/or planning a maintenance schedule to re-level or repair system components should settlement occur. The appropriate mitigation depends chiefly upon the severity of the liquefaction hazard and the specific light rail components supported above/over these areas.
Mitigation for Landsliding/Steep Slopes. For landslides and steep slopes, mitigation is required only if construction of an alternative traverses or cuts into existing steep slope/landslide hazard areas, removes vegetation from existing steep slopes, or is in such close proximity to an existing steep slope/landslide hazard where the construction could impact the slope or vice versa. Potential mitigation measures include using an engineered structure (retaining wall), re-grading the slope to an allowable inclination, installing drainage improvements, and re-vegetating to protect soils from erosion. Permanent slopes would be designed and constructed with adequate safety factors.
Mitigation for Erosion. See Section 4.17.10 for a discussion of erosion control/mitigation during construction. All soils exposed during construction would be permanently covered by buildings, pavement, track ballast, or vegetation. No long-term erosion impacts would occur.
Mitigation for Coal Mine Hazards. No impacts or mitigation for coal mine hazards are anticipated. However, if unmapped, abandoned mine works are discovered that could impact the project, mitigation could include planned maintenance and repair, filling the openings with controlled-density fill, or spanning the hazard with an elevated structure.

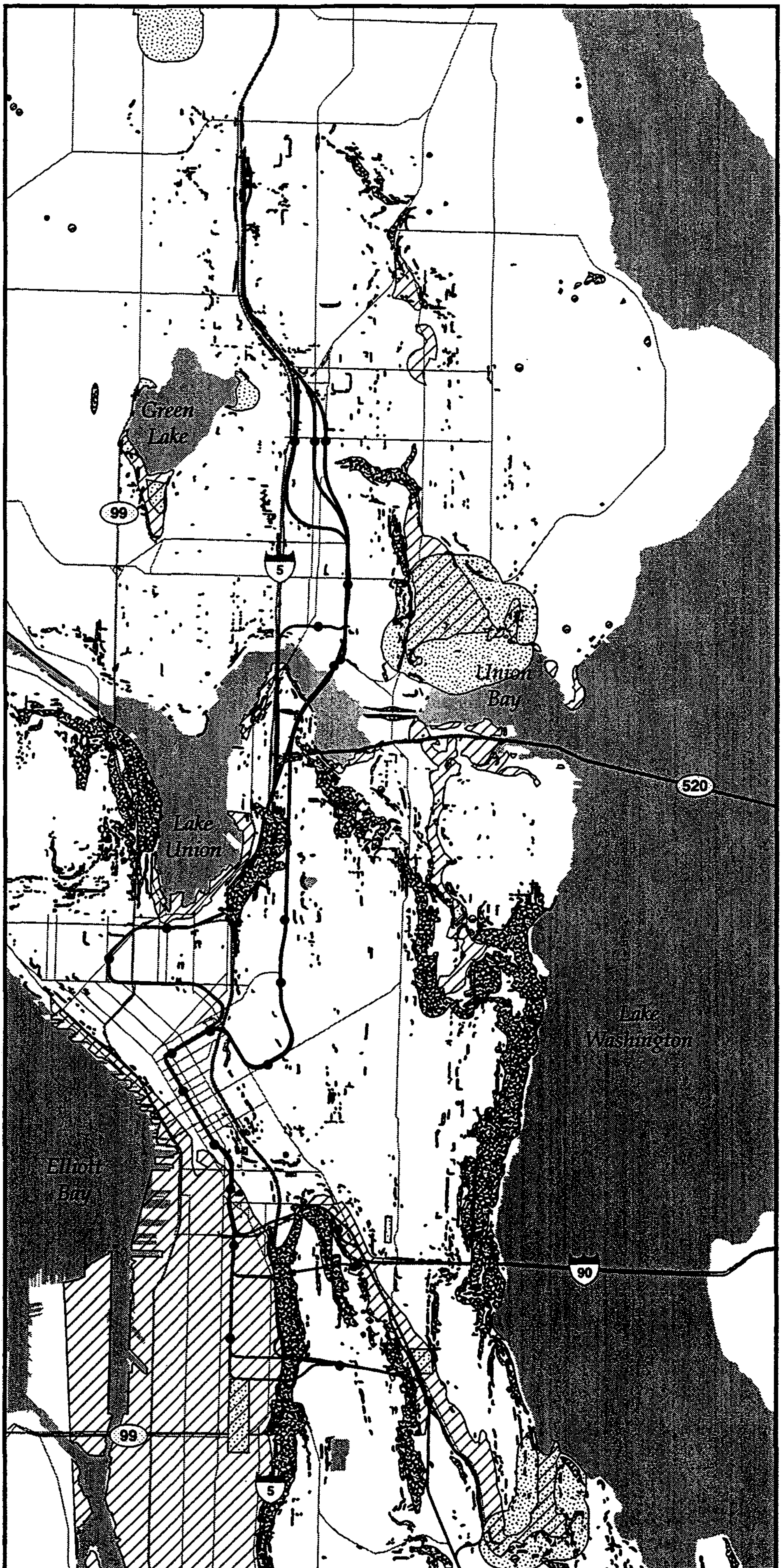
Mitigation for settlement and long-term monitoring are addressed in the construction section.

4.10.4 Significant Unavoidable Adverse Impacts

With committed and potential mitigation, significant long-term geologic impacts could be avoided. Facility design would consider all the geologic and seismic hazards that affect the project corridor.

SoundTransit

Figure 4.10-1
Geologic Critical Areas:
North Corridor



Landfill

Liquefaction Zone

Steep Slope/ Landslide Hazard

Coal Mine Hazard

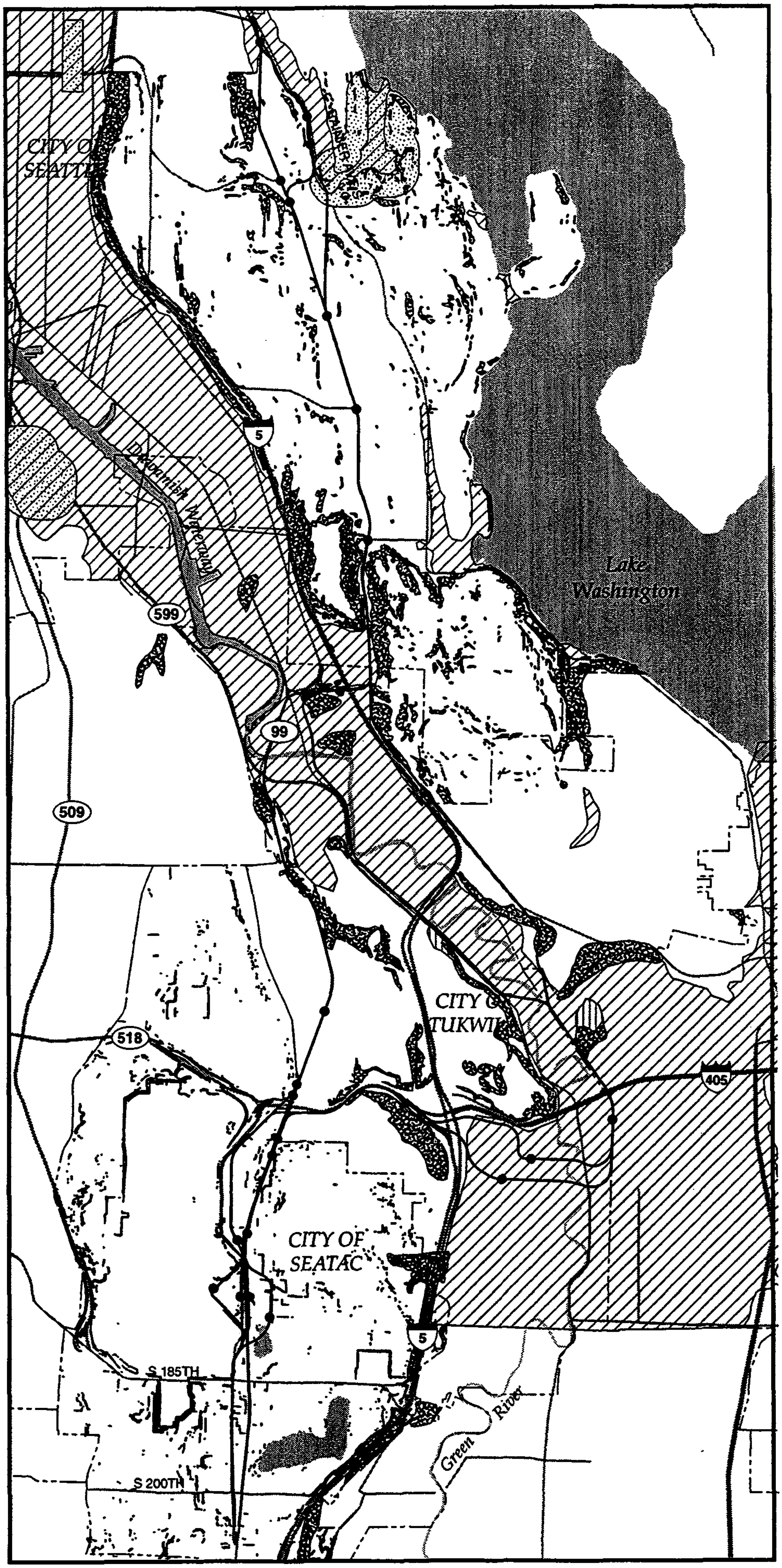
Alternative Route

Station

0 3,000 6,000
FOOT

SOUNDTRANSIT

Figure 4.10-2
Geologic Critical Areas:
South Corridor



Landfill
Liquefaction Zone
Steep Slope/ Landslide Hazard
Coal Mine Hazard
Alternative Route
Station

0 3,000 6,000
FOOT

4.11 HAZARDOUS MATERIALS

4.11.1 Affected Environment

4.11.1.1 Methodology

Facilities or properties that have released hazardous materials or waste to the environment, or that manage hazardous materials or waste in significant quantities, are required to report these activities to both federal and state regulatory agencies. The first step in evaluating a potential for hazardous materials impacts involves reviewing current databases maintained by these agencies.

Project staff identified and classified sites according to whether (1) chemical releases to the environment had been identified or (2) hazardous materials have been managed, with no release identified. Staff also mapped all known sites within two blocks of the proposed alternatives and conducted a drive-by reconnaissance to confirm the reported address, check current site activities, and evaluate site settings. In addition, project staff reviewed regulatory files compiled for each site having a reported environmental release to determine the magnitude of impact to the environment, the potential to affect project construction, and potential to affect worker or transit user health and safety.

Sound Transit project staff reviewed Sanborn Fire Insurance Maps, compiled from 1950 to 1969, for most of the project corridor to identify historical activities that may have impacted soil and groundwater. Site activities and features indicated on the maps were classified as having a potential for release associated with petroleum products, dry cleaner solvents, or a generic "other" designation. Project staff mapped and assigned an address to each site located within two blocks of the proposed alternatives.

A final route reconnaissance verified site locations, confirmed designated addresses, and identified additional sites with a potential to adversely impact the environment, based on observed characteristics.

4.11.1.2 Hazardous Materials Regulation

Hazardous materials may be classified into different categories based on the laws and regulations that define their characteristics and use. These classifications include the following:

- hazardous waste
- dangerous waste
- hazardous substances
- toxic substances

The U.S. Environmental Protection Agency (U.S. EPA) and Ecology maintain databases, to track sites with potential and confirmed releases of chemicals to the environment, and they monitor facilities that manage hazardous materials as part of their operations.

The Federal Resource Conservation and Recovery Act (RCRA) defines what is meant by hazardous waste. In Washington State, Ecology has been authorized by the U.S. EPA to implement most of the RCRA program. Authorization was based on state dangerous waste regulations that are consistent with and at least as stringent as the federal requirements. The U.S. EPA tracks hazardous waste management at individual facilities throughout the state based on notification requirements and records that define the magnitude of waste generated (i.e., small or large quantity), defines the type of handling performed (i.e., treatment, storage, or disposal), or identifies whether a release to the environment has occurred. Ecology tracks facilities based on required registration of underground storage tanks; it also maintains an inventory of solid waste facilities and landfill sites.

Nationally, the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), also known as Superfund, defines hazardous substances. Ecology operates a parallel program in Washington State under the Model Toxics Control Act (MTCA). Both programs are designed and administered to provide appropriate responses to the release of hazardous substances to the environment. MTCA also addresses releases of petroleum products not covered under federal statutes. The U.S. EPA tracks sites based on reported potential or actual releases to the environment, emergency response notifications, and cleanup progress at major release sites. Ecology tracks the same types of sites and also tracks petroleum releases from underground storage tanks.

Toxic substances are a subset of hazardous substances additionally regulated by the federal Toxic Substances Control Act (TSCA). TSCA was adopted so that all new chemical substances and existing chemicals put to new uses, other than pesticides, could be evaluated for health and environmental effects. Additional controls governing disposal, beyond CERCLA and RCRA, have been specifically applied to polychlorinated biphenyls (PCBs). TSCA sites are tracked by the U.S. EPA.

4.11.1.3 Site Categories

Hazardous materials sites in the study area fall into two categories based on whether a release to the environment has been documented or is considered a potential threat.

Documented Release Sites

Documented releases to the environment, identified in regulatory agency site files, directly affect soil and groundwater. Releases to soil generally are limited in lateral extent and so can result in potential impacts when found directly in the proposed light rail right-of-way. Releases to groundwater tend to extend further away from the area of origin and can potentially result in impacts even when the source is located beyond the proposed right-of-way.

Potential Release Sites

A potential for release is based on the activity registered with regulatory agencies, the development of site activities evident from historical documentation (for example, a foundry site that became a service station and then was developed for an office building), or the current activity evident from visual observation (e.g., junk yard).

4.11.1.4 Known and Potential Hazardous Materials Sites

Table 4.11-1 summarizes the sites identified as either reportedly having, or with a potential for, a release of hazardous materials to the environment. Review of regulatory files for sites with reported releases identified the extent of contamination determined through past characterization efforts. Sites designated with a release to soil only also may have impacted groundwater, but may not have been investigated. Figures 4.11-1 and 4.11-2 map the documented release sites within two blocks of each alternative.

Potential release sites were identified based on the following categories:

- reported current activities (e.g., hazardous waste generator)
- reported current features (e.g., registered underground storage tanks)
- recorded historical activities (e.g., mapped "oil and gas" designation)
- recorded historical features (e.g., mapped tank farm)
- visually identified activity or feature

Sites with potential for releases have not been characterized and may or may not have soil and/or groundwater contamination. Potential release sites have been identified within two blocks of each alternative, but due to the relatively small probability for project impacts, only those along the right-of-way have been mapped. The exception to this occurs along proposed tunnel alternatives, where the two-block area has been retained to account for some variability in tunnel positioning and the possibility for lateral contaminant migration as it moves downward through the soil column.

Table 4.11-1 includes the total number of sites (both on and adjacent to the alternatives, where appropriate) for each alternative in each of the six segments. Sites of the highest concern include documented release sites located either on properties planned for displacement or directly on the alignment, as well as those with releases to groundwater adjacent to elevated or tunnel sections. These sites present the potential for long-term impacts, as well as the potential to be impacted by construction. The Hazardous Materials Technical Report (Herrera 1998) provides more detailed mapping and database information.

4.11.2 Impacts

Potential long-term impacts could result from the use of hazardous materials (lubricants, fuels, solvents, etc.) during system construction, operation, and maintenance and/or from encountering sites with existing soil or groundwater contamination. The likelihood of impacts (releases) from operation and maintenance activities is low. The likelihood of impacts from encountering existing contaminated sites depends upon the extent and character of contamination and would be minimized by identifying the sites and potential sites prior to construction, and employing appropriate control, clean-up, and disposal measures. A variety of impacts, both beneficial and adverse, could result from encounters with existing hazardous materials sites, including:

- contamination that otherwise would remain in place and potentially migrate, may be discovered and addressed by the project
- contamination may be cleaned up faster to accommodate project construction
- contamination may be prevented by removing potential existing sources, such as underground storage tanks, before they release
- contaminated materials may be uncovered, allowing more direct exposure to the public
- contamination may be spread as a result of construction.

Light rail project impacts to the environment at each hazardous materials site cannot be assessed without detailed evaluations of site-specific conditions. However, with proper control techniques, contaminated soil can be removed and disposed of or treated at locations designed for hazardous materials management; contaminated groundwater will be treated onsite. By using licensed carriers and vehicles equipped for the task, limited risk of public exposure will occur during soil removal and transport offsite. Treatment of groundwater will employ techniques engineered for the specific contaminants encountered.

Potential impacts associated with existing contaminated sites will be largely short-term (during construction). However, long-term impacts could occur where Sound Transit acquires properties that have ongoing clean-up responsibility (after construction). Such sites are typically associated with groundwater contamination or are large, complex sites such as landfills (discussed below). Sites with predominantly short-term impacts are discussed in Section 4.17.11.

4.11.2.1 Impacts Associated with Existing Hazardous Materials Sites

The following text discusses sites with documented releases (existing contamination) posing potential long-term clean-up/control requirements, and therefore potential for long-term impacts. It also discusses notable differences between alternatives within each segment. Table 4.11-1 lists the documented number of release sites on or adjacent to each alternative as part of the sites of highest concern.

Segment A (Northgate to University District)

Known release sites found in Segment A alternatives include a gasoline fueling station at a rental car operation and underground tank petroleum release to soil at an electrical substation. Alternative A1.2 would tunnel directly beneath a site with a petroleum product release to soil (no cleanup has been reported in the regulatory site file). Alternatives A1.1 and A1.2 are indicated as having a potential long-term impact associated with a hazardous materials release based on partial acquisition of the electrical substation property. In addition, three potential release properties with historical use of hazardous materials are identified for displacement.

Segment B (University District to Westlake Station)

Known release sites in Segment B alternatives include two gas stations, an auto service center, an auto garage, a bus barn, a dry cleaner, and a historic manufactured gas plant site.

Alternative B1 (preferred alternative) would tunnel beneath two gas stations with releases of petroleum products to soil and groundwater. One of the properties is planned for full acquisition, providing access to the optional Roy/Aloha tunnel station (the other gasoline release site is across the street). Remediation efforts are underway at both sites. In addition, 22 potential release properties with historical use of hazardous materials are identified for acquisition.

Alternative B2.1 would tunnel beneath a petroleum release site associated with an automotive service center, as well as a dry cleaner property with releases of fuel oil and solvents to soil (no groundwater contamination reported). An automotive garage with petroleum release to soil, a historic automotive garage with releases of petroleum product and solvents to soil, and the Metro bus barn with releases of petroleum, PCBs, and metals to soil (the bus barn garage is located approximately 400 ft away from the alignment) all will be partially displaced. In addition, 15 potential release properties with historical use of hazardous materials are identified for displacement.

Alternative B2.2 would tunnel under the same automotive service center property and the same dry cleaner as Alternative B2.1. The automotive garage property identified for partial displacements as part of Alternatives B2.1 and B2.2 historically was associated with a manufactured gas facility. No characterization data are available, but typically these sites exhibit extensive soil and groundwater contamination. In addition, 24 potential release properties with historical use of hazardous materials are identified for displacement on Alternative B2.2.

All alternatives require displacement of properties with known contamination. Based on existing information, no one alternative appears to offer less long-term liability than another. If the optional Roy/Aloha Station is not included and the associated property is not acquired, Alternative B1 would include a deep tunnel under both release sites, with little probability they would be affected.

Segment C (Westlake Station to S. McClellan)

Known release sites in the Segment C alternative alignments include 10 sites with petroleum releases from leaking tanks; five to groundwater and five reported to soil only. One of the sites has operated as a RCRA treatment, storage, disposal facility (TSDF).

Alternative C1.2 (preferred alternative) includes one site with a release of petroleum product to groundwater directly on the route, plus two potential release properties with historical use of hazardous materials identified for displacement.

Alternative C1.1 includes the same release site as Alternative C1.2, plus four additional potential release properties with historical use of hazardous materials identified for displacement.

Alternative C1.3 includes the same release site as Alternative C1.2, plus three potential release properties with historical use of hazardous materials identified for displacement.

Alternative C1.4 includes the same release site as Alternative C1.2, plus one other potential release property with historical use of hazardous materials identified for displacement.

Alternative C1.5 includes the same petroleum release site as all other C1 alternatives, plus three sites with petroleum releases to groundwater and one petroleum release to soil directly on the alignment. One release property has operated as a permitted TSDF. In addition, eight potential release properties with historical use of hazardous materials are identified for displacement.

Alternative C2.3 includes one site with a petroleum release to groundwater and two others with petroleum releases to soil directly on the alignment. In addition, 22 potential release properties with historical use of hazardous materials are identified for displacement.

Table 4.11-1
Total Hazardous Materials Sites in the Affected Area

Route Alternative by Segment	Documented Release[1]		Potential Release				Sites of Highest Concern[2]		
	Petroleum	Non-Petroleum	UST	RCRA Generator	Historical	Recon.	Displaced /OA Releases	Displaced /OA Potential Releases	Adjacent Releases
Northgate									
A1.1 12th Ave. N.E. Tunnel	2	0	7	4	16	4	1	1	0
A1.2 Roosevelt Way Tunnel	3	0	10	6	26	7	2	2	1
A2.1 8th Ave N.E. – Short Elevated	2	0	5	5	16	5	0	1	1
A2.2 8th Ave N.E. - Elevated	2	0	3	4	10	4	0	1	1
University District									
B1 Capitol Hill Tunnel	14	0	4	10	111	10	2	22	3
B2.1 Sea. Ctr. – High-level Bridge	47	8	23	49	145	14	5	15	18
B2.2 Sea. Ctr. – Portage Bay Tunnel	45	10	23	46	143	14	5	24	19
Westlake									
C1.1 At-grade center of S. Lander Street	24	3	5	12	12	3	1	4	8
C1.2 At-grade north of S. Lander Street	24	3	5	12	14	3	1	2	7
C1.3 Elevated north of S. Lander Street	24	3	5	12	16	3	1	3	12
C1.4 Forest St./S. Lander Street Tunnel	26	3	4	13	11	0	1	1	8
C1.5 Massachusetts St. and I-5 right-of-way	20	1	4	8	9	4	5	8	4
C2.3 West of Rainier Ave. S. – Elevated	19	4	10	8	31	2	3	22	4
C2.4 Rainier Ave. S. Tunnel	19	4	11	8	32	2	3	12	5
C3 S. Massachusetts Street Tunnel	17	3	11	7	21	0	3	14	6
McClellan									
D1.1e MLK Jr. Way S. – At-grade	12	3	6	7	32	7	10	40	0
D1.3 MLK Jr. Way S. – Combined Profile	12	3	6	7	32	7	10	26	0
D3.3 S. Alaska St. Crossover	16	2	7	6	35	10	12	44	0
D3.4 37th Ave. S. Tunnel	14	2	6	4	29	8	9	32	0
Tukwila									
E1.1 Tukwila International Blvd. – At-grade	10	1	6	11	--	2	4	7	1
E1.2 Tukwila Int'l Blvd. – Elevated	9	1	6	11	--	2	4	7	2
E2 Interurban Ave. S.	15	2	4	7	--	1	4	2	7
E3 MLK Jr. Way S.	3	3	0	0	--	2	2	2	2
SeaTac									
F1[3] Intl. Blvd. – At-grade	19	1	9	13	--	1	13	16	1
F2.1[3] Wa. Mem. Park-City Center West	17	0	3	8	--	3	11	9	4
F2.2[3] Wa. Mem. Park-City Center East	17	0	3	5	--	3	10	7	4
F2.3 Wa. Mem. Park – Elevated east of 28th	16	0	4	9	--	3	7	7	5
F3.1[3] West of Intl. Blvd. – Grassy Knoll	20	0	5	7	--	3	8	12	5
F3.2[3] West of Intl. Blvd – Main Terminal	17	0	5	7	--	3	11	12	3
F3.3 West of Intl. Blvd – IMC Airport Station	17	0	5	7	--	3	11	13	5
F4 International Blvd. to 28th/24th	17	0	5	7	--	3	12	13	5
Maintenance Base Sites									
M1-A S. Lander St.	6	0	2	2	1	1	1	6	5
M1-B S. Lander St.	5	0	2	2	1	1	5	6	1
M1-C Atlantic/Central A	6	0	2	2	4	0	1	8	5
M1-D Rainier Brewery/Roadway Express	3	0	0	0	--	1	2	1	1
M1-E Rainier Brewery/Airport Way	3	0	0	0	--	1	2	1	1
M2 N.E. Boeing Access Rd.	2	0	1	3	0	0	2	1	1
M3 S.W. Boeing Access Rd.	3	0	1	1	0	0	3	2	1
System Wide Total									
N.E. 45th to SeaTac	64-130	4-21	17-58	26-95	149-213	19-34	23-43	43-121	9-47
Northgate to SeaTac	66-133	4-21	20-68	30-101	159-239	23-41	23-45	44-123	9-48
MOS A (with M1-B)	43	3	11	24	126	14	8	30	11
MOS B (with M2)	38	6	12	24	133	20	13	57	9
MOS C (with M1-B)	35	2	8	16	119	13	7	29	8
Preferred Alternative (with M1-B)	81	7	27	51	158	26	29	84	17

Notes: RCRA –Resource Conservation and Recovery Act (generators registered with U.S. EPA - 1998)
NA – Not Applicable - No Sanborn Fire Insurance Maps available
OA on alignment
UST – Underground storage tank (registered with the Washington Department of Ecology - 1998). Historical sites were identified on Sanborn Fire Insurance Maps (1950-1969). Reconnaissance sites were identified during route drive-through (1998).
[1] Includes all recorded release sites within two blocks of alternatives.
[2] Includes documented release sites on displaced properties, directly on the alignment, or adjacent to the alignment if groundwater was affected and subsurface construction is probable.
[3] Based on connection to Tukwila International Boulevard alternative in Segment E: if connected to SR 518 alternatives (E2, E3), there would be one less documented release and one less potential release site with all F routes, and one less site of highest concern for Alternatives F2.1 and F2.2.

Preferred alternative appears in italics.

Alternative C2.4 includes the same release to groundwater and one release to soil sites as Alternative C2.3 plus another petroleum release to soil and one to groundwater directly on the alignment. In addition, 12 potential release properties with historical use of hazardous materials are identified for displacement.

Alternative C3 includes two sites with a petroleum release to soil and one to groundwater directly on the alignment, one of which includes the TSDF identified in Alternative C1.5. In addition, 14 potential release properties with historical use of hazardous materials are identified for displacement.

Segment D (S. McClellan to Boeing Access Road)

Known release sites in the Segment D alternatives include six gas stations, two auto repair facilities, two commercial properties with leaking tanks, a dry cleaner, a vault with a complex mixture of contaminants, and a landfill. Full or partial acquisitions are considered for all sites. Four optional configurations, Alternatives D1.1c, d, e, and f, are included for evaluation.

Alternative D1.1e (preferred alternative) includes displacement of five gas station and two auto repair shop sites; four with releases to groundwater (including a vault with a complex mixture of contaminants) and three with releases to soil reported. Full displacement of a former dry cleaning establishment also is planned. Partial displacement is planned for an area bordering an abandoned landfill at S. Cloverdale Street. Alternatives D1.1d and D1.1f include the same affected sites; D1.1c includes an additional two commercial facilities with leaking tanks. In addition, 40 potential release properties with historical use of hazardous materials are identified for displacement on Alternative D1.1e; 17 on D1.1c; 39 on D1.1d; and 38 on D1.1f.

Alternative D1.3 includes displacement of eight sites identified in Alternative D1.1e (not including one auto repair petroleum release to soil and the dry cleaner release to soil). Two additional sites with petroleum releases to soil also are included. Partial displacement also is planned for an area bordering an abandoned landfill at S. Cloverdale Street. In addition, 26 potential release properties with historical use of hazardous materials are identified for displacement.

Alternative D3.3 includes displacement of nine sites identified in Alternative D1.1e (not including the dry cleaner release to soil). Three additional sites with petroleum releases to soil also are included. Partial displacement is planned for an area bordering an abandoned landfill at S. Cloverdale Street. In addition, 44 potential release properties with historical use of hazardous materials are identified for displacement.

Alternative D3.4 includes displacement of seven of the sites identified in Alternative D1.1e (not including two gas station petroleum releases to soil and the dry cleaner release to soil). Two additional sites with petroleum releases to soil also are included. Partial displacement also is planned for an area bordering an abandoned landfill at S. Cloverdale Street. In addition, 32 potential release properties with historical use of hazardous materials are identified for displacement.

Alternatives D1.1c, d, e, and f include full displacement of a dry cleaner site, which poses significant long-term liabilities associated with cleanup. Alternative D1.3 includes the fewest number of full displacements and a significantly fewer number of potential release site displacements of all alternatives. Alternative D1.3 appears to present the least potential for long-term impact.

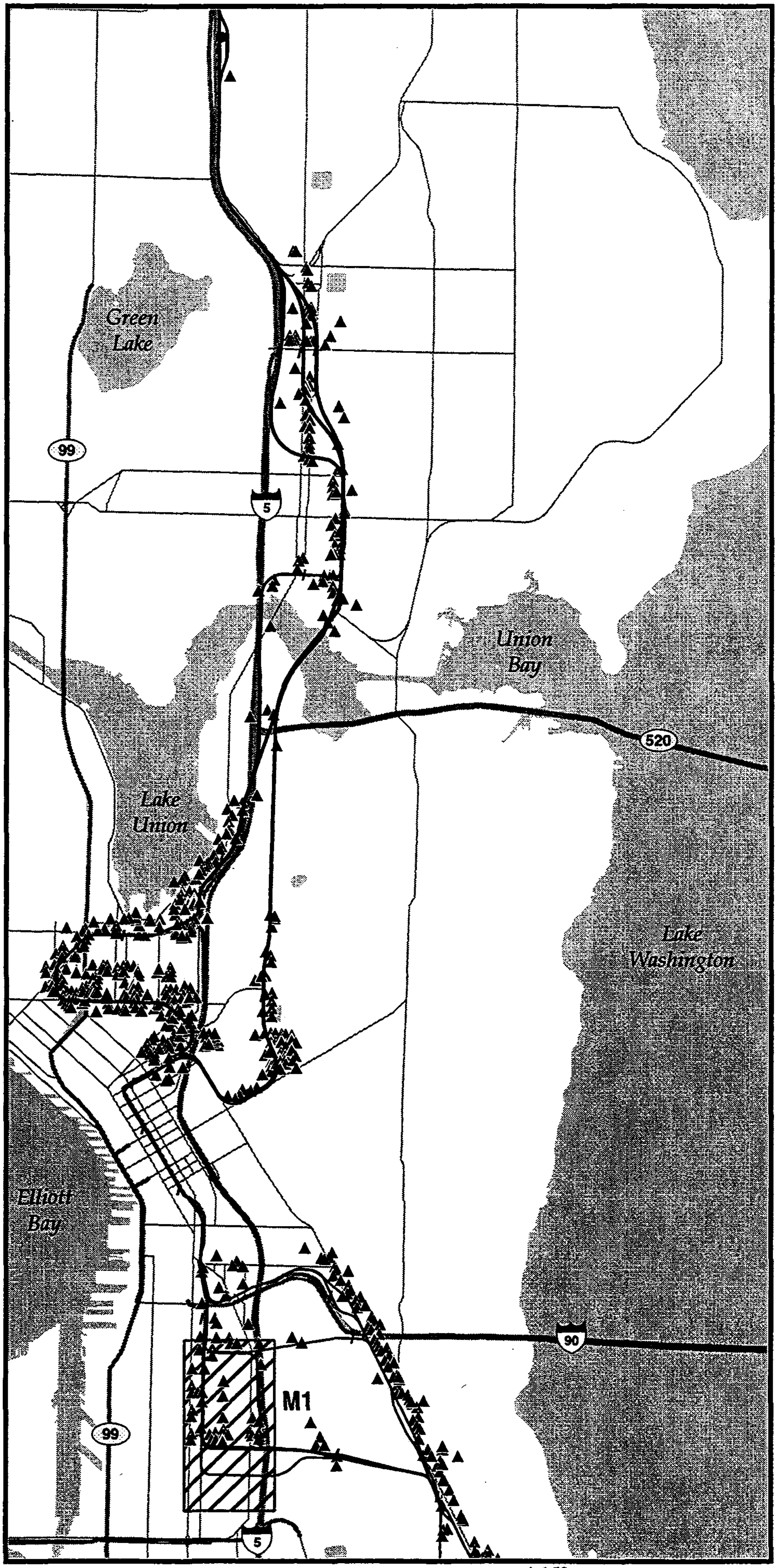
Segment E (Tukwila)

Known release sites on Segment E alternatives include five gas stations, three businesses with leaking petroleum underground storage tanks, and two landfills.

Alternatives E1.1 (preferred alternative) and E1.2 would be elevated and adjacent to an abandoned fill site with undefined boundaries where SR 99 and SR 599 cross. Alternatives E1.1 and E1.2 include the same full displacement of three properties and partial displacement of one property with releases of petroleum products to either soil or to soil and groundwater, including a property associated with the S. 144th Street Station. In addition, seven potential release properties with historical use of hazardous materials are identified for displacement on Alternatives E1.1 and E1.2.

SOUNDTRANSIT

Figure 4.11-1
Locations of Known Hazardous Waste Releases: North Corridor



M1 Maintenance Base Alternatives

▲ Recorded Hazardous Waste/Hazardous Materials Release Sites Within Two Blocks of Proposed Light Rail Alternativee

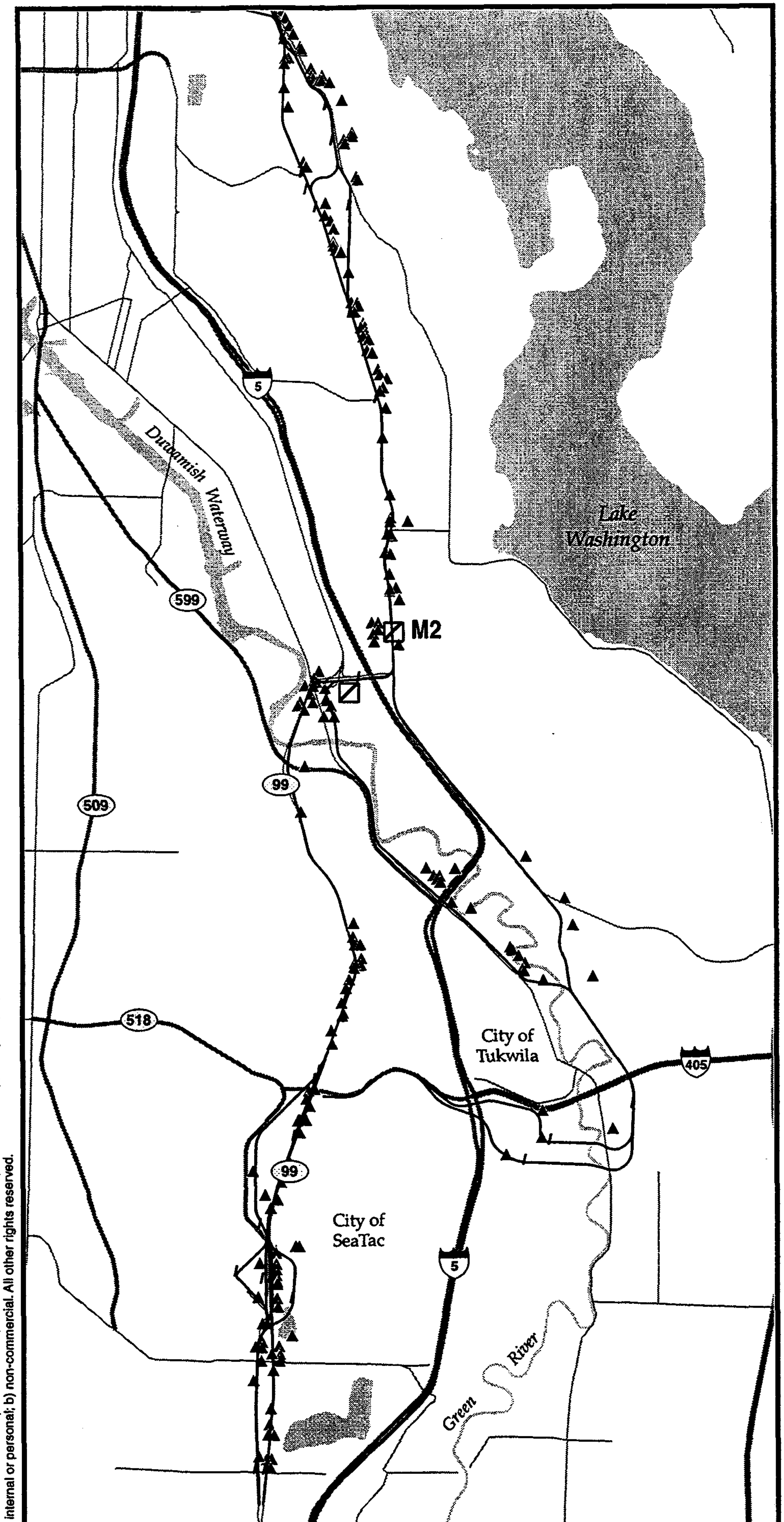
Alternative Route

● Station

0 .5 1
MILES

SoundTransit

Figure 4.11-2
Locations of Known Hazardous Waste Releases: South Corridor



Maintenance Base Alternatives

Recorded Hazardous Waste/Hazardous Materials Release Sites Within Two Blocks of Proposed Light Rail Alternativee

Alternative Route

Station

N

0 .5 1

MILES

Alternative E2 includes partial displacement of four properties with releases of petroleum products to either soil or to soil and groundwater. Alternative E2 also includes partial displacement along the Renton Junction Landfill, for which the contamination status is unknown. Two potential release properties with historical use of hazardous materials are identified for displacement on Alternative E2.

Alternative E3 includes partial displacement of the same gas station site with a documented release of gasoline to soil at the north end of the alignment included in all other alternatives, as well as a partial displacement along the Renton Junction Landfill. Two potential release properties with historical use of hazardous materials are identified for displacement on Alternative E3.

Alternative E3 would have the lowest potential for long-term impacts associated with existing hazardous materials releases; however, all Segment E alternatives pass adjacent to identified landfills.

Segment F (SeaTac)

Known release sites on Segment F alternatives include 18 gas stations and four others associated with petroleum activities. Each alternative includes two or three configuration options, at the north end where connections are made with Segment E alternatives, designated as A, B or C.

Alternative F2.3 (preferred alternative) includes one full displacement with a petroleum release to groundwater and six partial acquisitions with petroleum releases to soil. Five of the displacements are associated with elevated track and two are associated with at-grade track at the South SeaTac station. In addition, seven potential release properties with historical use of hazardous materials are identified for displacement.

Alternatives F1a and F1b both include the same 13 hazardous materials site displacements (one F1a site changed from full to partial displacement in F1b). Four full displacement properties have reported releases to groundwater, with three limited to soil. Three partial acquisitions reportedly have releases to groundwater and three partial acquisitions have releases to soil. Alternative F1c does not include one full displacement with a release to groundwater seen in the other options, but it crosses another petroleum soil release site with an elevated section. A petroleum release to soil is associated with a property at the North Central SeaTac station. In addition, 16 potential release properties with historical use of hazardous materials are identified for displacement on Alternative F1a; 16 on F1b; and 15 on F1c.

Alternative F2.1a includes three full displacements, two with petroleum releases to soil and the other to groundwater. Alternative F2.1a also includes eight partial acquisitions; two with releases to groundwater, the others to soil. All displacements occur along elevated track, except for the full displacement with a release to soil at the South SeaTac Station, which is at-grade. Releases to soil and groundwater are reported at three properties associated with the South Central SeaTac Station. Alternative F2.1b bypasses one partial displacement with a release to ground water seen in F2.1a. In addition, nine potential release properties with historical use of hazardous materials are identified for displacement on Alternative F2.1a; seven on F2.1b.

Alternative F2.2a includes the same number of release sites as Alternative F2.1a, minus one full displacement with a petroleum release to groundwater. Alternative F2.2b bypasses one partial displacement with a release to groundwater seen in F2.2a. Because the Alternative F2.2 alignment swings east at the South Central SeaTac Station, four of the hazardous material releases associated with large property partial acquisitions common to Alternative F2.1 would not be impacted by Alternative F2.2. In addition, seven potential release properties with historical use of hazardous materials are identified for displacement on Alternative F2.2a; six on F2.2b.

Alternative F3.1a includes two full displacements with releases to soil, five partial displacements with petroleum releases to soil, and one partial displacement with a petroleum release to groundwater. All displacements occur along elevated track, except for two partial acquisitions with releases to soil at the South SeaTac Station, which is at grade. Alternative F3.1b bypasses one partial acquisition with a release to groundwater seen in F3.1a. In addition, 12 potential release properties with historical use of hazardous materials are identified for displacement on Alternative F3.1a; 11 on F3.1b.

Alternative F3.2a includes three full displacements, one with a release to groundwater and two to soil; and eight partial acquisitions, all with releases to soil. Alternative F3.2b bypasses one full displacement with a release to groundwater seen in F3.2a, but crosses another petroleum release to soil along an elevated section. In addition, 12 potential release properties with historical use of hazardous materials are identified for displacement on Alternative F3.2a; 11 on F3.2b.

Alternative F3.3 includes three full displacements, one with a release to groundwater and two to soil; and eight partial acquisitions, all with releases to soil (same as Alternative F3.2a). In addition, 13 potential release properties with historical use of hazardous materials are identified for displacement.

Alternative F4 includes three full displacements, all with releases to soil; and nine partial acquisitions, one with a release to groundwater and eight with releases to soil. In addition, 13 potential release properties with historical use of hazardous materials are identified for displacement.

Alternative F2.3 would have the lowest potential for long-term impacts associated with existing hazardous materials releases, based on the number of properties reported. Alternatives F2.3, F3.1, F3.2, F3.3, and F4 all have only one petroleum release to groundwater, whereas the F1 and F2 alternatives include either two or three groundwater release sites.

Maintenance Base Sites

The S. Lander Street (M1-A) site (between Sixth and Eighth avenues) includes a property with a small amount of petroleum-contaminated soil reportedly left in place. In addition, six potential release properties with historical use of hazardous materials are identified for displacement.

The S. Lander Street (M1-B) site (between Eighth Avenue and Airport Way) includes three sites with petroleum releases to groundwater and two with releases to soil. In addition, six potential release properties with historical use of hazardous materials are identified for displacement.

The Atlantic/Central A (M1-C) site includes one site with a petroleum release to groundwater. In addition, eight potential release properties with historical use of hazardous materials are identified for displacement.

The Rainier Brewery/Roadway Express (M1-D) and Rainier Brewery/Airport Way (M-1E) sites include two sites with petroleum releases to soil and a historic landfill with unknown releases to groundwater. A historic landfill stretched from S. Lander to S. Horton Street and between Airport Way and Eighth Avenue. Various businesses in the area attribute contamination in groundwater to the landfill, which operated from before 1936 to the early 1950s. No potential release sites were identified on the proposed maintenance base properties.

The N.E. Boeing Access Road (M-2) site includes one property with a release of gasoline and diesel oil to groundwater with some floating product noted, and one property with a heating oil release to soil reportedly cleaned up. In addition, three potential release properties with historical use of hazardous materials are identified for displacement.

The S.W. Boeing Access Road (M-3) site includes two properties with reported gasoline releases to soil where groundwater has not been investigated, as well as a firing range site with a potential for lead contamination (no characterization data are available). In addition, two potential release properties with historical use of hazardous materials are identified for displacement.

Based on reported conditions at each site, the M1-A S. Lander Street site appears to have the lowest potential for long-term impact associated with existing hazardous materials releases.

4.11.2.2 Impacts Associated With Light Rail System Maintenance

Operation of the light rail system would require regular maintenance of machinery involving use of lubricants, solvents, and other chemicals. Hazardous waste (petroleum products, solvents, etc.) would be generated primarily at the designated maintenance facility. Hazardous waste would be managed to meet applicable regulatory requirements, which minimize the risk of exposure. No impacts would be expected.

4.11.2.3 System-Wide Impacts

Preferred Alternative

As noted in Table 4.11-1, the preferred alternative would directly affect 29 release sites plus 84 potential release sites on the route.

N.E. 45th Street to SeaTac

As noted in Table 4.11-1, the N.E. 45th Street to SeaTac Alternative would directly affect from 23 to 43 sites and 43 to 121 potential release sites on the alignment. Maintenance operations would use hazardous materials as described above.

Northgate to SeaTac

As noted in Table 4.11-1, the Northgate to SeaTac Alternative system would directly affect 23 to 45 release sites and 44 to 123 potential release sites on the alignment. Maintenance operations would use hazardous materials as described above. There would be no significant difference between the length alternatives.

MOS

As noted in Table 4.11-1, the MOS A alternative (including Site M1-B) would affect eight release sites and 30 potential release sites on the alignment; the MOS B alternative (including Site M-2) would affect 13 release sites and 57 potential release sites; and the MOS C alternative (including Site M1-B) would affect seven release sites and 29 potential release sites. Maintenance operations would use hazardous materials as described above.

No-build Alternative

Under the No-build Alternative, light rail maintenance would not occur and no known release sites would be affected by light rail construction. Contamination that would otherwise be cleaned up or controlled by the project would remain, with a potential to migrate. Also, potential existing sources (such as underground storage tanks) may not be removed and could result in releases.

4.11.3 Mitigation

Mitigation for Contaminated Sites

Potential impacts could be minimized by avoiding contaminated sites or portions of sites. By minimizing encounters with hazardous materials, the project would reduce exposure risk, as well as potential delays, construction costs, and liability associated with site cleanup. Conversely, avoiding all contaminated sites would also reduce the opportunity for beneficial impacts associated with cleanup.

Properties left with residual contamination would be clearly identified in documentation provided to Ecology. Restrictive covenants may be required as part of title reports, to place limits on property transfer as well as allowable conditions for future invasive work.

Light Rail Maintenance Mitigation

The project would implement standard operating procedures at the maintenance facility to address management of hazardous materials as part of system operation. These procedures involve development of a programmatic health and safety plan; worker training; materials use planning; and a tracking, documentation, and waste management program.

4.11.4 Significant Unavoidable Adverse Impacts

No known significant unavoidable adverse impacts are associated with hazardous materials for any of the alternatives.

4.12 ELECTROMAGNETIC FIELDS

4.12.1 Affected Environment

4.12.1.1 Existing Electromagnetic Fields

Electric charges and currents create both electric and magnetic force fields. Electric fields are produced by charges, and the stronger the charge (typically measured in volts [V]), the stronger the electric field (typically measured in volts per meter [V/m] or kilovolts per meter [kV/m]) at a given distance from the charge.

Magnetic fields are produced by the flow of electric current. The greater the current (typically measured in amps), the stronger the magnetic field (typically measured in gauss [G], milligauss [mG], tesla [T], or microtesla [μT]; 1 mG = 0.1 μT) at a given distance from the source of the current. The strength of both electric and magnetic fields decreases rapidly with distance from the source.

Electromagnetic fields (EMFs) surround all electrical equipment and facilities. The profusion of existing electrical conveyance lines and electrical devices in the light rail corridor results in a complex pattern of EMFs in the area surrounding the proposed light rail line.

In the U.S., the electricity used in residences, offices, and factories is typically an alternating current (AC) with a frequency of 60 Hertz (1 Hz equals 1 cycle per second). The EMFs associated with AC are time-varying in magnitude and direction. In addition to the more common AC, direct electric current (non-alternating or DC) is produced and used in some situations, including light rail traction power and electric trolley bus systems. The EMFs produced by DC are static; that is, they do not show the variability in magnitude and/or direction characteristic of fields associated with AC. The earth's magnetic field is static and has an intensity of 300 to 800 milligauss (mG) depending on location.

4.12.1.2 Potentially Affected Receptors

Receptors within the light rail corridor include people, whose health may be affected by exposure to EMFs, and equipment (e.g. heart pacemakers) and facilities that may be susceptible to operational interference from EMFs. In addition to light rail passengers and workers, residences, places of employment, and areas accessible to the public (such as parks and street rights-of-way), are located near the proposed light rail alternatives. The Rainier Valley segment (Segment D) and the Northgate to University segment (Segment A) have notably large numbers of residences near the proposed line.

Potentially affected equipment and facilities include utilities (discussed in Section 4.14 Utilities) and the research facilities at the University of Washington Physics and Astronomy Building. The Physics Department conducts extremely precise measurements of physical quantities having fundamental scientific importance. Magnetic fields generated external to the Physics Department facility can disrupt these sensitive experiments. For example, the electric trolley bus lines along 15th Avenue N.E. generate magnetic fields with intensities sufficient to interfere with the Department's experiments, and the University has developed an active cancellation system that detects the magnitude and direction of the external field and generates an opposing field that cancels the external field.

4.12.2 Impacts

4.12.2.1 Potential Physical Effects

Under Alternatives B1 (the preferred alternative) and B2.2, the proposed light rail line would be located within 200 to 300 ft of the exterior wall of the University of Washington Physics and Astronomy building's research laboratories. Based on measurements conducted at locations along Portland Oregon's light rail system, the peak magnetic field intensity generated by the light rail line would be approximately 40 mG at the laboratories' exterior wall. Information provided by the

University of Washington indicates that magnetic field intensities generated by the light rail line greater than approximately 1 mG at the laboratories' exterior wall could interfere with the department's experiments. Therefore, without mitigation, adverse impacts on the Physics Department facilities would be significant under Alternatives B1 and B2.2.

Under Alternative B2.1, the proposed light rail line would be located within approximately 1,000 ft of the exterior wall of the Physics and Astronomy building's research laboratories. Expected peak magnetic field intensities at the exterior wall would be approximately 1 to 2 mG. Significant impacts to the Physics Department research laboratories may or may not result.

4.12.2.2 Potential Health Effects from Light Rail Alternatives

EMFs can result in a variety of impacts to humans. Certain EMF combinations can cause shock and burn injuries; others can also interfere with the operation of electrical and magnetic devices, including heart pacemakers. However, based on data available from similar rail systems, operation of the light rail is unlikely to generate significant health impacts. Anticipated EMF intensities at locations of human exposure within and adjacent to the light rail line are considerably below exposure guidelines established by the American Conference of Governmental Industrial Hygienists (ACGIH) and the more recent guidelines established by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). These guidelines address known biological effects and do not address speculative concerns about cancer and other possible health effects. Given uncertainties in potential biological effects, these guidelines do, however, incorporate safety factors. Among the various alternatives, no significant differences exist in potential health impacts related to EMFs.

Substantial research has attempted to determine whether prolonged exposure to EMFs can result in other health effects. Concern regarding these potential health effects has focused primarily on AC fields—in particular the 50 to 60 Hz fields associated with electrical transmission and distribution facilities—rather than static electric fields associated with direct currents. This research, which has been primarily epidemiological, is inconclusive thus far and medical opinion appears to be divided on the possible extent of these effects.

The light rail would have a DC power system: the primary EMF components would be static, though variations in the DC system would result in minor AC field components at extremely low frequencies (0 to 3,000 Hz). The EMFs are primarily associated with the overhead electrical power system and the traction power substations. The substations would be located every 1 to 2 miles along the route, in the stations, and possibly at a few other locations. The configuration and exposure patterns that would be experienced by passengers in the proposed system are difficult to predict. However, study results from similar systems serve as a guide to possible exposure levels and potential health effects associated with the proposed system.

Measurements of the DC-powered MBTA system in Boston and the DC-powered portion of the TGV-A in France show that maximum static magnetic field intensities (including the contribution from the earth's magnetic field) are less than one percent of the levels established as safe by the ACGIH (Creasey and Goldberg 1993), and are less than one percent of ICNIRP guidelines for continuous exposure of the general public (ICNIRP 1994). Electric field intensities measured in similar situations have been reported at less than ten percent of the ACGIH exposure limit for pacemaker wearers, and less than one percent of the ACGIH limit for the general public (Eggert et al. 1997). Receptors external to the light rail system (e.g., general public, nearby residences, institutions, and places of employment) would experience EMFs primarily from the overhead wire system and the traction power substations. The substations would be separated from public areas and would be well shielded. Cables emerging from the substations would carry DC-power, creating primarily static EMFs. Because external receptors would be located at greater distances from the light rail electrical system than would passengers, the field intensities experienced by external receptors would be below those described above for passengers and would be considerably below ACGIH and ICNIRP standards.

Based on the above data, no significant health impacts related to electromagnetic field exposure are anticipated to result from operation of the light rail, and no substantive difference in health-related impacts would occur among the various alternatives.

4.12.2.3 No-build Effects

Under the No-build Alternative, there would be no additional EMF-related impacts. However, not building the light rail could result in an increase in electric trolley bus service adjacent to the University of Washington Physics and Astronomy Building. Modifications to the building's active cancellation system may be necessary to minimize impacts to research activities.

4.12.3 Mitigation

Sound Transit, with input from the University of Washington Physics Department, has analyzed several mitigation alternatives, that would reduce of the expected magnetic field strength below 0.5 milligauss at the outer wall of the Physics and Astronomy Building. The mitigation proposed involves a specific configuration of the light rail catenary-power feed system near the University of Washington Physics and Astronomy Building.

The catenary system would feed electrical power from DC power cables running parallel to and close to the track center lines of the northbound and southbound tracks. Both the northbound and southbound catenary systems would be divided into looped segments approximately 72 ft in length. Each looped segment would consist of two tap wires extending from the DC power cables to the ends of the catenary cable segment. The catenary cable would have an electrical resistance approximately 3 to 5 times that of the tap wires. Contact of a train car's pantograph with a segment's catenary cable would create two partial loops, with current flowing clockwise in one partial loop and counterclockwise in the other. The current flow in each partial loop would create a magnetic field, resulting in two opposing fields. As the pantograph moves along the segment with the train's forward motion, one partial loop becomes smaller as the other becomes proportionately larger. The varying length of the partial loops, together with the higher electrical resistance of the catenary cable compared to the tap wires, results in the two opposing magnetic fields partially cancelling each other, regardless of where along the segment the pantograph contacts the catenary cable.

Calculations of expected magnetic field strengths with the rails 180 ft below ground level, the near northbound track 105 ft west of the outer wall, and the catenary-power system configured as described above, demonstrate that field strengths would be well below 0.5 milligauss at the outer wall of the University of Washington Physics and Astronomy Building. The specific segment of track over which this mitigation is needed would be refined by Sound Transit in collaboration with the University of Washington Physics Department.

Because no significant health impacts are anticipated, no health-related mitigation measures are required.

4.12.4 Significant Unavoidable Adverse Impacts

No significant unavoidable adverse impacts related to electromagnetic fields or electromagnetic interference are expected under any of the alternatives.

4.13 PUBLIC SERVICES

This section discusses the primary public services that would serve or could be affected by the light rail system and facilities. Public services include fire and emergency medical services (including hospitals), local law enforcement, solid waste collection and disposal, and schools. Potential construction-related impacts are discussed in Section 4.17.12.

4.13.1 Affected Environment

4.13.1.1 Fire and Emergency Medical Services

Services

At least 14 Seattle Fire Department stations are available to serve fire and medical emergencies in light rail Segments A through D. The Seattle Fire Department's 1998 average response time, when units were dispatched following a 911 call, was just over 4 1/2 minutes (from call to arrival at the site) for fire and rescue responses, and just under 4 minutes for basic life support responses (Seattle Fire Department 1998). Several hospitals provide emergency medical services near the proposed Seattle, Tukwila, and SeaTac light rail routes. Figures 4.3-1 through 4.3-4 identify Seattle fire stations and hospitals serving the light rail routes. The Tukwila Fire Department's 60 uniformed firefighters provide fire suppression and prevention, emergency medical aid, hazardous materials response, rescue, planning and education, fire investigation code enforcement, and other services through four fire stations (see Figure 4.3-5). The Tukwila Fire Department's average response time is 4 minutes to all emergency incidents (Tukwila 1998a). The City of SeaTac Fire Department provides fire suppression and prevention, rescue, emergency medical services, and hazardous materials response services through three stations (see Figure 4.3-6). The ladder truck from the Tukwila Fire Department's Station 54 also serves the SeaTac Fire Department. The SeaTac Fire Department's average incident response time in 1997, from receipt of notification to on-scene arrival, was just over 4 1/2 minutes (SeaTac 1998). The Renton Fire Department provides fire protection services from five locations. Renton's new Station 14 (which began operation in 1997) is located at 1900 Lind Avenue S.W. and serves the southwest area of the city toward the Green River and the Tukwila city border (see Figure 4.3-5). Renton's average response time in 1997 was just over four minutes for emergency medical calls and just under five minutes for fire responses (Renton 1998a). King County Fire District No. 20 serves the small area of unincorporated King County between Tukwila, Renton, and the south end of Lake Washington. District 20 has a station in the Skyway area east of the project area at 12617 76th Avenue S. (see Figure 4.3-5). The District's average response time in 1997 was 6.4 minutes (Alexander 1998 personal communication). The Port of Seattle Fire Department provides fire protection and emergency medical services on Port of Seattle property, including Sea-Tac Airport. The department's station is located north of the airport's North Satellite building near Air Cargo Road and S. 170th Street (see Figure 4.3-6).

Light Rail Safety Data

As part of its National Transit Database, the FTA recently began collecting data on light rail safety, including incidents, collisions, injuries, and fatalities. According to their data (FTA 1998), in 1995, 291 collision incidents occurred among the light rail systems reporting (systems totaling 746 vehicles operating in maximum service). Of these, 98 (34 percent) occurred on at-grade crossings. This compares to 475 and 424 collision incidents in 1994 and 1993, respectively. Collisions involving the Portland, Oregon (Tri-Met), light rail system, which runs predominantly at-grade, also decreased from 51 incidents in 1994 to 11 in 1995. Also, the number of fatalities related to light rail nationally decreased from 15 in 1995 to six in 1996, and the fatality rate per VMT from accidents and other incidents has been decreasing since 1993 (BTS 1998).

Other studies and information provide additional information about light rail safety. A 1996 study by the Transportation Research Board, National Research Council's Transit Cooperative Research Program addressed the light rail safety and operating experience of a number of LRT systems operating on shared rights-of-way at speeds under 35 mph, including systems in Boston, Los Angeles, Portland, Sacramento, San Diego, San Francisco, and San Jose (TCRP 1996). For the systems surveyed in the TCRP study, most light rail accidents involved motorists making left-hand turns in front of overtaking light rail vehicles traveling in the same direction. Accidents involving pedestrians account for the smallest percentage of accidents, ranging between 2 and 15 percent of all accidents. A study of six LRT systems (San Diego, Dallas, San Jose, San Francisco, Sacramento, and Portland) over various periods between 1987 and 1999 indicate an average of just over four light rail-pedestrian collisions per year; less than three of these accidents occur at crossings (Korve Engineering 1999b). Accident data are discussed in more detail in the Transportation Impacts and Mitigation chapter (Section 3.3, Arterials and Local Streets).

4.13.1.2 Law Enforcement

Services

The Seattle Police Department (SPD) provides law enforcement and responds to 911 emergency calls in Seattle. The Operations Bureau includes the city's four precincts and stations: north (10049 College Way N.), east (1519 Twelfth Avenue), south (3001 S. Myrtle), and west (610 Third Avenue in downtown Seattle). A new west precinct station at Ninth Avenue and Lenora Street in downtown began operation in September 1999. Seattle's police precincts and stations are shown in Figures 4.3-1 through 4.3-4.

The City of Tukwila Police Department is a full-service department with 69 commissioned officers. The department maintains one station, located at 6200 Southcenter Boulevard (see Figure 4.3-5), and two community policing resource centers, one at Southcenter Mall and the other at the intersection of S. 148th Street and Tukwila International Boulevard The City of SeaTac contracts for police services with the King County Sheriff's Office, which provides a shared and stand-alone police department with 39 dedicated police officers and command staff. The station is located in SeaTac City Hall, at 17900 International Boulevard.

The Renton Police Department employs approximately 119 commissioned officers and noncommissioned staff, and has more than 30 volunteers who assist with its operations. The department is headquartered at 105 S. Grady Way and also has a substation located in the Renton Center shopping plaza off Rainier Avenue S. The King County Sheriff's Office Southwest Precinct (Precinct 4) is headquartered at 14905 Sixth Avenue S.W. in Burien and covers the area of the light rail project that could traverse through unincorporated King County. The Southwest Precinct employs 103 officers and noncommissioned staff, excluding SeaTac personnel. A community policing storefront is located in the Skyway area. The Port of Seattle Police Department provides police protection services on Port-owned properties, including Sea-Tac Airport. Headquartered in the airport's Main Terminal building (see Figure 4.3-6), the department employs approximately 100 officers and noncommissioned staff.

Crime Data

The cities of Seattle, Tukwila, and SeaTac maintain statistics related to crime in their jurisdictions. Crimes are generally divided into Part I and Part II crimes. In general, Part I crimes (also known as the "Crime Index") are more serious and include homicide, rape, robbery, aggravated assault, burglary, theft, auto theft, and arson. Part II crimes include all other crimes, such as simple assault, vandalism, forgery, prostitution, weapons offenses, drug and liquor violations, disorderly conduct, loitering, and other "lesser" offenses. These definitions may differ somewhat by jurisdiction.

In general, crime rates in Seattle have been slowly declining since the early 1990s. However, total Part I crimes increased slightly between 1995 and 1997. The trend reversed again between 1997 and 1998, as Part I crimes in Seattle decreased more than 6 percent, only auto theft and rape increased between 1997 and 1998. According to SPD crime data, several census tracts, in areas through which light rail alternatives would traverse, typically experience crime rates "considerably above the median" (i.e., the 15 percent of Seattle census tracts with the most offenses reported). Census tracts in Northgate (Segment A); the University District, Capitol Hill, and downtown Seattle (Segment B); and parts of areas along the MLK Jr. Way S. and Rainier Avenue S. corridors (Segments C and D) experience especially high numbers of crimes (Seattle 1998; 1999). Recent Part II crime statistics in Seattle were not available.

For years, Tukwila has experienced one of the highest crime rates in the state of Washington, presumably due to Tukwila's expansive commercial and industrial areas and its function as a commuter crossroads. The numerous parking lots make the city particularly prone to auto theft; for example, auto thefts in Tukwila in 1997 increased approximately 21 percent from 1996 to 1997, and another 7 percent from 1997 to 1998. In general, however, crime in Tukwila, including crime along the Tukwila International Boulevard corridor (E1 alternatives), has been declining since 1995. Part I crimes in Tukwila decreased more than 18 percent between 1995 and 1998. Total Part II crimes have gone up and down but were at their lowest levels in 1998 (4,627 crimes) since 1994. Approximately 10 percent fewer calls for service were recorded in 1998 (35,002) than in 1995. Robbery along the Tukwila International Boulevard corridor was reduced 64 percent from 1995 levels (Tukwila 1998, 1999). Tukwila's community-oriented policing programs, installed surveillance cameras to monitor and report suspicious activity on Tukwila International Boulevard, and other efforts may be partially responsible for this decrease. Substantial revitalization efforts in the Tukwila International Boulevard corridor by the City of Tukwila and local community organizations and action groups have likely contributed to the general decrease in area crime.

Crime rates in SeaTac (Segment F) also appear to be slowly decreasing. Part I crimes in SeaTac decreased more than 8 percent from 1996 to 1997, and total dispatched calls for service (11,808) decreased more than 2 percent. Nearly all categories of Part I crimes decreased during this period; however, auto theft increased 9 percent in 1997, from 397 to 433 offenses. Total Part II crimes in SeaTac decreased nearly 11 percent during this period. Vandalism and fourth-degree assaults were by far the largest single categories of Part II offenses, accounting for 43 percent of all Part II crimes. Total crimes in patrol district L2, which includes the area of International Boulevard between 160th and 176th streets, increased slightly between 1996 and 1997; all other district crime decreased (SeaTac 1998). The SeaTac Police Department has indicated that a substantial portion of the area's crime is in the Bow Lake neighborhood east of International Boulevard (Pentony 1998 personal communication).

The FTA maintains crime data related to light rail operations. Most crimes appear to be thefts or auto thefts, especially in the vicinity of stations or parking areas (FTA 1998). Of the light rail systems reporting in 1995 (systems totaling 678 vehicles operating in maximum service), 451 thefts, 128 auto thefts, 43 burglaries, and 6 arsons were reported. In Portland, Tri-Met reported 112 thefts and 48 auto thefts in 1995 associated with the MAX system. Crime around the MAX stations has generally been minor, but car theft around parking areas has been a concern. Crime in these station areas is largely an outgrowth of crime in the particular location but is not thought to affect surrounding neighborhoods (Sizer 1998 personal communication).

4.13.1.3 Schools

At least 19 Seattle public schools are located within several blocks of the alternative routes in Seattle. Several private schools and both public and private colleges, including the University of Washington, North Seattle Community College, Seattle Central Community College, and Seattle University, are also located near the proposed alignments. Schools near the Seattle alternative stations and routes are shown in Figures 4.3-1 through 4.3-4.

Tukwila School District 406, which operates within the city of Tukwila, includes three elementary schools, one middle school, and one high school. Foster High School, Showalter Middle School, and Thorndyke and Cascade View elementary schools are located in the general vicinity of the E1 alternatives. Tukwila Elementary School is located in the general vicinity of Alternative E2.

Public schools in the SeaTac area (part of the Highline Public School District 401) include three elementary schools—Riverton Heights, McMicken Heights, and Madrona—located in the vicinity of the Segment F alternative routes and stations. Four other Highline schools that could be affected by the light rail alternatives—Valley View and Bow Lake Elementary, Chinook Middle School, and Tyee High School—are located between ¾ and 1 mile east of International Boulevard. A private school, Pacific Christian School, is also located near the proposed routes (Figure 4.3-6).

School buses serving Seattle, Tukwila, and Highline schools travel on, cross, and make turns along many streets in the project area, including major arterials in at-grade and elevated route segments such as MLK Jr. Way S., Interurban Avenue S., Tukwila International Boulevard, and International Boulevard

4.13.1.4 Solid Waste Collection and Disposal

The Seattle Solid Waste Utility, a division of Seattle Public Utilities, currently contracts with two private firms—Waste Management of Seattle and Northwest Waste Industries—to collect commercial and residential solid waste generated in Seattle. Commercial recyclables are collected by several companies (Seattle 1998b). Solid waste collection, transportation, and disposal in Tukwila are provided under franchise agreements with vendors and licensing agreements between the state and the vendors. SeaTac Disposal currently handles most of the commercial waste collection and hauling in Tukwila. Waste Management, Inc. (Rainier) handles a small amount, including dry (non-putrescible) wastes (Erath 1998 personal communication). Commercial recyclables and construction waste are handled by a number of companies. The City of SeaTac currently has franchise agreements with SeaTac Disposal Company and Nick Raffo Garbage Company to collect residential and commercial solid waste, including garbage, construction debris, and land-clearing debris in SeaTac.

4.13.2 Impacts

4.13.2.1 Fire and Emergency Medical Services Impacts

The analysis in this section is based on known and expected design and operation commitments. For example, although making left-hand turns across the light rail trackway at unsignalized intersections would be considered illegal for general vehicles, emergency vehicles could be able to make these unauthorized left-hand turns at their discretion. Similarly, crossing light rail trackway mid-block would be illegal, but trackway curbing would be designed where necessary (e.g., MLK Jr. Way S.) to allow emergency vehicles to cross. Emergency vehicles could have signal priority over light rail train signal requests. Also, Link trains would be equipped with intelligent traffic signal control technology in coordination with local fire and transportation departments. Final design and operation decisions may change somewhat as the design process continues and following further coordination with emergency service providers through Sound Transit's Fire-Life Safety Committee. This committee includes representatives from the Seattle, Tukwila, SeaTac, King County, Port of Seattle, Renton, and University of Washington police and fire departments as well Sound Transit engineers and safety specialists. This committee will develop solutions regarding access to the light rail system, emergency routes, water and fire hydrant needs, training, costs, and other design features to ensure that the light rail system does not compromise fire and life safety in the project vicinity.

Light rail operation in shared rights-of-way introduces a new type of vehicle in the flow of traffic. Some collisions between Link trains and motorists and pedestrians will occur. Many of the safety problems associated with light rail result from a general lack of awareness and the failure of motorists and pedestrian to obey crossing warning and traffic control devices. There will be changes at pedestrian crossings, signals, traffic flow patterns, and other areas. Motorists, bicyclists, and pedestrians will take time to adjust to the new system. The Portland MAX system, in many ways similar to the proposed Link system, experienced a much higher number of accidents in its first three years of operation than in subsequent years. Potential impacts to fire, police, emergency medical, and other emergency services also include changes to some response routes and increased response time. However, with appropriate design features and mitigation measures, such as redesign of some roadway crossings, turning movements, additional signalized crossings, and other factors, these potential response time impacts and the potential for serious accidents requiring fire and emergency medical service would be minimized.

Signage would be installed to clearly delineate the Link trackway and adjacent streets and to warn pedestrians that trains may be approaching. Trains would operate at the speed limits designated for vehicles on adjacent streets in at-grade sections of the line. Designated pedestrian crossing areas would provide safe crossings of the Link facilities. Link trains would have a high intensity light that would remain on at all times, and operators would sound the train horn if they saw vehicles or pedestrians in the Link trackway.

The emergency service providers and Link personnel will be trained to respond to all types of emergencies that occur on, in, or near the Link system. According to Portland Tri-Met representatives, the MAX system has not compromised fire and emergency medical response (Saporta 1998 personal communication).

Several other factors would also minimize accidents and aid calls. Allowing automobiles to make left-hand turns at signalized intersections only, as proposed, would reduce the risk of vehicle-light rail accidents and would also likely decrease the number of auto-auto accidents that would otherwise occur at non-signalized intersections. Installing curbing that separates at-grade light rail from the roadway would also minimize accidents. A detailed review of accident records on MLK Jr. Way S. from 1994 through March 1999 indicates that a median (or curbing) might have prevented 233 collisions between motor vehicles during this period, or a 44-percent reduction in accidents. A similar analysis of accidents on Tukwila International Boulevard between 1994 and 1996 shows that a median might have prevented 11 collisions during that period, or a reduction of 3 to 4 percent. The number of estimated avoided accidents would be higher in future years as traffic volumes increase (see section 3.3, Arterials and Local Streets). Based on accident benchmarks from a survey of western urban light rail systems new light rail vehicle accidents with motor vehicles would occur. However, the number of new accidents is expected to be lower than the number of existing accidents reduced by the median light rail system on MLK Jr. Way S. or Tukwila International Boulevard under Alternative E1.1 (Korve Engineering 1999a). In addition, installing curbing could also reduce the number of pedestrian-auto accidents that might otherwise occur. A review of accident records on MLK Jr. Way S. indicated that a median could have prevented seven accidents per year between motor vehicles and pedestrians or bicyclists; four accidents per year could have been prevented on Tukwila International Boulevard with a median. The preferred alternative, with a raised median and additional signal protected pedestrian crossings would likely prevent some of these accidents. Light rail vehicle accidents with pedestrians and bicycles are expected to be lower, based on experience in other systems. In summary, light rail operating in its own divided trackway on MLK Jr. Way S. and Tukwila International Boulevard. would have a net result of fewer total vehicle and pedestrian accidents than would otherwise occur on these streets under current conditions.

Passing trains could briefly delay emergency vehicles attempting to cross the trackway along at-grade light rail sections, thereby compromising response time. Emergency vehicles crossing MLK Jr. Way S. (all D routes), Rainier Avenue S. (D3 routes), Tukwila International Boulevard (E1–preferred alternative), Interurban Avenue S. (E2), and International Boulevard (F1) could be affected. Sound Transit operations staff analyzed potential emergency vehicle delay at signalized at-grade intersections. At intersections along the route with no light rail station, 88 percent of emergency vehicle trips moving through signalized intersections would not be delayed, 4 percent would be delayed by 0 to 10 seconds, and 8 percent would be delayed by 10 to 30 seconds. At those intersections where a station platform is located just past the street crossing, a train that is reducing speed to stop at the platform will take longer to clear the crossing. Under these conditions, 81 percent of emergency vehicle trips would not be delayed, four percent would be delayed by 0 to 10 seconds, and 15 percent would be delayed by 10 to 45 seconds at these crossings.

Responding to fires and medical emergencies in areas west of MLK Jr. Way S. in the Rainier Valley (C2.3, C3 and all D routes) and in Tukwila west of Tukwila International Boulevard (E1.1 and E1.2) could require emergency vehicles to exercise more care when crossing the trackway or roadway because they would be crossing a median and the Link train may not yet be completely stopped. Most Seattle fire stations responsible for these areas are located on the east side of MLK Jr. Way S., including Station 6/Engine 6 and Ladder 3 (3,197 total responses in 1998); Station 28/Engine 28, Ladder 12, and Medic 28 (5,885 responses in 1998); Station 30/Engine 30 (1,861 responses in 1998); and Station 33/Engine 33 (1,646 responses in 1998). Many emergency responses from these stations use MLK Jr. Way S. as the preferred response route instead of Rainier Avenue S. because of the availability of turn lanes and the limited number of signalized intersections. Many of the responses from these stations also require crossing MLK Jr. Way S. or Rainier Avenue S. Station 13/Engine 13 and Battalion 5 (2,593 total responses in 1998) and Station 14/Ladder 7, Aid 14, and Rescue 14 (2.112 total responses in 1998) are located west of MLK Jr. Way S., and could also respond to emergencies related to the Link facilities in this area. All Tukwila Fire Department stations are located on the east side of Tukwila International Boulevard. (see Figure 4.3-5), and emergency response often requires crossing Tukwila International Boulevard. New signalized crossings at several locations along MLK Jr. Way S., Tukwila International Boulevard, and International Boulevard (see Chapter 3) would provide additional signalized crossing opportunities on these roads minimizing potential crossing delays. Significant impacts to the Port of Seattle, King County Fire District No. 20, or Renton Fire Department services would not be expected. In some cases, (if deemed necessary) King County, SeaTac, or Port of Seattle fire departments, through contractual arrangements and mutual aid agreements, could potentially handle emergencies in these areas. Similarly, the Renton Fire Department and King County Fire District No. 20 could assist with emergencies in the far eastern parts of the project area (that is, under Alternatives E2 and E3).

Restricting vehicle left-turns on these roads to signalized intersections only could limit the ability of fire, medical, and police vehicles to respond quickly to emergencies by forcing them to take longer alternate routes. Responding emergency vehicle depend upon left-turn lanes to navigate through traffic. This could be problematic in several areas, especially MLK Jr. Way S. (D1 alternatives) Tukwila International Boulevard (E1 alternatives) and International Boulevard. (F1 and F3 [S. 158th Street only]), where, depending on the location of the emergency, fire trucks may have to backtrack from the next signalized intersection or take routes on smaller side streets through adjacent neighborhoods. This would have associated impacts on neighborhoods, traffic, and pedestrian safety in those neighborhood areas. Elevated segments in these corridors (e.g., Alternatives C2.3, C3, D1.3, E1.2, and various F alternatives) could pose similar problems. Again, however, allowing emergency left-hand turns, retaining and adding signalized intersections, and installing appropriate curbs as necessary would minimize the potential impacts on emergency response from turning restrictions. Emergency vehicles traveling with traffic flow along at-grade sections in the center of the roadway (particularly MLK Jr. Way S.) could experience delays because center turn lanes would be eliminated. Crossable curb design would allow emergency vehicles to use the median to pass, but would likely not be desirable because of potential light rail traffic.

Alternative D1.1d and D1.1f could pose additional response difficulties. These options propose converting a section of MLK Jr. Way S. from its intersection with Rainier Avenue S. to S. Henderson Street from four lanes of traffic to two in a 90-ft and 93-ft right-of-way, respectively. Although the new lanes would be wider than a typical street, passing other vehicles could be difficult. This would limit the emergency vehicle's ability to negotiate traffic during the responses and response times for emergency vehicles that take routes on MLK Jr. Way S. could be compromised, especially during times when vehicle traffic is heavy. Any fire apparatus stopped at response locations along MLK Jr. Way S. would likely block the only available traffic lane, thereby obstructing traffic for the duration of the emergency. These alternatives could also create slightly longer delays at some intersections along MLK Jr. Way S. (see Chapter 3). Under Alternatives D1.1d and D1.1f, the light rail system may need to be designed to allow emergency vehicles to travel partially within the light rail right-of-way to avoid potential delays on MLK Jr. Way S. Some emergency routes in this vicinity may need to be altered to minimize response time impacts under all D alternatives.

Emergency response times in downtown Seattle could potentially be affected as Metro transit buses are moved from the Metro tunnel to city streets to allow Link to operate in the tunnel. While overall bus volumes on city streets would increase, however, Sound Transit estimates a related decrease in auto volumes on city streets because of more total transit opportunities (see Chapter 3 – Transportation). While certain areas could experience heavier traffic volumes and slightly increased delays, emergency response times are not expected to be significantly affected.

Fire department regulations and procedures prevent stretching fire hoses over active railroad tracks. Depending on the nature and location of the emergency (such as adjacent to MLK Jr. Way S., Tukwila International Boulevard, International Boulevard, or Interurban Avenue S.) and available hydrants, light rail operations would need to be temporarily shut down, possibly for several hours during some emergencies. Fire hydrants would be installed along some at-grade routes to avoid laying hose over tracks.

Access to fire and medical emergencies on elevated and tunnel track sections and stations would be more difficult than access at-grade. Ladder trucks would sometimes need to be used to access emergencies along elevated sections. High bridges or elevated sections, such as the proposed new bridges over the Lake Washington Ship Canal (B2.1), I-5 at Boeing Access Road, and the Duwamish River (E1.1, E1.2, and E2) and sections running along the south side of SR 518 (E2 and E3), could pose particularly difficult challenges. SeaTac Fire Department equipment, for example, has a maximum vertical reach of 30 ft, making rescues on the higher-elevated sections in that segment difficult. SeaTac currently has buildings that exceed these heights so accessing elevated light rail segments could be difficult but would not be a unique access issue to the SeaTac Fire Department. Mutual aid from the Port of Seattle, Tukwila or other fire departments would be called to respond to emergencies at higher elevations. Although it has a ladder truck, the Tukwila Fire Department also has concerns about reaching some of the more remote elevated sections of the light rail route in Tukwila (i.e., the E3 route). Access to tunnel sections (all A, B, and C alternatives and D3.4) would also need to be maintained at all times to ensure prompt response times and the safety of both passengers and service providers. Tunnels and elevated sections would be designed to provide emergency access and evacuation in conformance with NFPA 130.

Methods of access and evacuation during emergencies on elevated and in tunnel sections include using a second train on the adjacent track or using, elevators and emergency stairs. Emergency responders would use water standpipes or other firefighting and emergency features incorporated in the light rail design. In unusual cases where using a second train is not practical, Sound Transit would follow state and local fire codes and NFPA's Standard for Fixed-Guideway Transit Systems, which was developed especially for elevated and tunnel systems.

Precise emergency procedures and necessary equipment will be determined during final design. Fire fighting, emergency medical, and other safety and security issues and resolutions are being discussed through Sound Transit's Fire-Life Safety Committee.

4.13.2.2 Law Enforcement Impacts

Operation of the light rail system could focus criminal activity in some areas, particularly around parking facilities and possibly at some stations. Attempted car thefts, robberies, loitering, and other crimes could occur in these areas, especially at night, thereby increasing service calls to police and 911. The proposed Boeing Access Road Station (E1.1 and E1.2) is of particular concern to Tukwila police who indicate that this station's isolated location, coupled with the proposed parking area at this location, could concentrate criminal activity. In addition, the SPD has indicated that the anticipated increased call load and geographical divisions created by the light rail system may require redistricting some of its current sectors and beats (Mochizuki 1998 personal communication).

The overall effects of light rail operation could require additional police and security staff or additional patrol cars to monitor stations, tunnels, parking facilities, and other areas. There is a particular concern about safety and security in the deep tunnel stations in the University District, First Hill, and Beacon Hill. Increased policing or security in some areas, especially around stations and parking facilities, would substantially minimize criminal activity associated with the light rail system. Careful planning and design of stations and parking facilities in association with the local police and UW police would deter criminal activity and generally make light rail facilities safer and more secure. Sound Transit's Link Design Criteria include many principles and guidelines designed to ensure safety and security throughout the light rail system. These criteria include specific design requirements for pedestrian safety, elevators and escalators, ancillary spaces, patron information centers, public telephones, call-for-aid stations, emergency management panels, electronic surveillance, lighting, materials, vandalism, electrical requirements, public address systems, radio communications, alarms, and other measures. Proposed methods of addressing safety and security known at this time are identified in the Mitigation section. Sound Transit's Deep Tunnel Stations, Patron Access Options and Issues technical memorandum, which discusses these issues and methods in more detail, is included in the Public Services Technical Back-up Report.

As with fire and medical emergencies, police access to elevated track and tunnel sections and stations could be difficult. Responding to crimes, disturbances, or other emergencies occurring on trains in these sections or between stations could be difficult for both train drivers and police to control and manage. Also, at-grade platforms would be easier to patrol and have a deterrent benefit for officers who are on ground patrol. Congregations of people and the activity around stations and other light rail facilities may actually help deter crime in some areas. Police vehicle access over the curbing on at-grade sections could be difficult. Patrol cars responding to crimes or other emergencies on the opposite side of the streets on which they are traveling typically cross roads at the first available crossing. Police are less likely (or may not be able) to do this across the at-grade light rail curbing, thereby delaying emergency response time. In Portland, however, Tri-Met has indicated that police response times have not been hindered during light rail operation (Sizer 1998 personal communication). Curb design in some areas would allow emergency vehicles to cross more easily.

Maintenance base alternative M3 would displace the Seattle Police Department's Firing Range facility. This facility would likely be difficult to relocate in the nearby vicinity. In addition, SPD has plans to house support staff at the city of Seattle's Park 90/5 facility, located at 2203 Airport Way S. Maintenance base alternative M1-B would displace this facility and M1-A could affect access to the building. Tukwila's neighborhood community policing resource center located at Tukwila International Boulevard and S. 148th Street would be relocated under Alternative E1.1.

4.13.2.3 School Bus Route Impacts

School buses traveling along, crossing, or making turns from some major roadways in the project area could experience some delays during light rail operation. Buses crossing at-grade alternatives along MLK Jr. Way S. (all D routes), Tukwila International Boulevard (E1.1), and International Boulevard (F1) could be particularly susceptible to delays as trains pass intersections. Also, buses could be delayed or routes altered along all at-grade and elevated routes in Segments D, and under Alternatives E1.1, E1.2, E2, F1, and F4 because of the proposed restriction of left turns to signalized intersections only. Traffic and transportation impacts are discussed in Chapter 3 of this document.

Traffic at some intersections along MLK Jr. Way S., Rainier Avenue S., Tukwila International Boulevard, International Boulevard., and other roads would experience increases in average delay time during light rail operation (see Chapter 3). Seattle school buses traveling on MLK Jr. Way S. make turns at most signalized intersections (Anderson 1998 personal communication). Estimates prepared for 2010 traffic during the afternoon peak hour indicate some delay compared to no-build conditions along MLK Jr. Way S. at S. Alaska Street (eastbound and westbound approach), S. Graham (eastbound and westbound) Cloverdale (eastbound and especially westbound) streets, and S.

Henderson Street (westbound). Delays at intersections along Rainier Avenue S. include S. Walden (eastbound and westbound), S. Charlestown (westbound), S. Andover (westbound), and S. Alaska (all approaches).

Tukwila district buses make approximately 171 movements at most Tukwila International Boulevard intersections. More than 100 of these movements occur at S. 144th and S. 154th streets, 37 of which occur during A.M. peak traffic hours. Tukwila International Boulevard. is crossed 80 times per day (Silver and Lemen 1998 personal communication). Similarly, the Highline School District operates 79 bus routes daily and contracts private services for 48 additional special needs routes and field trips. Highline buses cross or turn off or onto International Boulevard at most major intersections in SeaTac, including S. 154th, 160th, 170th, 176th, 188th, 200th, and 208th streets (Carr 1998 personal communication). Noticeable delays at intersections along Tukwila International Boulevard. affecting Tukwila buses would occur at S. 112th Street and S. 144th Street under Alternative E1.1 (the preferred alternative) and E1.2, and at S. 154th Street under Alternative F1. Intersection delays affecting Highline buses on Tukwila International Boulevard/International Boulevard. would occur at S. 154th Street under F1 (see above); S. 160th Street (southbound and eastbound under F1, F2, and F3; westbound under F1 only); S. 188th Street (eastbound under F1, F2, and F3; westbound under F1 only); and S. 192nd Street (westbound under F1). Eastbound turns at S. 144th, 154th, and 170th streets and westbound turns at S. 188th Street would experience the most significant delays. Buses using other crossings along these main roads would experience slight delays (generally less than 10 seconds) or, in some cases, improved service with light rail. Level of service analyses and anticipated delays are discussed in Section 3.3, Arterials and Local Streets.

Traffic mitigation proposed at these intersections (see Chapter 3), however, would substantially reduce potential delays. Buses cross these major roadways at signalized crossings only, thereby minimizing potential left-turn delays. Most left-hand turns at currently signalized intersections would be retained and some additional left-hand turn lanes would be added. Additional signalized intersections would also be added along MLK Jr. Way S. at Andover, Dakota, Edmunds, Dawson, Brandon, Myrtle streets, Renton Avenue, and Norfolk Street; and along Tukwila International Boulevard. at 148th Street. In addition, a 100-ft exclusive right-turn lane is proposed for the eastbound to southbound movement on S. 144th Street, which should minimize bus delays at this intersection. Most A.M. school bus delays would likely occur during the morning peak traffic hours and most P.M. school bus runs would be completed before the typical P.M. peak traffic hour begins. Morning peak hour and afternoon traffic delays are generally less than the P.M. peak hour delays. These factors would also help minimize the overall impact on Seattle, Tukwila, and Highline schools.

Light rail facilities would likely require relocating some existing school bus stops, especially on at-grade sections around stations. These include some Seattle School District stops on MLK Jr. Way S. (all D routes), Tukwila School District stops on Tukwila International Boulevard (E1 the preferred alternative) and Interurban (E2), and Highline School District stops on International Boulevard (F1) and 28th Avenue S. For example, Highline bus stops along 28th Avenue S. would be affected under most alternative configurations of the South SeaTac Station and park-and-ride, particularly those north of S. 200th Street. These bus stops may need to be moved to accommodate Sound Transit bus stops and light rail station and park-and-ride facilities. Sound Transit would coordinate with the school districts to finalize solutions.

The safety of school children walking along major roads on at-grade sections such as MLK Jr. Way S. (all D routes), Tukwila International Boulevard (E1.1), and International Boulevard (F1) is a concern. Seattle, Tukwila, and Highline school district boundaries are generally devised so that school children are not required to cross major arterials to reach their schools. This would help provide students' safety during light rail operations. However, some students will cross these roads mid-block or at unsupervised intersections, regardless of school district policies. Appropriate design measures, such as installing signalized pedestrian crossings at strategic locations, and educating school officials and students about safe crossing practices, would minimize potential safety impacts to school children and all pedestrians. Sound Transit (Alternative D3.4) proposes a new grade-separated pedestrian-only walkways under S. Edmunds Street at the Columbia City Station. The intersection of MLK Jr. Way S./S. Andover Street, MLK Jr. Way S./S. Dawson Street, and Cheasty Boulevard/MLK Jr. Way S. intersections have been proposed for potential signalization to provide protected pedestrian and bicycle crossings. A new pedestrian-only signal at the unsignalized MLK Jr. Way S./S. Dakota Street intersection could serve as a new school crossing location. Three new pedestrian-only signals would be added on Tukwila International Boulevard near 130th, 132nd, and 142nd streets. As indicated in the Fire and Emergency Medical Services Impacts section (4.13.2.1), light rail operating in its own divided trackway on MLK Jr. Way S. and Tukwila International Boulevard would have a net result of fewer total pedestrian accidents than would otherwise occur on these streets under current conditions.

4.13.2.4 Solid Waste Collection and Disposal Impacts

No significant impacts on solid waste collection and disposal in the project area during light rail operation would be expected. Hauling routes in areas using the intersections experiencing increased delays (see School Bus Route Impacts above) would also experience some delays, but these should not significantly affect their services. One solid waste/recycling facility, the Black River Demolition Disposal and Recycling Station, located at 501 Monster Road S.W. in Renton, would be displaced under Alternative E3. Because of this facility's siting needs and operating characteristics, relocation could be difficult.

4.13.2.5 System-Wide Impacts

In general, public services would be most affected by at-grade light rail alternatives because of potential delays and structural impediments created by the light rail facilities. Fire, emergency medical, and police services could also be affected by the difficulty of accessing elevated and tunnel sections of the route. Based on the potential impacts identified above, the alternative with the highest overall potential impact on public services would likely consist of the following routes: A2.1 or A2.2; D1.1 (particularly D1.1d) or D3.3; E1.1; and F1.1. The preferred alternative includes D1.1e and E1.1, which contain significant portions of at-grade trackway making it susceptible to the potential at-grade impacts (e.g., response time, vehicle delays, potential accidents) identified above. There would be little difference in impacts among the Segment B routes, Segment C routes, or the Maintenance Base alternatives.

All three MOS alternatives would have both tunnel and at-grade sections, both of which create different potential impediments and safety concerns for emergency service providers. MOS B would include a Link route down MLK Jr. Way S., which would inevitably lead to some accidents and conflicts with motor vehicles, pedestrians, and bicyclists traveling on, across, and making turning movements on to and off of this arterial; such accidents would not occur in tunnel sections. Response times could also be affected in the Rainier Valley under MOS B because of traffic delays that would occur at some intersections. The at-grade traffic impacts and delays under MOS B would also affect Seattle School District buses using or crossing MLK Jr. Way S., potentially creating lengthier travel times. However, MOS A and MOS C both have longer tunnel sections than MOS B and deep tunnel stations, which are more difficult for service providers to access in emergency situations than at-grade sections. The deep tunnel stations could also be more of a safety concern as crimes may be more difficult to monitor, and therefore more frequent, than at open, at-grade stations. Regardless of the MOS, however, design measures and proposed mitigation would minimize the potential for significant public services impacts.

4.13.2.6 No-build Alternative Impacts

No known significant impacts to public services in Seattle, Tukwila, SeaTac, Renton, or King County would occur under the No-build Alternative. Continued growth in the project corridor would increase demand on all public services. Proposed projects in the south end of the light rail system (e.g., the 28th/24th Ave. S. corridor project and the SR 509 extension project) could affect public services in the general vicinity of the South SeaTac Station and park-and-ride.

4.13.3 Mitigation

Sound Transit would incorporate the following design mitigation measures into the project to maintain system safety and minimize the potential impacts of light rail operation on public services:

- Develop a system safety and security program that defines activities and management controls, plans, and monitoring processes to prevent patrons, personnel, and property from being exposed to hazards or unsafe conditions during light rail operation. The program will be developed in close coordination with local fire, police, and other public service agencies as part of Sound Transit's emergency management plan. The program will also:
    - Incorporate operational, occupational/industrial, traffic, facilities, and pedestrian safety considerations, compatible with other system requirements into light rail facilities, equipment, plans, and procedures to minimize the potential for accidents during operation.
    - Identify and eliminate or minimize hazards associated with light rail to acceptable safety levels.
    - Implement a safety certification program to provide all elements of a safe transit system before revenue service begins.
    - Maintain a proactive safety philosophy that emphasizes preventive measures over corrective measures to eliminate unsafe conditions.
    - Analyze and use historical data generated by the newer transit properties with characteristics similar to light rail to support the system safety program.
    - Coordinate safety and fire/life safety considerations with reliability, maintainability, and identified testing activities.
- Design and operate stations to address patron safety and station security through architectural configuration and station design; electronic monitoring, sensing, and communications; and manned surveillance, including the following: (Many of these concepts are designed for deep tunnel stations, but where feasible or deemed necessary would be applied to other stations.)
    - Design stations to be open and spacious, well-lit, and uncluttered, with open stairwells and high ceilings.
    - Minimize turns in public circulation areas, avoid or minimize interior columns, and avoid blind corners or nooks that are beyond a patron's or a security camera's field of vision.
    - Provide clear and direct access from a station entry to a station platform by limiting the number of entry points and avoiding long corridors or walkways.
    - Provide uniform lighting throughout the station area and place fare machines in locations selected to allow security monitoring.
    - Install closed circuit television (CCTV) surveillance cameras at strategic locations to effectively cover public areas.
    - Install a public address system to provide information to transit passengers. The system would provide adequate coverage of all public areas in stations.
    - Install an emergency telephone system providing direct contact with the central control and monitoring facilities. Emergency phones would likely be located in fare collection and platform areas and would be prominently identified.
    - Locate passenger information phones adjacent to fare machines and within view of a CCTV camera.

    - Provide security personnel to rove between stations. These personnel would likely be contracted with local law enforcement or private agencies, but could also be provided directly by Sound Transit. More precise needs for manned surveillance will be determined as the safety and security program advances.
    - Implement system security criteria at and around station sites that enhance patron security through: providing maximum visibility of the entrances and the facility from adjacent areas; planting vegetation that does not hinder fields of vision; providing adequate lighting and site accessibility; and providing clear lines of sight of parking lots, adequate illumination, and ease of access for surveillance.
    - Provide radio communication capabilities for emergency train operations and police and fire emergencies; provide two-way communication capability from within elevator cabs between the patron and the Link operations.
    - Install and maintain an intrusion and alarm system to protect against unauthorized entry into security-sensitive areas of the system such as fare vending machines, traction power substations, and money counting and storage rooms; lock or otherwise prevent access to tunnel and elevated sections when the light rail system is closed.
- Develop an emergency management plan in close coordination with Seattle, Tukwila, SeaTac, Renton, King County, and Port of Seattle police and fire departments, transportation divisions, and others through Sound Transit's Fire and Life Safety Committee during preliminary and final design, and construction, and operation of the proposed facilities. This plan would provide reliable emergency access, develop alternate plans or routes to avoid delays in response times, and institute other features, as necessary, so that general emergency services are not compromised.
- Work with local police departments to implement crime prevention through environmental design (CPTED) principles when feasible. This could include design elements such as installing appropriate lighting around the station areas, tunnels, parking facilities, and other system facilities, and incorporating other design features to help deter crime.
- Work with local fire and police departments to address training necessary to teach personnel about the light rail system facilities (tunnels, elevated sections, at-grade crossings) and operations.
- Final design of the at-grade sections will consider pedestrian safety measures such as a visual element in the center of the tracks to discourage crossing the tracks except at legal crosswalks. The visual element may consist of a high decorative fence or similar feature. Another potential measure being considered would provide an area for pedestrians to stand on one or both of the rail tracks at legel crossing intersections.
- Work with local school districts to educate school officials and children about the light rail system and safe street-crossing procedures, especially on at-grade sections; and to address specific issues related to bus stop relocations and potential school bus delays. Sound Transit would work closely with community groups and neighborhoods as part of its public education program to inform the general public about safety associated with the Link system.
- To minimize effects on response times, design at-grade tracks and curbs on MLK Jr. Way S. and other at-grade sections – as deemed necessary by Sound Transit and local transportation agencies – that would physically allow crossing by emergency vehicles. Crossing the tracks, other than at signalized intersections, would be considered illegal, but would be physically possible if the above-mentioned decorative fencing is not placed between the tracks.
- Equip Link trains with intelligent traffic signal control technology in coordination with local fire and transportation departments to minimize potential emergency response time delays. Priority control over specific signalized intersections would be coordinated with these departments on a case-by-case basis.

The Fire-Life Safety Committee and other Sound Transit safety and security specialists would continue to address public service issues throughout design, construction, and operation. Design features and mitigation to minimize any additional impacts would be incorporated as necessary.

4.13.4 Significant Unavoidable Adverse Impacts

With mitigation, no significant unavoidable adverse impacts on public services would be expected.

4.14 UTILITIES

This section evaluates long-term impacts to utility providers and systems that would serve or could be affected by the light rail system and facilities. Utility providers throughout the light rail project area include municipal agencies, special utility districts, and private companies providing electricity, water, wastewater and stormwater collection, natural gas, steam, and telecommunications services. Potential construction-related impacts to utilities (e.g., relocation and protection) are discussed in Section 4.17.13.

4.14.1 Affected Environment

4.14.1.1 Segments A through D

Seattle City Light, which supplies electric power to customers in Seattle and some portions of King County north and south of the city limits, would provide electric power to all Segment A, B, C, and D alternatives and the M1 and M2 operation and maintenance facilities. City Light owns and maintains approximately 650 miles of 115-kilovolt (kV) and 230-kV transmission lines that carry power from its generating facilities to 13 principal substations. At least eight of these substations (North, University, Broad Street, Union, E. Pine, Massachusetts, South, and Creston) serve areas through which the proposed light rail alternative routes pass. The utility currently supports an annual load of approximately 1,100 average megawatts (MW); this load is projected to grow by more than 10 to 20 average MW per year. Overhead transmission lines are located along the proposed Seattle segment alternative routes, including along Eighth Avenue N.E. in Roosevelt, adjacent to the I-5 bridge over the Lake Washington Ship Canal (B2.1), on the east side of the E3 busway south of downtown (C1), and across MLK Jr. Way S. near S. Henderson Street (Segment D). Major underground power lines are located in the Ravenna area between N.E. 75th and N.E. 60th streets (all Segment A alternatives), beneath Denny Way on Capitol Hill, and at crossings along Rainier Avenue S. near I-90 and S. Massachusetts Street (C2 and C3), and near S. McClellan Street at 17th and 21st Avenue S. (Alternative C1). Overhead distribution lines are also located along many streets in the project area, most notably along MLK Jr. Way S. (all Segment D routes).

Puget Sound Energy (formerly Washington Natural Gas) provides natural gas service throughout the entire project area. High-pressure gas mains are located in the project area, including along Fifth and Eighth Avenue N.E. (all A alternatives), Denny Way on Capitol Hill (B1), Sixth Avenue S. (C1), and MLK Jr. Way S., south of S. Henderson Street (all D alternatives).

US West Communications provides telephone service throughout the entire project area. Telephone lines in urban areas are typically located within street rights-of-way, aboveground on utility poles in most areas and underground in some areas (including part of downtown Seattle). Other smaller utilities often share the underground telephone duct banks.

Several private companies (including AT&T, Electric Lightwave, MCI, Sprint, Pacific Fiber Link, and others) and the City of Seattle maintain fiber-optic cables and/or provide long-distance and other telecommunications services in Seattle. Fiber-optic cables are located throughout the Seattle segments of the light rail project area, including along 11th and 12th Avenue N.E. (all A alternatives); crossings in the University District near Portage Bay, 11th Avenue E. in north Capitol Hill, and E. Thomas, E.

Union, and Seneca streets in Capitol Hill (various B alternatives); and along Fifth Avenue S., the E3 Busway, and crossings at S. Royal Brougham Way and Sixth Avenue S. near S. Lander Street (C1).

Seattle Steam, a district heating utility franchised by the City of Seattle, provides steam to commercial, residential, and institutional customers for space and water heating and other uses. High- and low-pressure steam lines are located underground, primarily in the downtown Seattle Central Business District and on First Hill. Lines are located near the proposed Convention Place and First Hill stations, and in some areas near the Downtown Seattle Transit Tunnel (DSTT).

Seattle Public Utilities (formerly the Seattle Water Department) provides potable water to more than 600,000 people in Seattle, and in other parts of the project area, through two surface water sources. The Cedar River provides approximately 70 percent of their service area's annual average consumption, and the South Fork Tolt River approximately 30 percent. Major water mains are located in all Seattle light rail segments. The most notable locations in the project area include the Ravenna/University area (all A alternatives), Capitol Hill (B1), several crossings in the I-90/S. Dearborn Street area and S. McClellan Street (various C alternatives), and several crossings along MLK Jr. Way S. (most D alternatives), in particular the Cedar River transmission lines 1, 2, and 3 at Beacon Avenue S. Other SPU facilities are located near the proposed Link routes, including the Lincoln Reservoir, and Broadway Pump Station (B1), the Water Operations Control Center at 2700 Airport Way S. (C1), and a water quality laboratory in the North Duwamish (C1, Site M1-B).

The King County Department of Natural Resources Wastewater Treatment Division (formerly Metro) provides sewage treatment services to Seattle and most of King County. King County's service area is divided into east and west regions, with wastewater from the west region being conveyed to its West Point treatment plant (133 million gallons per day (mgd) capacity) and wastewater from the east region going to the Renton treatment plant (115 mgd capacity). Flows from the Seattle segments of the light rail system would flow to West Point. The pipelines and other conveyance facilities in Seattle that carry wastewater to King County interceptors are owned, operated, and maintained by Seattle Public Utilities. Major King County and City of Seattle wastewater lines are located in all Seattle light rail segments, including along Ravenna Boulevard and in the University District (A alternatives); near Seattle Center in the Dexter Avenue/Mercer Street/Broad Street area (B2); along S. Lander Street (C1) and Rainier Avenue S. (C2 and C3); and along MLK Jr. Way S. south of Orcas Street (all D alternatives). The County is planning to install new 20-inch force mains beneath S. Henderson Street at MLK Jr. Way S. (all D alternatives) and expand the existing pump station near this intersection to improve capacity and help control combined sewer overflows in the local system. The new pipes would be buried approximately 10 to 15 ft beneath the street.

Seattle Public Utilities manages the City's drainage, surface runoff, and sewer systems. Sewage and stormwater that enter combined systems (i.e., combined sewage and stormwater flows) in Seattle is conveyed via the King County interceptor system to the West Point or Renton treatment plants; separate drainage-only systems drain directly to water bodies such as Lake Union, Elliott Bay, Lake Washington, and the Duwamish/Green River. Major storm drain lines in the Seattle segments are located primarily in Segment D near Rainier Avenue S. from approximately S. Dearborn Street to S. McClellan Street. Stormwater and drainage is discussed further in Section 4.8, Water Quality and Hydrology.

The University of Washington also operates a utility system that serves campus facilities. Many of these utilities are located in tunnels in Segment B, including beneath N.E. Campus Parkway (B2.1) and South of N.E. Pacific Street (B1 and B2.2). Olympic Pipeline also has petroleum (jet fuel) lines in some parts of the area, including a crossing of MLK Jr. Way S. near Henderson Street (all D alternatives).

4.14.1.2 Segment E

Seattle City Light and Puget Sound Energy (formerly Puget Power) provide electric power in the corridor. Puget Sound Energy operates and maintains an extensive system of generating plants, transmission lines, distribution systems, and substations. Hydroelectric projects provide much of the company's power base.

Seattle City Light provides service generally north of S. 160th Street, west of I-5, and north of S. 139th Street on the east side of I-5; Puget Sound Energy provides service south of this line, including service to Southcenter Mall. Seattle City Light would likely serve Segment E on Tukwila International Boulevard and either Boeing Access Road maintenance facility site. Either provider could serve Interurban Avenue S. and MLK Jr. Way S. alternatives, depending on their location. (The Longacres and Southcenter areas, however, may be served by Puget Sound Energy). Overhead 230 KV transmission lines are located across Tukwila International Boulevard in the vicinity of S. 112th Street (including along the south side of the S.W. Boeing Access Road Maintenance Base Site [M3]) and in the vicinity of Longacres, east of the Southcenter Mall. Overhead power lines are located along much of Tukwila International Boulevard (E1).

Puget Sound Energy provides natural gas service in Segment E. A major high-pressure gas line (20-inch) is located in the railroad right-of-way across the Boeing Access Road (E1 and E2) and another (16-inch) crosses Tukwila International Boulevard at S. 146th Street (E1).

US West provides local telephone service, and other private companies (including AT&T, Sprint, Electric Lightwave, MCI, and others) own fiber-optic cables and/or provide long-distance and other telecommunications services in Tukwila. Pacific Fiber Link, a telecommunications company, is installing new fiber-optic cable and building a major switching station near the Gateway Corporate Park off Interurban Avenue S. in Tukwila near Alternative E2 (Micheau 1998 personal communication). A fiber-optic cable runs parallel to the railroad tracks at the Boeing Access Road. TCI Cablevision provides cable television service to customers in Tukwila.

The City of Tukwila Water Department and King County Water District No. 125 supply drinking water in the area of Segment E alternatives. Tukwila Water purchases all of its water from the City of Seattle. Water District 125 receives its water supply directly from the City of Seattle and through interties with King County Water District Nos. 20 and 49. Major water mains are located in Segment E, including along Tukwila International Boulevard, S. 160th Street (SPU's Cedar River Pipeline No. 4), a segment of Interurban Avenue S., and across S. 112th Street and the Green River just north of Foster Golf Course.

The City of Tukwila Sewer Department and Val-Vue Sewer District provide sewer service in the area of the Segment E alternatives. Tukwila Sewer provides sewer service for more than half of the city. The Tukwila and Val-Vue collector systems have no treatment component. Most flows from both the Tukwila and Val-Vue systems go to the King County treatment plant in Renton (Matelich 1998 personal communication). Val-Vue provides sewer service to the Pacific Highway area (S. 144th Street and possibly the Boeing Access Road station), while the City of Tukwila provides service to the Interurban or MLK Jr. Way S. areas, N.E. Boeing Access Road maintenance facility, and probably the Boeing Access Road station and S.W. Boeing Access Road maintenance facility. A sewer line (96"FM) crosses the route north of SR 599 near Riverton Creek, south of the Duwamish River. Major sewer lines are located along the north end of Tukwila International Boulevard over the Duwamish River (E1), along Interurban Avenue S. (E2), near the railroad right-of-way east of Fort Dent (E3), and near the Southcenter Mall along Strander Boulevard and Southcenter Parkway (E3).

Tukwila's stormwater drainage system consists of both drainage improvements and the natural drainage of the area. Several storm drainage culverts and pipes are located near Alternatives E2 and E3, especially in the Southcenter area and along SR 518. Most of these are associated with the Gilliam Creek drainage system and drain to the Green River through a 108-inch pipe or several smaller outflows east of Southcenter. Almost all storm water in Segment E ultimately drains to the Duwamish/Green River. Section 4.8 offers further discussion of surface water and drainage.

An Olympic Pipeline jet fuel line is located along Strander Boulevard (E3). This line crosses the Green River to West Valley Highway south of Strander Boulevard.

4.14.1.3 Segment F

Puget Sound Energy furnishes electric service in Segment F south of S. 160th Street, while Seattle City Light serves north of S. 160th Street. Most Segment F alternatives are within Puget Sound Energy service areas. The area north of S. 160th Street could be served by Seattle City Light. Underground power lines run along the length of International Boulevard. Overhead transmission lines are also located along the east side of International Boulevard between S. 176th and S. 192nd streets. Substations are located near S. 170th Street and International Boulevard and near S. 200th Street and 28th Avenue S. These transmission lines continue on the east side of 28th Avenue S., south of S. 192nd Street (F2 and F3).

Puget Sound Energy also provides natural gas service in Segment F. High-pressure gas lines are located along International Boulevard and 28th Avenue S. from S. 176th Street to S. 204th Street, with a crossing just north of S. 188th Street.

US West is the local telephone service provider, and other private companies (including AT&T, Electric Lightwave, MCI, and others) own fiber-optic cables and/or provide long-distance and other telecommunications services in SeaTac. TCI Cablevision brings cable television service to customers in SeaTac. TCI's South Seattle office is located at 15242 Tukwila International Boulevard (in Tukwila) adjacent to all F routes coming down Tukwila International Boulevard All US West and TCI Cable TV lines in the area are located underground.

The Highline Water District and King County Water District No. 125 supply drinking water in the area of the Segment F alternatives. The Highline Water District generally serves the eastern and southern portions of SeaTac; it would provide service to SeaTac segment alternatives between S. 160th Street and S. 200th Street. Highline receives about 80 percent of its water supply directly from the City of Seattle; the remaining 20 percent is supplied by two wells. King County Water District No. 125 could provide service to the S. 154th or S. 160th stations. The airport system receives its water from the City of Seattle and provides water to the airport and its tenants. Major water mains are located on S. 160th Street (SPU's Cedar River Pipeline No. 4), along International Boulevard between S. 176th and S. 182nd streets, and on Port of Seattle property.

The Val-Vue and Midway sewer districts provide sanitary sewer service in the area of the Segment F alternatives. The Midway Sewer District generally serves all of SeaTac south of S. 176th Street (excluding Sea-Tac Airport). Midway also has its own 6 mgd secondary wastewater treatment plant and will soon be able to accommodate an additional 3 mgd after making facility improvements. Val-Vue serves the northeast area of SeaTac and would likely provide service to any potential SeaTac segment stations located north of S. 160th Street. Most sewage from the Val-Vue system ultimately flows into King County's regional collection and treatment system, but a small portion is handled and treated by the Midway Sewer District.

Sea-Tac Airport operates a utility tunnel beneath its main terminal to serve airport facilities. This utility tunnel (which includes cooling lines) could be affected under Alternative F3.2. In addition, a jet fuel line leading to Sea-Tac Airport is located along International Boulevard between S. 170th Street and approximately S. 184th Street.

Four Puget Sound Energy substations are located in the vicinity of the Segment F alternatives. These facilities are scheduled to undergo expansions or modifications over the next few years to accommodate additional capacity requirements in the Sea-Tac Airport vicinity.

4.14.2 Impacts

4.14.2.1 System-Wide and Route Impacts

Operating the light rail system would increase electricity demand in the project area but would reduce overall transportation energy consumption (see Section 4.9 Energy, which discusses energy consumption). The proposed line would use up to four-car electric trains operating on DC power taken from the 26-kV electric distribution facilities. Lighting installed at stations, safety lighting along the routes, the maintenance facility, parking areas, and other light rail facilities would increase electrical demand. Light rail alternatives requiring tunnels would have additional electricity requirements. In descending order of need, these alternatives are B2.2, B1 (preferred alternative), B2.1, C2.4, C1 (preferred alternative), C3, C2.3, A1.1, A1.2, A2.1, D3.4, and A2.2. In addition, longer alternatives (such as B2.1, B2.2, E2, and E3) would consume more electricity, although not significantly more, than shorter alternatives. The maximum peak demand for all alternatives, however, will be the same. Sound Transit estimates the maximum peak electrical demand for the entire light rail system (including traction power, stations, park-and-rides, tunnels, and other facilities) to be approximately 22 megawatts (MW); total average consumption is estimated to be approximately 240,000 kilowatt hours (kWh) per day or 87.6 million kWh per year, assuming that light rail operates every day. Based on Seattle City Light and Puget Sound Energy existing and projected capacity, the extra peak demand and required kWh placed on the existing electrical system by light rail would not be significant. However, some new local distribution line extensions may need to be constructed to connect to the light rail system (Gray 1998 personal communication).

Alternatives F2 and F3 could affect Puget Sound Energy's substations in the SeaTac area. Although Sound Transit does not anticipate any displacement of these properties and facilities, the elevated F2 and F3 routes may cross above the North Substation at International Boulevard and S. 170th Street. Similarly, the at-grade F2 section west of Washington Memorial Park would come very near the small substation in that vicinity, potentially causing some conflict with modifications being proposed at that facility. Alternatives F2 and F3 would travel near the substation located on 28th Avenue S. near S. 200th Street, but should not affect this facility. Any potential impacts to these facilities should be able to be minimized through the design process and in coordination with Puget Sound Energy.

Stray electrical current from the light rail traction power electrical system has the potential to damage or accelerate the corrosion of buried metal pipes and conduits. Such damage to metal pipes and conduits would tend to be more severe in the vicinity of the tracks. The light rail facilities would incorporate features used on all modern DC-powered transit systems to isolate the electric system from the ground and thereby reduce stray current to acceptable levels. Rail isolation testing done on the Hillsboro extension to the Portland Westside MAX light rail system indicates that such design measures (in this case, surrounding the steel rails with an elastomeric rubber boot) adequately insulate the rail and isolate rail return currents from the concrete trackway and surrounding soil and utility lines (Eacker 1999 personal communication). The system would also include stray current monitoring points that allow the continued effectiveness of the electrical isolation to be verified. Stray current would be controlled in accordance with Sound Transit's Stray Current Corrosion Control Guidelines for Utility Structures.

No significant impacts to natural gas, telephone and telecommunications, water supply, wastewater, steam, or solid waste collection and disposal services would be expected during light rail operation under any of the proposed alternatives. The cities of Seattle and Tukwila, the water and sewer utility districts serving Tukwila and SeaTac, Puget Sound Energy, US West, and several telecommunications companies have nearby service connections. All have adequate capacity to provide utility services to the proposed light rail system. However, the Alternative C1 route would encroach upon Seattle Public Utilities' Water Operations Control Center (WOCC) at 2700 Airport Way S. as the route tunnels into Beacon Hill. This facility's maintenance building and an associated parking lot would be displaced under both the C1.1 and C1.2 routes; however, the main building and operations of the WOCC facility would not be affected. Also, under Alternatives D3.3 and D3.4, the proposed Genesee Station would displace King County DNR's Rainier Pump Station at 3807 Letitia Avenue S. All F alternatives on Tukwila International Boulevard connecting from the E1 alternatives would encroach upon the TCI facility near S. 154th Street, but would not be expected to displace any buildings or affect operations. In addition, all F alternatives would require acquiring King County Water District No. 75's property at 19863 28th Avenue S. to construct the South SeaTac Station, park-and-ride, and other light rail facilities. The District's property at this location, however, is currently vacant.

Significant service disruptions to utility customers during light rail repair and maintenance operations would not be likely. The light rail route would be located so that access to utilities for maintenance and repair could be maintained. In some cases, manholes, pipes, vaults, and other access points may have to be relocated. Maintaining and repairing underground utilities (especially those beneath or close to street rights-of-way) on at-grade segments could be more difficult than on elevated or tunnel segments. Alternative D1 (preferred alternative), E1 (preferred alternative), and F1 could potentially cause the most difficulties because of their extensive at-grade segments. Sound Transit would work closely with utility providers, during design, to provide free and safe access to these utilities and any relocated manholes and vaults, utility mains, fire hydrants, and other features.

Existing underground gas, water, sewer lines, and other pipes and conduits beneath columns would be relocated or otherwise protected before or during construction (see Section 4.17.13), and would therefore not be affected by the weight of elevated segments. It is possible that soil settlement due to elevated structure foundations and shallow tunnels, could affect underground utilities. Vibration from Link trains passing over relatively shallow utilities could also potentially damage those utilities. However, light rail design and construction procedures, relocation and protection policy, and other measures such as monitoring of some deep utilities, would minimize the potential for impacts on these utilities. With input from utility owners and operators, the maximum allowable settlement for tunnel, elevated, and at-grade facilities will be determined and written into contractor specifications. Pipes within the potential zone of impact will either be protected or possibly relocated so that this infrastructure would not be affected by the weight of Link trains or by settlement of Link facilities. In addition, case studies on vibration impacts and impacts to special utility infrastructure, such as lead joint pipes, will be analyzed to help make sound decisions during final design about appropriate protection of pipes.

Other than new potential at-grade access and maintenance difficulties identified above, no significant differences would be expected in long-term utility service impacts among the segment alternatives or for the full-length alternative, including the preferred alternative. As previously discussed, longer segments and segments with longer tunnel sections would consume slightly more electricity than other alternatives. Selection of light rail power service points would be coordinated with the power providers to avoid impact to other power customers. In the aggregate, light rail system power demand has an insignificant effect on the total demand on the region's electrical providers.

Compared to any of the full-length alternatives, all three MOS alternatives would have fewer impacts on utilities during Link operation since fewer resources (e.g., electricity, water, etc.) would be required. There would be no significant differences in utility impacts between the three MOS alternatives during Link operation. MOS A would include more tunneled sections than MOS B or MOS C, thereby requiring some additional electrical demand. This additional demand, however, would not be significant. Both MOS A and MOS B would require encroaching on Seattle Public Utilities' Water Operations Control Center near S. Lander Street and Airport Way S. as the Link route tunnels into Beacon Hill, displacing the facility's maintenance building and a parking lot; the WOCC facility would not be affected under MOS C. MOS B would also likely present more challenges in maintaining access to utility infrastructure for maintenance because of its extensive at-grade section down MLK Jr. Way S. Tunneled sections would generally have far fewer impacts on utility infrastructure and maintenance. This is especially true during construction (see Section 4.17.13). MOS B would also likely have more concerns regarding stray electrical current than the other MOS alternatives because of the potential to corrode shallow underground pipes located beneath the at-grade tracks. As discussed previously, however, these impacts would be minimized through design features, guidelines, and additional mitigation, regardless of the alternative selected.

4.14.2.2 Maintenance Base Impacts

At all potential sites, the proposed maintenance facility would require new water supply connections for vehicle washing and other uses. Approximately 95 percent of maintenance base water demand is for vehicle washing. Vehicle wash water would be recycled. The additional demand would not significantly affect the water providers' existing and projected water supplies. Similarly, water demand would not be likely to compromise flow for fire protection, but demand should be coordinated with fire departments and water suppliers to ensure that impacts are avoided.

The maintenance facility's drainage system would be designed to filter and recycle a high percentage of the wash and rinse water. Solids, oils, soaps, and other contaminants would be filtered and settled to a sludge tank and periodically hauled for disposal in accordance with applicable regulations. Some disposal to the local sanitary sewer system would be expected from the recycled, filtered washwater. All water discharged to the sanitary system would be disposed of in accordance with local and state regulations. For all potential sites, existing sewer lines on adjacent streets are available for sewer connections. Any necessary stormwater detention facilities and infrastructure to collect storm and wastewater would require connections both to the existing sewer system and to stormwater conveyances. Impacts on stormwater are discussed in sections 4.8.2 and 4.17.8.

A Seattle Public Utilities water quality laboratory would be displaced if the M1-B maintenance base is selected under Alternative C1 (preferred alternative). Sound Transit would work with SPU as needed in accordance with established displacement and relocation guidelines to relocate this facility.

4.14.2.3 No-build Alternative Impacts

No significant impacts on utility services or infrastructure in Seattle, Tukwila, SeaTac, Renton, King County, or the Port of Seattle airport facilities would occur under the No-build Alternative. Continued growth in the project corridor would increase demand on all utility services.

4.14.3 Mitigation

Based on design measures and coordination with utility service providers, impacts to utilities during light rail operation would be minimal. Sound Transit would continue to work with utility providers to minimize any potential service interruptions and to conserve resources. The light rail project would include the following measures to prevent or minimize potential operational impacts for any proposed alternative on utilities:

- Comply with applicable utility policies and strategies as specified in the adopted operational Seattle, Tukwila, SeaTac, Renton, and King County comprehensive plans, including those provisions related to levels of service, conservation strategies, and coordination of service providers. Sound Transit would discuss the undergrounding of relocated aboveground utilities with the local jurisdictions.
- Incorporate and comply with Seattle, Tukwila, SeaTac, Renton, King County, and Washington State energy, building and fire codes, building code, fire code, design guidelines, and other requirements applicable to utilities into all design aspects of the system, stations, maintenance facility, and parking areas.
- Continue to meet with and coordinate closely with both municipal and private utilities to provide acceptable and safe relocation of manholes and other access points for ongoing utility

maintenance, once light rail is in operation; adopt design standards for providing access for repair and maintenance of utilities.

- In accordance with Sound Transit's Stray Current Erosion Control Guidelines for Utility Structures, use industry-standard methods to reduce the effect of stray current; where necessary and possible, install devices to reduce the impact of stray current between the traction system and the utilities facilities, or replace particularly susceptible metallic utility infrastructure with nonmetallic materials.
- Use industry-standard methods to reduce the potential impacts of vibration on underground pipes and special infrastructure concerns such as lead joint pipes; closely coordinate with utility owners to determine appropriate measures to protect against potential tunnel, elevated, and at-grade Link facility settlement.
- Coordinate with affected water utilities and local fire departments so that water use, especially at the maintenance facility, does not compromise flow required for fire protection.

4.14.4 Significant Unavoidable Adverse Impacts

No significant unavoidable adverse impacts on utility services during light rail operation would be expected under any of the alternatives. Significant service disruptions would be avoided. Displacing the King County DNR pump station under Alternatives D3.3 and D3.4 could be considered a particularly adverse impact, but the Genesee Station could likely be moved to avoid displacing this facility. This impact would not occur with the preferred alternative.

4.15 HISTORIC AND ARCHAEOLOGICAL RESOURCES

Resources identified in the light rail project area include districts, sites, buildings, structures, objects, and landscapes significant in American history, prehistory, architecture, archaeology, engineering, and culture.

4.15.1 Affected Environment

4.15.1.1 Applicable Legal and Regulatory Requirements

Historic sites are one of several resource categories protected under Section 4(f) of the Department of Transportation Act of 1966, as amended. Section 4(f) requires that the Secretary of Transportation not approve federally assisted transportation projects that may adversely affect protected resources unless there is (1) no feasible and prudent alternative, and (2) all possible planning has been done to minimize harm (see Appendix E, 4(f) Evaluation).

Section 106 of the National Historic Preservation Act of 1966, as amended, requires that federal agencies identify and assess the effects of federally assisted undertakings on historic resources, archaeological sites, and traditional cultural properties and to consult with others to find acceptable ways to avoid or mitigate adverse effects. Resources protected under Sections 106 and 4(f) are those that are listed in or are eligible for listing in the National Register of Historic Places (NRHP). Eligible properties must be at least 50 years old, possess integrity of physical characteristics, and meet at least one of four criteria of significance. Regulations implementing Section 106 (36 CFR Part 800) encourage maximum coordination with the environmental review process required by the NEPA and with other statutes, including Section 4(f).

Regulations in effect during 1998 and the first half of 1999, when this project was underway, required federal agencies to follow these steps in the Section 106 review process:

- determine that the Section 106 provisions apply to the undertaking or proposed action;
- define the area of potential effect (APE) in consultation with the State Historic Preservation Officer (SHPO);

- identify historic, archaeological, and cultural resources, and evaluate their significance to determine eligibility for listing in the NRHP;
- apply the criteria of effect and adverse effect to determine impacts on identified resources;
- consult with the SHPO and other interested persons, agencies, and tribes to agree on appropriate mitigation measures;
- execute a formal agreement with the SHPO that specifies the mitigations and identifies those responsible for carrying out the specific measures;
- obtain the comments and acceptance of the ACHP.

This section summarizes the results of the completion of the first five steps noted above. When new 36 CFR Part 800 regulations become effective on June 18, 1999, the Advisory Council on Historic Preservation (ACHP) has requested involvement in this project and will be a consulting party and signatory to a Programmatic Agreement. A draft Programmatic Agreement has been prepared and is included in the Final EIS. The execution of the final Programmatic Agreement will complete the Section 106 review process prior to the issuance of the Record of Decision.

At the local level, the City of Seattle adopted specific environmental policies and procedures related to historic properties and archaeological sites that require compliance with the Landmarks Preservation Ordinance and the identification of resources that meet criteria for landmark designation. Properties eligible for City Landmark designation must be at least 25 years old and meet at least one of six criteria of significance. The cities of Tukwila, SeaTac, and Renton encourage preservation of historic and archaeological sites through policies contained in their comprehensive plans, but they do not have ordinances implementing local landmark designation. Historic properties in unincorporated King County are reviewed and, if they are at least 40 years old and found to meet at least one of five criteria of significance, are designated County Landmarks by the King County Landmarks and Heritage Commission.

4.15.1.2 Archaeological Sites, Traditional Cultural Properties, and Paleontological Resources

Several previously known/recorded archaeological sites are located within the general project vicinity and at least two archaeological sites (45-KI-431 and 45-KI-438 and -438A) and one property of cultural importance and one TCP lie either within or immediately adjacent to alternatives in the Tukwila area (see Table 4.15-1). Project staff conducted archaeological reconnaissance surveys in 1998 and detected no additional archaeological sites within or immediately adjacent to the alignments. As part of the 1998 survey effort, project staff conducted surface examinations of open (non-developed) land parcels where rights of access were available, and identified numerous areas along the alternatives with potential for prehistoric archaeological resources and several locations with paleontological resources (fossils); these are discussed in Section 4.15.2.

In 1999, project staff conducted additional surface examination of open (non-developed) land parcels, where rights of access were available. In addition, subsurface testing (shovel probes) of selected open, accessible parcels in the SW Boeing Access Road and Duwamish River Crossing (on Pacific Avenue South) was carried out to check for the presence/absence of prehistoric archaeological sites in these designated high probability areas. Seventeen (17) shovel test probes produced negative findings with the exception of one test probe in the future footprint of the park-and-ride at Boeing Access Road Station which yielded a small chert flake fragment. The subsurface testing is more fully described in the Final Cultural Resource Assessment Report (Courtois and Bard 1999).

Preliminary and continuing consultations with local Indian Tribes will explore the significance of the property of cultural interest in the Boeing Access Road area. The findings are described in the Final Cultural Resource Assessment Report (Courtois and Bard 1999).

4.15.1.3 Historic Resources

Project staff identified historic resources in the area of potential effect (APE), which varied from 200 ft to 400 ft on either side of route alignments, and from 800 ft to 1,000 ft around stations, depending on topography, existing environment, and system profile (tunnel, at-grade, or elevated). The distribution of historic resources is shown in Figures 4.15-1 and 4.15-2. Several historic resources in the APE are already listed in the NRHP and/or the Washington Heritage Register or they are designated City of Seattle Landmarks. Project staff evaluated newly recorded resources using NRHP criteria, and the SHPO concurred in the determinations of eligibility to the NRHP. For those resources located in Seattle, surveyors also used City Landmark criteria; however, only the Seattle Landmarks Preservation Board can determine City Landmark status after formal review. Therefore, eligibility for Seattle City Landmark status (eSL) is based solely on the professional judgment of the surveyors and is not an official designation.

Table 4.15-1, lists 131 individual historic properties and ten historic districts. Components of the city-wide Olmsted Parks plan that are located in the APE are identified as (OP) in Table 4.15-1. Resources are grouped by segment and assigned an identification number. Table 4.15-1 lists the resources, their addresses and status. The status of each resource is noted in the following manner:

NR	listed in the National Register of Historic Places (NRHP)
deNR	previously determined eligible for NRHP through another project review
eNR	eligible for listing in NRHP
WHR	listed in the Washington Heritage Register
SL	designated City of Seattle Landmark
eSL	appears to meet criteria for City Landmark designation
SRD	Special Review District (City of Seattle)

The Historic and Archaeological Resources Technical Report (Courtois and Bard 1998), describes the historic resources, provides historic context statements, and discusses in more detail the methodology used to identify and evaluate these properties.

4.15.2 Impacts

This section summarizes impacts for historic and archaeological resources. A more detailed explanation of specific impacts was presented in the Historic and Archaeological Resources Technical Report (Courtois and Bard 1998). A revised Cultural Resources Technical Report incorporates new information developed for the preferred alternative including the results of additional archival research, Tribal consultation, and limited subsurface testing of accessible high-probability areas in the SW Boeing Access Road and Duwamish River Crossing (Tukwila International Boulevard S.) areas.

4.15.2.1 Impacts on Archaeological Sites, Traditional Cultural Properties, and Paleontological Sites

Potentially impacted sites would include the following:

- known/recorded archaeological sites;
- known/recorded traditional cultural properties;
- previously unrecorded archaeological sites (none were found during the 1998 field reconnaissance); archaeological probability areas; and
- potential paleontological deposits.

The following summarizes potential impacts from the light rail alternatives on known sites and probability areas.

Segment A (Northgate to University District). No known sites are located near the Segment A alternatives. All Segment A alternatives, however, pass through a moderate probability area for archaeological resources associated with a former creek that drained from Green Lake, through what is now Ravenna Park, and flowed into Lake Union. Impacts could occur with all three alternatives if resources are present.

Segment B (University District to Westlake Station). Alternative B1, the preferred alternative, is near no known or probable sites, and impacts are not likely. The preferred alternative does cross a high-probability area for archaeological resources along the north bank of Portage Bay where subsurface impacts could occur if resources are present in the Pacific Station and tunnel construction staging areas. Alternative B2.2 would cross a high-probability area for archaeological resources on the south end of Lake Union. Alternative B2.1 would cross two high-probability areas for archaeological resources along the margins of Portage Bay and the southern margin of Lake Union. Impacts could occur with both alternatives if resources are present.

Segment C (Westlake Station to S. McClellan Street). Alternatives C1.2 (the preferred alternative), C1.1, 1.3, C1.4, C1.5, C2.3, and C3 would each cross one moderate-probability area for archaeological resources on the west side of I-5 just south of the I-90 interchange. Impacts could occur if resources are present. No known sites or probability areas would be crossed by Alternative C2.4. Historic archaeological resources might be present beneath any of the alternatives where they run between the International District Station and I-5. Impacts could occur if resources are present.

Segment D (S. McClellan Street to Boeing Access Road). All Segment D alternatives, including the preferred alternative, would cross a high-probability area for archaeological resources south of S. Norfolk Street along MLK Jr. Way S. Impacts could occur if resources are present.

Segment E (Tukwila). Alternative E2 could adversely affect two, and Alternative E3 could adversely affect one known/recorded archaeological site(s) within the Duwamish River floodplain. The preferred alternative (Alternative E1.1) and Alternative E1.2 are located well away from these two known sites and their construction would not affect the sites.

Alternatives E1.1 (preferred alternative), E1.2, and E2 would pass near a hill south of Boeing Access Road that is a property of cultural interest for the Muckleshoot and Suquamish Tribes and Duwamish group near Boeing Access Road and E. Marginal Way S. The precise site boundaries of the cultural property and its eligibility for listing in the National Register of Historic Places (or in the Washington Register of Historic Places) are undetermined. Further, the nature of adverse impacts to the property, and appropriate measures to mitigate any identified harmful impacts, are not yet determined. Tribal consultations are being conducted to resolve these issues. One of the archaeological sites that could be affected by Alternative E2 is a known traditional cultural property. This archaeological site/traditional cultural property is located on the east bank of the Duwamish River; Alternative E2 is located across the river on the west bank.

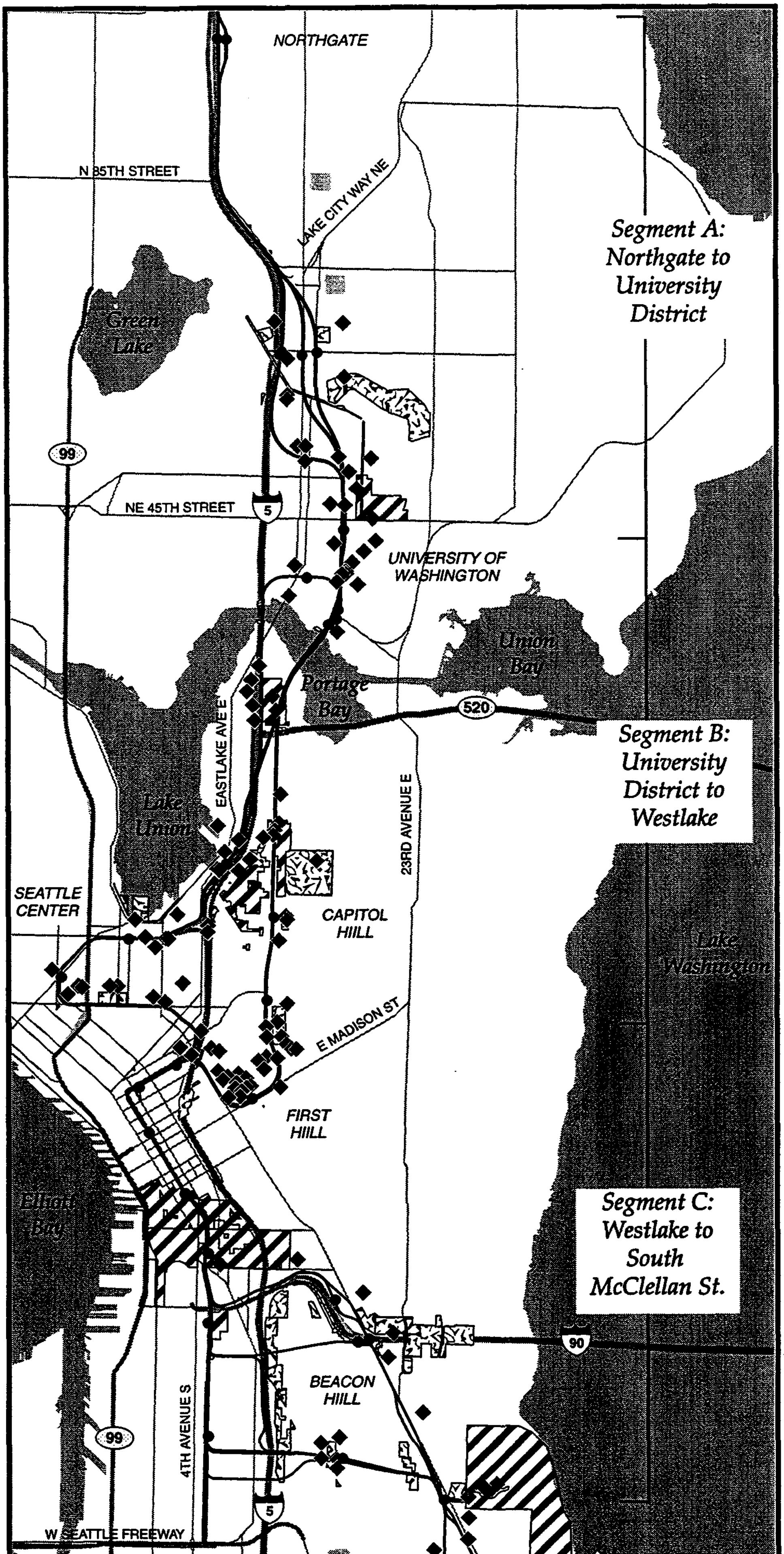
Alternatives E1.1 (preferred alternative), E1.2, and E2 would cross an area with high probability for archaeological resources near I-5 and Boeing Access Road. Alternative E3 would also cross this area, as well as an additional high-probability area near Southcenter Mall. Impacts could occur if resources are present.

All Segment E alternatives, including the preferred alternative, would pass through areas where important paleontological resources (fossil deposits) are present.

Segment F (SeaTac). The other Segment F alternatives would pass near the following number of areas with both moderate probability (first number shown) and high probability (second number shown) for archaeological resources in the vicinity of Bow Lake and west of Angle Lake: Alternative F1 (2;0), F2.1 (1;0), F2.2 (2;2) F2.3 (1;0), F3.1 (1;0), F3.2 (1;0), F3.3 (1;0), and F4 (1;0). Impacts could occur if resources are present. The preferred alternative would pass through a moderate-probability area west of Bow Lake. Impacts could occur if resources are present.

SOUNDTRANSIT

Figure 4.15-1
Historic Resources and Parklands, Segments A, B, and C



◆ Historic Resources

Historic Districts & Boulevards

Parklands

Alternative Route

● Station

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Table 4.15-1
Central Link Historic and Archaeological Resources Inventory

ID#	Resource Name	Address	Status	Alternatives
Segments A, B, and D				
ABD	Olmsted Parks, Blvds. and Playgrounds System (OP)	Seattle	eNR, eSL	A1.1, A1.2, A2.1, B1, D1.1, D1.1d, D1.3, D3.3, D3.4
Segment A (Northgate to University District)				
A01	Roosevelt High School	1410 N.E. 66th St.	eNR, eSL	A1.1
A02	John Marshall Junior High School	520 N.E. Ravenna Blvd.	eNR, eSL	A2.1, A2.2
A03	N.E. Ravenna Blvd (OP)	N.E. Ravenna Blvd.	eNR, eSL	A1.1, A1.2, A2.1
A04	Cowen Park (OP)	N.E. Ravenna & Brooklyn N.E.	eNR, eSL	A1.1
A05	Homer Russell House	5803 Eighth Ave. N.E.	eNR, eSL	A2.1, A2.2
A06	Annie Russell House	5721 Eighth Ave N.E.	eNR, eSL	A2.1, A2.2
A07	Blessed Sacrament Church & Rectory (& School —NR)	5041 Ninth Ave. N.E.	NR, SL	A2.1, A2.2
A08	Seattle Public Library–University Branch	5009 Roosevelt Way N.E.	NR, eSL	A2.1, A2.2
A09	University Heights School	5031 University Way N.E.	eNR, SL	A1.1, A1.2, A2.1, A2.2
A10	17th Ave. N.E. to University Pkwy (OP)	N.E. 45th St. to N.E. Ravenna Blvd.	eNR, eSL	N.E. 45th Station
A11	Fraternity/Sorority Historic District	17th Ave. N.E. to 19th Ave. N.E./ N.E. 45th to N.E. 50th	part deNR	N.E. 45th Station
A12	University Christian Church	4731 15th Ave. N.E.	eNR	A1.1, A1.2, A2.1, A2.2
Segment B (University District to Westlake Station)				
B04	University Unitarian Church	4555 16th Ave. N.E.	eNR, SL	B1, B2.1, B2.2
B05	University State Bank	4500 University Way N.E.	eNR, eSL	B1, B2.1, B2.2
B06	Meany Hotel	4507 Brooklyn Ave. N.E.	eNR, eSL	N.E. 45th St Station
B07	University Observatory	UW campus	WHR, eNR	N.E. 45th St Station
B08	Denny Hall	UW campus	WHR, eNR	N.E. 45th Street Station
B09	Parrington Hall	UW campus	WHR, eNR	N.E. 45th St Station
B10	University Methodist–Episcopal Church and Parsonage	4142 Brooklyn Ave. N.E.	WHR, SL	N.E. 45th St Station
B11	Henry Art Gallery	UW campus: 15th Ave. N.E.	deNR	B1, B2.1, B2.2
B12	Duchess Apartments	4009 15th Ave. N.E.	eNR	B1, B2.1, B2.2
B13	Commodore Apartments	4005 15th Ave. N.E.	eNR	B1, B2.1, B2.2
B14	Ye College Inn	4000 University Way N.E.	NR, eSL	B1, B2.1, B2.2
B15	Architecture Hall	UW campus	WHR, eNR	B1, B2.2
B16	Jensen Boat Company	1417 N.E. Boat St.	eNR, eSL	B1, B2.2
B17	Roanoke Park Historic District	Roanoke Park area	eNR	B1, B2.1, B2.2
B18	Albert Rhodes House	1901 10th Ave. E.	eNR, eSL	B1
B19	Federal Ave. Historic District	E. Blaine to E. Prospect	eNR	B1
B20	Eliza Ferry Leary House	1551 10th Ave. E.	NR, eSL	B1
B21	Pierre P. Ferry House	1531 10th Ave. E.	NR, SL	B1
B22	St. Nicholas School	1501 10th Ave. E.	eNR, SL	B1
B23	Volunteer Park - (OP)	E. Galer to E. Prospect	NR	B1
	Seattle Asian Art Museum	Volunteer Park	SL	B1
B24	Harvard-Belmont Historic District	E. Highland to E. Roy	NR, SL	B1
B25	Anhalt Apartments	1014 E. Roy St.	eNR, SL	B1
B26	Anhalt Apartments	1005 E. Roy St.	eNR, SL	B1
B27	Pilgrim Congregational Church	500 Broadway	eNR	B1
B28	Lincoln Park & Reservoir	E. Denny Wy. to E. Pine St.	deNR, SL	B1
B29	First Christian Church	1632 Broadway	eNR	B1
B30	Broadway High School Auditorium	1625 Broadway	eSL	B1
B31	Masonic Temple	801 E. Pine St.	eNR, eSL	B1
B32	IOOF Temple	915 E. Pine St.	eNR, eSL	B1
B33	Mortuary	1400 Broadway	eSL	B1
B34	Fire Station #25	1400 Harvard Ave.	NR, SL	B1
B35	William Phillips House	711-713 E. Union St.	NR	B1
B36	Seattle First Baptist Church	1121 Harvard Ave.	eNr, SL	B1
B37	Jesuit College (Garrand Building)	Seattle University	eNR, eSL	B1
B38	Spring St. Apartments	1223 Spring St.	eNR, eSL	B1
B39	San Marco Apartments	1205-09 Spring St.	eNR, eSL	B1
B40	Gainsborough Apartments	1017 Minor Ave.	eNR, eSL	B1
B41	Stacy House/University Club	1004 Boren Ave.	eNR, eSL	B1
B42	Baroness Apartments	1005 Spring St.	eNR, eSL	B1
B43	Hofius House/Archbishop House	1104 Spring St.	eNR, eSL	B1
B44	Dearborn House	1117 Minor Ave.	NR, eSL	B1

Table 4.15-1 continued

ID#	Resource Name	Address	Status	Alternatives
B45	Piedmont Apartments	1215 Seneca St.	eNR, eSL	B1
B46	Stimson-Green House	1204 Minor Ave.	NR, SL	B1
B47	Marlborough Apartments	1220 Boren Ave.	eNR, eSL	B1
B48	Sunset Club	1021 University St.	eNR, eSL	B1
B49	Sovereign Apartments	1317 Boren Ave.	eNR, eSL	B1
B50	Wintonia Hotel	1431 Minor Ave.	deNR, SL	B1
B51	Hotel Avondale (Villa Apts.)	1100-12 Pike St.	deNR	B1
B52	Olive Tower Apts.	1624 Boren Ave.	deNR, eSL	B2.1, B2.2
B53	Paramount Theater	901 Pine St.	NR, SL	B1, B2.1, B2.2
B54	Camlin Hotel	1619 Ninth Ave.	deNR, SL	B1, B2.1, B2.2
B55	Columbia Lumber Co. Office	3935 University Way N.E.	eNR, eSL	Campus Pkwy Station
B56	University Friends Meeting House	4001 Ninth Ave. N.E.	eSL	B2.1
B57	University Bridge	Eastlake Ave. spanning canal	NR, eSL	B2.1
B58	L'Amourita Apartments	2901-15 Franklin Ave. E.	deNR, eSL	B2.1
B59	Fisher-Howell House	2819 Franklin Ave. E.	eNR, SL	B2.1
B60	Castlewood Apartments	2717 Franklin Ave. E.	eNR, eSL	B2.1
B61	Nelson-Steinbrueck House	2622 Franklin Ave. E.	eNR, SL	B2.1
B62	William Parson House	2706 Harvard Ave. E.	NR, SL	B2.1
B63	Ole Hanson House	2609 Broadway Ave. E.	deNR, eSL	B2.1
B64	Seward School	2515 Boylston Ave. E.	NR, SL	B2.1
B65	Egan House	1500 Lakeview Blvd. E.	eSL	B2.1, B2.2
B67	Lake Union Drydock Company	1515 Fairview Ave. E.	eNR, eSL	B2.1, B2.2
B68	Steinhart, Theriault & Assoc.	1264 Eastlake Ave. E.	eSL	B2.1, B2.2
B69	Lake Union Steam Plant & Hydro House	1179 Eastlake Ave. E.	SL	B2.1, B2.2
B70	Felder House – a	1134 Eastlake Ave. E.	eNR	B2.1, B2.2
B71	Felder Duplex	1132 Eastlake Ave. E.	eNR	B2.1, B2.2
B72	Felder House – b	1130 Eastlake Ave. E.	eNR	B2.1, B2.2
B73	Jensen Block	601-611 Eastlake Ave. E.	eNR, SL	B2.1, B2.2
B74	Carolina Court Apartments	527 Eastlake Ave. E.	eSL	B2.1, B2.2
B75	Ford Motor Co. Assembly Plant	1155 N. Valley St.	deNR, SL	B2.1, B2.2
B76	House	1124-26 Republican St.	eSL	B2.1, B2.2
B77	House	1118 Republican St.	eSL	B2.1, B2.2
B78	House	1116 Republican St.	eSL	B2.1, B2.2
B79	C.B. Van Vorst Building	415-421 Boren Ave. N.	eNR, eSL	B2.1, B2.2
B80	Vance Lumber Company	960 Republican St.	eNR, eSL	B2.1, B2.2
B81	William O. McKay Auto Dealership	601-609 Westlake Ave. N.	eNR, eSL	B2.1, B2.2
B82	Space Needle	Seattle Center near Broad St.	SL	B2.1, B2.2
B83	"Seattle, Chief of Suquamish" Statue	Fifth Ave and Denny Way	SL	B2.1, B2.2
B84	Teamsters' Building	552 Denny Way	eNR, eSL	B2.1, B2.2
B85	Seattle First National Bank	566 Denny Way	eNR, eSL	B2.1, B2.2
B86	Denny Park	Denny Way and Dexter Ave. N.	WHR,eNR	B2.1, B2.2
B87	Parks Dept. Headquarters	100 Dexter Ave. N.	eNR, eSL	B2.1, B2.2
B88	William Volker Building	1000 Lenora St.	NR, eSL	B2.1, B2.2
B89	Brewster Apartments	133 Pontius Ave. N.	deNR, eSL	B2.1, B2.2
B90	Old Norway Hall	2015 Boren Ave.	eNR, SL	B2.1, B2.2
B91	Seattle Automobile Company	1000 E. Pike St.	deNR, eSL	B1
B92	Lorraine Court Apartments	1025 E. Pike St.	deNR, eSL	B1
B93	Liebeck Garage Building	1101 E. Pike St.	deNR, eSL	B1
B94	Shafer Building	515 Pine St.	NR, SL	B1
Segment C (Westlake Station to S. McClellan Street)				
C01	International Special Review District		SRD	C1, C2.3, C2.4, C3
C02	Seattle Chinatown Historic District		NR	C1, C2.3, C2.4, C3
C03	Pioneer Square Historic/ Preservation District		NR, SRD	C1, C2.3, C2.4, C3
C04	Immigrant Station & Assay Office	815 Airport Way S.	NR, eSL	C1, C2.3, C2.4, C3
C05	Beacon Hill Elementary School	2524 16th Ave. S.	deNR, eSL	C1
C06	St. Peter Catholic Church	2807 15th Ave. S.	eNR	C1
C07	Beacon Hill First Baptist Church	1607 S. Forest St.	SL	C1
C08	Apartment Building	2810 16th Ave. S.	eSL	C1
C09	Commercial Building	2805 Beacon Ave S.	eSL	C1
C10	Jose Rizal Bridge– 12th Ave S. Bridge	12th Ave. S. over Dearborn St.	NR, eSL	C2.3, C2.4
C11	Black Manufacturing Co Building	1130 Rainier Ave. S.	deNR, SL	C2.3
C12	Deaconess Settlement	2103 S. Atlantic St.	deNR. ESL	C2.3, C2.4, C3
C13	Stewart Lumber & Hardware Co	1761 Rainier Ave. S.	eNR, eSL	C2.3, C2.4, C3

Table 4.15-1 continued

ID#	Resource Name	Address	Status	Alternatives
C14	Occidental Sheet Metal Co	2310 Rainier Ave. S.	eNR, eSL	C2.3, C2.4, C3
C19	Lander Apts	2541 15th Ave. S.	eSL	C1
C20	Sixth Ave. S. Historic District	6th Ave. S.	deNR	C1, C3
Segment D (S. McClellan Street to Boeing Access Road)				
D01	Mt. Baker Park Historic District	Mt. Baker neighborhood	deNR	McClellan Station
D02	Franklin High School	3013 S. Mt. Baker Blvd.	deNR, SL	McClellan Station
D03	Mt. Baker Blvd. (OP)	S Mt. Baker Blvd.	deNR, eSL	D1.1, D1.1d, D1.3, D3.3,D3.4
D04	Cheasty Blvd. (OP)	Cheasty Blvd. S.	eNR, eSL	D1.1, D1.1d, D1.3, D3.3, D3.4
D05	Boy Scouts of America–Chief Seattle Council	3120 Rainier Ave. S.	eSL	McClellan Station
D06	York Apartments	3315 Rainier Ave. S.	eNR, eSL	D3.3, D3.4
D07	Quigley House	3433 Claremont Ave. S.	eNR. ESL	D3.3, D3.4
D08	Ohman House	3836 Letitia Ave. S.	eNR, eSL	D3.3, D3.4
D09	Gill House	3869 Rainier Ave. S.	eNR, eSL	D3.3, D3.4
D10	Foglia House	4005 Rainier Ave. S.	eNR, eSL	D3.3, D3.4
D11	Albutt House	3509 S. Lilac St.	eNR, eSL	D3.3, D3.4
D12	Hubachek House	4430 Letitia Ave. S.	eNR, eSL	D3.3, D3.4
D13	Columbia City Historic District with boundary increase	Rainier Ave. S.	NR, SL, eNR	D1.1, D1.1d, D1.3, D3.3, D3.4
D14	Hitt House	5224 37th Ave. S.	eNR, eSL	D3.4
D15	McKinstry House	4054 Letitia Ave. S.	eNR, eSL	D3.3, D3.4
Segment E (Tukwila)				
E01	Riverton Park Methodist Church	13001 37th Ave. S.	eNR	E1.1, E1.2
E02	Ray-Carrossino Farmstead	11269 E. Marginal Way S.	eNR	E2
E04	Lutz House	14237 Interurban Ave. S.	eNR	E2
E05	Women's Improvement Club	14275 Interurban Ave. S.	eNR	E2
E06	Monster House	13710 Beacon Coal Mine Rd. S.	eNR	E3
E07	Archaeological Site 45-KI-431/Allen Town Fishing TCP	Location confidential	eNR	E2
E08	Archaeological Sites 45-KI-438/438A	Location confidential	eNR	E2, E3
Segment F (SeaTac)				
F01	Angle Lake Elementary School	19215 28th Ave. S.	eNR	F2.1, F2.2a, F2.2b, F3.1a, F3.1b, F3.2a, F3.2b
F02	"Belmont Farm"– Hambach Family Compound (demolished 9/98)	19612-16 Int. Blvd. S.	eNR	F1a, F1b, F1c
Maintenance Base Sites				
M01	"Mountain Beaver" sh-HEE-yah-du	Boeing Access Rd.	ND	M3

Notes:
NR listed in the National Register of Historic Places (NRHP)
deNR previously determined eligible for NRHP through another project review
eNR eligible for listing in NRHP
WHR listed in the Washington Heritage Register
SL designated City of Seattle Landmark
eSL appears to meet criteria for City Landmark designation
SRD Special Review District (City of Seattle)
ND Not determined

Maintenance Base Sites. Sites M1-A, M1-B, M1-C, M1-D, and M1-E are located in an area that has moderate potential for prehistoric and historic archaeological resources Sites M2 and M3 are within the Duwamish River floodplain, an area with high potential for prehistoric archaeological resources. Impacts could occur if resources are present.

No-build Alternative. The No-build alternative would have no cultural resource impacts associated with light rail operation or construction. Unrelated developments could impact resources.

4.15.2.2 Impacts on Historic Resources

The Advisory Council on Historic Preservation's regulations implementing Section 106 of the National Historic Preservation Act, create a process by which federally assisted undertakings are reviewed for their effect on National Register-listed or -eligible properties. The impacts of this project were assessed under the regulations in effect prior to June 18, 1999. Under those regulations, the

Criteria of Effect and Adverse Effect are applied to determine whether the proposed action could affect the property and whether that effect should be considered adverse. If the undertaking could change in any way the characteristics that qualify the property for inclusion in the National Register, for better or worse, it is considered to have an effect. If the undertaking could diminish the integrity of such characteristics, it is considered to have an adverse effect.

Potential adverse effects on historic resources in the APE include, but are not limited to:

- physical destruction, damage, or alteration of either a portion of a historic resource or an entire historic resource;
- introduction of visual elements that are out of character with the historic resource or alter its setting;
- introduction of short-term or long-term audible or atmospheric elements that are out of character with the historic resource or alter its setting.

These types of adverse effects also apply to designated City of Seattle Landmarks where components of the alternatives directly affect the landmark or are adjacent to or across the street from a landmark. Potential impacts from the light rail alternatives are summarized in Table 4.15-2 and highlighted below.

Segment A (Northgate to University District). Under Alternatives A2.1 and A2.2, the elevated guideway over Ravenna Boulevard (A03) would require the removal of some trees, lawn area, and other vegetation, and a support column would be placed in the median (see Appendix I, View Location 4). The elevated structure would increase the shading effects over the boulevard already created by the I-5 overpass. Placement of the Roosevelt Station adjacent to the boulevard would increase the bulk of visual intrusions already caused by the elevated freeway.

The revised tunnel route of all Segment A alternatives would require the placement of a vent shaft on the grounds of University Heights School (A09). The aboveground housing for the shaft is a substantial structure and its siting would add a visible non-historic feature to the school grounds as well as introduce potential noise from the operation of the ventilation system.

Segment B (University District to Westlake Station). The preferred alternative, Alternative B1a, would have some effect on Lincoln Park and Reservoir (B28). The underground Capitol Hill Station, located beneath Broadway or one block to the west (options A, B, and C), could increase pedestrian traffic through the park and reservoir site, although this is not likely to reach the level of an adverse effect. Station Option D, which is not a preferred option, requires the removal of significant trees in the northwest corner of the park for an underground station beneath Nagle Place, resulting in an adverse effect on this resource.

Other alternatives would affect additional historic resources. Alternative B1b includes a potential underground station at Roy/Aloha. Station entrances at Roy Street could be incompatible with the historic character of the Harvard-Belmont Historic District (B24) immediately to the west and the two Anhalt Apartment buildings (B25, B26) to the east. Careful design of the entrances and a potential associated private development could moderate this visual intrusion. Similarly, an entrance to the First Hill underground station could impair views of the Garrand Building (Jesuit College, B37) on the Seattle University campus. First Hill Station entrances in the preferred alternative are located on Madison in positions that would not affect these views.

Alternative B2.1 would require the demolition of the University Friends Meeting Hall (B56). The elevated guideway of Alternatives B2.1 and B2.2 would obstruct views from the south of the Ford Assembly Plant (B75) and the William O. McKay Auto Dealership (B81).

Segment C (Westlake Station to S. McClellan Street).

All alternatives in Segment C include two new entrance options for the existing Westlake Station. Option A proposes a street level entrance in the northwest corner of the Shafer Building (B94) at 515/519 Pine Street. Substantial alterations to the storefronts of this historic building have already occurred, and future alterations are regulated by the Seattle Landmarks Preservation Board. Locating a new station entrance here would not be an adverse effect.

The preferred alternative, Alternative C1.2, includes the Royal Brougham Station with an at-grade center platform on the eastside of the E3 Busway. The station is located adjacent to the rear of six warehouses that are included in the Sixth Avenue S. Historic District (C20). While the addition of a new structure may affect the setting of the district, in this case the effect would not be adverse since the buildings are already in an industrial zone and views of the rear of the warehouses are not now available to the general public. Street improvements in the Pioneer Square Historic District and the International Special Review District associated with downtown bus rerouting could enhance rather than harm the historic character of these districts. Similarly, station entrances, sidewalk reconfigurations and landscaping adjacent to the Beacon Hill School (C05) and the Lander Apartments (C19) associated with the underground Beacon Hill Station could provide an opportunity to enhance the neighborhood character.

Other alternatives result in impacts ranging from none to severe. Alternative C2.4 would not affect any historic resources. Alternative C2.3 requires the acquisition of a portion of the Stewart Lumber Company (C13) for right-of-way, and the property would be extensively altered as well as visually impacted by the retained fill and supported ramp as the trackway transitions from at-grade to elevated at this point. These impacts cannot be mitigated. The elevated trackway of Alternative C3 would also obstruct views of Stewart Lumber Company, and this impact could be only partially mitigated by careful placement of guideway piers.

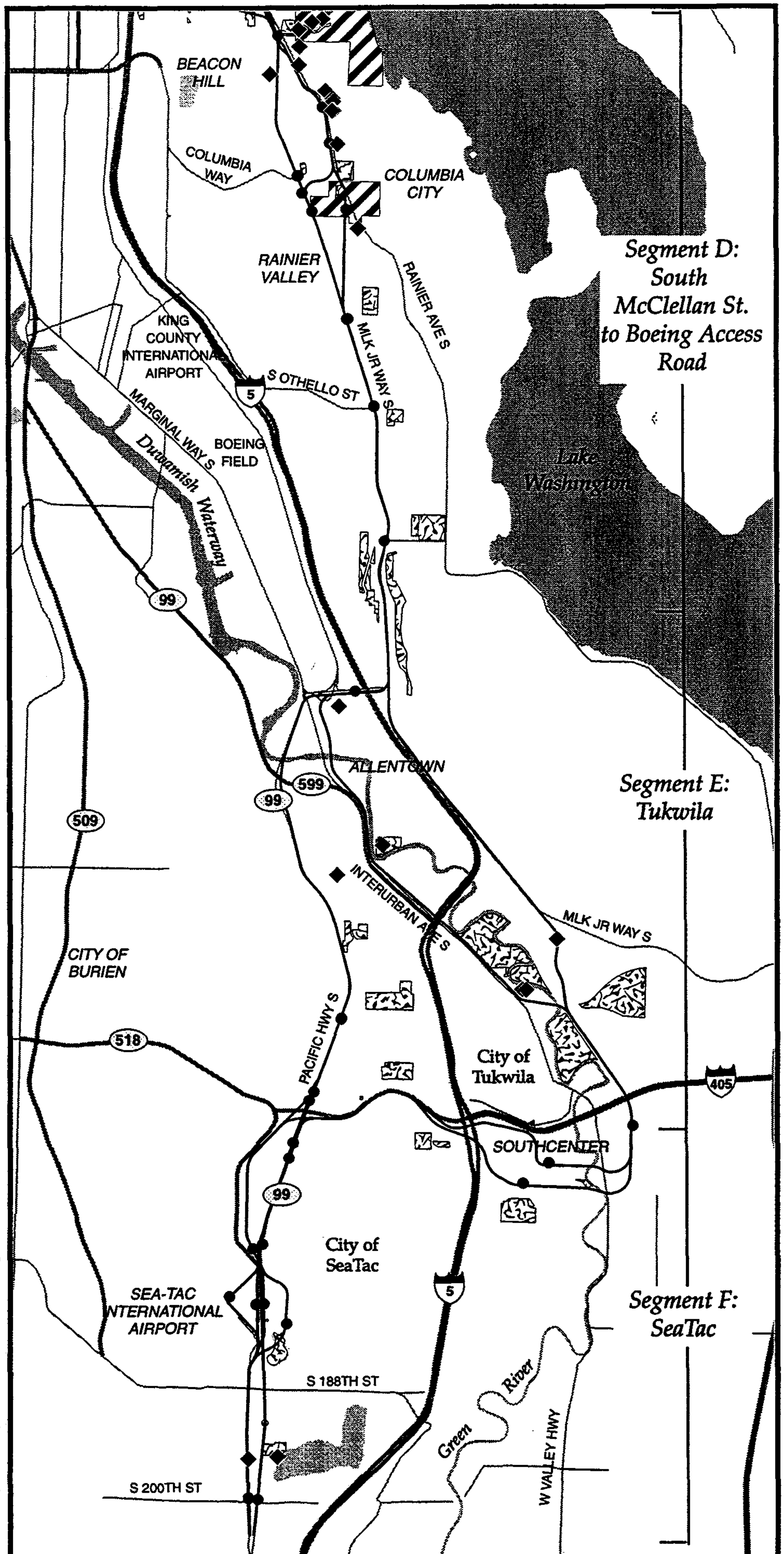
Segment D (S. McClellan Street to Boeing Access Road).

The preferred alternative, Alternative D1.1e, and other Segment D alternatives locate the McClellan Station (options B and C) west of Rainier Avenue S. and north of S. Winthrop Street, an undeveloped portion of the historic Cheasty Boulevard (D04). The station is elevated, and the elevated guideway continues southward across the boulevard (see Appendix I, View Location 9-1 and 9-3). Views toward the east, which include Mt. Baker Boulevard (D03), Mt. Baker Park Historic District (D01), and Franklin High School (D02), would be obscured by the elevated structures and ground-level station access components. Views from Mt. Baker Boulevard west towards Cheasty Boulevard would also be affected. The elevated guideway, while introducing a highly visible feature above the boulevard, does not preclude the at-grade reconnection of Cheasty and Mt. Baker boulevards as existed in the Olmsted Plan prior to the 1960s.

An at-grade McClellan Station (Option A) across S. Winthrop Street (see Appendix I, View Location 9-1 and 9-2) has somewhat less visual impact on the historic resources in the vicinity, but precludes an at-grade reconnection of Cheasty and Mt. Baker boulevards. The light rail project would reconstruct the affected portion of Cheasty Boulevard (S. Winthrop Street) and add landscaping and street trees consistent with boulevard character.

The preferred alternative locates the at-grade Edmunds Station between S. Alaska Street and S. Edmunds Street, just outside the boundaries of the expanded Columbia City Historic District. Street improvements planned for S. Edmunds Street could enhance rather than detract from the historic character of the district. The remainder of the preferred alternative in Segment D has no effect on historic properties. Under Alternatives D3.3 and D3.4, two historic houses and one historic apartment building on Rainier Avenue S. would be acquired and removed, and the settings of four other historic houses would be altered. The Columbia City Historic District (D13) would be affected by all Segment D alternatives, but the most direct impact would occur due to tunnel and station construction under Alternative D3.4. These impacts can be mitigated.

Figure 4.15-2: Historic Resources and Parklands, Segments D, E, and F



SoundTransit

Historic Resources

Historic Districts & Boulevards

Parklands

Alternative Route

Station

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Segment E (Tukwila). No historic resources would be affected under the preferred alternative, Alternative E1.1 or Alternative E1.2. The Lutz House (E04) and the Women's Improvement Club (E05) could be adversely affected by visual and noise impacts under Alternative E2. Under Alternative E3, the elevated trackway would cross a portion of the Monster Farmstead property (E07). These impacts can be mitigated.

Segment F (SeaTac). The preferred alternative, Alternative F2.3, would not adversely affect any historic resources. The elevated guideway on the east side of 28th Avenue S. would not obstruct existing views of Angle Lake School (F01). Alternative F1 would widen the right-of-way on the east side of International Boulevard, taking a strip of land 25 ft wide and removing some design features of the Hambach Family Compound (F02), which is specifically identified (cited as "the Hughes property") in the City of SeaTac Comprehensive Plan as a historic resource to be preserved; however, the seven buildings at the site were demolished by the City in September 1998.

Maintenance Base Sites. None of the maintenance base sites and associated routes would affect historic resources.

System Total Impacts. The full-length alternative from Northgate to SeaTac would adversely affect between 5 and 27 historic resources, while the shorter N.E. 45th Street to SeaTac Alternative would affect between 5 and 25, depending on the alternatives chosen. The preferred alternative and the MOS alternatives would avoid a direct impact on Cheasty Boulevard because they would include an elevated station option at McClellan Street.

No-build Alternative. Under the No-build Alternative there would be no direct acquisition of historic resources and no alteration to the settings of historic resources associated with light rail operation or construction. There would be no impact on historic resources, except by other, unrelated developments.

4.15.3 Mitigation

4.15.3.1 Mitigation for Archaeological Sites, Traditional Cultural Properties, and Paleontological Sites

Required and potential mitigation measures to avoid or minimize impacts to archaeological, cultural or paleontological resources are summarized below. Table 4.15-3 indicates potential mitigation for the presently undetected sites in all the segments. FTA and Sound Transit have prepared an Archaeological Resources Monitoring and Treatment Plan to govern the action to be taken when historic properties are discovered during project implementation. This plan will be part of the Programmatic Agreement between FTA, the Advisory Council on Historic Preservation and the state Historic Preservation Office.

Known/Recorded Archaeological Sites. NRHP-eligible sites must be taken into consideration during project planning and/or design. Where project impacts to NRHP-eligible sites cannot be avoided through project redesign, mitigation through data recovery (controlled excavation) would be required. There are no known/recorded archaeological sites that would be affected by construction of the preferred alternative. If any archaeological sites are detected by subsurface testing of high-probability areas within the preferred alternative (see below), likely mitigation measures that would be required include data recovery prior to construction and/or monitoring during construction. Two known/recorded archaeological sites would be potentially affected if Alternatives E2 and E3 are constructed. An archaeological monitoring and data recovery plan would be prepared and included in the Programmatic Agreement that would be signed by FTA, the Washington SHPO, and the Advisory Council.

Likely mitigation measures would be required for the known/recorded archaeological sites (potentially affected by Alternatives E2 and E3) include subsurface testing to determine the presence of resources prior to construction, data recovery prior to construction if resources are discovered in the area to be disturbed, and monitoring during construction.

Table 4.15-2
Summary of Impacts on Historic Resources by Segment, Route Alternative and Option

Segments, Route Alternatives and Options	Number of Resources			
	Within APE[1]	Adversely Affected	Potentially Mitigable	Unavoidable Adverse Impact
Segment A (Northgate to University District)				
A1.1 12th Ave. N.E. Tunnel[2]	8	0	0	0
A1.2 Roosevelt Way N.E. Tunnel[2]	6	0	0	0
A2.1 8th Ave. N.E. Short-Elevated[2]	8	2	2	0
A2.2 8th Ave. N.E. Elevated[2]	9	2	2	0
Segment B (University District to Westlake Station)				
B1a Capitol Hill Tunnel	*53*	*0-1*	*0-1*	*0*
B1b Capitol Hill Tunnel[3]	53	5-7	5-7	0
B2.1 Seattle Center/High-level Bridge[3]	49	3-5	2-4	1
B2.2 Seattle Center/Portage Bay Tunnel[3]	42	2-4	2-4	0
Segment C (Westlake Station to S. McClellan Street)				
C1.1 At-grade center of Lander St.	11	0	0	0
C1.2 At-grade north of Lander St.	*11*	*0*	*0*	*0*
C1.3—Elevated north of Lander Street	11	0	0	0
C1.4—Elevated south of Forest Street	11	0	0	0
C1.5—Massachusetts Street and I-5 right-of-way	12	1	0	1
C2.3 West of Rainier Ave. S. Elevated	9	2	1	1
C2.4 Rainier Ave. S. Tunnel	9	0	0	0
C3 S. Massachusetts St. Tunnel	8	1	1	0
Segment D (S. McClellan Street to Boeing Access Road)				
D1.1 MLK Jr. Way S. At-grade[4,5]	5	1	0-1	0-1
D1.1e MLK Jr. Way S. At-grade	*5*	*1*	*1*	*0*
D1.3 MLK Jr. Way S. Combined Profile[5]	5	2	1-2	0-1
D3.3 Alaska St. Crossover[5]	14	9	8-9	0-1
D3.4 37th Ave. S. Tunnel[5]	15	10	9-10	0-1
Segment E (Tukwila)				
E1.1 Tukwila International Blvd.–At-grade	*1*	*0*	*0*	*0*
E1.2 Tukwila International Blvd.–Elevated	1	0	0	0
E2 Interurban Ave. S.	3	2	2	0
E3 MLK Jr. Way S.	1	1	1	0
Segment F (SeaTac)				
F1 International Blvd. At-grade[2]	1	0	0	0
F2.1 Wash. Mem. Park City CenterWest[2]	1	1	1	0
F2.2 Wash. Mem. Park City Center East[2]	1	1	1	0
F2.3 Wash. Mem. Park – Elevated East of 28th	*1*	*0*	*0*	*0*
F3.1 W. of Int. Blvd. Grassy Knoll[2]	1	1	1	0
F3.2 W. of Int. Blvd. Main Terminal[2]	1	1	1	0
F3.3 W. of Int. Blvd. IMC Airport Station[2]	1	0	0	0
F4 International Blvd. To 28th/24th	1	0	0	0
Maintenance Base Sites				
M1-A Lander Street	0	0	0	0
M1-B Lander Street	0	0	0	0
M1-C Atlantic/Central A	0	0	0	0
M1-D Rainier Brewery/Roadway Express	0	0	0	0
M1-E Rainier Brewery/Airport Road	0	0	0	0
M1 S. Lander St.	0	0	0	0
M2 N.E. Boeing Access Rd.	0	0	0	0
M3 S.W. Boeing Access Rd.	0	0	0	0
System-Wide Alternatives				
Northgate to SeaTac	64-93	2-24	1-23	0-3
N.E. 45th St. to SeaTac	58-84	2-22	1-21	0-3
Preferred Alternative	73	1	1	0
MOS A N.E. 45th to McClellan Street	72	0-1	1	0
MOS B Capitol Hill to Henderson	47	1	1	0
MOS C N.E. 45th St. to Lander	62	0-1	0	0

Notes:
[1] Area of Potential Effects
[2] All options
[3] Low end of range is without new Convention Place Station; high end is with new station.
[4] All non-preferred alternative options.
[5] Low end range is McClellan Station elevated, high end is McClellan Station at-grade.

Known/Recorded Traditional Cultural Properties. Sound Transit is conducting ongoing consultation with three local Tribes to address the property of cultural interest that may be eligible for listing in the NRHP (based on information provided by local Tribes). One known traditional cultural property, the Allentown Fishing, is located on the east bank of the Duwamish River - across the river from the route of Alternative E2. Mitigation measures would be determined through Tribal consultation.

The property of cultural interest located south of Boeing Access Road may also be adversely affected by construction of an elevated segment of the preferred alternative (E1.1 and Alternatives E1.2 and E2). Consultations with the Tribes conducted to date indicate that this property is culturally important and that light rail construction and/or operation could affect the property. The NRHP eligibility status of this property is currently undetermined; however, further consultation with local Tribes are expected to clarify whether or not this potential property will be formally documented and submitted to the Washington SHPO with a request for determination of eligibility. Continuing consultation with the Tribes is expected to identify appropriate mitigation measures if needed.

Previously Unrecorded Archaeological Sites and Archaeological Probability Areas. The 1998 surface reconnaissance survey and additional survey reconnaissance of the preferred alternative conducted in 1999 did not discover any previously unrecorded archaeological sites.

A Programmatic Agreement for this project includes an Archaeological Resources Treatment and Monitoring Plan that specifies that any previously undiscovered archaeological sites found during construction would be evaluated for their eligibility for listing in the NRHP. If determined eligible, mitigation measures that are described in the Archaeological Resources Treatment and Monitoring Plan would apply. Archaeological monitoring of ground–disturbing operations located in archaeological high–probability areas will be conducted by qualified archaeologists.

Potential Paleontological Deposits. Mitigation for paleontological deposits potentially affected would include monitoring and salvage during construction.

4.15.3.2 Mitigation for Historic Resources

Required or potential mitigation measures for impacts on historic resources include, but are not limited to:

- modification of project design to avoid or limit physical alteration, visual, atmospheric, or long-term noise impacts;
- relocation of historic resource to appropriate new site.

Modification of the project has been ongoing during the environmental review and design processes. As design progresses, refinement of specific elements such as stations, elevated structures, and bridges will continue. The continuing review process would minimize impacts on historic resources and to ensure compatibility with the historic environment.

Other potential mitigation measures include, but are not limited to, the following.

Segment A. Under Alternatives A2.1 and A2.2 it may be possible to locate the Roosevelt Station back farther from Ravenna Boulevard and screened by appropriate landscaping. Landscaping improvements to the boulevard could be designed to minimize the visual intrusion of the support column and to offset the shading effect of the elevated guideway. The vent shaft at University Heights School could be located elsewhere, if feasible, or the visual impact could be mitigated by appropriate design screened by landscaping.

Segment B. For the Capitol Hill Station Option D (B1a), the lost trees at Lincoln Reservoir could be replaced with new trees and the landscaping restored. Plans for this work would be coordinated with Seattle Public Utilities, which is scheduled to replace the existing reservoir with underground tanks, and with the Seattle Landmarks Preservation Board, which regulates alterations at this City Landmark site. Design of station entrances and associated structures at the potential Roy/Aloha

Station (Alternative B1b) could be reviewed by the SHPO and the Seattle LPB to assure compatibility with the historic context. Under Alternative B2.1 demolition of the University Friends Meeting Hall could be avoided by altering the route, if feasible, or mitigated by documenting the property according to prescribed standards. View obstruction at the Ford Assembly Plant and W.O. McKay dealership could be minimized, but not eliminated, by careful design of the elevated guideway, support columns, and station components. The preferred alternative would avoid impacts to these resources.

Segment C. In all C1 alternatives, a carefully designed Royal Brougham Station, following guidelines for the preservation of the setting of adjacent historic properties, could moderate any effect on the Sixth Avenue South Historic District. Street improvements associated with bus rerouting would be reviewed and approved by the Pioneer Square Preservation Board or the International Special Review District Board when they occur within district boundaries. Redesign of route and profile is not feasible for Alternative C2.3, and the impacts to Stewart Lumber Company could not be reduced. The obstruction of views of the lumber company building in Alternative C3 could be minimized by careful placement of guideway support columns. The preferred alternative would avoid these impacts.

Segment D. Under the preferred alternative, the visual impacts of the elevated McClellan Station (Options B and C) and guideway could be minimized, but not entirely eliminated, by locating the ground-level entrance north of the boulevard right-of-way, by careful design of station components, and by appropriate landscaping in keeping with the Olmsted Boulevard character. Reestablishing the visual connection between Cheasty and Mt. Baker boulevards, according to the Olmsted Plan, and providing pedestrian, bicycle and handicapped connections at-grade, would partially mitigate the intrusion of the elevated guideway over the boulevard.

Other alternatives require both similar and additional mitigation measures. An at-grade McClellan Station, Alternatives D1.1 (Option A) and D3.3, could be designed to include pedestrian and bicycle access above or below the trackway and landscaping appropriate to the boulevard character. Removal of historic houses on the Rainier Avenue S. route (Alternatives D3.3 and D3.4) could preserve the buildings, but would separate them from their historic setting. Those historic homes remaining could be screened from the trackway by appropriate landscaping. Placement and design of ground-level entrances to an underground station in the Columbia City Landmark District (Alternative D3.4) would be reviewed and approved by the Seattle LPB to assure compatibility with the district's historic character.

Segment E. No mitigation is required in this segment for the preferred alternative (E1.1). Other alternatives could require landscaping and noise buffers for two properties on Interurban Avenue S.(E2), and design refinements and landscaping for the elevated guideway across a rear portion of the Monster Farmstead (E3).

Segment F. No mitigation is required in this segment for the preferred alternative (F2.3). For other alternatives, landscaping at the Angle Lake School could compensate for the acquisition of a narrow strip of frontage.

In accordance with Section 106, the FTA (with Sound Transit) has consulted with the SHPO in completing the inventory and determinations of eligibility for historic and cultural resources. Also as part of the Section 106 process, the FTA has consulted with the SHPO to determine the effects of the proposed undertaking and to agree on appropriate mitigation measures. The FTA has entered formal consultation with the SHPO and the ACHP and has developed a draft Programmatic Agreement (PA) to minimize adverse impacts on those cultural resources affected by the light rail project. The draft PA is included in the Final EIS in Appendix R.

Table 4.15-3
Mitigation Measures for Presently Undetected Archaeological Sites by Project Segment

Segment	Monitoring During Construction	Subsurface Testing Prior to Construction	Standard Precautionary Measure
Segment A (Northgate to University District)			
A1.1 12th Ave. N.E. Tunnel			X
A1.2 Roosevelt Way Tunnel			X
A2.1 8th Ave.–Short-Elevated	X		X
A2.2 8th Ave.– Elevated	X		X
Segment B (University District to Westlake Station)			
B1 Capitol Hill Tunnel			X
B2.1 Seattle Center via High—level Bridge	X	X	X
B2.2 Seattle Center via Portage Bay Tunnel	X		X
Segment C (Westlake Station to S. McClellan Street)			–
C1 S. Lander St. Tunnel	X		X
C2.3 West of Rainier Ave. S. Elevated	X		X
C2.4 Rainier Ave. S. Tunnel	X		X
C3 S. Massachusetts St. Tunnel	X		X
Segment D (S. McClellan Street to Boeing Access Road)			
D1.1 MLK Jr. Way S. At-grade	X		X
D1.3 MLK Jr. Way S. Combined profile	X		X
D3.3 S. Alaska St. Crossover	X		X
D3.4 37th Ave. S. Tunnel	X		X
Segment E (Tukwila)			
E1.1 Tukwila International Blvd. At-grade	X	X[1]	X
E1.2 Tukwila International Blvd. Elevated	X	X[1]	X
E2 Interurban Ave.	X	X[2]	X
E3 MLK Jr. Way S.	X	X[2]	
Segment F (SeaTac)			
F1 International Blvd.–At-grade	X		X
F2.1 Washington Memorial Park City Center West	X		X
F2.2 Washington Memorial Park City Center East	X	X[3]	X
F3.1 West Side International Blvd. Grassy Knoll	X		X
F3.2 West Side International Blvd. Main Terminal	X		X
Maintenance Base Sites			
M1-A Holgate St. to Lander St	X		X
M1-B Holgate St. to Lander St	X		X
M1-C Massachusetts St. to Holgate St.	X		X
M1-D Rainier Brewery/Roadway Express	X		X
M1-E Rainer Brewery/Airport Way	X		X
M2 N.E. Boeing Access Road	X	X[1]	X
M3 S.W. Boeing Access Road	X	X[3]	X

Notes: [1] if feasible
[2] near known sites
[3] in certain locations

For the segments of the system in Seattle, the Seattle LPB will reviews those elements of the project that affect designated city landmarks and landmark districts. The LPB may require specific mitigation measures, and its approval is required under the City's Landmark Preservation Ordinance. If elements of the project are adjacent to or across the street from a designated landmark, the Seattle HPO reviews design plans for compatibility and may require specific mitigation measures.

When avoidance is not feasible, and it is necessary to acquire and remove a historic resource, in some cases the resource may be moved to another site, or in rare cases the resource may be demolished. The relocation or demolition of a historic resource requires complete review and approval by the SHPO and/or Seattle HPO and Seattle LPB and must meet established standards for documentation, site selection, relocation methods, and rehabilitation. A more detailed explanation of specific mitigation measures for each historic resource within the APE is in the Historic and Archaeological Resources Technical Report (Courtois and Bard 1998).

4.15.4 Significant Unavoidable Adverse Impacts

Archaeological Sites, Traditional Cultural Properties (TCP), and Paleontological Sites.

No significant unavoidable adverse impacts to known or unknown archaeological sites, traditional cultural properties, or paleontological sites have been identified.

Historic Resources.

No significant adverse impacts to historic resources exist that cannot be mitigated through the Section 106 and City of Seattle review procedures, with the following exceptions:

- Alternative B2.1 would require the demolition of the University Friends Meeting Hall (B56). The adverse impact on this resource cannot be mitigated without changes to the proposed route.
- Alternative C2.3 would result in the loss of a portion of the Stewart Lumber Company building (C13) and substantial alteration to its setting, impacts that cannot be mitigated.
- In Alternatives D1.1 and D3.3, the McClellan Station Option A would be located at-grade across Cheasty Boulevard (D04), thus precluding the reconnection of Cheasty Boulevard and Mt. Baker Boulevard (D3) as envisioned in the Olmsted Plan. The adverse impact on this resource cannot be mitigated with this station location and at-grade profile, which prohibit pedestrian and vehicular passage. The preferred alternative, D1.1, with McClellan Station Option B would avoid this impact.

4.16 PARKLANDS

4.16.1 Affected Environment

Many parks and other recreational facilities are situated close to the light rail alternatives. The public parks vary in size, type, and function. The other recreational facilities may include one or more of the following: greenbelts and other undeveloped open spaces; pedestrian and bicycle trails; boulevards; playfields; and school district play areas that are available for public use during non-school hours. Except for the school district sites, these facilities are generally owned or maintained by the parks and recreation departments of the cities of Seattle, Tukwila, Renton, and SeaTac. King County, WSDOT, the UW, and the Port of Seattle also own and maintain facilities in the study area.

The parks and other recreational facilities listed in the project-area inventory include those parklands and other recreational facilities situated as follows:

- within 250 ft (roughly one city block) of alignment tunnel sections
- within 500 ft (roughly two city blocks) of at-grade and elevated sections of the alignment
- within one-quarter mile (roughly 1,300 ft) of stations

In all, 101 identified parkland resources from these areas are included in the inventory (Table 4.16-1). These resources include both existing and proposed facilities. The inventory groups resources by segment and assigns an identification number to each resource. A detailed inventory in the Parklands Technical Report notes each resource's size, type, and function; facilities and activities; unique features (historic significance, special features, environmentally critical areas, etc.); ownership; and distance to routes and/or stations.

4.16.2 Impacts

Of the 101 parkland resources identified in the potentially affected area (Section 4.16), 32 are considered likely to be impacted in some way by the proposed alternatives. The probable long-term impacts include: direct effects, primarily from acquisition of all or part of the facility property to accommodate the project; and indirect or "proximity" effects. Proximity effects relate primarily to increased noise, degradation of the visual or aesthetic setting, or access restrictions.

The remaining parkland resources were determined not to be impacted by the project, based on a number (or a combination) of factors:

- Many were some distance from a proposed route or station. Little or no direct or proximity impacts would be experienced;
- Many were separated from the proposed routes and/or stations by a freeway or other major highway. These facilities would not experience direct impacts and, because of the nature of these significant physical barriers, proximity impacts would be unlikely.

4.16.2.1 Relevant Regulations

Parklands are specifically protected by federal and local regulations. Federal Law 23 U.S.C. Section 138, commonly referred to as Section 4(f) in the Department of Transportation Act of 1966, requires that any transportation project financed with federal funds that will require use of land from a public park or recreation area (as well as wildlife and water fowl refuge or historic site) can only be approved and constructed if:

- There is no feasible and prudent alternative to the use of the land; and
- The project includes all possible planning to minimize harm to the site.

As part of the Section 4(f) process, an evaluation must be prepared that describes the resources affected, discusses the direct impacts and the proximity impacts that would substantially impair the use of these resources (referred to as "constructive use" in Section 4(f)), and identifies and evaluates alternatives that avoid such impacts and measures to minimize or mitigate for unavoidable adverse effects. The Section 4(f) Evaluation is included in Appendix E of this Final EIS.

In addition, if federal funds granted through Section 6(f) of the U.S. Land and Water Conservation Act (administered through the State Interagency Committee for Outdoor Recreation [IAC]) have been used to acquire or develop park facilities that would be converted to non-recreational use, all practical alternatives to the conversion must be evaluated. If no alternatives are practical, the U.S. Department of the Interior must approve replacement land of reasonably equivalent recreational utility and location, equal to or greater than the fair market value of property being converted to non-recreational use, in compliance with National Park Service LWCF policies.

Seattle parklands are further protected through Ordinance 118477, enacted in February 1997. The ordinance specifies that all lands and facilities held now or in the future by the city for parks and recreational purpose, whether designated as park, park boulevard, or open space, must be preserved for such use. No such land or facility is to be sold, transferred, or changed from park use to another use unless the city receives in exchange land or a facility of equivalent or better size, value, location, and usefulness in the vicinity (and serving the same community and the same park purpose). This process requires a City Council finding that the transaction is necessary with no reasonable alternative.

Some existing park resources noted in Table 4.16-1 are part of the Olmsted Plan for Seattle's parks, boulevards, and playgrounds. Two of these, Ravenna Boulevard and Cheasty Boulevard, would be impacted by the project. Being part of the Olmsted Plan heightens the historic and cultural significance of a resource to the surrounding community and to the city as a whole. While no regulatory significance is attached to the designation of an Olmsted Park, the City's Park and Recreation COMPLAN recommends the designation of these resources for special consideration as Park Historic Resource Areas.

Table 4.16-1
Affected Environment Parkland Inventory

Identification Number and Name	Acreage	Facility/Features	Route Alternative(s)/Station Area
Segment A (Northgate to University District)			
A1 Banner Way Triangles	0.1 each	Street triangles	A1.1, A1.2, A2.1, A2.2
A2 Rainbow Point	0.6	Mini-park with view	A1.1, A1.2, A2.1, A2.2
A3 Ravenna Blvd.		Olmsted Boulevard	A1.1, A1.2, A2.1, A2.2; Roosevelt Station
A4 Marshall Alternative School Playfield	2.75	School playfield	A2.1, A2.2; Roosevelt Station
A5 Roosevelt High School Playfield	4.1	School playfield	A1.1; Roosevelt Station
A6 Cowen Park	8.4	Olmsted Park	A1.1; Roosevelt Station
A7 Ravenna Park	52.7	Olmsted Park	Roosevelt Station
A8 N.E. 60th St. Park	0.5	Freeway buffer	A2.1, A2.2; Roosevelt Station
A9 17th Ave. N.E. Center Strip	1.78 (0.59 miles)	Olmsted Blvd.	NE 45th Station
A10 University Heights Playground	0.1	Play Structure	A1.1, A1.2, A2.1, A2.2
Segment B (University District to Westlake Station)			
B1 Burke-Gilman Trail		Bike/pedestrian trail	B1, B2.1, B2.2; Pacific St. and Campus Parkway stations
B2 Sakuma Viewpoint	0.3	Waterfront open space	B1, B2.2; Pacific Station
B2a Portage Bay Vista/Boat St. View Corridor		Landscaped open space corridor	B1, B2.2; Pacific Station
B3 North Passage Point Park	0.79	Waterfront open space	B2.1
B4 South Passage Point Park	0.65	Waterfront open space	B2.1
B4a North Gateway Park	1.0	Highway landscape area	B2.1
B5 Roanoke Park	2.2	Olmsted park	B1, B2.2
B6 10th Ave. E./E. Roanoke St. Strip	0.6	Freeway buffer	B1, B2.2
B7 Harvard-Miller/ Roanoke Annex	0.1	Street triangle	B2.1, B2.2
B8 St. Mark's Greenbelt	12	Greenbelt w/ trails	B1; Eastlake Station
B9 Volunteer Park	48.3	Olmsted Park	Roy/Aloha Station
B10 Lowell School Playfield	2.3	School playfield	B1; Roy/Aloha Station
B11 Bullitt Life Estate	1.5	Historic property	Roy/Aloha and Eastlake stations
B12 Lakeview Place	0.01	Steep wooded bank	Eastlake Station
B13 Belmont Place	0.01	Street triangle	Roy/Aloha Station
B13A Bellevue Place	1.7	I-5 viewpoint	B2.1, B2.2; Eastlake Station
B13B Summit Place	0.01	Street triangle	Eastlake Station
B14 Tashkent Park	0.46	Neighborhood park	Roy/Aloha station
B15 Bobby Morris Playfield	4.5	Athletic playfields, reservoir	B1; Capitol Hill Station
B16 Boylston Place	0.01	Street triangle	First Hill Station
B17 First Hill Park	0.2	Neighborhood park	First Hill Station
B18 Boren-Pike-Pine Park	0.6	I-5 viewpoint park	B1, B2.1, B2.2; Convention Place Station
B19 South Lake Union Park (existing & proposed)	2.1 existing (13 proposed)	Waterfront open space	South Lake Union Station
B21 South Lake Union Trail		Bike/pedestrian trail	B2.1, B2.2; South Lake Union and Eastlake stations
B22 Tillikum Place	0.01	Historic triangle	B2.1, B2.2; Seattle Center Station
B23 Denny Park	5	Historic park	B2.1, B2.2; Seattle Center Station
B24 Denny Playfield	1.8	Athletic playfields	B2.1, B2.2
B25 Westlake Park	1	Urban park	B1, B2.1, B2.2; Westlake, Convention Place, and University St. stations
B26 McGraw Square	0.02	Street triangle w/ statue	Westlake and Convention Place stations
B27 Westlake Square	0.01	Street triangle	Westlake and Convention Place stations
B28 Freeway Park	5.2	Urban park	Convention Place Station
B29 Hubbell Place	0.4	Landscaped slope	Convention Place Station
B30 Pigott Corridor	0.2	Walkway	Convention Place Station

Table 4.16-1 continued

Identification Number and Name	Acreage	Facility/Features	Route Alternative(s)/Station Area
Segment C (Westlake Station to S. McClellan Street)			
C1 Prefontaine Place	0.05	Street triangle w/ fountain	C1.1, C1.2, C2.3, C2.4; Pioneer Square and International District stations
C2 City Hall Park	1.3	Urban park	C1.1, C1.2, C2.3, C2.4; Pioneer Square and International District stations
C4 Kobe Terrace Park	1.1	Neighborhood park	International District Station
C5 Pioneer Square	0.3	Historic street triangle mini-park	Pioneer Square Station
C6 Occidental Square	0.61	Historic urban park	Pioneer Square Station
C7 Union Station Square	0.03	Street triangle	International District and Pioneer Square stations
C8 Hing Hay Park	0.33	Neighborhood park	International District Station
C9 Waterfall Park	0.1	Passive park	Pioneer Square and International District stations
C10 International Children's Park	0.23	Neighborhood park	International District Station
C11 E3 Busway Urban Art Corridor (existing and proposed)		Pedestrian walkway, proposed multi-use trail	C1.1, C1.2, C1.3, C1.4, C1.5, C2.3, C2.4, C3; Royal Brougham and Lander stations
C12 Beacon Place	0.25	Undeveloped wooded parcel	C2.3, C2.4
C13 Dr. Jose Rizal Park	9.6	Neighborhood park, wooded area	C2.3, C2.4
C14 Lewis Park	1.4	Undeveloped woody hillside	Poplar Place Station
C15 Colman Playfield	2.8	Athletic playfields	C2.3
C16 Sam Smith Park	59	Open space, play areas	C2.3; I-90 (Rainier) Station
C17 I-90 Trail		Bike/pedestrian trail	C2.3, C2.4, C3; I-90 (Rainier) and I-90 (17th Ave. S.) stations
C18 Judge Charles M. Stokes Overlook	14.1	Greenbelt	C2.3, C2.4, C3; I-90 (Rainier) and I-90 (17th Ave. S.) stations
C19 Sturgus Park	2.9	Freeway buffer w/trail	C2.3, C2.4
C19A Taejon Park	5.3	Freeway buffer w/trail	C2.3, C2.4; I-90/Rainier and Poplar Place stations
C19B Future Sister City Park	4.6	Freeway buffer w/trail	C2.3, C2.4, C3; I-90/Rainier and I-90/17th Ave. S. stations
C19C Atlantic Street Park	1.0	Freeway buffer w/trail spur	C2.3, C2.4, C3; I-90/Rainier station
C21 I-5/City Light right-of-way Trail (proposed)		Proposed urban trail	C1.1, C1.2, C3, D1.1c, D1.1d, D1.1e, D1.3, D3.3, D3.4; Henderson Station
C22 East Duwamish Greenbelt	79.8	Wooded greenbelt	C1.1, C1.2, C1.3, C1.4, C1.5
C23 Stevens Place	0.3	Street triangle	Beacon Hill Station
C24 McClellan Place	0.1	Street triangle	C1.1, C1.2 C1.3, C1.4, C1.5; Beacon Hill Station
C26 Cheasty Greenbelt	12	Wooded greenbelt	C1, C2.3, C2.4, C3
C27 Mount Baker Blvd.		Olmsted Boulevard	C1, C2.3, C2.4, C3, D1.1c, D1.1, D1.3, D3.3, D3.4; McClellan Station
C28 Cheasty Boulevard		Olmsted Boulevard	C1, C2.3, C2.4, D1.1, D1.3, D3.3, D3.4; McClellan and Alaska St. stations
Segment D (S. McClellan Street to Boeing Access Road)			
D1 Franklin High School Playfield	4.6	School playfield	C1, C2.3, C2.4, C3, D1.1c, D1.1, D1.3, D3.3, D3.4; McClellan Station
D2 Rainier Playfield	9.5	Athletic playfields	D1.1, D3.3, D3.4; Genesee and Columbia City stations
D2A Rainier Vista Playfield	2.3	Neighborhood playfield	D1.1, D1.3; Alaska Station
D4 Columbia Park	2.46	Neighborhood park	D3.3, D3.4; Edmonds, Alaska, and Columbia City stations
D5 Brighton Playfield	13.7	Athletic playfields, play areas	Graham Station
D6 Othello Playground	7.6	Open space, play areas	D1.1, D1.3, D3.3, D3.4; Othello Station

Table 4.16-1 continued

Identification Number and Name	Acreage	Facility/Features	Route Alternative(s)/Station Area
D7 Rainier Beach Playfield	10.9	Athletic playfields, play areas	Henderson Station
D8 Dunlap School Playfield	4.6	School playfield	Henderson Station
D9 East Duwamish Greenbelt	79.8	Wooded greenbelt	D1.1, D1.3, D3.3, D3.4; Henderson Station
Segment E (Tukwila)			
E1 Tukwila Community Center	12	Athletic playfields, play areas, community center	E2
E2 Duwamish/Green River Trail		Bike/pedestrian trail	E1.1, E1.2, E2, E3; E2 Southcenter Station
E3 Southgate Greenbelt	10	Wooded greenbelt	E1.1, E1.2
E4 Foot Trail-57th Ave. S		Pedestrian trail	E2
E5 Lookout Park	0.1	Riverfront view area	E2
E6 Foster Golf Course	70	18-hole golf course	E2, E3
E7 Green River Lots (proposed Log House Park)	1	Planned passive park	E2
E8 Foster High School Playfield	27	School playfield	S. 144th Station
E9 Alde/Markham Stream Frontage (proposed Alde/Markham Park)	0.9	Undeveloped open space	E2, E3
E10 Fort Dent Park	54	Athletic playfields	E2, E3
E11 Black River Riparian Forest	90	Undeveloped open space	E2, E3
E12 Ikawa Park	0.5	Neighborhood park	E2
E13 Crystal Springs Park	11	Neighborhood park	E2, E3
E14 Thorndyke School Playfield	8	School playfield	E2, E3
E15 Interurban Trail		Bike/pedestrian trail	E2, E3; Longacres Station
E16 Bicentennial Park	1.5	Community park	E2, E3; E2 Southcenter Station
E17 Tukwila Pond Park	24.7 (2.4 developed)	Open space, trails	E3; E3 Southcenter Station
E18 Cascade View Neighborhood Park (proposed)		Site not selected	E1.1, E1.2
Segment F (SeaTac)			
F1 Angle Lake Park	10.5	Community beach park	F1
F2 Bow Lake (proposed improved public access)		Lake surrounded by private property	F1, F2.1, F2.2; South Central SeaTac Station
F3 Flag Pavilion	0.25	Pocket park	F1, F2.1, F3.1, F3.2; South Central SeaTac Station
F4 SeaTac Office Center Park	0.25	Pocket park	F1, F2.1, F3.1; South Central SeaTac Station
F5 Pedestrian/Bike Crossing of Int. Blvd. at S. 192nd St. (proposed)			F1

4.16.2.2 Parklands Impacts

Table 4.16-2 identifies the likely long-term direct and/or proximity impacts that would be experienced at specific parklands resources. More detailed information on long-term operations impacts to parkland resources is presented in back-up material maintained by Sound Transit. Short-term construction impacts are discussed in Section 4.17. No impacts are anticipated as a result of the development of any of the maintenance bases, or the No-build Alternative.

Of the impacts identified in Table 4.16-2, only a few are of a sufficiently adverse nature to be considered significant. The following is a brief discussion of those impacts, by alternative. Alternatives not mentioned would not have significant impacts.

Alternative A2.2. Westward views from Rainbow Point Park would be somewhat impacted. While the top of the elevated structure has been lowered to be below the level of the park and approximately 70 to 80 ft. from the edge of the park, the passing trains and the associated overhead catenary support poles would be visible to park users in middle distance views (view location 3 in Appendix I-Visual Simulations). Long-distance views to the Olympic Mountains should not be affected. Because Rainbow Point derives its primary recreational value from its viewpoint setting, this partial view impact may be viewed as significant to some park users.

Alternatives A2.1 and A2.2. The elevated structure over Ravenna Boulevard would require an easement or right-of-use and the removal of several median trees, other vegetation, and lawn areas within a 27-ft-wide strip under the new structure. A column to support the structure would be placed in the median. The structure would increase the shading and "tunnel" effects over Ravenna Boulevard already created by the I-5 Bridge. The new structure may also create minor visual intrusion to some viewers within the median or travelling along the boulevard (especially those to the southeast of the structure).

Alternative B2.1. The new high-level bridge over the Ship Canal would require acquisition of 11 percent of the North Passage Point Park, and 17 percent of the South Passage Point Park. In addition, a portion of each park would be under the new bridge, resulting in additional shading of the parks (the parks are already extensively covered by the I-5 Bridge). The large piers would also impact views from the parks to the Ship Canal Bridge. The bridge structure may also require the relocation of the Pocock Rowing Center's western float.

Alternative C3. The I-90 Station for this alternative would be sited across the western spur of the I-90 Trail, which leads to/from Rainier Avenue S. Placing the station across the trail spur at this location would potentially disrupt the connection for trail users between the main I-90 Trail and Rainier Avenue S. The I-90/17th Avenue S. station would be sited within the future Sister City Park's boundaries between 17th Avenue S. and 19th Avenue S., and would require approximately 7.5 percent of the total park area. To the east of the station, 350 ft of the light rail route's elevated section would cross directly over the park.

Alternatives D1.1 – preferred alternative, D1.3, D3.3, and D3.4. In the Option A station for Alternatives D1.1, D1.3, D3.3, and D3.4, the at-grade light rail station would cross the undeveloped Cheasty Boulevard (S. Winthrop Street) right-of-way. With the McClellan Station options B and C for Alternatives D1.1, D1.3, D3.3, and D3.4, the elevated section of the light rail route would cross directly over the right-of-way and the elevated station would be located immediately to the north of the boulevard. The at-grade or elevated crossing would require a right of use or easement from the City of Seattle. The at-grade crossing of the boulevard would create some safety and traffic impacts, which are discussed in Section 3 of this Final EIS. The at-grade alignments would make the envisioned connection with Mt. Baker Boulevard. more difficult and thus would be contradictory to the unstated but continuing goal of linking these Olmsted boulevards both visually and functionally. The elevated alignments would create some shading effects over the boulevard and would also affect the visual linkage with Mt. Baker Boulevard. The McClellan Station would increase the amount of traffic and activity along the boulevard as transit riders access the station. However, the project would provide reconstruction of Cheasty Boulevard, will add landscaping, and a pedestrian connection to Mt. Baker Boulevard consistent with the boulevard's intended character.

Alternative E2. Between the light rail crossing of the Duwamish River and the Allentown Bridge, the E2 route and the Duwamish/Green River Trail would share the Seattle City Light right-of-way. Three sections of the trail (along the south shore of the river where light rail would cross the trail, near the intersection with 40th Avenue S., and just north of the Allentown Bridge) would be re-located within the right-of-way to avoid conflicts with the light rail. The proximity of the trail and the light rail could create moderate visual impacts and slight noise impacts within 75 ft of the route, affecting the character of the trail and the recreational experience of trail users.

The elevated section of Alternative E2 would cross directly over Lookout Park. The 27-ft-wide, 16-ft-tall structure would create additional shading and visual impacts that would substantially change the character of this park. According to the City of Tukwila Parks Department (letter from Don Williams, Director, City of Tukwila Parks and Recreation Department September 28, 1998), Lookout

Park is rarely used, is not considered of significant value to the community, and could be relocated or eliminated.

The proposed retained cut-and-fill section (the transition from the elevated section over I-5 to the at-grade section farther south) would relocate the Foster Golf Course entrance at least 250 ft farther south and make the access to/from a planned clubhouse longer and more circuitous. Approximately 105 existing parking spaces (slightly over one-half the supply) would be taken, complicating the City's efforts to satisfy a growing parking demand. South of the existing parking area, some of the landscaped areas that visually buffers the golf course from Interurban Avenue (and the light rail route) would be lost. The light rail trains would also create a noise impact to the course within 75 ft of the route.

Alternative F1. At Angle Lake Park, Alternative F1 would widen the east side of SR 99 (International Boulevard), acquiring a strip of land 25 ft wide within the park's street frontage. This impact would comprise a loss of approximately 2.2 percent of the park area. The widened roadway would also move the International Boulevard northbound traffic lanes 20 to 25 ft closer to park activities. The light rail route would create visual impacts to the park (trains would be visible to park users) and noise impacts within 75 ft of the route.

No-build Alternative. The No-build Alternative would result in no impacts to parklands. The No-build Alternative may reduce the region's ability to meet density goals, which could result in park impacts from other development and transportation facilities.

4.16.2.3 Terminus Station Impacts

If the Capitol Hill Station is a terminus station as part of MOS B, impacts to Bobby Morris Playfield would be less than those projected for the non-MOS alternatives. If the McClellan Station is a terminus station as part of MOS A, Cheasty Boulevard would be impacted by increased bus traffic and station area activity. If the Henderson Station is a terminus station as part of MOS B, impacts to Chief Sealth Trail would be the same as those projected for the non-MOS alternatives.

4.16.2.4 System-Wide Impacts

System-wide impacts are the long-term effects on parklands of the various system improvement alternatives proposed. The range of affected parklands reflects the various alignment alternatives being considered. The preferred alternative would have a significant impact on only one parkland prior to mitigation and no significant impacts after mitigation. Table 4.16-3 summarizes the total number of parklands affected (including minor and proximity impacts) for each length alternative.

Alternative A2.2

Rainbow Point – Place/space the catenary support poles to minimize the middle distance view impact (the precise placement would be determined during final project design). The elevation of the viewpoint could be raised to allow unobstructed views over the catenary.

Alternatives A2.1 and A2.2

Ravenna Boulevard – Where possible, re-landscape temporarily disturbed areas after construction. Sound Transit would create additional open space within the station design.

Alternative B2.1

North and South Passage Point Parks – Replace land acquired for the project, consistent with City Ordinance 118477, with land of equivalent or better size, value, location, and usefulness in the vicinity. Considering the urbanized nature of the area, it may be difficult to find replacement property that meets these criteria. If necessary, Sound Transit would relocate the Pocock Rowing Center's western float.

Table 4.16-2
Summary of Long-term Impacts to Parklands

Segment/Alternative Park Facility (ID)	Direct Impacts		Proximity Impacts				
	Property Acquisition	Other[1]	Noise	Visual	Station Area Activity[2]	Access Restrictions[3]	Shading Effects
Segment A (Northgate to University District)							
A1.1 Roosevelt H.S. Playfield (A5)	--	--	--	--	X	--	--
A2.1 Ravenna Blvd. (A3)	--	X	--	X	X	--	X
A2.2 Rainbow Point (A2)	--	--	--	X	--	--	--
A2.2 Ravenna Blvd. (A3)	--	X	--	X	X	--	X
Segment B (University District to Westlake Station)							
B1 Burke-Gilman Trail (B1)	--	--	X	--	X	--	--
B1 Sakuma Viewpoint (B2)	--	--	--	--	X	--	--
B1 Portage Bay Vista/Boat St. View Corridor (B2a)	--	--	--	--	X	--	--
B1 Bobby Morris Playfield (B15)	--	--	--	--	X	--	--
B2.1 Burke-Gilman Trail (B1)	--	X	X	X	--	--	X
B2.1 North Passage Point Park (B3)	X	X	--	X	--	--	X
B2.1 South Passage Point Park (B4)	X	X	--	X	--	--	X
B2.1 North Gateway Park (B4a)	--	X	--	--	--	--	--
B2.2 Burke-Gilman Trail (B1)	--	--	--	--	X	--	--
B2.2 Sakuma Viewpoint (B2)	--	--	--	--	X	--	--
B2.2 Portage Bay Vista/Boat St. View Corridor (B2a)	--	--	--	--	X	--	--
Segment C (Westlake Station to S. McClellan Street)							
C2.3 I-90 Trail (C17)	--	--	--	--	X	--	--
C2.3 Judge Charles M. Stokes Overlook (C18)	--	--	--	X	--	--	--
C2.3 Future Sister City Park (C19b)	--	--	--	--	X	--	--
C2.3 Atlantic Street Park (C19c)	--	--	--	--	X	--	--
C3 I-90 Trail (C17)	--	X	--	X	X	--	X
C3 Future Sister City Park (C19b)	X	X	--	X	X	X	X
C3 Atlantic Street Park (C19c)	--	--	--	X	--	--	--
Segment D (S. McClellan Street to Boeing Access Road)							
D1.1 Cheasty Boulevard (C28)[4]	--	X	--	X	X	--	X
D1.1 Rainier Vista Playfield (D2a)	--	--	--	--	X	--	--
D1.1 Chief Sealth Trail (proposed) (C21b)	--	X	--	--	X	--	--
D1.1c, D1.1e East Duwamish Greenbelt (D9)	X	--	--	--	--	--	--
D1.3 Cheasty Boulevard (C28)[4]	--	X	--	X	X	--	X
D1.3 Rainier Vista Playfield (D2A)	--	--	--	--	X	--	--
D1.3 Chief Sealth Trail (proposed) (C21b)	--	X	--	--	X	X	--
D1.3 East Duwamish Greenbelt (D9)	X	--	--	--	--	--	--
D3.3 Cheasty Boulevard (C28)[4]	--	X	--	X	X	--	X
D3.3 Rainier Playfield (D2)	--	--	X	--	--	--	--
D3.3 Chief Sealth Trail (proposed) (C21B)	--	X	--	--	X	X	--
D3.3 East Duwamish Greenbelt (D9)	X	--	--	--	--	--	--
D3.4 Cheasty Boulevard (C28)[4]	--	X	--	X	X	--	X
D3.4 Rainier Playfield (D2)	--	--	X	--	--	--	--
D3.4 Columbia Park	--	--	--	--	X	--	--
D3.4 Chief Sealth Trail (proposed) (C21b)	--	X	--	--	X	X	--
D3.4 East Duwamish Greenbelt (D9)	X	--	--	--	--	--	--

Table 4.16-2 continued

Segment/Alternative Park Facility (ID)	Direct Impacts		Proximity Impacts				
	Property Acquisition	Other[1]	Noise	Visual	Station Area Activity[2]	Access Restrictions[3]	Shading Effects
Segment E (Tukwila)							
E1.1 Duwamish/Green River Trail (E2)	--	X	X	X	--	--	X
E1.1 Southgate Greenbelt Park (proposed) (E3)	--	--	X	--	--	--	--
E1.2 Duwamish/Green River Trail (E2)	--	X	X	X	--	--	X
E1.2 Southgate Greenbelt Park (proposed) (E3)	--	--	X	--	--	--	--
E2 Duwamish/Green River Trail (E2)	--	X	X	X	--	--	X
E2 Lookout Park (E5)	--	X	--	X	--	--	X
E2 Foster Golf Course (E6)	--	X	X	X	--	--	--
E2 Log Cabin Park (proposed) (E7)	--	--	--	--	--	X	--
E2 Fort Dent Park (E10)	--	--	X	X	--	--	--
E2 Interurban Trail (E15)	--	X	X	X	--	--	X
E3 Fort Dent Park (E10)	--	--	X	X	--	--	--
E3 Interurban Trail (E15)	--	X	X	X	--	--	X
E3 Duwamish/Green River Trail (E2)	--	X	X	X	--	--	X
E3 Bicentennial Park (E16)	--	--	X	X	--	--	--
Segment F (SeaTac)							
F1 Angle Lake Park (F1)	X	--	X	X	--	--	--
F2.2 Bow Lake (F2)	--	X	--	--	--	--	--

Notes: [1] The "other" column includes a variety of impacts:
Elevated structure crosses over the facility (Ravenna Blvd., Burke-Gilman Trail, North and South Passage Point Parks, "North Gateway Park", I-90 Trail, Future Sister City Park, Cheasty Boulevard, Duwamish/Green River Trail, Lookout Park, Interurban Trail). Need for easement or right-of-use (Ravenna Blvd., E. Duwamish Greenbelt, Cheasty Blvd.)
At-grade section crosses the facility (Chief Sealth Trail, Cheasty Boulevard, Duwamish/Green River Trail).
Project would affect ability to achieve city goal (Bow Lake).
[2] Impacts related to the proximity to proposed stations and terminus stations (such as higher usage of the facility by transit riders, increased traffic, noise, and activity in the general area).
[3] Access restrictions relate to impeded vehicular and/or pedestrian access to the facility
[4] With McClellan Station options B and C (elevated station) there would be a visual impact and shading effects. With station Option A (at-grade station) the impacts would not occur.
Preferred alternative appears in italics.

Table 4.16-3 Summary of Impacts to Parklands by Length Alternative

System Alternative	Number of Affected Parklands		
	Total[1]	Significant[2]	After Mitigation
Northgate to SeaTac	10 to 21	2 to 10	0 to 7
45th to SeaTac	9 to 19	1 to 9	0 to 7
Preferred Alternative	9	1	0
MOS A (45th Station to McClellan Station)	4	1	0
MOS B (Capitol Hill Station to Henderson)	3	1	0
MOS C (45th to Lander)	4	0	0

[1]Impacts are prior to mitigation and include minor and proximity impacts.
[2]Impacts are prior to mitigation and include only the parklands that would be significantly impacted.

4.16.3 Mitigation

Many of the identified impacts noted above could be minimized with appropriate mitigation measures as discussed below.

Alternative C3

I-90 Trail – Relocate the western trail spur to/from Rainier Avenue S. slightly to the north, between the I-90/17th Avenue S. station and the I-90 retaining wall.

Future Sister City Park – Replace park land acquired for the project under City Ordinance 118477. Considering the urbanized nature of the area and the park's continuity and trail linkage with other public open spaces, it may be difficult to find replacement property that meets the criteria.

Alternatives D1.1 – preferred alternative, D1.3, D3.3, and D3.4

Cheasty Boulevard – All station components, street improvements, and landscape plans associated with the design of the McClellan Station and guideway overpass at Cheasty Boulevard (S. Winthrop Street) would be prepared in consultation with the Seattle Public Parks Department, Seattle Landmarks Preservation Board and the SHPO. Such plans would be developed with the objective of:

- Improving Cheasty Boulevard in the light rail station area in a manner compatible with the original Olmsted design;
- Providing at-grade pedestrian and bicycle access across Rainier Avenue S. and MLK Jr. Way S. between the Olmsted-designed Mt. Baker and Cheasty boulevards;
- Minimizing, to the extent practicable, the physical encroachment into the right-of-way of Cheasty Boulevard;
- Minimizing, to the extent practicable, the obstruction of views from Cheasty Boulevard toward Mt. Baker Boulevard;

Alternative E2

Duwamish/Green River Trail – Provide a buffer between the trail and the light rail route. Where possible, re-landscape disturbed areas and add new vegetation to help buffer the trail from the light rail route. To minimize potential safety conflicts, install gates and/or signals wherever the trail and the light rail route would cross, or provide a grade-separation if feasible.

Lookout Park – Sound Transit would coordinate with the City to identify suitable replacement sites that provide views of the Green River.

Foster Golf Course – Install gates and/or signals at the proposed golf course entrance to minimize potential safety conflicts between golf course users and the light rail. Sound Transit would work with the City of Tukwila to identify ways to replace the lost parking spaces. The planned maintenance building and clubhouse relocation could make land available for replacement parking; other locations within the golf course could also provide space for parking. Where possible, re-landscape disturbed areas and add new vegetation to help buffer the golf course from the light rail route. Investigate the feasibility of extending the elevated configuration farther south to minimize parking and access impacts.

Alternative F1

Angle Lake Park – Install new sidewalk and a landscaped buffer along the park's street frontage. Replace land acquired for the project, according to Section 6(f) of the Land and Water Conservation Act, with land of reasonably equivalent recreational utility and location.

Specific mitigation measures for other lesser impacts to parkland resources are identified in the Parklands Technical Back-up.

4.16.4 Significant Unavoidable Adverse Impacts

While the proposed mitigation measures will help to minimize the identified impacts, some of the adverse impacts will not be avoided or minimized to levels below the significance threshold. Those significant impacts would include acquisition of park property, or other impacts that would significantly impair the features and/or attributes, and thus the enjoyment of the park. Those impacts include the following:

- B2.1 High-level bridge would acquire and cover portions of the North and South Passage Point Parks, resulting in additional shading effects and visual impacts (replacement land would be needed to compensate for the property acquisition).
- C3 I-90/17th Avenue S. station and the adjacent elevated section would acquire and cover portions of the Future Sister City Park (replacement land would be needed to compensate for the property acquisition).
- The D1.1c, D1.1d, D1.1f, D1.3, D3.3, and D3.4 at-grade crossing of Cheasty Boulevard would make the envisioned physical connection of Cheasty Boulevard with Mt. Baker Boulevard more difficult. With the elevated option over Cheasty Boulevard, impacts could be mitigated below the significance threshold.
- The proximity of the Duwamish/Green River Trail and the Alternative E2 route along Interurban Avenue could affect the recreational experience of trail users.
- F.1 would acquire a portion of Angle Lake Park, reducing its overall size by approximately 2.2 percent and resulting in SR 99 traffic being up to 25-ft closer to central park activities. Replacement land would be needed to compensate for the property acquisition, following Section 6(f) of the Land and Water Conservation Act requirements.

4.17 CONSTRUCTION IMPACTS

This section discusses impacts that would result from construction activities and would typically end when construction is complete. The primary goals of the evaluation of short-term (construction) impacts in the EIS are to:

- Identify potential major construction impacts
- Identify potential mitigation measures for major impacts
- Compare the major construction impacts of the alternatives

The current analysis is based on conceptual design and assumptions regarding the construction approach. The construction mitigation plan would be refined throughout project design and construction. The major construction activities that could cause environmental impacts include:

- Demolition (buildings, pavement)
- Fill and Excavation
- Utilities (major relocations or disruptions)
- Drainage changes
- Vegetation removal (temporary)
- Construction easements and staging areas
- Construction activity in or near a water body or sensitive area
- Tunneling, including spoils removal and transport
- Elevated structure construction
- Retaining wall construction
- Pile driving or drilling
- Blasting
- Temporary partial road or lane closures
- Temporary total road closures and reroutes
- Building temporary, new detour routes
- Delivery of materials and equipment

The construction activities that have been analyzed are intended to represent possible construction techniques and operations, truck routes, and staging schemes. The following discussion summarizes the assumptions used in the EIS.

Construction Sequence and Activities

Linear projects such as the Central Link Light Rail are typically divided into various segments or line sections for construction of at-grade trackway, elevated structures, tunnels and underground stations, park-and-ride facilities, station platforms, transit centers, maintenance yards, sub-station and signal control facilities, and other related improvements. The construction sequence would vary depending upon pre-existing conditions and the characteristics of the light rail facilities. A work-specific construction plan would be developed during the final design effort to establish the limits for the various construction phases and construction contracts, their estimated schedule and duration, and appropriate sequencing. Where possible, construction activities would be coordinated with other capital improvement projects being carried out by the local jurisdictions to help minimize construction impacts.

The initial phase of construction work would normally involve demolition/clearing and rerouting of utilities. In some areas it would be necessary to demolish existing buildings or structures prior to starting construction of light rail facilities. Demolition would involve implementing stormwater and erosion control measures, tearing down buildings and structures, relocating utilities, removing debris, and containment and disposal of hazardous materials. Demolished structures could potentially contain asbestos material, lead paint, or other regulated materials. There may also be underground storage tanks associated with some structures, thus increasing the risk of potential soil contamination. All regulatory requirements for asbestos removal, soil testing, fuel tank removal, structure demolition, utility abandonment, and removal and disposal of hazardous materials would be followed during the demolition phase. Demolition work would create noise and dust, and truck traffic associated with debris removal.

Surface construction activities would occur primarily between the hours of 7 A.M. and 10 P.M.; below ground activities would likely extend beyond these hours. Construction noise levels would be expected to comply with noise ordinance limitations, but may occasionally exceed noise criteria during certain activities. In addition, to reduce the overall construction duration and costs, there may be a need to perform some activities outside of these hours. Sound Transit expects to seek a noise variance that would specify allowable exceedances and limitations. Truck hauling would typically occur between the hours of 8 A.M. and 8 P.M. Truck haul routes would be approved by local jurisdictions. In emergencies or urgent necessity, occasional hauling may occur outside these hours. Pedestrian access to existing businesses and residences would be maintained at all times during construction. Vehicle deliveries to businesses would be maintained via existing or alternate routes.

Although project construction and testing will last approximately five years, construction-related disruption would occur over about a two to four year period. The duration of heavy civil construction in front of any particular property will typically not exceed six to twelve months, with some exceptions. The exceptions are primarily associated with tunnel construction, including adjacent to tunnel vent shafts, tunnel portals, spoils removal locations, tunnel construction staging areas, and transitions between bored/mined tunneling sections and cut-and-cover construction sections. Examples include the Convention Place and Pacific Street staging areas. In these areas, spoils removal and handling, supplying tunnel construction and tunnel finish work will result in ongoing heavy construction activity for up to 48 months. These will be the most severely impacted areas. Also, tunnel stations would likely have intense activity occurring on the surface at the actual station entrance for much of the construction period.

In most other areas, even with cut-and-cover construction, the heavy civil work would be completed in less than a year, followed by subsequent, less disruptive installation of systems components. For example, construction of the Capitol Hill Station would disrupt one side of Broadway at a time for a total of nine to eleven months until the street is lidded over. Then most of the finishing work would occur under the lid, with less disruption.

Construction Staging Areas

Another element in the initial construction sequence is the development of staging areas. Staging areas are needed in advance of all construction work. The staging areas for tunnel boring and mining would be located at or near tunnel portals, station entrances or vent shafts. These staging areas would be used to accomplish one or more of the following: stockpile, load, and haul tunnel spoils; receive and stockpile precast tunnel liners, construction materials and construction equipment; assemble the tunnel boring machine and other boring/mining equipment; and collect, store, and discharge construction water and ground water.

Unlike bored and mined tunnel construction, which requires surface construction staging areas at the points where material is taken out of the ground, at-grade, elevated and retained cut-and-fill sections would have construction staging areas all along the routes. Staging areas for the stations (both at-grade and elevated) would generally need to be larger than for the guideway segments (line sections), and be located at or near the station location. For the line sections, contractors would generally use the property in which the facility is being constructed as the staging area. Other staging areas may be needed where the facility property is not large enough. These areas would be acquired for temporary use through negotiations with private property owners. Potential construction staging areas are identified in Appendix H.

At-grade Light Rail Construction

Open track segments of the route, consisting of at-grade tracks, would require clearing, grading, and shallow excavations. Clearing may include demolition and/or removal of pavement, vegetation, and other surface features, and implementation of an erosion, sediment, and stormwater control plan. During the grading phase, the contractors would install culverts or other permanent drainage structures and below-grade light rail infrastructure. Underground utility services may be relocated before or during the grading phase to remove conflicts with the proposed below-grade infrastructure. This may require temporary steel plates in the roadway and temporary lane closures. Where in-street track is proposed within existing or expanded street right-of-way, grading would be minimal, but extensive reconstruction of streets, sidewalks, and other existing facilities may occur.

Shallow, near-surface excavations would be required to construct the subgrade and track and station platform slabs for at-grade segments. Overhead catenary support poles would be placed in the street or on the sidewalks, before the overhead catenary system would be installed above the trackway. Where the project would partially or fully close streets, traffic would need to be rerouted via detours to ensure that construction proceeds in an efficient and timely manner, while still maintaining access to existing businesses and residences. Traffic closures or detours would be approved by local jurisdictions and/or Washington State Department of Transportation (WSDOT), and comply with agency standards.

Elevated Light Rail Construction

For areas with elevated trackway, light rail transit infrastructure and systems would likely be incorporated within the elevated structures to minimize the probability for below-grade conflicts with existing utilities. Constructing an elevated trackway within existing street right-of-way, depending on the size and location of foundations, may temporarily close some traffic lanes and detour traffic.

Elevated guideways and stations for light rail– similar to structures such as highway bridges– are generally constructed of steel, reinforced concrete or combinations of both. Within road segments or paved areas, pavement would be removed first, while in other areas vegetation and surface material would be removed. Construction would begin with preparation to build foundations that may consist of shallow spread footings, deep driven, augered piles, or drilled shafts. Existing utilities underlying foundation locations would be temporarily or permanently relocated and may result in temporary utility service disruptions (light rail infrastructure and systems such as utility raceways would be incorporated within elevated structures to minimize the probability for below-grade conflicts with existing utilities). Temporary utility service would only be disrupted as approved by local utility service providers. Following clearing, grading, and/or excavation, foundations would be poured. Once foundations are in place, concrete columns and crossbeams would be constructed. Work on foundations, columns and crossbeams may require temporary traffic lane closures or detours.

The superstructure is constructed over the crossbeams and may be built of steel, cast-in-place concrete, or precast concrete. If steel and/or precast concrete is used, they can be transported to the site and lifted onto the substructure from the street. If cast-in-place concrete is used, then a falsework would be required to support the superstructure until the cast concrete has gained enough strength (during curing) to support itself. The falsework would generally require temporary lane closures and traffic detours until a sufficient portion of the elevated structure is complete and the street can be safely reopened. Some short-term, partial to full street closures may be required when completing elevated structures, and will be approved by local jurisdictions.

Where constructing an elevated trackway in undeveloped areas (primarily parts of Segment E), clearing and grading activities would mostly be limited to foundation locations for columns supporting elevated structures. However, clearing and grading activities, along with demolition of other structures for newly acquired right-of-way would likely be greater where the elevated guideway transitions to at-grade track.

Below-grade Light Rail Construction

Tunnels and underground stations would be constructed using mining, boring, or cut-and-cover techniques. The project would likely use cut-and-cover methods for shallow stations (generally less than 90 ft deep) and where the route transitions from at-grade to tunnel sections (typically range in length of 500 to 1,000 ft).

Boring would be used to construct both tunnels and portions of underground stations. Boring begins with construction of an access portal. On hillsides, the access portal can be dug directly into the hillside (using cut-and-cover method). In flatter areas, an access shaft must first be excavated, through which the tunnel-boring machine (TBM) is lowered. Once a portal or shaft is dug, the TBM can begin excavating earth. The resulting excavated materials (spoils) are transported to the shaft or portal for hauling or stockpiling.

As the earth is excavated, the support for the tunnel walls is constructed. The support structure may also be the final tunnel lining (known as a one-pass lining) or the final tunnel lining may be placed later. The latter method involves casting the final lining after the tunnel is bored. After the tunnel lining is completed, the concrete invert, which would support the track, is put in place. After the invert is constructed, the track is then installed along with traction power, signals, communications, etc.

Bored tunnels and stations could result in high levels of truck traffic related to removing excavation spoils and delivering materials. These impacts would likely be limited to tunnel portal areas. Below ground activities would likely extend beyond the hours of 7 A.M. to 10 P.M. for longer tunnels with greater quantities of spoils to be removed. Also, for long tunnels and deep underground stations, there may be the need to construct shafts to provide ventilation. Construction on vent shafts generally begins at the surface and continues down to the tunnel or station level. Excavation spoils are typically brought to the surface for removal by trucks. (Haul routes would be approved by local jurisdictions). Therefore, vent shaft locations would experience potentially high noise levels and impacts to traffic during construction. Mining would be used at some station locations. This work involves a controlled, sequential excavation and ground support of the underground space. Under any of the various techniques, the soft ground may be dewatered, and if necessary, "modified" by grouting or treatment prior to excavation.

The major advantage of boring and mining (compared to cut-and-cover excavation) is that surface disruptions to traffic, utilities, and buildings are minimized. Some surface disruptions would occur because of the need for shafts to the surface to provide ventilation, emergency access, station access, removal of excavated materials, and access for construction materials. Mined station construction tends to be more expensive than cut-and-cover methods.

Cut-and-cover stations (and cut-and-cover tunnel segments) would be excavated from the surface and are essentially large trenches. Excavation proceeds downward from the surface to the station or tunnel invert level. Utilities must be temporarily or permanently diverted, or supported across the excavation. As excavation continues, wall supports are needed. Walls may be supported by bracing or tied-back. The excavation can be decked over at the street level to allow traffic to continue once the excavation is deep enough (10 to 15 ft) to allow earth moving equipment below. Another method to maintain traffic flow is to build a semi-permanent or permanent roadway bridge over the excavation. Openings in the decking or bridge are needed to allow removal of the excavated material.

Cut-and-cover work also requires backfill following wall construction. This work requires the use of imported material or suitable material from the excavation. Cut-and-cover is advantageous because of the low cost. The disadvantage is there is a larger amount of surface disruption to surrounding areas during construction.

For any below-grade work such as underground construction, it is often necessary to install dewatering facilities. Dewatering can be accomplished by a number of general mechanical methods including sumps and pumps in the excavation, wellpoints generally spaced between 3 ft and 20 ft apart, or deep wells spaced further than wellpoints. All of these systems require that water generally be pumped to the surface and either discharged, stored, or recharged into the ground. Three important questions pertaining to water from the dewatering operation are: where to dispose the water; does the water require some type of settlement prior to discharge; and are there any contaminants in the water?

If water is not recharged (pumped back into the ground), it must be discharged or stored for later disposal. Discharge may be directed to the local sewer system. However, some storage or flow control device may be necessary to control flows into the system. If there are particulates such as soil particles in the water, it can be stored until the particulates settle out. If water is to be recharged, additional surface piping may be required to distribute the water over a recharge area. If contaminants are found in the groundwater, measures must be implemented in accordance with applicable environmental regulations. One other concern when dewatering occurs in soft ground is the potential for settlement to occur. If not mitigated, settlement can adversely affect utilities, buildings, and other structures.

During much of the construction activity, excess excavated material would be removed and disposed. Depending on the location of the construction activity, two main removal methods are used. The most common method would be truck hauling (haul routes would be approved by local jurisdictions). This method is the most versatile and is a proven method for hauling material from urban construction sites. Truck hauling would require an off-street loading area, provisions for stockpiling excavated material, staging space for trucks awaiting loading, and provisions to prevent tracking soil and sediment on public streets. The second method is barging and requires proximity to a navigable waterway. Conveyor and barge systems are widely used to transport materials when water access is available. There is a large supply of barges and tugs in the Puget Sound area and a number of these routinely travel through the Chittenden Locks and serve Lake Union, Lake Washington, and the Ship Canal. In the tunnel portal area near Portage Bay, it would be possible to set up a conveyor system from the excavation area to the water where a barge loading operation could be situated.

A conveyor and barge system at the Pacific Station would include an aerial conveyor from the vicinity of the tunnel shafts to an off-shore moorage site located west of the Sakuma viewpoint and south of the University of Washington's Bryant complex. A loading facility at each shaft would place material on the conveyor. From the loading site, the conveyor would be built on elevated piling or bents approximately 18 to 20 ft above ground level. The conveyor would be elevated to cross Pacific and Boat streets and the Burke-Gilman Trail thus minimizing impacts on transportation.

Two types of conveyors could be used: belt or pipe. Belt conveyors are less expensive and typically open on top. However, it would be necessary to enclose some parts of an open style belt conveyor to prevent possible debris from escaping onto surface streets or the Burke Gilman Trail. The pipe conveyor is essentially a flexible belt that is rolled into a cylindrical shape. This type of conveyor is more expensive but has the benefit of being able to transport material that has a higher moisture content.

Two alternatives were considered for barge moorage: the existing dock at the Bryant complex or construction of a new facility. The existing dock is located west of the Sakuma viewpoint. With some minor repair and modifications, this dock could be used for the barge/conveyor operation. A new facility would be comprised of a set of mooring dolphins driven into Portage Bay approximately 75 to 100 ft offshore. The conveyor would be elevated over the water on piles out to the mooring dolphins. A barge that was 75 ft by 275 ft could be accommodated under either alternative.

Barging would reduce truck traffic and truck noise impacts along the haul route. Barging would require additional measures to avoid impacts to water quality and fisheries. Additional descriptions of both barging and trucking options are included in the Central Link Light Rail Tunnel Excavation Disposal Study (Reid Middleton 1999). Refer to Appendix H for figures showing potential staging areas and conveyor barge options.

Following excavation and completion of structures, the next phase of construction would include trackwork, at-grade system facilities, and other light rail transit-related facilities such as surface station platforms, park-and-ride lots, transit centers, and maintenance facilities. Constructing elements located within or directly adjacent to the existing street right-of-way would likely produce high levels of construction truck traffic.

4.17.1 Transportation

4.17.1.1 Traffic and Freight Impacts

Construction of any of the alternatives would result in temporary impacts to local and regional automobile and truck traffic. Construction activities analyzed include construction operations, truck routes, and staging schemes, and their related effects, including:

- Potential lane closure requirements, roadway alignment shifts, areas of construction activity adjacent to travel lanes, or other reductions to street capacity due to construction activities;
- Major construction activities where complete closures and construction of interim detour facilities or identification of available detour routes are desirable to provide the least impact to daily users;
- Areas that would require significant construction coordination between Sound Transit representatives and local jurisdictions, impacted neighborhoods, adjacent businesses and other affected agencies.

Construction traffic impacts would occur where construction site access routes require use of streets not typically used by or designated for use by trucks. In these cases, local jurisdiction approval of truck routes would be required. The City of Seattle's Comprehensive Plan designates all arterial roadways as truck streets to serve local truck traffic. The City of SeaTac also designates certain arterial routes as truck routes. Truck routes are not designated in the City of Tukwila, but are determined on a project–by–project basis as part of final engineering and permitting.

Complete closure of arterials during peak travel periods could be significant, especially if other routes would be congested or lengthy. Impacts could also be significant if the arterial closure prohibits access to businesses.

Truck traffic would be greatest and have potential effects at the locations generating the highest amounts of excavation and tunnel spoils. Table 4.17-1 quantifies the total expected number of truck trips based on excavated material quantities from tunnel construction. Specific quantities and haul routes analyzed for the tunneling work in Segments B and C are summarized in Table 4.17-2. These routes generally follow arterial roadways. For the north Capitol Hill and University District tunneling work, spoils may be removed via an elevated conveyor from the Pacific Station to barges at Portage Bay; this would greatly reduce the impacts on surrounding arterials. The method for disposal of tunnel spoils would be selected as part of final engineering and permitting.

Even with careful designation of haul routes, access to construction areas would require use of non-arterial streets in certain areas. Coordination with local agency staff would take place as part of final engineering and permitting to ensure streets are adequately signed and any necessary traffic control measures installed. Table 4.17-3 below lists non-arterial streets likely to be impacted by truck traffic during construction activities for the preferred alternative.

In general, construction staging areas for at-grade, elevated and retained cut-and-fill structures will be located in areas all along the routes. Staging areas at the at-grade and elevated stations will generally need to be larger than along the guideway (line sections). Depending on their schedule for accomplishing the work, these staging areas are usually obtained by the contractors. If additional staging area is needed, beyond the property on which the station is being constructed, contractors will negotiate with private property owners (generally parking lots and other parcels without structures on them) on an "as needed" basis.

Table 4.17-1
Truck Trips Needed for Removal of Spoils

Segment/Alternative	Excavation/ Spoils [1]	Truck Trips[4]
Segment A		
A1.1 12th Ave. Tunnel	338 K	22,500
A1.2 Roosevelt Way Tunnel	339 K	22,600
A2.1 8th Ave.-Short Elev.	242 K	16,100
A2.2 8th Ave.-Elev.	157 K	10,500
Segment B		
B1 Capitol Hill Tunnel	1,210 K	80,700
B2.1 Sea. Ctr.-High-level Br.	872 K	58,100
B2.2 Sea. Ctr.-Port. Bay Tunnel	943K	62,900
Segment C		
C1.1—At-grade center of Lander Street	188 K	12,500
C1.2—At-grade north of Lander Street	187 K	12,500
C1.3—Elevated north of Lander Street	182 K	12,100
C1.4—Elevated south of Forest Street	235 K	15,700
C1.5—Massachusetts Street and I-5 right-of-way	188 K	12,500
C2.3 W. of Rainier-Elev.	32 K	2,100
C2.4 Rainier Ave. S. Tunnel	248 K	16,500
C3 S. Mass. St. Tunnel	102 K	6,800
Segment D		
D1.1d MLK S. – At-grade,4-lane	101 K	6,700
D1.3 MLK S. – Combined Pr.	47 K	3,100
D3.3 Alaska St. Crossover	87 K	5,800
D3.4 37th Ave. S. Tunnel	277 K	18,500
Segment E		
E1.1 Tukwila Intl Blvd	31 K	2,100
E1.2 Tukwila Intl Blvd – Elevated	9 K	600
E2 Interurban Ave.	85 K	5,700
E3 MLK Jr. Way S.	104 K	6,900
Segment F		
F1 Int. Blvd – At-grade	62 K	4,100
F2.1 Wa. Mem. Park – City Ctr. W.	29K	1,900
F2.2 Wa. Mem. Park – City Ctr. E.	30 K	2,000
F2.3 Wa. Mem. Park-Elev. E. of 28th	25 K	1,700
F3.1 W. of Int. Blvd. Gr. Knoll	25 K	1,700
F3.2 W. of Int. Blvd., M. Terminal	22 K	1,500
F4 Int. Blvd. To 28th/24th	25 K[2]	1,700
Maintenance Facilities		
M1-A – S. Lander Street	92 K	6,100
M1-B – S. Lander Street	79 K	5,300
M1-C – Atlantic/Central A	65 K[3]	4,300
M1-D – Rainier Brewery/Roadway Express	74 K[3]	4,900
M1-E – Rainier Brewery/Airport Way	90 K[3]	6,000
M2 N.W. Boeing Access Rd.	100 K	6,700
M3 S.W. Boeing Access Rd.	80 K	5,300

Note: A high rating in one segment does not necessarily correspond to a high rating in another segment. The qualitative ratings are relative to an individual segment with the purpose being to differentiate between alternatives within a segment.

[1] Approximate only. Based on Earthwork and Drainage Areas Matrix, April 1999. (Units in thousands of yd^3).

[2] Estimated based on available information and similar alternatives.

[2] Based on earthwork quantities provided by S. Kirby 7/14/99. (units in thousands of yd^3).

[4] The number of truck trips expected for spoils removal was estimated by assuming that each truck will carry 15 yd^3 of material per trip.

Table 4.17-2
Summary of Truck Traffic Impacts at Tunnel Station and Portal Locations

Location	Facility	Impacted Alt.	Const. Duration	Haul Route	Truckloads/ Day	Spoil Hauling Duration	Route
N.E. 45th St./15th Ave. N.E.	N.E. 45th St. Station	B1, B2.1, B2.2	34 months	From N.E. 45th St./15th Ave. N.E. to I-5 via N.E. 45th St. to I-5	8 to 25	16 months	From N.E. 45th St./15th Ave. via NE 15th Ave. N.E. to Pacific St. to SR 520
Pacific St./15th Ave. N.E.	Pacific Street Station and Tunnel Construction Area	B1, B2.2	47 months	From Pacific Street/15th Ave. N.E. to I-5 via 15th Ave. N.E. to N.E. 45th St.	25-80	31 months	Pacific St to Montlake Blvd. to SR 520
10th Ave./SR 520	SR 520 Vent Shaft	B1, B2.2	8 months	From 10th Ave./SR 520 to I-5 via 10th Ave. E. and Roanoke St. to Harvard Ave. Return from I-5 NB via Lakeview off-ramp and from I-5 SB via Boylston Ave. off-ramp.	6-8	5 months	
Broadway/E. Howell to John St. (Station), Broadway/E. John to E. Thomas (Crossover)	Capitol Hill Station and Crossover Structure	B1	Crossover – 21 months Station – 22 months	From Broadway/ Olive via E. Olive to I-5 NB on-ramp or to Boren NB and Yale EB to I-5 SB on-ramp. Return via I-5 SB to Stewart off-ramp, Boren to E. Olive. Return via I-5 NB to Olive Way off-ramp, E. Olive.	40-55	Crossover – 12 months Station – 9 months	
Boylston Ave. E./E. Madison St.	First Hill Station	B1	34 months	From E. Madison St. and Boylston Ave. via Madison to Broadway, to E. Olive Way then follow Capitol Hill Station route	10-20	Shafts, Station Cavern – 13 months, Headhouse above Shaft A – 2 months, Headhouse above Shaft B – 3 months	Broadway to James to I-5
Pine St./9th Ave. to Terry St.	Convention Place Station	B1, B2.1, B2.2	23 months	From 9th/Terry via Terry and Howell St. to I-5 SB on-ramp at Yale St. , Terry to Olive to I-5 NB on-ramp. Return: I-5 SB to Stewart off-ramp to Terry, I-5 NB to Mercer St. off-ramp to Fairview to Terry, or NB I-5 to Olive off-ramp to Olive, Denny to Stewart to Terry.	25 to 80	23 months	
West of Airport Way/Lander St. intersection	Beacon Hill Tunnel	C1.1, C1.2, C1.3, C1.4, C1.5	40 months	From Airport Way/Lander St. to I-5 via Lander to 4th Ave. Return via I-5 SB to Airport Way SB off-ramp to Airport Way to Lander St.	25 to 80	13 months	
Beacon Ave./Lander St.	Beacon Hill Station	C1.1, C1.2, C1.3, C1.4, C1.5	40 months	From Beacon Ave. to I-5 at Spokane St. via Holgate Ave. to Fourth Ave. S.	8 to 25	12 months	

Source: Sound Transit, Draft Haul Routes Documentation, 6/14/99
Notes: cy = Cubic Yard
Number of truck trips per day calculated assuming 15 cy per truck, with activity 20 to 24 hours per day, five to six days per week. An average of 8 trucks per hour from any one activity site would be expected during major excavation activities.

Table 4.17-3
Construction Traffic Impacts on Non-Arterial Roadways

Location	Potentially Affected Non-Arterial Roadways
N.E. Pacific Street Station Area	N.E. Boat Street Brooklyn Avenue N.E. South of N.E. Pacific St. University Way N.E. South of N.E. Pacific St.
Capitol Hill Station Area	Nagle Place 10th Avenue E.
First Hill Station Area	Summit Avenue E. Boylston Avenue E.
Convention Place Station Area	Terry Avenue
Beacon Hill Station Area	16th Avenue S., 17th Avenue S.
S. Edmunds Station Area	30th Avenue S. 31st Avenue S. 32nd Avenue S. S. Edmunds Street S. Angeline Street
S. Graham Station Area	36th Avenue S. 39th Avenue S. S. Eddy Street S. Angel Place
S. Othello Station Area	43rd Avenue S. 44th Avenue S.

Segment A (Northgate to University District)

Table 4.17-4 summarizes the construction traffic impacts for Segment A. All alternatives in Segment A could cause partial road closures and possible short-term full closures during the placement of the elevated structure over First Avenue N.E. for the Northgate Station Option B; significant truck traffic would be expected. At the 80th/85th street ramps on I-5, full road closures may be necessary during trackway construction; ramp modifications would be required, and temporary detour routes would need to be constructed. Similarly, at Lake City Way N.E./I-5/N.E. 75th Street, all alternatives would cause partial road closures during the construction of elevated or cut-and-cover sections, and a temporary bypass route on I-5 ramps may need to be constructed. Heavy truck traffic would be expected during construction spoils removal, materials delivery, and/or placement of elevated trackway.

Alternatives A2.1 and A2.2 would require partial road closures on Eighth Avenue N.E. for construction of elevated trackway sections. Full closures would likely be required during the construction of the north tunnel portal. Traffic would need to be rerouted during peak construction periods. The longer elevated trackway needs in Alternative 2.2 would require more construction truck traffic. At N.E. Ravenna Boulevard, alternatives A2.1 and A2.2 would involve partial to full road closures during the construction and placement of the elevated trackway. The N.E. Ravenna Boulevard off-ramps from I-5 would likely be closed and reconstructed, and temporary ramps may be needed to avoid a significant impact during construction.

With Alternative A2.2, freight trucks may experience increased delay from temporary lane closures during construction of the elevated crossing of SR 522. Station construction near Northgate Way could also result in freight-truck delays for all Segment A alternatives.

In general, significant traffic impacts for Segment A are concentrated at locations where an elevated trackway is proposed. Except for the ramp closures, which could be significant, minor impacts are also expected along I-5 (all alternatives), N.E. 65th Street (Alternative A2.1), and 15th Avenue N.E. (Alternatives A2.1 and A2.2). Overall, Alternative A2.2 would likely create the most impact during construction of the proposed light rail, followed by Alternative A2.1. Alternatives A1.1 and A1.2 would both result in relatively minor traffic impacts during construction.

Segment B (University District to Westlake Station)

Traffic impacts for Segment B, summarized in Table 4.17-5, are concentrated in areas with proposed light rail profile transitions and high construction traffic volumes. Minor construction impacts, such as partial road closures and truck traffic, would also be expected at other locations during the construction of light rail stations, construction of elevated trackway and locations with lower construction traffic volumes, and tunnel boring. With the preferred alternative (B1), the following streets could be impacted by tunnel boring or cut-and-cover construction: E. John St./Olive Way E., Broadway E., Madison St., E. Denny Way, and Boren Avenue Freight trucks may experience delays from temporary lane closures that may be necessary during station construction near N.E. 45th Street and N.E. Pacific Street. Overall, Alternative B2.1 would likely create the most impact during construction of the proposed light rail, followed by Alternative B2.2. Alternative B1 (preferred alternative) would have fewer impacts to streets, but spoils removed from tunneling activities could involve higher volumes of truck activities on area arterials, particularly in the Pacific Street and Convention Place station areas.

For Alternatives B2.1 and B2.2, partial to full short-term road closures would be expected on Mercer Street from Eastlake Avenue E. to Minor Avenue, and on Harrison Street between Fifth Street and Broad Street. This would be required for construction of transitions between tunnel and elevated trackway and, on Mercer Street to construct the elevated S. Lake Union Station. Pedestrian control may be an issue. Truck traffic may be high for demolition, excavation spoils, delivery of materials, and debris removal.

Staging areas for tunnel spoils removal and construction of stations and ventilation shafts would generate locally concentrated trucking activity. The preferred alternative would have fewer impacts to streets, but spoils removed from tunneling activities could involve higher truck volumes on area arterials, particularly in the Pacific Station area. Haul routes identified for the N.E. 45th Street Station and the Pacific Station use N.E. 15th Street between N.E. 45th Street and I-5. High truck volumes would create a conflict with the high levels of pedestrian activity along N.E. 15th Street during the day and evening hours. The alternate truck traffic route to I-5 via N.E. Pacific Avenue, N.E. Montlake Boulevard and SR 520 would reduce potential conflicts between pedestrians and truck traffic. The Portage Bay barging option for tunnel spoils removal would reduce construction impacts for Alternative B1. Non-significant lane closures would be necessary on I-5 at night during boring operations for the Convention Place Station.

For Alternatives B2.1 and B2.2, construction staging areas for the N.E. 45th Station would be the same as for Alternative B1 (preferred alternative). With Alternative B2.2, construction staging areas for the Pacific Station and south side of Portage Bay would also be the same as for Alternative B1 (preferred alternative). With Alternative B2.1, the N.E. Campus Parkway construction staging area would impact the N.E. Campus Parkway right-of-way and adjacent properties that would be acquired by Sound Transit; acquired property and I-5 right-of-way would also be used for construction staging just south of Portage Bay. West of I-5, staging areas for alternatives B2.1 and B2.2 would be the same, impacting only properties acquired for light rail and the existing Convention Place Station.

With Alternative B1 (preferred alternative), cut-and-cover construction of the Capitol Hill station could result in restrictions on bus service to trolley bus routes (numbers 43 and 8) on E. John Street. Alternatively construction impacts would be limited to impacts to bus stop locations on E. John Street and Broadway with slight interruptions in trolley bus service during off-peak hours.

Table 4.17-4
Construction Impact Summary Segment A (Northgate to University District)

Location/ Alternative	Street Characteristics	Construction Truck Traffic[1]	Road Closure[2]	Detour of Traffic: Detour Route Available?	Detour of Traffic: Neighborhood Traffic Intrusion[3]	On-Street Parking Loss[4]
First Avenue N.E.						
A1.1, A1.2, A2.2	Minor Arterial	Moderate	Partial, possible short-term full closure, significant	Yes	Low	No
I-5						
A1.1, A1.2, A2.1, A2.2	Interstate Freeway	Moderate	Partial	No	Medium	No
N.E. 92nd St., 85th/80th St. Ramps N.E. 70th St. and 70th Ave. N.E. @ I-5						
A1.1, A1.2, A2.1, A2.2	Interstate freeway ramps	Moderate	Full, significant	Limited in immediate vicinity. May require rerouting via I-5	Low	No
Lake City Way N.E. at I-5/N.E. 75th St.						
A1.1, A1.2, A2.1, A2.2	Principal Arterial (SR 522)	Moderate	Partial, significant	Limited in immediate vicinity. May require rerouting via I-5	Low	No
N.E. 65th Street						
A2.1	Minor Arterial	Moderate	Partial to full short-term, off-peak closures	Yes	Low	No
8th Ave. N.E.						
A2.2	Minor Arterial (north of N.E. 65th St.); Principal Arterial (south of N.E. 65th St.)	Moderate	Partial, significant	Yes	Low	No
8th Ave. N.E.						
A2.1, A2.2	Minor Arterial (north of N.E. 65th St.); Principal Arterial (south of N.E. 65th St.)	Moderate	Partial (short-term) and full, significant	Yes	Low	No
N.E. Ravenna Blvd						
A2.1, A2.2	Minor Arterial	Moderate	Partial to full closure of NE Ravenna Blvd off ramps from I-5	Limited in immediate vicinity; may require rerouting via I-5	Low	No
15th Ave. N.E.						
A2.1, A2.2	Principal Arterial	Low	Unlikely	Yes	Low	No

Notes: [1] Moderate truck traffic is associated with major fill, excavation, and concrete work.
[2] Road closure significance is directly related to the street classification, level of traffic affected, and existing levels of service. Closures with systemwide effects would be significant.
[3] Potential for neighborhood traffic intrusion is characterized as either high, medium, or low impact and is related to both potential road closure and options for traffic detour.
[4] Parking loss is characterized as "yes" for parking loss and "none" for no loss. Some off-street parking might be lost due to location and operation of construction staging.

Table 4.17-5
Construction Impact Summary Segment B (University District to Westlake Station)

Alternative	Street Characteristics	Constr. Truck Traffic[1]	Road Closure[2]	Detour of Traffic: Detour Route Available?	Detour of Traffic: Neighborhood Traffic Intrusion[3]	On-Street Parking Loss[4]
15th Avenue N.E. between N.E. 50th Street and N.E. 47th Street						
B1, B2.1, B2.2	Principal Arterial	Moderate	Partial, possible short-term closure	Yes	Medium	None
N.E. Pacific Street						
B1	Principal Arterial	Moderate	Partial	No	Medium	None
N.E. Campus Parkway						
B2.1	Minor Arterial	Moderate	Partial	Yes	Medium	Yes
Eastlake Ave. E.						
B2.1	Principal Arterial	Moderate	Partial, short-term, off-peak	Yes	Low	None
Harvard Ave. E.						
B2.1		Moderate	Partial	Yes	Medium	Yes
Eastlake Ave. E. @ Fairview Ave. N.						
B2.1, B2.2	Principal Arterial (Eastlake) and Collector (Fairview)	Moderate	Partial	Yes	Low	Yes
10th Ave. E. between E. Aloha and E. Roy Streets						
B1	Minor Arterial	Moderate	Partial	Yes	Medium	Yes
Broadway @ Denny Way						
B1	Minor Arterial	Moderate	Partial	Yes	Medium	Yes
E. Madison Street between Broadway E. and Boren Avenue						
B1	Principal Arterial	Moderate	Partial	Yes	Medium	Yes
I-5 near Convention Center						
B1	Interstate Freeway		Partial	No	Low	None
Pine St. between 7th Ave. and I-5						
B1, B2.1, B2.2		Moderate	Partial	Yes	Medium	Yes
Mercer St. from Eastlake to Minor						
B2.1, B2.2	Principal Arterial	Moderate	Partial, possible full, short-term closures	Yes	Medium	Yes
Aurora Ave. @ Broad St.						
B2.1, B2.2	Principal Arterial	Moderate	Partial	Yes	High	None
Harrison St. between 5th and Broad St.						
B2.1, B2.2		Moderate	Full, significant	Yes	Medium	Yes
5th Ave. N. between John St. and Denny Way						
B2.1, B2.2	Minor Arterial	Moderate	Partial, not significant	Yes	Medium	None

Notes: [1] Moderate truck traffic is associated with major fill, excavation, and concrete work.
[2] Road closure significance is directly related to the street classification, level of traffic affected, and existing levels of service. Closures with systemwide effects would be significant.
[3] Potential for neighborhood traffic intrusion is characterized as either high, medium, or low impact and is related to both potential road closure and options for traffic detour.
[4] Parking loss is characterized as "yes" for parking loss and "none" for no loss. Some off-street parking might be lost due to location and operation of construction staging.

Segment C (Westlake Station to S. McClellan Street)

Spoils removal at portals to Alternatives C1.2 (preferred alternative), C1.3, C1.4, C1.5, C2.4 and C3 tunnels would cause impacts such as partial and full road closures. These impacts are summarized in Table 4.17-6. High levels of truck traffic would be expected for each of these alternatives. The E-3 Busway, which is a limited access roadway, could be partially closed. Detour routes are available for all locations during construction activity. With the preferred alternative (C1.2), station construction and removal of cut-and-cover tunnel spoils would generate high levels of construction truck traffic and cause impacts including partial and full closures along Beacon Avenue S., S. Lander Street (near Beacon Avenue S.), 15th Avenue S., 16th Avenue S., and 17th Avenue S. Pedestrian control would need to be addressed should the Beacon Hill Station be constructed. Construction activity would be coordinated with other projects by King County Metro and WSDOT, including SR519, E-3 Busway, and Ryerson Base Expansion. Overall, Alternative C3 would likely create the most impact during construction of the proposed light rail, followed by alternatives C1, C2.3, and C2.4, with the least amount of impact. With available alternate routes and low traffic volumes on surrounding streets, road closure impacts would not be significant.

Freight trucks may experience delays from temporary lane closures during at-grade construction between the E-3 Busway and Airport Way S. for Alternatives C1, C1.1, C1.2 and C1.3 on S. Lander Street and Alternatives C1.5 and C3 on S. Massachusetts Street. Similar delays may occur during elevated and/or at-grade trackway construction for alternatives C2.3 and C3 along sections of Rainier Avenue S. Construction of Alternative C1 would impact BNSF railroad activity, especially north of S. Lander Street, and construction activities would need to be scheduled.

Construction staging areas for at-grade, elevated and retained cut-and-fill structures will be located in areas all along the routes. Staging areas at the at-grade and elevated stations will generally need to be larger than along the guideway (line sections). These staging areas are usually obtained by the contractors, depending on their schedule for accomplishing the work. If additional staging area is needed, beyond the property on which the station is being constructed, contractors will negotiate with private property owners (generally parking lots and other parcels without structures on them) on an "as needed" basis. Construction would be coordinated with other projects by Metro and WSDOT (i.e. SR519, the E-3 busway, Ryerson Base Expansion).

Table 4.17-6
Construction Impact Summary Segment C Westlake to S. McClellan Street

Location/ Alternative	Street Characteristics	Constr. Truck Traffic[1]	Road Closure[2]	Detour of Traffic: Detour Route Available?	Detour of Traffic: Neighborhood Traffic Intrusion[3]	On-Street Parking Loss[4]
E-3 Busway from South Portal to Royal Brougham Way						
C1 (all), C2.3, C2.4, C3	Limited Access Roadway	Moderate	Full	Yes	None	None
E-3 Busway from Royal Brougham Way to S. Massachusetts Street						
C1 (all), C3	Limited Access Roadway	Moderate	Partial	Yes	None	None
E-3 Busway from S. Massachusetts Street to S. Lander Street						
C1.1, C1.2, C1.3, & C1.4	Limited Access Roadway	Moderate	Partial	Yes	None	None
S. Lander Street from E-3 Busway to I-5						
C1.1, C1.2 and C1.3	Minor Arterial	Moderate	Partial	Yes	Low	Yes
S. Lander Street from 15th Avenue S. to 17th Avenue S.						
C1 (all)	Minor Arterial	Moderate	Partial	Yes	Medium	None
26th and 27th Avenue S.						
C1 (all)		Moderate	Partial	Yes	Medium	Yes
S. Massachusetts Street from E-3 Busway to west of I-5						
C1.5, C3	Collector	Moderate	Partial	Yes	Medium	Yes
S. Forest Street From E-3 Busway to I-5						
C1.4	Collector	Moderate	Partial	Yes	Low	None
S. Massachusetts (vicinity of 17th Avenue S. to Rainier Avenue S.)						
C3	Collector	Moderate	Partial	Yes	Low	None
Rainier Avenue S.						
C2.3, C3	Principal Arterial	Moderate	Partial, significant	Yes[5]	High	None

Notes: [1] Moderate truck traffic is associated with major fill, excavation, and concrete work.
[2] Road closure significance is directly related to the street classification, level of traffic affected, and existing levels of service. Closures with systemwide effects would be significant.
[3] Potential for neighborhood traffic intrusion is characterized as either high, medium, or low impact and is related to both potential road closure and options for traffic detour.
[4] Parking loss is characterized as "yes" for parking loss and "none" for no loss. Some off-street parking might be lost due to location and operation of construction staging.
[5] Via minor collectors and local streets; may be limited in some sections.

Segment D (S. McClellan Street to Boeing Access Road)

MLK Jr. Way S. would experience major traffic impacts with construction of any of the alternatives, as shown in Table 4.17-7. All alternatives impacted by at-grade light rail would generate some truck traffic during demolition of adjacent structures and grading of newly acquired right-of-way. With Alternative D1.1e (preferred alternative), lane and roadway closures would occur on MLK Jr. Way S. from S. Norfolk Street to S. McClellan Street. Lane closures would be coordinated with the City of Seattle and be included in construction traffic control plans. All other at-grade light rail alternatives would impact shorter segments of MLK Jr. Way S. North/south traffic could divert to other streets including Rainier Avenue, Renton Avenue and Beacon Avenue during construction. During station area construction, local traffic diversion would be expected from MLK Jr. Way S. onto S. Edmunds Street, S. Graham Street, S. Eddy Street, 32nd Avenue S., 39th Avenue S., and 44th Avenue S. Detour routes would be posted to minimize construction traffic impacts on residential streets parallel and connecting to MLK Jr. Way S. Maintaining left-turn access to businesses and active shipping routes during construction would be difficult. Special consideration for pedestrian safety would likely be required, especially along school walk routes near Franklin High School. Sound Transit would coordinate all construction activity with other projects in the alignment vicinity, including King County Metro's CSO project at Henderson Street.

Alternative D1.3 would further impact MLK Jr. Way S. with higher levels of truck traffic during construction of the elevated trackway. Lane closures during erection of support beams would likely be necessary.

Alternative D3.3 would involve full closure of S. Alaska Street. Other alternatives may use S. Alaska Street for removal/delivery of materials. Alternatives D3.3 and D3.4 could cause significant truck traffic on Rainier Avenue S., related to delivery of materials. Alternative D3.4 would cause similar truck traffic impacts to 37th Avenue S, and parts of the roadway would be closed during tunnel construction.

Freight trucks may experience delays from temporary lane closures on MLK Jr. Way S. during at-grade trackway and station construction for all Segment D alternatives.

Segment E (Tukwila)

Construction activity would create traffic impacts for all alternatives and along much of the segment, although the location of the impacts would differ. Table 4.17-8 summarizes these impacts for Segment E.

Alternatives E1.1 (preferred alternative) and E1.2 would impact Tukwila International Boulevard (SR 99) due to truck traffic and reduced access to surrounding businesses. Special considerations for pedestrian safety, particularly along school walk routes and near the Riverton Hospital, would likely be needed. With Alternative E1.1, partial lane closures would be necessary along MLK Jr. Way S. between S. Norfolk Street and Boeing Access Road, and on Tukwila International Boulevard (SR 99) from Boeing Access Road to S. 148th Street. Additional partial lane closures during off-peak hours would be needed on I-5. Alternative E1.2 would cause higher levels of truck traffic, and partial lane closures for longer periods than E1.1 due to excavation and elevated trackway construction activities.

All alternatives would impact MLK Jr. Way S. with high levels of truck traffic during construction of transitions to elevated trackway, and for delivery and erection of elevated structures. The cut-and-cover tunnel for Alternative E3 would require partial roadway closures for short-term periods, and staged tunnel construction to maintain traffic would likely be necessary. Some minor, short-term closures of side streets would be likely.

Alternative E2 would impact Interurban Avenue north of S. 115th Street due to truck traffic for excavation and construction activities on at-grade and elevated trackway. Some short-term closures of side streets with rerouting of local traffic may be needed, and the Green River Trail may need to be partially closed or rerouted. To avoid impacts to train traffic on the BNSF and UP railroad tracks, the construction schedule may need to be restricted.

Alternative E2 may also require partial lane closures and short–term full closures of Baker Boulevard and Andover Park West for construction of elevated trackway and, on Baker Boulevard, an elevated station. Pedestrian access would likely need to be rerouted. Alternative E3 would cause similar impacts to Strander Boulevard, but due to its importance as a primary access route to Southcenter Mall, careful traffic control practices would likely be required to ensure full access. Strander Boulevard would also experience high levels of truck traffic.

Alternatives E2 and E3 could cause partial lane closures at the I-5/I-405 interchange, but would likely be limited to off peak hours. There may be periods when truck traffic would need to have access to interstate right-of-way to facilitate construction of elevated sections. Alternatives E2 and E3 would cause similar impacts on SR 518, although truck traffic would likely be higher for removal of excavation spoils, delivery of materials, and placement of concrete.

Freight trucks may experience delays from temporary lane closures for at-grade trackway and station construction on Tukwila International Blvd. for alternatives E1and E1.2, on Interurban Avenue for Alternative E2, and on streets in the Southcenter area for alternatives E2 and E3. Some limited impacts to freight railroad activity may occur during elevated trackway construction for alternatives E2 and E3.

Table 4.17-7 Construction Impact Summary Segment D (S. McClellan to Boeing Access Road)

Location/ Alternative	Street Characteristics	Construction Truck Traffic[1]	Road Closure[2]	Detour of Traffic		On-Street Parking Loss[4]
				Detour Route Available?	Neighborhood Traffic Intrusion[3]	
MLK Jr. Way S. from S. Holly Street to S. Norfolk Street						
D1.1, D1.3, D3.3, D3.4	Principal Arterial	Moderate	Partial, significant	Yes	High	Yes
MLK Jr. Way S. from S. McClellan Street to S. Holly Street						
D1.1	Principal Arterial	Moderate	Partial, significant	Yes	High	Yes
Rainier Avenue S.						
D1.1, D1.3, D3.3, D3.4	Principal Arterial	Moderate	Insignificant	No	Low	None
MLK Jr. Way S. from S. McClellan Street to S. Holly Street						
D1.3	Principal Arterial	Moderate	Partial, significant	Yes	High	Yes
MLK Jr. Way S. from S. Alaska Street to S. Holly Street						
D3.3	Principal Arterial	Moderate	Partial, significant	Yes	High	Yes
S. Alaska Street between MLK Jr. Way S. and Rainier Avenue S.						
D3.3	Minor Arterial	Moderate	Full, significant	Yes	Low	None
Rainier Avenue S. from S. Winthrop Street to S. Alaska Street						
D3.3 and D3.4	Principal Arterial	Moderate	Partial, significant	Yes	Low	None
37th Avenue S. from S. Alaska Street to S. Graham Street						
D3.4	Local	Moderate	Partial, significant	Yes	Low	Yes (at transition from at-grade to tunnel section)

Notes: [1] Moderate truck traffic is associated with major fill, excavation, and concrete work.
[2] Road closure significance is directly related to the street classification, level of traffic affected, and existing levels of service. Closures with systemwide effects would be significant.
[3] Potential for neighborhood traffic intrusion is characterized as either high, medium, or low impact and is related to both potential road closure and options for traffic detour.
[4] Parking loss is characterized as "yes" for parking loss and "none" for no loss. Some off-street parking might be lost due to location and operation of construction staging.

Table 4.17-8. Construction Impact Summary Segment E Tukwila

Location/ Alternative	Street Characteristics	Constr. Truck Traffic[1]	Road Closure[2]	Detour of Traffic: Detour Route Available?	Detour of Traffic: Neighborhood Traffic Intrusion[3]	On-Street Parking Loss[4]
MLK Jr. Way S. from S. Norfolk Street to Boeing Access Road						
E1.1, E1.2, E2, and E3	Principal Arterial	Moderate	Partial significant	Yes	Low	None
Boeing Access Road from MLK Jr. Way S. to E. Marginal Way						
E1.1, E1.2, and E2	Principal Arterial	Moderate	Partial	Not Required	Low	None
I-5						
E1.1, E1.2, and E2	Interstate Freeway	Moderate	Partial	Not Required	Low	None
Tukwila International Blvd. (SR 99) from Boeing Access Road / to Highline-Riverton Community Hospital						
E1.1 and E1.2	Principal Arterial	Moderate	Partial, significant	Yes	Medium	None
Tukwila International Blvd. (SR 99) from Highline/Riverton / Community Hospital to S. 148th St.						
E1.1	Principal Arterial	Moderate	Partial, significant	Yes	Low	Yes
Tukwila International Blvd. (SR 99) from Highline/Riverton / Community Hospital to S. 148th Street						
E1.2	Principal Arterial	Moderate	Partial, significant	Yes	Low	None[5]
Interurban Avenue from S. Boeing Access Road to S. 115th Street						
E2	Principal Arterial	Moderate	Partial, significant	Yes	Medium	None
Interurban Avenue S. from S. 115th Street to I-405						
E2	Principal Arterial	Moderate	Partial, significant	Yes	Medium	None
Baker Boulevard						
E2	Collector	Moderate	Partial, significant	Yes	High	None
Andover Park W.						
E2	Minor Arterial	Moderate	Partial	Yes	Low	None
I-5/I-405 Interchange						
E2 and E3	Interstate Freeway	Moderate	Partial, significant	No	Low	None
SR 518 from I-5/I-405 Interchange to International Blvd.						
E2 and E3	State Highway	Moderate	Partial, significant	No	Low	None
MLK Jr. Way S.						
E3	Principal Arterial	Moderate	Partial, significant	Yes	Medium	Yes
Strander Boulevard						
E3	Minor Arterial	Moderate	Partial	Not Required	Low	None

Notes: [1] Moderate truck traffic is associated with major fill, excavation, and concrete work.
[2] Road closure significance is directly related to the street classification, level of traffic affected, and existing levels of service. Closures with systemwide effects would be significant.
[3] Potential for neighborhood traffic intrusion is characterized as either high, medium, or low impact and is related to both potential road closure and options for traffic detour.
[4] Parking loss is characterized as "yes" for parking loss and "none" for no loss. Some off-street parking might be lost due to location and operation of construction staging.
[5] Some parking spaces located in front of businesses and within the Tukwila International Boulevard right-of-way, could be impacted during construction.

Segment F (SeaTac)

All Segment F alternatives would have impacts, and much of the activity would occur on principal arterials. Table 4.17-9 summarizes these traffic impacts for all Segment F alternatives. Alternative F3.2 would have the greatest construction impacts due to its relationship with Sea-Tac Airport's existing terminal access drives.

International Boulevard would experience high levels of truck traffic throughout construction with Alternatives F1, F3.1, F3.2, F3.3, and F4. Partial, short-term lane closures would likely occur, making access to office complexes, hotels, Sea-Tac Airport and businesses more difficult. Cross-streets would be impacted, affecting access to other key transportation links. Traffic control at all major intersections would likely be required.

On 28th Avenue S., Alternatives F2.1, F2.2, F2.3, F3.1 F3.2, F3.3 and F4 would require traffic control measures to maintain access to residential properties during construction. Truck traffic would likely be high for removal of excavation spoils, delivery of materials and erection of elevated trackway.

All alternatives would impact 170th Street S., requiring traffic control during erection of elevated trackway west of and on International Boulevard as well as for construction of at-grade trackway at the intersection. S. 170th Street would have increased traffic if it is used for rerouting of traffic.

All alternatives would cause short-term partial closures of S. 188th and 200th Streets but would be restricted to off-peak to maintain access to I-5, businesses, and residential properties. The park-and-ride site at S. 200th Street would likely provide a construction staging area.

Alternative F3.2 would require careful construction staging and other measures to maintain access on the airport's Terminal Access Drives. Truck traffic would likely be high and could cause significant impacts to departing and arriving passengers, particularly in drop-off and pick-up zones.

For Alternatives F1, F3.1, F3.2, F3.3, and F4, freight trucks may experience delays from temporary lane closures during at-grade and elevated trackway and station construction on International Boulevard.

Table 4.17-9 Construction Impact Summary Segment F SeaTac

				Detour of Traffic		
Location/ Alternative	**Street Characteristics**	**Constr. Truck Traffic[1]**	**Road Closure[2]**	**Detour Route Available?**	**Neighborhood Traffic Intrusion[3]**	**On-Street Parking Loss[4]**
International Blvd.						
F1, F3.1, and F3.2, F3.3 and F4	Principal Arterial (SR 99)	High	Partial, significant	Yes	Low	None
28th Avenue S.						
F2.1, F2.2, F2.3 F3.1, F3.2, F3.3, and F4	Minor Arterial	High	Partial, significant	Yes	Low	None
S. 170th Street						
F1, F2.1, F2.2, F2.3, F3.1, F3.2, F3.3, and F4	Minor Arterial	Low	Partial	Yes	Low	None
S. 188th Street						
F1, F2.1, F2.2, F2.3, F3.1, F3.2, F3.3, and F4	Principal arterial	High	Partial, significant	Yes	Low	None
S. 200th Street						
F1, F2.1, F2.2, F2.3, F3.1, F3.2, F3.3, and F4	Principal Arterial	High	Partial, significant	Yes	Low	None
Terminal Access Drives						
F3.2	Access Roadway	High	Partial, significant	No	Low	None

Notes: [1] High truck traffic is associated with major fill, excavation, and concrete work.
[2] Road closure significance is directly related to the street classification, level of traffic affected, and existing levels of service. Closures with systemwide effects would be significant.
[3] Potential for neighborhood traffic intrusion is characterized as either high, medium, or low impact and is related to both potential road closure and options for traffic detour.
[4] Parking loss is characterized as "yes" for parking loss and "none" for no loss. Some off-street parking might be lost due to location and operation of construction staging.

Maintenance Bases

Construction of the maintenance bases would take approximately 12 to 18 months and involve at-grade trackway approaches to the facility. Short-term construction impacts would likely include partial closure of adjacent streets during construction of at-grade trackway, and some construction traffic for debris removal and material delivery.

4.17.1.2 Traffic and Freight Mitigation

All mitigation measures would comply with local regulations governing construction traffic control and construction truck routing. Sound Transit would finalize detailed construction mitigation plans in close coordination with local jurisdictions, King County Metro, and other affected agencies and organizations. Mitigation measures for traffic and freight impacts due to light rail construction would include the following practices:

- Follow standard construction safety measures, such as installation of advance warning signs, highly visible construction barriers, and the use of flaggers.
- Post advance-notice signs prior to construction in areas where surface construction activities would affect access to surrounding businesses.
- Provide regular updates to assist public school officials in providing advance and ongoing notice to students and parents concerning construction activity near schools.
- Coordinate street sweeping services in construction areas with construction activity, particularly areas with surrounding residential and retail development.
- Use lighted or reflective signage to direct drivers to truck haul routes, to ensure visibility during nighttime work hours.
- Temporary reflective truck prohibition signs should be used on certain non-arterial streets with a high likelihood of diverted truck traffic.
- As possible, schedule traffic lane closures during off-peak hours to minimize delays during periods of higher traffic volumes as much as possible.
- Cover potholes and open trenches during construction hours where possible, and use temporary concrete or other protective barriers to protect drivers from trenches remaining open.
- Post advance warning and install temporary traffic cones and markings to ensure that peripheral surface activities do not adversely affect pedestrian and bicyclist traffic.
- Develop a multi-media public information program (e.g. print, radio, posted signs and electronic web page) to provide information regarding street closures, hours of construction, business access, and parking impacts.
- Provide temporary parking to mitigate loss due to construction staging or work activities, where practical.
- Work with transit agencies to post informative signage well before construction at existing transit stops that would be affected by construction activities.

Transit Impacts

Closure of the DSTT would be required for a period of up to 26 months, during which time downtown streets would need to accommodate the buses that currently operate in the DSTT. Surface street modifications necessary to maintain acceptable operating levels would need to be completed before closing the DSTT. Construction of the pre-closure surface street improvements would require up to 12 months. Impacts of the DSTT closure and improvements to mitigate the impacts on both transit riders and automobile users are discussed in detail in Section 3.2.2 Transit Impacts and Mitigation.

King County Metro's electric trolley bus (ETB) operations would be affected by construction work along some road segments at the Capitol Hill Station on Broadway Avenue. Overhead contact lines would be moved in coordination with in-street excavation and construction. This may involve moving the contact lines from one side of the street to the other, placing new temporary or permanent strain poles, extending support arms, and/or relocating span wires. These measures would allow the trolley buses to continue operating during construction.

4.17.2 Land Use and Economics

Construction activities can temporarily impact land use by affecting the quality and character of existing land uses. Construction impacts to land use quality include increased noise and dust, increased traffic, and adverse visual quality. Land use character would mainly be impacted by activities that temporarily change the land use. For example, staging areas would be used during construction to store materials and equipment. This would temporarily alter existing land uses such as parking lots and vegetated or landscaped areas. Following construction, these areas would generally revert to their previous land use or to uses consistent with adopted station area plans. However, other than acquisition and displacements (which are addressed elsewhere), construction would generally not have a permanent effect on land use (see noise, air, traffic, and aesthetics construction sections for nuisance impacts to adjacent land uses).

Construction work would have more tangible impacts on economic activity, particularly affecting businesses that rely on drive-by or pedestrian traffic. Construction would cause temporary partial blockages to access, traffic detours, parking restrictions, and nuisance impacts such as noise and dust. Smaller businesses may be severely impacted especially if there are weeks or months of nuisance impacts associated with construction. If construction impacts to businesses are sufficiently adverse, then businesses may fail or relocate. Less severely impacted businesses would likely experience short-term declines in revenues due to reduced business activity.

Construction activity would also result in increased output, income, and jobs for the local economy. Estimates of the economic impact of construction expenditures are provided in Section 4.1.

4.17.2.1 Impacts

In Segment A, construction impacts to businesses are likely to be greater for alternatives A1.1 and A1.2 than in A2.1 and A2.2, because potential cut-and-cover tunnel and station construction would occur in proximity to the concentration of businesses in the Roosevelt area retail core. Construction staging could also temporarily affect use of the University Heights Community Center.

In Segment B, overall construction impacts to businesses and institutional facilities at the university are likely to be greater for Alternative B2.1 combined tunnel and elevated profiles, than for Alternative B1, the preferred alternative, or B2.2 because of the elevated structure tunnel route.

Under any of the Segment B alternatives and options, land uses in the northwest corner of the University would be temporarily affected by light rail construction. Uses include the Burke Museum, the natural buffer area along 15th Avenue N.E., and sites of planned University and potential museum development. One of the planned developments is the University's proposed new Law School building, which is funded and planned for a site on the south half of the parking lot. The other structure, the proposed expansion of the Burke Museum (not currently funded), would likely be built along the west side of the existing facility. Sound Transit would need the westerly portion of the parking lot and a portion of the natural buffer for use as a construction staging area. Depending upon the timing of construction, there could be conflicts between use of this area for staging and construction associated with the light rail line/station and the law school building and museum expansion. Use of a portion of the parking lot for construction staging would temporarily reduce the amount of parking available for use by the museum, which would affect visitation. Increased levels of ambient noise and vibration could also affect museum operations/visitation. Indirectly, construction-related activity would disrupt pedestrian access to the campus from the west/northwest, which presently occurs at the entry located at the southeast corner of N.E. 45th Street and 15th Avenue N.E. and at N.E. 43rd Street and 15th Avenue N.E.

Construction staging for N.E. 45th Station Option B would temporarily remove parking and landscaping from the northwest corner of the University campus. Following construction, the landscaping and parking would be replaced or converted to other uses by the University.

To construct the station and provide the needed staging areas for both the station and the adjacent tunnel section, N.E. 45th Station Option C would affect six properties on a temporary basis (primarily construction staging). These properties include the entire eastern half of the long block between N.E. 45th and N.E. 43rd streets. In addition, three small buildings located to the west of the alley and north of the University Bookstore would be acquired and demolished. This would displace three multiple-use properties, consisting of residential (apartment) and commercial (retail uses). A single, larger apartment building, providing 123 units of housing would also be acquired and residents relocated. The property occupied by this apartment building is not necessarily needed for construction staging. However, because of the nature of this structure and its proximity to proposed excavation for the northern station entrance, there is a high probability that the building could be damaged due to settling. Thus for this analysis, the need to acquire this property is assumed. If damage is minimal and repairable, this apartment building could be re-occupied following construction. Construction staging would also likely occur on property currently occupied by the University of Washington Alumni Association Building and parking associated with the University Bookstore.

Indirect construction-related activity could periodically affect pedestrian and service vehicle access to businesses in the general vicinity of the site and result in increased levels of ambient noise and vibration. Noise and vibration associated with construction of light rail access to the station associated with Alternative B1 or B2.2, Option C could also periodically affect services in the church immediately south of the station site. Depending upon the magnitude and duration, vibration may affect terra cotta architectural details on buildings near the construction site and stained glass in nearby churches.

Alternatives B1 and B2.2 would impact university land uses near Pacific Street where the Pacific Station would be constructed. These impacts include: temporary loss (about 4 years) of approximately two acres of parking lots on the university campus, relocation of existing University programs located in facilities within the proposed construction staging area, noise and air quality impacts, which could periodically affect educational activities adjacent to the proposed construction staging area. There would also be considerable activity at this location relative to truck or barge activity to and from this site during tunnel construction for either B1 or B2.2. Noise and vibration associated with conveyors, trucks and/or barge activity could also temporarily affect academic programs and research that is conducted in nearby University facilities.

Under Alternative B2.1, a grassy area located within the right-of-way of Campus Parkway would be altered, because of its use for staging for the Campus Parkway Station. Construction work would likely cause nuisance impacts to Condon Hall (existing law school building) and the Terry-Lander Residence Halls.

Capitol Hill Station Option A could require approximately eight parcels for construction staging. Options B and C would each require approximately nine parcels for construction staging including the properties displaced by the station design option. One commercial parcel would be acquired specifically for the location of a proposed emergency ventilation shaft. Sidewalks along Broadway Avenue would be impacted during construction in Options B and C. For construction staging, Option D would displace approximately 14 business, residential, and mixed-use properties. This option would require partial acquisition of three properties (a bank property, an apartment and approximately 10,800 ft^2 of the public park at Lincoln Reservoir).

In Segment C, with the preferred alternative, modification of existing DSTT stations would permanently displace buses that now use the DSTT. Existing data indicate that about 480 buses now use at First, Second, Third, Fourth, and Fifth avenues for downtown north-south travel and 145 buses operate in the tunnel[2]. By 2004, the numbers are expecting to remain at 480 on the surface but increase to 170 in the tunnel. During construction, a total of 650 buses would be operating on surface streets. Surface street improvements and other mitigation to accommodate the additional bus volumes and bus stops during tunnel renovation would not likely have any significant effect on retail activities. Construction-related land use impacts are also expected as a result of tunnel construction through Beacon Hill. At the west portal, such impacts would involve displacement of existing commercial and housing/distribution land uses that are located east of Airport Way at S. Lander Street and S. Forest Street (extended) and at the east portal. Industrial businesses in the vicinity of the west portal construction staging area could experience temporary disruptions due to increased truck traffic and congestion. Construction activities near the east portal staging area and Beacon Hill tunnel station area could also be disruptive to local residents and community activities at El Centro de la Raza. Also in Segment C, there would be high economic impacts in the north Rainier Valley during construction of alternatives C2.3, C2.4, and C3 because of displacements affecting the narrow strip of businesses along Rainier Avenue S. These businesses are the main source of economic activity in the area. Businesses that are not displaced would be potentially affected because of the removal of neighboring businesses and access limitations caused by construction. In general, adverse economic impacts are likely to be greatest in Alternatives C3 and C2.3, and somewhat less in C2.4. Economic impacts would be lowest in the C1 route alternatives because the route tunnels through Beacon Hill and does not travel along or parallel to Rainier Avenue S. Under the C1 route alternatives, construction-related traffic delays and temporary detours could result in short-term, localized business impacts in the industrial area. The C1 alternatives follow a similar route with small variations associated with the maintenance base alternatives south of the Royal Brougham Station and west of I-5 (see the discussion of the maintenance base alternatives in Chapter 2). Under Alternatives C1.1, C1.2 and C1.3, localized access and circulation impacts would occur in association with construction of at-grade and elevated trackway and would be concentrated along S. Lander Street between Sixth Avenue S. and I-5. Under Alternative C1.4, potential construction business impacts would be concentrated along S. Forest Street between Sixth Avenue S. and I-5. Potential construction business impacts would be relatively greater for Alternative C1.5 than the other C1 alternatives. Construction of at-grade facilities would affect businesses along S. Massachusetts Street from Fourth Avenue S. to I-5 and along Airport Way S. between S. Massachusetts Street and S. Lander Street.

In Segment D, construction impacts would be highest for alternatives D3.3 and D3.4, which would parallel the west side of Rainier Avenue for about a mile in the northern third of the segment. High economic impacts would likely occur along much of the route in all Segment D alternatives because of displacements and other construction impacts to the narrow strip of businesses that provide the main economic activity. Alternative D3.3 would have the greatest number and types of businesses displaced or affected by construction activity. Alternative D3.4 would likely have the most substantial localized construction impacts during cut-and-cover construction of the Columbia City Station.

In Segment E, temporary land use impacts would likely be greatest for Alternative E1.1 (preferred alternative), followed by Alternative E1.2. Many auto-oriented businesses are located along the southern portion of Tukwila International Boulevard where access would be temporarily affected by construction. Construction would require partial closure of Tukwila International Boulevard and could adversely impact many businesses that rely on easy auto/truck access and those whose parking is disrupted by construction activities. Associated access and congestion impacts could deter customers and/or adversely impact freight movement and result in lost revenues for some businesses. Residential uses within Segment E are generally far enough removed from rail routes and would not be substantially affected by construction activities. Alternatives E2 and E3 would be constructed in

[2] Sound Transit, King County, City of Seattle. 1999. Downtown Seattle Surface Report—Alternatives to Improve Transit Operations. April 14, 1999.

areas with somewhat lower concentrations of businesses, with the exception of the commercial office and retail areas in the vicinity of the Longacres and Southcenter stations (within Tukwila's Urban Center). Concentrations of businesses along E. Marginal Way (E2) and within the Tukwila Urban Center (E2 and E3) could be adversely impacted during construction. In the Southcenter area, construction of at-grade and elevated facilities would require partial closure of Strander Boulevard which could adversely affect businesses in this area that rely on easy auto/truck access and circulation. Alternative E2 is in the lowest-density area and would accordingly have the lowest construction economic impacts of the Segment E alternatives.

In Segment F, construction of Alternative F1 in the median of International Boulevard would temporarily reduce access to local businesses and have the greatest potential economic impact. Alternatives F2.1 and F2.2 would have potential construction economic impacts around the City Center Station and along 28th Avenue S.; Alternative F2.1 would also have business economic impacts near the grade transition at S. 150th Street. Construction impacts to residential uses would be greatest under Alternative F2.2, which would require elevated station and track construction near residences along 32nd Avenue S. Alternative F2.2 would result in more displacements and greater construction impacts than Alternative F2.1. Alternatives F3.1, F3.2, F3.3, and F4 would have similar economic impacts, and they would be less severe than the other alternatives in this segment, but impacts to businesses may be high along International Boulevard and 28th Avenue S.

For the maintenance base sites, particularly those located in the North Duwamish industrial area (M1-A, B, C, D, and E), construction-related traffic delays and dust that could adversely impact a business with strict air quality requirements are expected to be the only potentially substantial impacts. The North Duwamish maintenance base sites are located in an industrial area that supports a number of warehousing, industrial, commercial and transportation facilities. Businesses in the area require good vehicular, truck, and/or rail freight access. Traffic congestion and detours associated with construction of the maintenance base and the Beacon Hill Tunnel (for the C1 alternatives) would be likely to result in a small increase in travel times and potentially less reliable travel times which could affect the profitability of distribution-related businesses. The levels of business and transportation activity, and the potential for adverse construction economic impacts, are lower for the N.E. or S.W. Boeing Access Road sites (M2 and M3, respectively). The S.W. Boeing Access Road Site (M3) would probably have the lowest traffic-related construction economic impacts of the three sites; otherwise, construction economic impacts at the M2 and M3 sites would be similar.

4.17.2.2 Mitigation

A business relocation assistance program will be developed as discussed in Section 4.2.2. Additional mitigation measures that will reduce impacts to local businesses during project construction include:

- Establishing effective communication with residents and businesses; developing and implementing a public relations plan that would ensure that local residents and businesses are fully informed about potentially significant disruptions, such as temporary street closures, changes in transit service, and parking availability. Sound Transit would work with community and neighborhood groups prior to and through the construction process to identify types of impacts that would occur and to work on ways to reduce those impacts.
- Sound Transit could work with affected business owners, chambers of commerce, merchants associations, community leaders, and other stakeholders to develop a business marketing program to minimize business losses during construction including:
  - Providing temporary replacement parking and shuttle bus and/or increased transit to affected areas
  - Supporting street festivals, promotions and other activities in affected areas
  - Providing exterior advertising, including signs, banners, and sandwich boards

- Sound Transit could take additional measures aimed at strengthening small businesses' place in the community by:
  - Creating a special outreach team to help small businesses more effectively market by developing marketing plans
  - Supplementing advertising budgets through the provision of flyers and television, newspaper, and radio ads.
- Ensuring that paths to and from major transportation facilities, such as designated pedestrian routes, bicycle lanes, bus routes and stops, designated truck routes, and tunnel entrances, are clearly identified and accessible.
- The program could provide shuttle bus and/or increased transit service to affected areas, additional signage, advertising and promotion, and incentives to attract and retain customers.
- Requesting the assistance of local ethnic community organizations to help tailor business marketing programs to the specific needs of ethnic business owners whose customers are mainly from a single ethnic group.
- Providing business cleaning services on a case-by-case basis, including business interiors, exteriors, faced improvements and landscaping.
- Working with Community Capital Development and similar organizations to assist affected businesses in gaining access to technical assistance and small business loans or grants.
- Developing a 24-hour monitoring center that provides telephone access for the public to forward complaint and incident reports. The center would coordinate immediate responses to emergencies.
- Developing a mitigation commitment tracking system that would provide a record of all mitigation commitments and a means to track progress toward meeting those commitments.
- Specific mitigation to reduce short-term economic impacts on businesses during construction are also discussed in Transportation (4.17.1), Visual and Aesthetics (4.17.4), Noise and Vibration (4.17.6), Public Services (4.17.12), and Utilities (4.17.13).

4.17.3 Neighborhoods

Noise, vibration, visual, aesthetic, and traffic impacts could temporarily affect neighborhood quality. Physical barriers to isolate construction sites from traffic lanes would likely restrict access across arterials on elevated and especially at-grade sections during construction. Some streets would also be partially or fully closed during certain phases of construction, hindering access to some community facilities (e.g., Swedish Hospital under B1; Franklin High School, the Columbia Library, the Southeast Neighborhood Service Center, and the Seattle School District head Start Program under the D alternatives; and Highline Community Hospital, Foster High School and Library under E1.1 and E1.2). Although signed detour routes would be provided, access to community facilities could become more circuitous. Additional traffic from detour routes would have high impacts on some neighborhoods including Seattle Center (B2.1, B2.2), North Rainier (C2.3, C3, D1.1, D1.3), MLK at Holly Street (D1.1, D1.3, D3.3, D3.4), Rainier Beach (D1.1, D1.3, D3.3, D3.4), and Southcenter (E2). Some delays could occur along school bus routes in southeast Seattle, Tukwila, and SeaTac, especially on at-grade sections.

Fire, emergency medical, and police response times could be affected due to blocking problems on at-grade and elevated sections and around cut-and-cover station construction (Roosevelt Station and Columbia City Station). Crossings of MLK Jr. Way S. (all D alternatives), Tukwila International Boulevard. (E1.1 and E1.2), and International Boulevard. (F1, F3.1, F3.2, and F3.3) could be particularly affected. The safety of neighborhood residents, visitors, and employees would be a concern near construction sites.

Construction impacts to neighborhoods could be mitigated using measures listed for each particular discipline. Refer to sections 4.17.1, 4.17.4, and 4.17.6 for details on mitigation measures for traffic, visual, and noise impacts.

4.17.4 Visual and Aesthetics

During construction of the light rail alternatives, construction equipment, materials, signage, and staging areas would reduce the visual quality in the immediate area. Impacts would be greatest for at-grade and elevated route alternatives, tunnel station locations, tunnel portals, vent shafts, and cut-and-cover tunnel construction and maintenance base sites.

Temporary lighting may be necessary for nighttime construction of certain project elements or at tunnel portals and along surface or elevated alternatives in existing road or highway rights-of-way (to minimize disruption to daytime traffic). This temporary lighting could impact residential areas by exposing residents to uncomfortable glare from unshielded light sources, or by increasing ambient nighttime light levels. Temporary lighting impacts could be reduced by shielding light sources to block direct views from residential areas, and by aiming and shielding to reduce spillover lighting in such areas.

4.17.5 Air Quality

4.17.5.1 Impacts

Construction activities primarily generate particulate matter (PM_{10} and $PM_{2.5}$), as well as small amounts of CO and NO_X from construction machinery exhaust and vehicular traffic delayed in construction zones. Specific sources of particulate include dust from earth moving-excavation activities (termed fugitive dust) and diesel smoke.

Fugitive dust from construction activities would occur with all alternatives. Ground surface disturbance and rail line installation would generate fugitive dust along the entire length of the aboveground sections of the line. For underground or tunnel route alternatives, soil handling would be focused on construction staging locations where earth removed by tunneling would be stockpiled and/or loaded for transport. In addition, demolition activities would create fugitive dust, as would removal of concrete foundations and asphalt paving.

The quantity of particulate emissions generated by construction would be proportionate to the construction area. A quantitative estimate of particulate emissions generated has not been determined; however, temporary increases in particulate emissions would be noticeable if uncontrolled. It is typical for construction projects to implement mitigation measures similar to those listed below to offset temporary particulate increases.

All alternatives would have potential but temporary impacts from construction including exhaust from construction vehicles and equipment, and odors created during paving of station areas, parking lots, and roads.

During construction to retrofit the Downtown Seattle Transit Tunnel (DSTT) beginning in 2004, the DSTT would be closed to buses, resulting in increased bus volume on downtown Seattle streets and some related traffic congestion. Sound Transit has recommended a preferred alternative to redistribute buses and other vehicular traffic on downtown streets. The preferred alternative would result in increased delay at several intersections, but only two intersections would decrease to LOS E, and none to LOS F. Even with predicted increased bus traffic during the construction period, downtown Seattle's two–worst case intersections (in terms of bus-related traffic impacts), located at Fourth Avenue/Pine Street and Fifth Avenue/Airport Way, would have much lower traffic volumes, better traffic operations, and much less delay than the eight intersections selected for CO microscale analysis as described in Section 4.5.2.2. The two permanent CO monitors operated by the Washington State Department of Ecology in downtown Seattle (at Fourth and Pike, and Fifth and James) have reported no violations of the 8-hour CO standard in the 1990s. The Puget Sound Clean Air Agency

(1997 Data Summary) reports CO concentrations for the two sites that are annually among the lowest of the region's monitoring sites, and on a declining annual trend. Thus, traffic congestion would not significantly increase in downtown Seattle, and no violations of air quality standards are anticipated as a result of the increased traffic during the light rail construction period. On a long-term basis, operation of light rail through the DSTT is estimated to decrease total vehicle trips in downtown Seattle compared to the No-build condition. No impacts to air quality are anticipated.

4.17.5.2 Mitigation

The Puget Sound Clean Air Agency enforces air quality regulations in King County, including those for controlling fugitive dust (Regulation 1, Section 9.15). Contractors engaged in construction activities must comply with this regulation, which requires the use of best available control technology to control fugitive dust emissions. Controls used to meet this standard may require the following actions:

- Use water spray as necessary to prevent visible dust emissions—particularly during demolition of brick or concrete buildings by mechanical or explosive methods.
- Minimize dust emissions during transport of fill material or soil by wetting down or by ensuring adequate freeboard on trucks.
- Promptly clean up spills of transported material on public roads by frequent use of a street sweeper machine.
- Cover loads of hot asphalt to minimize odors.
- Schedule work tasks to minimize disruption of the existing vehicle traffic on streets.
- Keep all construction machinery engines in good mechanical condition to minimize exhaust emissions.

These standard measures would avoid significant, construction-related dust impacts. Where businesses with unusually high air quality requirements are located adjacent to high dust-generating construction activities, additional mitigation may be required. Potential measures include more frequent cleaning or replacement of the building's air conditioning system filters, or more frequent exterior dust and particulate control measures.

4.17.6 Noise and Vibration

4.17.6.1 Noise Criteria and Impacts

The Washington State Noise Control Ordinance defines three classes of property use and the maximum noise levels allowable between them. For example, the noise caused by a commercial property must be less than 57 dBA at the closest residential property line. This ordinance, which is also used by the Cities of Seattle, Tukwila and SeaTac and is applicable to project modifications such as general construction activities, park-and-ride lots and maintenance facilities. Highway noise on public roadways and rights-of-way are exempt under the noise ordinance. The Washington State Noise Ordinance is summarized in Table 4.17-10.

Table 4.17-10. Washington State Administrative Code Noise Ordinance

(Also used by the City of Seattle, SeaTac, and Tukwila)

Property Usage on Noise Source	Maximum Allowable Sound Level, dBA at Receiving Property		
	Residential	Commercial	Industrial
Residential	55	57	60
Commercial	57	60	65
Industrial	60	65	70

Between the hours of 10:00 P.M. and 7:00 A.M., the maximum allowable levels shown in Table 4.17-10 are reduced by 10 dBA. Besides the property line noise standards, there are the following exemptions for short-term noise exceedances based the minutes per hour that the noise limit is exceeded:

Maximum Minutes per Hour of Exceedance	Adjustment to Allowable Sound Level Exceedance
15	+5 dBA
5	+10 dBA
1.5	+15 dBA

Construction–specific allowable noise is described below for general and impact construction equipment, haul trucks and truck back-up alarms.

General Equipment—For construction activities, the limits set in Table 4.17-10 may be exceeded between the hours of 7:00 A.M. and 10:00 P.M. on weekdays, and 9:00 A.M. and 10:00 P.M. on weekends according to the following limits:

Allowable Exceedance	Equipment Covered
Twenty-Five (25) dBA	Equipment on construction sites, including but not limited to crawlers, tractors, dozers, rotary drill and augers, loaders, power shovels, cranes, derricks, graders, off-highway trucks, ditchers, trenchers, compactors, compressors, and pneumatic powered equipment
Twenty (20) dBA	Portable powered equipment used for temporary locations in support of construction activities, such as chain saws, log chippers, lawn and garden equipment and powered hand tools
Fifteen (15) dBA	Powered equipment used in temporary repair or periodic maintenance of the grounds such as lawn mowers and powered hand tools.

Impact Equipment—Impact equipment includes but is not limited to pavement breakers, piledrivers, jackhammers, sandblasting tools, or by other types of equipment or devices that create impulse noise or impact noise or are used as impact equipment. Noise from impact equipment, as measured at the property line or at 50 ft from the equipment, which ever is greater, may exceed the limits given above in any one-hour period between the hours of 8:00 A.M. and 5:00 P.M. on weekdays and 9:00 A.M. and 5:00 P.M. on weekends, but in no event to exceed the following limits:

Maximum Hourly L_{eq}	Allowable Time for Sound Level Exceedance
90 dBA	Continuously
93 dBA	Thirty Minutes
96 dBA	Fifteen Minutes
99 dBA	Seven and One-half Minutes

Haul Trucks—Maximum permissible sound levels for haul trucks are limited to 86 dBA for speeds of 35 mph or less, and 90 dBA for speeds over 35 mph.

Alarms—Sounds created by back-up alarms are exempt if operated for less than thirty minutes per incident.

Noise Impacts: Tunneling can be performed either by conventional mining, using mechanical equipment, by blasting, or by a tunnel-boring machine. It is anticipated that either conventional mining or tunnel-boring machines would be used for all tunnels. Major noise sources associated with conventional mining include haul trucks, loaders, hoe-rams, excavators, conveyors and other miscellaneous mining equipment. Major sources associated with tunnel boring machines include all the above equipment plus the boring machines. Noise from the boring machine is normally not an issue, because it would be located inside the tunnel. The location of the noise sources associated with tunneling are usually located at the tunnel portals, or at alternate excavation locations such as vent shafts. Noise levels near these areas could exceed 90 dBA L_{max} for short periods of time, depending on the concurrent activities.

There is the potential for the use of pile driving, soil compacting and vibratory sheet installation. The most annoying noise source associated with these activities is pile driving. Maximum noise levels associated with pile driving could reach 105 dBA at distances of 50 ft.

Other construction activities would include the use of bulldozers, haul trucks, loaders, cranes, scrapers, and soil compactors. Noise levels are expected to range from 80 to 90 dBA at receivers within 50 ft of a construction site. Table 4.17-11 contains some general activities and the projected maximum noise levels at 50 ft.

Although the levels may be high at times, no exceedance of the Washington State Noise Control ordinance was predicted by the noise impact model at any of the staging areas or cut-and-cover construction sites as long as all construction work would be performed within the hours given in the Noise Control Ordinance. If construction activities are going to be performed outside these hours, impacts could occur that would require noise control measures such as limiting the types of activities or installing temporary noise barriers between the construction site and nearby noise sensitive receivers.

Table 4.17-11. Estimated Peak Hour Construction Noise Levels

Construction Phase	Loudest Equipment	Noise Level at 50 ft (dBA Lmax)
Clearing and grubbing	Bulldozer, Backhoe, Haul Trucks	88
Earthwork	Scraper, Bulldozer	88
Foundation	Backhoe, Loader	85
Structures	Crane, Loader, Haul Trucks	86
Base preparation	Trucks, Bulldozer	88
Tunnel Boring with Conventional Methods	Loader, Haul Trucks, Hoe-ram	90
Tunnel Boring with Boring Machine	Loader, Haul Trucks	88
Paving	Paver, Pumps, Haul Trucks	89
Pile Driving	Pile Driver, Trucks	90 – 105

Source: U.S. Department of Transportation. Highway Construction Noise: Measurement, Prediction, and Mitigation. 1977, and MM&A measured noise levels.

Segment A. Land use in the Northgate Segment is predominantly single- and multi-family residential and commercial and retail. In the central and southern end of this segment, land use is still primarily a mixture of single- and multi-family residential, intermixed with commercial land use along local arterial and collector roadways. Traffic noise from I-5 dominates area noise levels, with peak hour noise levels of 69 to 74 dBA, depending on the distance from the roadway.

Because Segment A has the potential for elevated, at-grade (in a retained cut) and tunnel (cut and cover and bored) track segments, the range of potential impacts could come from a variety of sources. Construction of the elevated section of the alignment could involve the use of pile driving. As previously stated, pile driving can cause noise levels in excess of 100 dBA at nearby noise-sensitive receivers. For the tunnel sections, noise and vibration impacts are expected primarily at the tunnel portal and station locations, where construction staging for tunnel and station construction will occur. Major noise sources associated with the construction of the tunnel sections in Segment A include haul trucks, loaders, cranes, excavators, and tunnel locomotives. Other noise-producing sources include compressors, conveyors, backhoes, generators, ventilation fans and blowers, and light duty vehicles. The locations of cut-and-cover tunnel construction have the greatest potential for temporary noise impacts.

Segment B. Land use includes single- and multi-family residential, hospitals, hotels, schools, commercial, and industrial. High-density multi-family, residential, commercial, and some single-family residential uses exist in the Eastlake area. Several hospitals and hotels may be found in the southern portion of this segment and in the downtown Seattle area. Noise-producing sources include traffic, commercial, and residential activities.

Alignment alternative B1 is wholly in tunnel. Noise and vibration impacts are expected primarily at tunnel portals and station locations, where construction staging for tunnel and station construction will occur. Potential construction noise impacts are similar to those described in the tunnel section of Segment A. Other noise sources in this segment could include barging tunnel spoils using a conveyor system from the Pacific Station staging area to Portage Bay. Under alternatives B2.1 and B2.2, a combination of tunnel, at-grade (retained cut) and elevated structures would be used for the track alignment, making the construction noise and mitigation similar to those portions of Segment A.

Segment C. The core of Segment C is the high-rise commercial and residential structure of downtown Seattle. In addition, multi-family and single-family uses occur on Beacon Hill in the south. Industrial uses dominate the area just south of downtown.

Major noise sources associated with the construction of Segment C include a potential tunnel boring machine (alternatives C1 and C3), haul trucks, loaders, cranes, excavators, and tunnel locomotives. Other noise producing sources such as compressors, conveyors, backhoes, generators, fans and blowers, and light duty vehicles would also be required. Land use in the south downtown section of Segment C is commercial and industrial. The route through this area is at-grade, and the construction activities are not expected to result in any noise impacts. Under the tunnel alternatives, major construction staging areas would be located at the portals west of I-5 and at the east portals in Rainier Valley. An additional staging area would also be placed at the Beacon Hill Station under Alternative C1. Under Alternative C2.3, a combined profile similar to those in Segment B (B2.1) would result in a variety of noise impacts similar to those given under Segment B and A. Additionally, due to the location of the Beacon Hill Station, there is a high potential for nighttime construction or hauling of spoils.

Segment D. Land use in the northern end of this segment supports a mixture of medium-density multi-family residential, commercial and industrial activities. Major noise sources include traffic on arterial and collector roadways (Rainier Avenue S. and MLK Jr. Way S.), aircraft fly-overs, and activities in commercial and industrial areas.

There are several different route alternatives considered through the Rainier Valley, including at-grade, elevated, and some tunnel segments. The potential for noise impacts given under segments A through C are also possible in this segment. If construction of the tunnel segments (D3.4) is performed using cut-and-cover method, construction noise increases may be more severe and last longer than the at-grade or elevated alternatives. Review of the geological conditions shows that the tunnel section of Alternative D3.4 will most likely not require blasting. No additional noise impacts beyond those discussed in the other segments are expected in this segment.

Segment E. Land use in Segment E includes primarily commercial and industrial uses as well as single- and multi-family residential, hotels, and as hospitals. Noise sources in this segment include traffic on I-5 and I-405, state highways and other major arterial and collector roadways, aircraft fly-overs, freight trains and commercial and industrial activities.

Segment E alternatives have primarily at-grade and elevated routes as well as a short cut-and-cover tunnel route. Construction activities and potential impacts in this segment would be similar to those already described above. Alternatives E1.1 and E1.2 would be located near more residential receptors than the other routes. However, most residences are set far enough back from the route so as not to be severely impacted by construction noise.

Segment F. Land use in the SeaTac segment is primarily commercial, with some residential, hotels and motels, and a cemetery located near the proposed alternatives. Noise sources include aircraft from Sea-Tac Airport, traffic on International Boulevard and other roadways, and miscellaneous commercial activities.

Construction noise impacts in Segment F would be similar to those given in Segment E.

4.17.6.2 Noise Mitigation

Several general construction noise abatement methods can be implemented to limit noise impacts. Noise barriers can be constructed along the perimeter of the construction site to control the transmission of noise to residential and other noise-sensitive receivers Operation of construction equipment can be restricted during nighttime hours (10 P.M. to 7 A.M.) or on Sundays or legal holidays, when noise and vibration would have the most severe effect. All engine-powered equipment can be required to have mufflers installed according to the manufacturer's specifications and all equipment can be required to comply with pertinent equipment noise standards of the U.S. EPA. Because reduction of the noise associated with pile driving is not feasible, the only mitigation measure may be to limit the time this activity can take place.

Some additional restrictions on operational hours, hauling routes and times may be required in the most sensitive locations. For those construction sites where nighttime operations may occur, Sound Transit will request a noise variance. The variance will contain site-specific noise control measures and limits on allowable construction noise during nighttime hours. The variance will also require the contractor to take the appropriate steps to control potential noise impacts.

4.17.6.3 Vibration Impacts

Construction Vibration Regulations and Guidelines

There are no vibration-specific regulations that are applicable to this project. Also, because the mitigation of construction vibration is very difficult, and in most cases can only be performed through limiting the times the activities can occur, the following general vibration mitigation measures and information are provided.

Table 4.17-12 summarizes the levels of vibration and the usual effect on people and buildings. The U.S. Department of Transportation (U.S. DOT) has guidelines for vibration levels from construction related to their activities, and recommends that the maximum peak-particle-velocity levels remain below 0.05 inches per second at the nearest structures. Vibration levels above 0.5 inches per second have the potential to cause architectural damage to normal dwellings. The U.S. DOT also states that vibration levels above 0.015 inches per second are sometimes perceptible to people, and the level at which vibration becomes annoying to people is 0.64 inches per second.

Table 4.17-12 Effects of Construction Vibration

Peak Particle Velocity (in/sec)	Effects on Humans	Effects on Buildings
<0.005	Imperceptible	No effect on buildings
0.005 to 0.015	Barely perceptible	No effect on buildings
0.02 to 0.05	Level at which continuous vibrations begin to annoy in buildings	No effect on buildings
0.1 to 0.5	Vibrations considered unacceptable for people exposed to continuous or long-term vibration	Threshold at which there is a risk of architectural damage to buildings with plastered ceilings and walls. Some risk to ancient monuments and ruins.
1 to 2	Vibrations considered unpleasant by most people	U.S. Bureau of Mines data indicates that blasting vibration in this range will not harm most buildings. Most construction vibration limits are in this range.
>3	Vibration is unpleasant	Potential for architectural damage and possible minor structural damage

Vibration Impacts: Vibration associated with general construction activities and tunneling can result in vibration impacts. With conventional tunneling methods, vibration is caused by excavation equipment and hoe-rams. When a tunnel boring machine is used, there is the potential for the vibration from the machine to reach the surface, and result in impacts. Pile driving is also a potential source of vibration impacts. Other vibration sources could include bulldozers and soil compactors. Construction activities that may cause high levels of vibration, such as pile driving and soil compacting, could cause structural damage to nearby older and historic buildings.

Areas with the highest potential for construction-phase vibration impacts include areas near proposed elevated structures, tunnel portals and structures located within the first few 100 ft of the tunnel portals. Other potential vibration impacts could occur at mined or cut-and-cover station locations, along at-grade track sections requiring soil compacting and potentially along haul routes.

Vibration Mitigation: The construction contract specifications would contain a section specific to vibration, and include, at a minimum, vibration monitoring of all activities that may produce vibration levels near the U.S. DOT maximum recommended vibration level whenever there are structures located near the construction activity. This would include pile driving, vibratory sheet installation, soil compacting, and other construction activities that have the potential to cause high levels of vibration.

Vibration mitigation could include limiting the hours when the vibration-producing equipment can be used near sensitive receivers. Mitigation for the tunnel-boring machine may not be necessary due to the geologic conditions and type of machine expected to be used for the project. Reduction of vibration related to pile driving is not feasible; however, the use of an augur to install piles instead of a pile driver would greatly reduce the noise and vibration levels. By restricting and monitoring vibration-producing activities, vibration impacts from construction could be kept to a minimum.

During high vibration-producing activities such as pile driving and shoring installation, there is a potential for settlement and small movements of nearby structures. Design and installation of suitable shoring systems and other mitigations would reduce the potential of settlement-related damage. Other mitigation includes underpinning adjacent structures, installing recharge wells to reduce dewatering induced settlement, and/or re-leveling and repairing impacted areas following construction. In addition, pre-construction condition surveys and during-construction monitoring programs for neighboring structures would be conducted and repairs made as necessary.

4.17.7 Ecosystems

4.17.7.1 Impacts

In Segment A, construction of Northgate Station options A, B or C would remove riparian vegetation and could result in an increase in pollutants or sediment in stormwater runoff entering Thornton Creek. Because station option A closely parallels Thornton Creek, potential impacts on the creek would be greater under this option. Best management practices (BMPs) described in Section 4.17.7.2, would be implemented to control stormwater runoff and thereby avoid impacts to fish.

For Alternatives B1 and B2.2 in Segment B, tunnel spoils removal at the Pacific Station and disposal at an offsite upland location could cause construction-related impacts on fish and wildlife habitat. If tunnel spoils are barged, a conveyor system would transport spoils from Pacific Station to the barge facility. Soil material on the conveyor may inadvertently drop into the water during barge loading operations. During periods of rainfall, stormwater could carry loose soils stockpiled on the barge into the water thus affecting water quality and fish. Use of barges could also affect fish habitat due to shading of nearshore habitat. Pile driving to install dolphin piers, which are used to moor barges and support the conveyor system may disrupt bottom sediments and cause turbidity. Juvenile fish mortality may increase due to predation in the vicinity of mooring dolphin piers.

Trucking the tunnel spoils to an offsite location may also affect water quality. During periods of rainfall, stormwater can carry loose soils from disturbed construction sites or soil stockpiles into water thus affecting water quality and fish. However, fewer of the construction activities associated with tunneling would occur in proximity to the water if trucks are used; therefore, potential impacts on water quality and fish would be fewer than if barges are used.

Alternative B2.1 could affect fish and wildlife due to in-water work required for construction of pier fittings and false work support for the high-level bridge. In-water pile driving may disturb bottom sediments causing increased turbidity. In-water construction may cause fish, including chinook and coho salmon, and other wildlife to avoid the area due to water quality degradation and noise disturbance.

Peregrine falcons that winter-roost and hunt from the I-5 Bridge may avoid the construction area and seek alternative roosting sites under Alternative B2.1. Increased in-water activity due to construction of the bridge or barging tunnel spoils under all Segment B alternatives may cause peregrine falcons to seek new foraging sites. Effects on peregrine falcon foraging ability are expected to be minimal.

Each of the C1 alternatives and Alternative C3 would remove about 6,400 ft^2 of deciduous forest within the East Duwamish Greenbelt for cut-and-cover tunnel portals on the east side of Beacon Hill. Alternatives C1.1, C1.2, C1.3, C1.4, and C1.5 would remove an additional 3,750 ft^2 of deciduous forest within the Cheasty Greenbelt for cut-and-cover portal construction on the west side of Beacon Hill. Once construction is complete, these areas would be re-graded and planted with native shrubs and trees. The City of Seattle identifies the greenbelts on the sides of Beacon Hill as containing several types of environmentally critical areas, including wildlife habitat. Forest-associated species that are less common in urban settings would be displaced by construction. Some wildlife with limited mobility, such as nestlings, may perish.

In Segment D, potential short-term water quality impacts on wetlands (AR-3) could occur, and clearing of trees at the edges of deciduous forest patches may disturb wildlife using the patches. Two bald eagle nests are located in Seward Park approximately 1.5 miles from the light rail alternatives, but no adverse impacts are expected because of the distance from the nests to the proposed light rail route.

All Segment E alternatives would affect wetlands, wildlife, and fish habitat due to bridge construction over the Duwamish/Green River, crossing of several wetlands, and clearing of deciduous trees. The estimated 12- to 18-month construction period for bridges over the Duwamish/Green River would involve over-water work and potentially in-water work, affecting fish habitat and potentially affecting water quality. Chinook salmon could be affected by construction during the in-migration of adults spawning in the fall and out-migration of juveniles in the spring, but impacts can be minimized by performing in-water construction when chinook salmon are not migrating through the project area.

Impacts on fish and wildlife could also result from culvert extensions and vegetation removal at tributary streams to the Duwamish/Green River including Riverton and Southgate Creeks under Alternatives E1.1 and E1.2, Southgate and Gilliam Creeks under Alternative E2, and Gilliam Creek and Watercourse 3.1 under Alternative E3. Impacts include disturbance of in-stream habitat, increases in turbidity downstream of the construction area, and temporary loss of buffer functions, such as bank stabilization and shading. Impacts on wetlands may include increased sediment in runoff from exposed soils, placement of temporary fill for construction access, displacement of wildlife, and temporary vegetation removal. These impacts can be minimized by implementing best construction management practices. Wildlife in deciduous forest would be displaced from the immediate vicinity of the construction area. Wildlife with limited mobility may perish.

Additional impacts on fish could occur under alternatives E1.1 and E1.2 during construction in the vicinity of the Riverton Side Channel Project. Altering construction timing at this site would also minimize fish impacts. Standard measures for controlling stormwater runoff and sedimentation from exposed soils would also minimize impacts on chinook and coho salmon.

The greatest fish impacts in Segment E would occur under Alternative E2 because of the extent of vegetation removal and resulting exposed soils during construction of the four bridge crossings and segments of track paralleling the river. Under Alternatives E2 and E3, construction activities would likely cause bald eagles potentially using large trees along the Duwamish/Green River to avoid the area. While all alternatives require deciduous forest removal, the greater forest removal required for Alternatives E2 and E3 would disturb and permanently displace higher numbers of wildlife in and adjacent to these areas than Alternatives E1.1 and E1.2. Alternatives E2 and E3 would have lower impacts on wetlands than alternatives E1.1 and E1.2.

In Segment F, Alternative F2.2 would cross Bow Lake on an elevated structure, requiring clearing of riparian vegetation and in-water construction. These activities would result in the temporary displacement of fish and wildlife and may degrade water quality. Alternatives F3.1, F3.2, F3.3, and F4 would remove trees along the eastern edge of Washington Memorial Park and may disturb wildlife using the adjacent habitat. Construction of the South SeaTac Station Options A, B, and C would displace wildlife nesting and foraging in the dense trees and shrubs at these locations. Some wildlife with limited mobility may perish. Construction of South SeaTac Station Options D, E, and F would displace common urban songbirds. In addition, short-term water quality impacts on AR-42 and AR-43 could result from vegetation clearing in the buffer and soils exposed for construction activities.

A bald eagle nesting territory exists at Angle Lake. However, the pair has not attempted to nest since 1996. Because the pair returns to the area each year, they could attempt to nest again. If they do, and pile driving is used to construct the elevated portions of Alternatives F2.1, F2.2, F2.3, F3.1, F3.2, F3.3, or F4, impacts to bald eagles attempting to nest could occur. Before construction begins in this segment, surveys should be conducted or the local state biologist should be contacted to determine whether the pair is nesting. If they are, timing restrictions for pile-driving activities could then be implemented to mitigate potential impacts on the nest.

Maintenance Base Sites

No construction-related impacts on wetlands, fish, or wildlife would occur at any of the M1 site alternatives. Vegetation would be removed and common urban wildlife would be displaced from the buffers of wetland AR-4 at maintenance site M2 and wetland AR-9 at M3.

4.17.7.2 Mitigation

Mitigation for short-term ecosystem impacts would be based on a hierarchy of avoiding and minimizing impacts and compensating for unavoidable adverse impacts. The implementation of BMPs such as silt fencing, stabilizing exposed soils, landscaping with native plants, marking the limits of clearing, and collecting runoff during construction would minimize impacts on wetlands, wildlife, and fish. See Section 4.17.8 for a discussion of stormwater runoff and water quality mitigation.

In many instances, construction timing can reduce or eliminate impacts on wetlands, fish habitat, and threatened and endangered species. Restricting construction in wetland areas to the drier summer months minimizes the impact on those wetlands that flood only during winter and early spring months and reduces wetland impacts caused by stormwater runoff. Additional mitigation measures for impacts on wetlands and wildlife include locating staging areas outside of wetlands or potential wildlife habitat and limiting staging areas to sites scheduled to become part of the permanent light rail alignment. Wetland areas disturbed by construction would be replanted with native species once construction is complete. Trees removed from street rights-of-way or city parks would be replaced in accordance with local city requirements.

If temporary in-water work is required to construct bridges, it would be conducted while anadromous fish species are not migrating through the project area. The WDFW requirements in the hydraulic project approval permit would specify this time period. Because sediment runoff to the Duwamish River and its tributaries could have adverse effects on salmonids and other fish species, a temporary erosion and sedimentation control plan would be implemented. At construction sites over or near the river and its tributaries, water quality would be measured regularly throughout the construction period to ensure control measures are in place and functioning properly.

In addition, high-level bridge construction in Segment B (B2.1 and B2.2) could be scheduled to reduce impacts on peregrine falcon winter roosting and foraging at the I-5 bridge, and impacts on migrating salmon. Barge moorage during tunnel spoil removal could occur away from nearshore areas to reduce shading impacts. If a new dock facility is required, it would be temporary. If the tunneling alternative is selected for Segment B, a temporary erosion and sedimentation control plan would be implemented. This plan would prevent sediment runoff from stockpile sites on land and over the water. Additional BMPs including an emergency spill control plan should be implemented and monitored throughout the construction period. If barges are used, the decks could have sideboards to contain the stockpiles and prevent sediments from spilling into the bay. A piped conveyor rather than an open-belt conveyor could be used to prevent soils from spilling into the water.

If the bald eagle nest near Angle Lake in Segment F becomes active again, potential construction impacts from F1 could be avoided by drilling rather than driving piles, or by restricting pile-driving activities to the non-nesting period.

Biological Assessments (BA) for chinook and coho salmon and a BA for bull trout and bald eagles have been prepared. These documents identify conservation measures to avoid, minimize, and mitigate potential impacts on threatened and endangered species, including BMPs for erosion, spill prevention, construction timing, construction methods to reduce in-water work and habitat disturbance, and coordination with the Riverton Creek Restoration Project.

4.17.8 Water Quality

4.17.8.1 Impacts

Construction-related water quality impacts would be temporary and caused mainly by erosion of disturbed soil areas or soil stockpiles resulting in silt and sediment transport to water by stormwater runoff. Stormwater runoff may also carry other contaminants such as fuel or oil from construction operations. Sediment and other contaminants can increase turbidity and affect other water quality parameters, such as the amounts of available oxygen in the water. Construction activities such as clearing and grading can also result in increased stormwater runoff velocities. Increased velocities may increase erosion rates and destabilize streambanks.

Segment A. Construction of Northgate Station options A, B, and C, could impact water quality in Thornton Creek. Erosion and transport of sediments or spills that could occur during construction near the channel (under Option A) or ditch that flows into Thornton Creek (under Option B) could affect water quality in the stream .

Segment B. Alternatives B1 (preferred alternative) and B2.2 could impact Portage Bay and Lake Union water quality during construction of the tunnel under Portage Bay. During construction, tunnel spoils would be trucked or barged off-site. Spills associated with this process, and potential erosion at the fill/disposal location, could impact short-term water quality. If they occur, impacts are expected to be minor and temporary.

Alternative B2.1 could impact water quality during construction of the bridge crossing, which is estimated to take from 18 to 24 months to complete. During over-water and in-water work, installation of support falsework and concrete placement would be required. Site access would be via adjacent streets and from barges.

Dewatering of the tunnel and underground stations, from the N.E. 45th Station to the International District, could require specific water quality mitigation, such as treating water in a sediment trap or tank prior to discharge to storm sewers. Seattle Public Utilities has evaluated the capacity of CSOs and storm sewers at each potential discharge site. Alternative discharge sites or detention would be required at discharge locations where the existing storm sewer or CSO does not have sufficient capacity.

Segment C. Without mitigation, vegetation removal and construction could cause small increases in runoff and sedimentation.

Segment D. Construction of all of the alternatives in this segment would require increasing the existing rights-of-way along much of MLK Jr. Way S. Local flooding and downstream water quality problems could occur if roadside ditches are blocked and/or if significant erosion from construction is allowed to occur.

Segment E. Several proposed actions within this segment could cause short-term impacts to water quality unless mitigated. Alternatives E1.1 (preferred alternative) and E1.2 would require construction of a bridge over the Duwamish River; this would take approximately 12 to 18 months to complete. Potential spills could impact Duwamish River water quality. Vegetation removal, soil compaction, and potential spills could increase water temperatures and turbidity, and impact Riverton Creek and Riverton Side Channel water quality. Construction of a retaining wall north of S. 139th Street along Tukwila International Boulevard, which would require fill and culvert extensions that could cause bank erosion or be the source of spills that could impact the water quality of the stream. BMPs for in-stream work and sediment and erosion control would be implemented during construction and fill activities near creek crossings and those activities associated with culvert extensions. These BMPs include silt fences, coffer dams or flow diversion around the disturbed area, limiting construction to the dry season, minimizing clearing, restricting heavy equipment from crossing the creek, and stabilizing slopes.

Alternatives E1.1 and E1.2 would require constructing a bridge over the Duwamish River. Alternative E2 would require constructing four bridges over the Duwamish, Green, and Black rivers and crossing three minor streams. Alternative E3 would require constructing bridges over the Green and Black rivers. All four alternatives would require some in-water work. In-water and over-water construction could impact water quality if spills or bank erosion occurs due to vegetation removal. The construction of elevated portions of the alignment over water would require vegetation removal, possible in-stream work and/or crossing of rivers or streams by construction equipment. Potential soil compaction and vegetation removal could cause increases in turbidity and stream temperature. Spills during construction could also adversely impact water quality. Construction of an elevated structure over 42nd Avenue S., south of SR 518, could generate sediments and spills that would impact the water quality of a spring that supplies water to Gilliam Creek. Construction of the retained cut south of SR 518 would result in soil compaction, vegetation removal, disruption of seeps and springs, and potential water quality degradation.

Segment F. Construction in this segment is not expected to have major impacts to hydrology, water quality or floodplains, except for construction of Alternative F2.2. This alternative would require shoreline and in-water construction of support piers in Bow Lake. Spills associated with this process, vegetation removal, and potential erosion, could impact short-term water quality.

Maintenance Base Sites. With erosion control measures, maintenance facility construction is not expected to impact hydrologic, water quality, or flooding conditions.

4.17.8.2 Mitigation

An NPDES stormwater permit for construction activities would be required for this project. The NPDES permit require development of a Storm Water Pollution Prevention Plan (SWPPP) for erosion and sedimentation control and for control of pollutants other than sediment. The objective of an SWPPP for construction phases of a project is to implement BMPs to minimize erosion and sedimentation, reduce, eliminate, or prevent the pollution of stormwater, prevent violations of surface water quality, or sediment management standards, prevent adverse water quality impacts on beneficial uses of the receiving water body, and eliminate discharges of unpermitted process wastewater to stormwater or waters of the state. Mitigation during construction would be based on generally accepted principles and local regulatory requirements which state that (1) the project would fit the natural topography, soils, and drainage patterns; (2) sediment and erosion control BMPs including mulches, nets, and temporary seeding would be implemented; (3) retaining sediment on-site would be emphasized through the implementation of accepted BMPs such as stabilized parking and traffic areas, barrier beams, silt fences, and sediment ponds; (4) the extent and duration of exposed areas would be minimized by using mulches or seeding; (5) runoff velocities would be kept low by installing dikes or swales; (6) erosion and sediment control measures would be monitored and maintained; (7) to the extent possible, earthwork would be scheduled during the dry season; (8) spill controls would be implemented at all individual construction sites to prevent the uncontrolled release of fuels and any other construction materials on the site that could enter downstream receiving waters through stormwater runoff: (9) dust-control street sweepers would be used to collect dirt and debris from roadways: and (10) in-water barriers would be used to prevent sediment diffusing during construction of support piers. Impacts would also be avoided by complying with local regulations.

4.17.9 Energy

The Northgate to SeaTac Alternative would consume the most energy during construction (29,527 x 10^9 Btu). The second length alternative, N.E. 45th to SeaTac would consume the second-most construction energy (25,678 x 10^9 Btu). Construction of MOS alternatives 1, 2, and 3 would consume 14,185 x 10^9 Btu, 12,493 x 10^9 Btu, and 11,965 x 10^9 Btu, respectively. The No-build Alternative would consume no energy associated with light rail construction. However, under the No-build Alternative there would likely be an increase in energy demand for road construction and maintenance associated with not having the light rail system.

4.17.10 Geology and Soils

Tunneling would create large volumes of spoils that can have high erosion potential when stockpiled. The estimated volume of spoils for each alternative segment, based on conceptual design, is presented in Table 4.17-12. Substantial dewatering may be required during tunneling depending upon the type of TBM used, the depth to groundwater, and the permeability of soils. Settlement may occur due to vibrations, dewatering, or ground loss; however, the vibrations would be considerably less for soft ground tunneling than for tunneling through rock.

Cut-and-cover construction creates more spoils per linear feet of track than tunneling or mining, and a greater potential for erosion and contamination of spoils exists. Soils may settle during dewatering and movement of structures near the excavation.

Constructing the light rail system could cause erosion impacts associated with vegetation removal, fill placement, and removal or stockpiling of spoils. Earthwork could cause silt-laden runoff to be transported off-site, thereby degrading water quality in local surface waters. The severity of potential erosion would be a function of the quantity of vegetation removed, site topography, and the volume of soils stockpiled.

Vibrations or settlements from the following construction methods may result in damage to nearby structures: excavations that encounter bedrock; installation of driven piles; tunneling, dewatering, or cut-and-cover construction. In tunneled sections, settlement could occur due to vibrations, dewatering, or ground loss; however, the vibrations would be considerably less for soft ground tunneling (such as Capitol Hill, Alternative B1) than for tunneling through rock (such as 37th Avenue, Alternative D3.4).

Construction of the light rail could produce over 2,340,550 yd^3 of spoils (primarily from tunnel and cut-and-cover excavations) and require about 378,000 yd^3 of structural fill (primarily for at-grade and elevated alignments and stations). The required structural fill materials would likely be generated from the excavated spoils. Of the remaining 1,962,550 yd^3 of spoils, a small portion may be contaminated (most likely spoils generated from near-surface excavations) and would need to be properly treated and/or disposed (see Section 4.17.11). Most spoils would be generated from deep tunneling, where the likelihood of encountering contamination is very low due to most contamination being generated near the surface.

Currently, there is a regional deficit of suitable structural fill materials due to the considerable growth this region has been experiencing. A high demand for coarse-grained spoils (sand and gravel) is anticipated. If growth continues, even marginal, fine-grained spoils (silt and clay) may have a market. One project of note is the Sea-Tac Airport Third Runway. Earthwork projections for the Third Runway Project estimate 17.6 million yd^3 of fill would be required and demolition waste and marginal quality fill materials may be acceptable for portions of the fills. Other potential future construction projects that would likely also require large quantities of fill material include landfill closure projects in Thurston County, Port Angeles, and Kitsap County, remediation of the Weyerhaeuser sewage lagoons on Smith Island in Everett, and the potential future closure of Cedar Hills landfill in eastern King County. Fine-grained or otherwise unsuitable spoils generated during construction that do not have a market would need to be landfilled. Many sites in the Puget Sound area can accept tunnel spoil materials. For example, CSR Associated landfill sites in Everett and Maltby, Washington, currently accept material that would be unsuitable as structural fill. The Maltby site has a capacity of 1.5 million cubic yards. Other quarry sites include the Lone Star Northwest Mats Mats Steilacoom sites, which have ongoing needs for fill material to accomplish quarry reclamation. Except for the Mats Mats site, which is accessible only by barge, these sites would accept material transported by truck. Transportation of spoils (both suitable and unsuitable) would use either trucks and/or barges.

4.17.10.1 Impacts by Segment

Segment A. Alternatives A1.1 and A1.2 have a high potential for requiring dewatering during construction, a low potential for settlement impacts, and would generate this segment's largest volumes of spoils. Alternatives A2.1 and A2.2 have a moderate and low potential, respectively, for both dewatering and settlement impacts associated with tunneling. Alternative A2.1 would generate more spoils than A2.2 but less than either A1.1 or A1.2. Alternative A2.2 has the highest potential for settlement due to pile installation; however, these settlements, if any, are anticipated to be relatively small. All alternatives have a moderate potential for erosion.

Segment B. All Segment B alternatives have high potential for encountering groundwater and requiring dewatering of large volumes of soil. Alternative B1 would generate the highest volume of spoils. The Seattle Center alternatives have a high (B2.1) and moderate (B2.2) potential for settlement and vibration impacts during pile installation and would generate high spoil volumes.

Segment C. All the C1 alternatives have high potential for dewatering and a low potential for settlement impacts. Alternatives C1.1, C1.2, C1.3, and C1.5 would produce moderate volumes of spoils in comparison to Alternatives C1.4 and C2.4 (Rainier Avenue S. Tunnel) which would produce relatively large volumes of spoils. Alternative C2.4 has a low potential for dewatering, low volume of spoils and moderate potential for settlement impacts. Alternative C3 (S. Massachusetts Street Tunnel) has a moderate potential for requiring dewatering, a high potential for settlement impacts, and would produce moderate spoils (less than all the C1 alternatives and C2.4, but more than C2.3). All Segment C alternatives have low erosion potential.

Segment D. Alternatives D1.1a through f would produce moderate spoils and generally have low potential for construction-related geologic impacts. Alternative D1.3 has a moderate potential for settlement impacts and low or no potential for other construction-related geologic impacts. Alternative D3.3 has low or no potential for geologic impacts. Alternative D3.4 has a high potential for requiring dewatering, moderate potential for erosion, and would produce this segment's highest volume of spoils. Because this alternative would require tunneling through rock, vibration and settlement could result.

Segment E. Alternative E1.1 has moderate potential for settlement impacts. Alternative E1.2 has moderate erosion potential and a high potential for settlement impacts. Alternative E2 has moderate potential for requiring dewatering and a high potential for erosion and settlement impacts. Alternative E3 has high potential for erosion and settlement impacts and for requiring dewatering. It would produce the segment's largest volume of spoils, but still moderate.

Segment F. Alternative F1 has moderate erosion potential due to removing vegetation from the roadway median. None of the Segment F alternatives would produce high volumes of spoils;

although, F1 would be higher than the others. Alternative F2.1 has low or no potential for construction-related geologic impacts. Alternatives F2.2, F2.3, F3.3, and F4 have moderate potential for settlement impacts.

The two alternatives west of International Boulevard (F3.1 and F3.2) both have moderate potential for settlement impacts and low or no potential for other geologic impacts.

Maintenance Facility Sites. All maintenance facility sites have low potential for requiring dewatering. Maintenance facility sites M1-D and M1-E (the Rainier Brewery sites) have higher settlement potential due to an unmapped landfill possibly underlying the sites. Site M3 has moderate erosion potential. All sites have low or no potential for other construction-related impacts.

4.17.10.2 Mitigation

Additional study would be conducted during project design to determine the specific extent and severity of geologic hazards of the preferred alternative and to develop specific mitigation details. To control erosion during construction, contractors would employ standard mitigation measures within the construction limits and will be approved by the Department of Ecology (DOE) and local jurisdictions. These would reduce the amount of silt-laden runoff leaving the construction site, minimize dust, and reduce erosion. Use of clean fill soils containing little or no silt and clay would also help reduce the erosion potential.

Mitigation for vibration and settlement impacts to shallow foundations would include a pre-condition survey and a construction monitoring program. Additional mitigation could include underpinning structures, installing recharge wells (for dewatering), modifying construction techniques, displacement grouting (during tunneling), or re-leveling and repair.

For dewatering mitigation, detailed analysis during project design would estimate potential dewatering effluent volumes and the potential presence of contaminants. Construction techniques would be used to reduce the sediment and contaminants in the effluent, if necessary, prior to disposal. The project would coordinate with local jurisdictions to dispose large volumes of dewatering effluent to storm or sanitary sewers as appropriate (see Utilities discussion, Section 4.17.13).

For pile drilling and driving, selecting the appropriate pile type would balance the potential impacts associated with vibrations, spoils, and dewatering. Construction techniques, such as selection of hammer size and cushion material for driven piles, and following mitigation measures described for construction-induced vibration and settlement would reduce impacts.

In areas with over-water construction, compressible soils may require pre-loading to reduce settlement under the approach fills, and turbidity could be controlled with appropriate erosion control methods.

For tunneling and mined stations, standard mitigation measures would minimize the erosion potential of the spoils and stockpiles (see Section 4.10). A closed-face, positive pressure TBM could reduce the need for dewatering during tunneling. The main difference between stockpile on land and the barge acting as a stockpile is that on land erosion and sediment control measures such as settlement ponds or silt fences would be needed. There are self-contained barges, which would keep the sediment on-board. In addition, the erosion potential would increase with increased time spent exposed to the elements. Materials removed by barge should have a shorter duration between excavation and final destination, which would tend to reduce erosion potential.

Erosion impacts of cut-and-cover construction could be mitigated by using standard measures to minimize the erosion potential of spoils and stockpiles. Designing and installing suitable shoring systems and following the mitigations described for construction-induced vibrations and settlement would reduce the potential for settlement-related damage to nearby structures.

Table 4.17-13
Potential Short-term Geologic Impacts

Segment/Alternative	Groundwater/ Dewatering[10]	Excavation/ Spoils[9] (yd^3)	Fill[9] (yd^3)	Vegetation Removal (Erosion Potential)	Overwater Crossings	Vibrations and possible settlement from pile installation	Blasting/ Difficult Excavation[11]
Segment A							
A1.1 12th Ave. Tunnel	High[3]	338 K	45 K	Med.[5]	None	Low[7]	None
A1.2 Roosevelt Way Tunnel	High[3]	339 K	45 K	Med.[5]	None	Low[7]	None
A2.1 8th Ave.-Short Elev.	Med.[3]	242 K	15 K	Med.[5]	None	Med.[7]	None
A2.2 8th Ave.-Elev.	Low[6]	157 K	15 K	Med.[5]	None	High[5]	None
Segment B							
B1 Capitol Hill Tunnel	High[1]	1,210 K	200 K	None[8]	None	None[8]	None
B2.1 Sea. Ctr.-High-level Br.	High[1]	872 K	120 K	Low[7]	Ship Canal	High[5]	None
B2.2 Sea. Ctr.-Port. Bay Tunnel	High[1]	943K	90K	Low[7]	None	Med.[7]	None
Segment C							
C1.1—At-grade center of Lander Street	High[3]	188 K[15]	7 K[15]	Low[7]	None	Low[7]	None
C1.2—At-grade north of Lander Street	High[3]	187 K[15]	7 K[15]	Low[7]	None	Low[7]	None
C1.3—Elevated north of Lander Street	High[3]	182 K[15]	17 K[15]	Low[7]	None	Low[7]	None
C1.4—Elevated south of Forest St.	High[3]	235 K[15]	17 K[15]	Low[7]	None	Low[7]	None
C1.5—Massachusetts Street and I-5 right-of-way	High[3]	188 K[15]	7 K[15]	Low[7]	None	Low[7]	None
C2.3 W. of Rainier-Elev.	Low[6]	32 K	5 K	Low[7]	None	Med.[7]	None
C2.4 Rainier Ave. S. Tunnel	High[3]	248 K	None	Low[7]	None	None	None
C3 S. Mass. St. Tunnel	Med.[6]	102 K	None	Low[7]	None	High[5]	None
Segment D							
D1.1a MLK at-grade	None	2 K[16]	N/A	Low[7]	None	None	None
D1.1b MLK elevated	None	1 K[16]	5 K[16]	Low[7]	None	Med.[2]	None
D1.1c MLK at-grade 4-lanes 104'	None	260 K[16]	N/A	Low[7]	None	None	None
D1.1d MLK At-grade,4-lane 90'	None	230 K[16]	N/A	Low[7]	None	None	None
D1.1e MLK at-grade 4-lanes 93'	None	236 K[16]	N/A	Low[7]	None	None	None
D1.1f MLK at-grade 2-lanes 93'	None	236 K[16]	N/A	Low[7]	None	None	None
D1.3 MLK S. – Combined Pr.	None	47 K	5 K	Low[7]	None	Med.[2]	Low[4]
D3.3 Alaska St. Crossover	Low[6]	87 K	5 K	Low[7]	None	Low[7]	None
D3.4 37th Ave. S. Tunnel	High[6]	277 K	45 K	Med.[7]	None	Low[7]	Med.[7]
Segment E							
E1.1 Tukwila Intl Blvd	None	31 K	10 K	Low[2]	One	Med.[2]	None
E1.2 Tukwila Intl Blvd – Elevated	None	9 K	5 K	Med.[2]	One	High[2]	None
E2 Interurban Ave.	Med.[6]	85 K	12 K	High[2]	Three	High[5]	Low[7]
E3 MLK Jr. Way S.	High[6]	104 K	78 K	High[2]	Two	High[5]	Med.[5]
Segment F							
F1 Int. Blvd – At-grade	None	62 K	None	Med.[2]	None	Low[7]	None
F2.1 Wa. Mem. Park – City Ctr. W.	None	29K	20K	Low[5]	None	Low[2]	None
F2.2 Wa. Mem. Park – City Ctr. E.	Low	30 K	20 K	Low[5]	Bow Lake	Med.[2]	None
F2.3 Wa. Mem. Park-Elev. E. of 28th	None	25 K	5 K[12]	Low[5]	None	Med[2]	None
F3.1 W. of Int. Blvd. Gr. Knoll	None	25 K	5 K	Low[7]	None	Med.[2]	None
F3.2 W. of Int. Blvd., M. Terminal	None	22 K	5 K	Low[7]	None	Med.[2]	None
F3.3 W. of Int. Blvd.	None	30 K[16]	5 K[16]	Low[7]	None	Med[2]	None
F4 Int. Blvd. To 28th/24th	None	25 K[12]	5 K[12]	Med[2]	None	Med[2]	None
Maintenance Facilities							
M1-A S. Lander St.	Low	92 K	10 K	Low[7]	None	Med.[5]	None
M1-B S. Lander St.	Low	79 K	10 K	Low[7]	None	Med.[5]	None
M1-C Atlantic/Central A	Low	65 K[13]	10 K[13]	Low	None	Med[5]	None
M1-D Rainier Brewery/Roadway Express	Low	74 K[13]	10 K[13]	Low	None	Med-High[14]	None
M1-E Rainier Brewery/Airport Way	Low	90 K[13]	10 K[13]	Low	None	Med-High[14]	None
M2 N.W. Boeing Access Rd.	Low	100 K	10 K	Low[7]	None	Med.[5]	None
M3 S.W. Boeing Access Rd.	Low	80 K	10 K	Med.[2]	None	Med.[5]	Low[7]

Note: A high rating in one segment does not necessarily correspond to a high rating in another segment. The qualitative ratings are relative to an individual segment with the purpose being to differentiate between alternatives within a segment.

[1] >50% of route affected, temporary condition or no mitigation required
[2] >50% of route affected, mitigable through design or construction methods
[3] <50 % of route affected, temporary condition or no mitigation required
[4] <50% of route affected, impractical to mitigate with current design
[5] <50% of route affected, mitigatable through design or construction methods
[6] <25% of route affected, temporary condition or no mitigation required
[7] <25% of route affected, mitigatable through design or construction methods
[8] Only near portals and cut-and-cover stations.
[9] Approximate only. Based on Earthwork and Drainage Areas Matrix, April 1999. Provided by PSTC. (Units in thousands of yd^3).
[10] Primarily associated with tunnel and underground construction. Open-faced TBM is assumed for worst-case scenario.
[11] Difficult excavation is considered excavation which encounters bedrock.
[12] Estimated based on available information and similar alternatives.
[13] Based on earthwork quantities provided by S. Kirby of PSTC on 7/14/99. (units in thousands of yd^3).
[14] Higher settlements may be due to an unmapped landfill under the Rainier Brewery sites.
[15] Preliminary Estimate provided by PSTC 8/3/99
[16] Approximate only. Based on earthwork quantities provided by S. Kirby 8/19/99 (units in thousands of yd^3).

As indicated in Table 4.17-12, underground construction for many of the alternatives would generate large volumes of spoils. Potential impacts include erosion at stockpile and disposal sites. Erosion mitigation is discussed above. Disposal of the spoils would depend upon whether the spoils are clean or contaminated, the type of soil (coarse-grained or fine-grained), soil moisture content, regional demand for fill soils at the time the project is undertaken, availability of disposal sites, and several other factors. These determinations require site-specific analysis, construction planning and sequencing, and an economic evaluation. Truck hauling and/or the use of barges is being considered for moving the spoils.

4.17.11 Hazardous Materials

Potential hazardous materials impacts would be largely beneficial because some existing contaminated sites would be cleaned up during project construction. However, adverse impacts can occur if cleanup activities create opportunities for workers or the public to come in contact with contaminated soil and groundwater, and if dewatering during construction causes contamination within groundwater to migrate.

Cleanup efforts during construction include removal of contaminated soil and/or groundwater. Contaminated soil typically would be stockpiled then transported from the construction area for further accumulation, treatment, or disposal. Contaminated groundwater removed as a result of dewatering, may be stored in tanks, discharged to the sewer, or transported from the construction site for treatment or disposal.

Soil contamination typically impacts only a portion of an affected property, but a hazardous material release to groundwater may more easily spread beyond property boundaries. Groundwater contamination may move laterally into the construction area or vertically to deeper water-bearing zones when subsurface construction makes connections to the surface (such as at tunnel vents and station entrances). Construction dewatering associated with tunneling or installing structural supports for elevated sections may facilitate contaminant transport into the construction area.

Sites having documented hazardous material releases to soil or groundwater that are on or close to the route were considered to have the most likely potential construction impact. Sites of highest concern are noted in Table 4.11-1 (Section 4.11), which lists those sites on the route where a known release has occurred or where historical activity associated with hazardous materials is indicated. Sites adjacent to the route that have a documented release to groundwater, and where subsurface construction is probable, are also listed.

4.17.11.1 Impacts

Two Segment A alternatives, A1.2 and A2.1, are one to two blocks from a site with a known release of petroleum products to groundwater; no impact is expected unless contamination in groundwater migrates during construction. The A1.1 and A2.2 alternatives are further from this site than the A1.2 and A2.1 alternatives, and they would have less potential for impact. The Roosevelt Station in Alternative A1.2 would be 1½ blocks from one release site that had a contaminate release to groundwater.

In Segment B, Alternative B1 tunnels beneath two sites that have had releases of gasoline to groundwater. Alternatives B2.1 and B2.2 would cross coal gasification and dry cleaner sites and be adjacent to other sites where contaminants have been released to groundwater. Alternative B1 appears to have the lowest potential to impact sites with hazardous materials releases.

In Segment C, all C1 alternatives pass through a site with a petroleum release to groundwater at the west tunnel portal. Alternative C1.5 also passes through three at-grade sites with petroleum releases to groundwater and one with a release to soil. Alternative C2.4 passes through one at-grade site with a petroleum release to soil at the Poplar Place Station. Alternative C3 passes through one site with a petroleum release to soil in an elevated section. Alternative C2.3 does not pass directly through any sites with known hazardous materials contamination.

A significant portion of all Segment D alternatives track down the middle of major thoroughfares and therefore have little potential to encounter a contaminated site. However, some soil contamination could be encountered at sites where stations are planned because they involve acquiring street-side properties. This occurs at two locations in Alternative D1.1 and one location in Alternative D3.3. Alternatives D1.3 and D3.4 include portions of track that would be elevated or tunneled, both of which may impact contaminated groundwater originating at adjacent sites. Three sites with hazardous materials releases to groundwater exist at the Graham Street Station (optional) where Alternative D1.3 is elevated and Alternative D3.4 transitions from tunnel to at grade. It appears that Alternative D1.3 would have the least impact at this location based on construction requirements.

Alternatives E1.1 and E1.2 would be elevated over two soil petroleum release sites and one groundwater petroleum release site. Alternative E2 would involve subsurface construction at three soil release sites, and near seven groundwater release sites. It would pass adjacent to a portion of the Renton Junction Landfill, which has not been characterized for hazardous materials. Alternative E3 with elevated and cut-and-fill segments would pass two groundwater release sites, as well as the Renton Junction Landfill in an elevated section. Alternative E3 appears to present the lowest potential for impacts.

Alternative F1 (Options A and B) is located within the International Blvd. right-of-way for their entirety and do not pass through any documented hazardous materials release sites. Alternative F1c is elevated where it passes over a single petroleum release to soil site as it connects to International Blvd. Alternative F2.1 passes through two groundwater and two soil petroleum release sites between the airport and SeaTac City Center, as well as a petroleum soil release site at the South SeaTac Station. Alternatives F2.2a and F2.3a pass only through the soil release site located at the South SeaTac station. Alternative F2.2b and F2.3b both pass over a petroleum release to soil site as they connect to International Blvd. Alternatives F3.1, F3.2, F3.3, and F4 do not pass through any hazardous materials release sites until the petroleum soil release site at the South SeaTac Station. Alternative F1a, which would be at grade, would have the least potential for construction impact. The other alternatives, which include some subsurface construction, would generally have a similarly low potential for impact.

Maintenance Base Sites. Based on reported conditions at each site, the M1-A S. Lander Street site appears to have the lowest potential for construction impacts associated with existing hazardous materials releases. Site M1-A has a small amount of petroleum-contaminated soil. The M1-B S. Lander Street site includes three groundwater and two soil petroleum release sites. The M1-C Atlantic/Central A site has had one petroleum release to groundwater. The M1-D and M1-E Rainier Brewery sites have had two petroleum releases to soil. Both alternatives are situated on top of a historic landfill with reported releases to groundwater. The N.E. Boeing Access Road (M2) site has had one release of gasoline and diesel oil to groundwater with some floating product noted, and one release of heating oil, which has reportedly been cleaned up. The S.W. Boeing Access Road (M3) site has reported gasoline releases to soil, but groundwater has not been investigated. A firing range was located on the site and there is potential for lead contamination (no characterization data are available). Based on reported conditions, the M1 S. Lander Street site appears to have the lowest potential for construction impacts to hazardous materials.

4.17.11.2 Mitigation

A formalized health and safety plan and a contaminated soil and groundwater management plan would be required before construction work begins. Public health and safety measures would be implemented to minimize exposure through both airborne and direct contact routes. Increased setbacks, additional barriers to public access, and expeditious removal of contaminated materials may be required to limit contact by the public. The health and safety plan will also identify measures to ensure construction worker safety, outline emergency medical procedures, and specify reporting requirements.

The soil and groundwater management plan would specify methods and procedures for stockpiling, transportation, disposal, and treatment of contaminated soil, as well as groundwater removal, storage, treatment, discharge (to sewer), transportation, and disposal. Most encounters with hazardous materials are expected to involve petroleum products that can be managed using relatively standardized approaches.

Throughout the construction process, encounters with hazardous materials would be documented and reported appropriately. Project planning would accommodate regulatory agency requirements as well as disposal or treatment facility requirements.

4.17.12 Public Services

4.17.12.1 Impacts

Fire and Emergency Medical Services

Some traffic re-routings or delays could affect emergency vehicles during construction; crossings of MLK Jr. Way S. (all D alternatives), Tukwila International Blvd. (E1.1 and E1.2), and International Blvd. (F1, F3.1 F3.2, and F3.3) could be particularly affected. Sound Transit would attempt to keep at least one lane of traffic open at all times, especially on main arterials. Some cross streets could be temporarily closed to complete construction work (e.g., final paving). In some cases, construction requiring temporary road closures would be conducted at night or during off-peak hours to minimize traffic impacts. All traffic control plans would be reviewed and approved by the Washington State Department of Transportation (WSDOT) and local jurisdictions. Emergency service providers may need to develop contingency plans in coordination with Sound Transit to reduce response time delays during construction. The plans may involve changing routes to avoid street blockages and, depending on the extent of the area under construction, arranging to have emergencies handled by the closest service providers.

Fire hydrants would need to be relocated during construction. Most of these relocations would occur along at-grade sections requiring sidewalk and street curb relocations, such as on MLK Jr. Way S. (D alternatives), Tukwila International Blvd. (E1.1), Interurban Avenue S. (E2), and International Boulevard (F1 and F4). Water line relocations during construction could temporarily affect water supplies used for fire-fighting and hospitals. During relocations, careful coordination with affected fire departments and hospitals would prevent service interruptions.

Law Enforcement

Construction of at-grade and elevated sections in some high-volume traffic and pedestrian areas could require additional police support services to direct and control traffic and pedestrian movements. Traffic mobility during construction in heavily traveled areas such as MLK Jr. Way S. (all D alternatives), Southcenter Mall (E2 and E3), Tukwila International Blvd. (E1), and International Blvd. near Sea-Tac Airport (F alternatives) could be most difficult, especially during peak hours. Construction contractors would be responsible for maintaining security at sites under construction.

School Bus Routes

Construction of at-grade and elevated light rail sections would delay buses traveling on, crossing, or making turns from the roadway under construction. Major north-south school bus thoroughfares such as MLK Jr. Way S. (D alternatives), Tukwila International Blvd. (E1.1 and E1.2), and International Blvd. (F alternatives), would be affected, as would key intersections along these roads (see Section 4.13.2). Buses normally using MLK Jr. Way S. could potentially use Rainier Avenue S. as a reasonable alternate route. Alternate route options for buses on Tukwila International Blvd. and International Blvd. are fewer and less desirable because these are the only major north-south roads through Tukwila and SeaTac, respectively. Elevated sections in the southern project area that are located primarily off of the major north-south roads (e.g., E2, E3, F2.2, F2.3, and F4) would likely have few major delays during construction.

Tukwila School District buses transporting students from the west side of Tukwila International Blvd. to schools on the east side of the highway (that is, Foster High School and Showalter Middle School) could be particularly affected during some construction activities (E1.1 and E1.2). Highline School District buses serving schools east of International Blvd. could also be affected (all F alternatives). Some bus stops would need to be relocated during construction of at-grade sections and possibly during construction of elevated sections.

School bus stops located near light rail stations, elevated sections, tunnel portals, and other system features requiring aboveground construction would likely need to be temporarily or permanently relocated in coordination with the school districts.

Solid Waste Collection

Solid waste haulers could experience slight delays or disruptions on collection routes during construction activities, especially along route segments in which access to curbsides, driveways, or other access points would be closed or impeded. Alternative solid waste collection locations, modified collection times, or other elements to minimize potential impacts to the City's solid waste collection operations would be developed in coordination with solid waste haulers.

Construction and demolition debris could be disposed of at a number of disposal facilities in the Puget Sound region. A portion of this debris, including clean wood waste, metals, gypsum, and other materials, can be recycled at facilities such as Seattle's recycling and disposal stations.

4.17.12.2 Mitigation

Sound Transit would continue to work with the cities of Seattle, Tukwila, SeaTac and Renton, King County, University of Washington, and Port of Seattle police and fire departments, transportation divisions, and others, through Sound Transit's Fire-Life Safety Committee during project construction to ensure that reliable emergency access is maintained and alternate plans or routes are developed to avoid significant delays in response times. Sound Transit would coordinate with construction contractors and, if necessary, with local police departments to ensure adequate staffing during construction for traffic and pedestrian movement control and other necessary policing efforts. Additional staffing requirements and financial responsibilities for police services required during construction would be determined in collaboration with the local police departments. Sound Transit would coordinate with fire departments and hospitals during water utility relocations to prevent water supply disruptions to these facilities, and it would notify school districts of major construction activities that may affect bus routing during the upcoming school year. Sound Transit would coordinate with school districts to minimize safety issues for children who need to walk near construction zones; bus stops or walking routes that could pose dangers during construction would be temporarily relocated. Sound Transit would work with local jurisdictions and solid waste haulers to minimize impacts to solid waste collecting operations during light rail construction.

4.17.13 Utilities

Utility pipes, lines, conduits, cables, and other infrastructure would need to be supported in place, relocated or otherwise avoided during construction. Major utilities that would be crossed, and the approximate length of utility infrastructure that could be affected in areas where the routes parallel utilities, are identified in Table 4.17-13. Potential impacts to utilities are based on an examination of available utility maps, discussions with utility representatives, and field visits, and may not completely or precisely assess all existing utilities. Precise locations and depths of utilities would be verified in later design stages and prior to construction of the light rail facilities. The table identifies impacts to major utilities (e.g., minimum of 36-inch storm drains, 24-inch sewer pipes, 16-inch water lines, and high-pressure gas lines) only. Numerous smaller utility conveyances, side sewers, electric distribution lines, and connections to homes and businesses would also be affected and would either need to be supported in place, relocated, or otherwise avoided during construction. The table does not identify utilities potentially affected by maintenance base alternatives. These are discussed in Section 4.17.13.1.

Typically, water lines and high-pressure gas mains are located about 3 to 6 ft underground, and sewer pipes are located at least 6 ft below the surface, and often much deeper. Smaller pipes, fiber-optic cables, telephone lines, and other utilities are often buried less than 3 ft deep. Water, sewer, and storm drain pipelines typically run parallel beneath streets, placed in various locations ranging from the center to the roadway periphery; fiber-optic cables, telephone lines, underground electrical conduits, and smaller pipes are often located beneath sidewalks. These utilities may or may not be affected during construction, depending on their depth below grade, material composition, the excavation limits, the exact location of proposed track, and other factors. However, most underground utilities crossed by the proposed route are located within approximately 6 ft of surface grade and within 35 ft directly under elevated segment columns. Underground utilities would be relocated or otherwise protected to allow for excavation and to minimize potential load impacts on existing utilities from the weight of the light rail trains and infrastructure.

Potential impacts include relocation of numerous utility poles supporting overhead lines; relocation of underground utilities from the track zone, station areas, and maintenance facility site (particularly in line segments constructed in street rights-of-way); and inspection, repair, and encasement of underground utilities at track crossings. In addition to those utilities identified in Table 4.17-13, project construction would also affect fiber-optic cables, telephone lines, and cable television lines strung on affected utility poles. The project would also require relocating some utilities occupying the right-of-way, posing a safety hazard, or conflicting with construction activities. Access to underground utilities (i.e., manholes and vaults) for maintenance activities could be affected depending on the location of light rail facilities. In some cases, access points, including manholes, would need to be relocated. Relocating water mains could also affect access to and use of fire hydrants; in some cases, establishing a parallel water main to avoid utility lines crossing under the tracks may be considered. Some of these impacts may be significant to some utility service providers in terms of relocation costs incurred, staff time and resources, and temporary loss of existing access to utilities. Generally, Sound Transit would compensate for City-owned utilities in accordance with City codes or charter provisions. Private utilities in public rights-of-way would be required to pay relocation costs themselves, except under certain circumstances (see Mitigation section below).

Disruptions to utility service during utility relocations would likely be minimal because temporary connections to customers would typically be established before relocating utility conveyances. However, inadvertent damage to underground utilities can occur during construction if utility locations are uncertain or misidentified. While such incidents do not occur frequently, the numerous relocations required during light rail construction under any alternative make accidents more likely. Such accidents could temporarily affect service to customers served by the affected utility.

Generally, cut-and-cover, followed by at-grade light rail construction, would have the greatest impacts on utility infrastructure, because these segments require more relocations of underground pipes and aboveground utility poles for trackways, stations, and right-of-way curb and sidewalk acquisition. At-grade routes and cut-and-cover sections have the potential to require relocation of longer sections of underground pipes and cables in street rights-of-way.

Bridge work and fittings and supports for elevated sections could also require relocation of utilities. However, elevated supports can often be placed to avoid conflicts with major utilities and could "straddle" crossing roadways, thereby avoiding utilities running beneath them. Tunnel sections would generally pass beneath most existing underground utilities and would not require relocation; protection of these utilities in some cases (typically deeper sewer pipes) may be required. Construction of stations, ventilation shafts, the maintenance facility, parking areas, TPSS facilities, and other light rail features would be likely to affect utility infrastructure.

Table 4.17-14
Potential Impacts of Central Link Construction on Major Utilities.[a]

Rail Segment	Storm Drains[b]		Sanitary & Combined Sewers[c]		Water Mains[d]		Fiber Optics[e]		Overhead Power		Underground Power		Natural Gas[f]		Petroleum (Jet Fuel)		UW Utility Tunnels	
	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings	# of Poles (Parallel ft)	# of Xings	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings
Northgate to University District																		
A1.1	–	–	–	2	2,500	6	2,000	–	20	–	–	2	–	1	–	–	–	–
A1.2	–	–	–	2	2,500	6	–	1	20	–	1,200	1	–	1	–	–	–	–
A2.1	–	–	–	2	–	7	–	1	20	–	3,600	1	–	3	–	–	–	–
A2.2	–	–	–	2	–	7	–	–	20	–	3,600	1	–	3	–	–	–	–
Notable features: 66"/72" brick sewer on Ravenna Blvd; 42" water on 12th Ave. N.E.																		
University District to Westlake Station																		
B1[g] (pref.)	–	–	–	1	450	1	150	-	-	–	300	7	–	1	–	–	–	3
B2.1[g]	–	–	–	7	4,100	10	–	6	17	5	–	–	–	–	–	–	1,400	2
B2.2[g]	–	–	–	6	2,900	4	–	6	NA	NA	–	–	–	–	–	–	–	3
Notable features: 96" sewer tunnel in University District; UW utility tunnel system on Campus Pkwy, N.E. 40th St., and Pacific Ave.; 108" brick sewer on N.E. Pacific; 66" sewer @ 7th Ave. and Denny Way; underground 115-kV transmission line, 36" storm, HP gas, and 26"/39" brick combined sewer at the Capitol Hill Station at Broadway/Nagel and Denny.																		
Westlake Station to S. McClellan Street																		
C1.1[h]	1,550	2	2,310	4	1,350	3	4,370	1	15	-	200	-	-	1	-	-	-	-
C1.2[h] (pref.)	200	2	960	4	100	3	4,370	1	(2,900)	–	200	-	–	1	–	–	–	–
C2.3	4,700	1	4,000	2	1,000	6	–	4	63	–	–	2	–	–	–	–	–	–
C2.4	4,800	–	4,400	2	500	6	–	4	63	–	–	1	–	–	–	–	–	–
C3	900	–	–	2	–	5	–	4	NA	–	–	2	–	–	–	–	–	–
Notable features: 230-kV transmission line along E-3 Busway; 42" water on 12th Ave. S., 13th Ave. S., and Beacon Ave. S.; 66" water on 20th Ave. S.; 102" storm in old railroad right-of-way west of Rainier Ave. S.; numerous major utilities on Rainier Ave. S.																		
S. McClellan Street to Boeing Access Rd																		
D1.1 (pref.)	-	4	6,720	3	-	4	–	1	326[i] (22,420)	1	–	–	520	1	–	1	–	–
D1.3	600	–	6,400	3	1,100	5	–	1	326 (22,420)	1	–	–	520	1	–	1	–	–
D3.3	600	–	6,400	3	1,100	5	–	1	326 (22,420)	1	–	–	520	1	–	1	–	–
D3.4	600	–	6,400	3	1,100	5	–	1	326 (22,420)	1	–	–	520	1	–	1	–	–
Notable features: 36"-60" sewer on MLK Jr. Way S. and proposed 48" sewer pipes on S. Henderson St.; 42", 54", and 66" water on Beacon Ave. S.; transmission lines and jet fuel line crossings of MLK Jr. Way S. near Henderson St.; HP gas line on MLK Jr. Way S. south of Henderson St.																		

Table 4.17-14 Continued

Rail Segment	Storm Drains[b]		Sanitary & Combined Sewers[c]		Water Mains[d]		Fiber Optics[e]		Overhead Power		Underground Power		Natural Gas[f]		Petroleum (Jet Fuel)		UW Utility Tunnels	
	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings	# of Poles (Parallel ft)	# of Xings	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings	Parallel (ft)	# of Xings
Boeing Access Rd to SR 518 (Tukwila)																		
E1.1	–	–	–	1	–	-	–	1	171 (3,600)	9	–	1	–	1	–	–	–	–
E1.2	–	–	–	3	–	1	–	1	171 (3,600)	9	–	–	–	1	–	–	–	–
E2	–	1	17,000	6	–	3	3,700	1	106	3	–	–	–	-	–	–	–	–
E3	–	1	2,800	8	–	2	–	–	43	2	–	–	–	–	2,800	–	–	–
Notable features: 20" HP gas line and other major utilities in railroad right-of-way at Boeing Access Rd. crossing; transmission and distribution lines and 48" water on S. 112th St. (extended); 96" and other sewer force main on Interurban Ave. S. from Interurban pump station; 60" water along Tukwila Pkwy, Andover Park E., and Baker Blvd. (extended) at Southcenter; transmission line crossings in vicinity of West Valley Hwy.																		
SR 518 to S. SeaTac Station (SeaTac)																		
F1	5,300	1	–	–	4,800	1	–	–	183	1	9,000	–	5,200	1	12,900	–	–	–
F2.1	4,800	1	–	–	2,000	2	–	–	37	–	4,000	–	3,900	2	–	9	–	–
F2.2	2,600	1	–	–	–	2	–	–	22	2	2,500	0	2,400	2	–	9	–	–
F2.3 (pref.)	2,600	1	–	–	–	1	–	–	–	1	–	–	2,400	2	12,900	3	–	–
F3.1	3,100	1	–	–	2,200	1	–	–	113	–	1,000	1	6,000	–	12,900	3	–	–
F3.2	400	2	–	–	3,600	1	–	–	95	–	1,000	1	4,000	–	5,100	3	–	–
F3.3	2,600	1	–	–	2,000	1	–	–		1	–	1	3,000	–	12,900	3	–	–
F4	2,600	1	–	–	2,000	1	–	–		1	–	1	3,000	1	12,900	3	–	–
Notable features: 60" water on S. 160th St.; underground power for length of Int'l Blvd; numerous major utilities on Int'l Blvd, especially between S. 170th and S. 192nd St. (storm, HP gas, jet fuel, water); Sea-Tac Airport utility tunnel (F3.2); overhead transmission line on 28th Ave S.																		

Notes: NA not available.

[a] Data compiled from June 10, 1998 in-progress utility information plans and from July 1998 data updates; utilities potentially affected by maintenance base alternatives are discussed in section 4.17.13.1.

[b] Major storm drainage utilities ≥36-inch diameter.

[c] Major sanitary sewer utilities ≥24-inch diameter (gravity); ≥12-inch diameter (force mains).

[d] Major water mains ≥16-inch diameter.

[e] Indicates underground fiber-optic cables only; elevated cables on utility poles may also be affected.

[f] High-pressure (HP) gas lines only.

[i] Substantially fewer utility poles would be affected under Alternative D1.1d than D1.1c or D1.1e.

[g] All B routes would cross an underground steam line, and B2.1 would parallel the line for 350 ft.

Locations of other fiber-optic cables, including Pacific Fiber Link, MFS/Worldcom, Starcom, City of Seattle, and possibly other telecommunications fiber-optics were not available.

[h] Differences in affected utilities between alternatives C1.1 and C1.2 reflect position of trackway down E-3 busway and along S. Lander St.

4.17.13.1 Impacts by Segment

Notable or potentially significant impacts associated with specific route alternatives include the following (see Table 4.17-13 for more detailed information):

Segment A. A1 alternatives could require more relocations of water mains, fiber-optics (A1.1), and utility poles than A2 routes; A2 routes could require more relocations of underground and overhead power lines and natural gas lines than A1 routes.

Segment B. The preferred alternative would affect more underground power lines. Proposed cut-and-cover construction of the Capitol Hill station (B1) would affect a number of utilities near Broadway and Denny Way, including a major underground 115-kV electrical transmission line, high pressure natural gas, a combined sewer line, and a storm drain line. Option C would likely have the greatest impact of these station alternatives. Also, option D on Nagle Place could interfere with SPU's Broadway Pump Station, located along Nagle Place near E. Howell Street. The B2 alternatives in the Eastlake, South Lake Union, and Seattle Center areas have the potential to affect substantially more water, fiber-optic, and overhead power lines than the preferred alternative (B1). Alternative B2.1 could affect University of Washington utility tunnels, especially on Campus Parkway. The proposed deep tunnels in the University District would not affect the UW tunnels. The N.E. 45th Station would likely avoid the 96-inch Lake City sewer line in the vicinity; however, this deep line may need to be protected during construction and operation. Groundwater from tunnel construction dewatering would be disposed in existing City of Seattle storm drains. King County Department of Natural Resources requires discharge permits with stipulations, restrictions on water quantity and quality discharged to sanitary sewer systems. The largest dewatering quantity is expected at the N.E. 45th Station, in excess of 2000 gpm. This flow can be distributed between three existing storm drains and one combined sewer in this area, thereby preventing overload on any single drainage line. Size of drainage facilities at other locations is adequate to accommodate projected dewatering flows. Wastewater flows generated at the face of the tunneling operation will be generally much lower than groundwater dewatering flow, but this flow will have high solids loading that will require treatment prior to discharge.

Segment C. The preferred alternative (C1.2 and the other C1 alternatives would cross more sewer and storm lines and would affect more parallel fiber-optic lines than the other alternatives, while C2 and C3 would cross more fiber-optics than C1. The preferred alternative (C1.2) would avoid potential relocations of major sewer, storm, and water lines on S. Lander Street by locating the route along the north side of that street rather than the center. However, the E-3 Busway for Alternatives C1.2, C1.3 and C1.4 would require relocating 2,900 ft of overhead 230-kV transmission line and 4,370 ft of a Sprint fiber-optic line that parallels the busway. The C1 alternatives would also cross major sewer and water lines beneath Airport Way S. The C2 alternatives could affect more parallel sewer and storm lines than the C1 or C3 alternatives.

Segment D. All D alternatives would require significant relocation of aboveground utility poles. The Segment D at-grade alternatives, including the preferred alternative, would require relocating approximately 1¼ miles of major sewer line and would cross a number of major water lines. Construction of the route, Henderson Street station, TPSS facility, and bus facility in the S. Henderson Street/MLK Jr. Way S. vicinity could affect a substantial number of utilities, including an Olympic Pipeline, jet fuel line, high pressure gas line, and existing and proposed sewer lines. In addition, the proposed Genesee Station under Alternatives D3.3 and D3.4 would displace King County DNR's Rainier Pump Station at 3807 Letitia Avenue S.

Segment E. Alternatives E1 and E2 would require substantial utility pole relocations along Tukwila International Blvd. and Interurban Avenue S., respectively. The E1 alternatives, including the preferred alternative (E1.1), would require raising Seattle City Light transmission and distribution lines near S. 112th Street to allow adequate clearance for the elevated light rail routes in this area. Major (20-inch) high pressure gas and sewer lines located in the BNSF right-of-way beneath the proposed E1 Boeing Access Road crossing and station should not be affected. More than 3 miles of major sewer line running adjacent to Alternative E2 could be affected, substantially more than under any of the other alternatives. In addition, the City of Tukwila requires all new or relocated utilities to be located underground, including utility distribution poles requiring relocation under E1.1, E1.2, and E2. It is also possible that columns from the elevated section of E2 could affect the 108-inch piped section of the Gilliam Creek drainage near the Southcenter frontage road north of Andover Park West (see Section 4.8).

Segment F. Numerous utilities are located beneath or adjacent to International Boulevard in Segment F. Alternative F1 would affect more utilities than the other F alternatives. Substantially more underground power lines could be affected under Alternative F1 than under any of the other Segment F alternatives. Alternative F1 would also require substantial utility pole relocation. There would also be potential conflicts with the Sea-Tac Airport utility tunnel and water cooling system under Alternative F3.2. Alternatives that cross S. 160th Street at-grade (F1 and F2, including the preferred alternative) would cross the 60-inch Cedar River Pipeline #4 running beneath that street and would likely require protecting the line. The elevated sections of Alternatives F2.3 (the preferred alternative), F3.3, and F4 on 28th Avenue S. could conflict with the PSE transmission and natural gas lines running on the east side of that street. The transmission lines, however, are scheduled to be relocated to the west side of 28th Avenue S. as part of SeaTac's 28th/24th Avenue S. project, which would occur before the light rail system is constructed.

Maintenance Facility Impacts

Although significant major utilities (96-inch sanitary sewer and 84-inch storm drain) are located beneath S. Lander Street, the approach route to the M1-A and M1-B alternative sites (north of S. Lander Street) would not affect these utilities. However, the M1-A and M1-B route would require crossing a fiber-optic line beneath Sixth Avenue S. and a 30-inch water main on Airport Way S. The M1-A Alternative could also affect the same fiber-optic line beneath Sixth Avenue S. on the site's west boundary. The M1-A and M1-B alternatives would also affect approximately 800 ft of overhead transmission line along the E-3 busway. M1-A and M1-B could affect approximately 800 ft of three underground electrical conduits located beneath the extension of 8th Avenue S. (the M1-A/M1-B border); M1-B would also affect another 800 ft of these lines as they run east/west between a point south of S. Walker Street and Airport Way S. In addition, the M1-A and M1-B routes would likely encroach upon Seattle Public Utilities Operations Control Center at 2700 Airport Way S. as the route tunnels into Beacon Hill. In addition, the M1-B Alternative would displace a Seattle Public Utilities water quality laboratory located on the M1-B site. The Atlantic Central A Alternative (M1-C) would affect less of the overhead transmission line, but could potentially affect approximately 800 ft of high-pressure gas line, 800 ft of 16-inch water main, 1,200 ft of fiber-optic line, and 1,500 ft of electric utility (distribution) poles. Route C1.5 could also affect as much as 3,000 ft of a 54-inch Washington Department of Transportation storm drain line in the abandoned railroad right-of-way adjacent to I-5.

Sites M1-D and M1-E appear to have the greatest potential impact on utility infrastructure of the five North Duwamish maintenance base alternatives. Major utilities are located in this area. M1-D could affect 1,800 ft of 48- to 120-inch WSDOT and City of Seattle storm drain line coming from the railroad right-of-way, along S. Forest Street, and down the entire length of Site M1-D. Site M1-E could affect 1,600 ft of this line. Major King County sewer lines are located beneath S. Hanford Street, and sites M1-D and M1-E would be built on top of these lines. Site M1-D could affect 700 ft of 100-inch-by-150-inch sewer main (concrete) and would displace a 28- by 76-inch underground sewer on the site. Site M1-E would be worse, potentially displacing these lines and 250 ft of 108-inch line and another 200 ft of 108-inch tunnel. Site M1-E could also affect 2,200 ft of 30-inch water main running beneath Airport Way S. Site M1-E could affect 3,700 ft of overhead electric distribution lines along Airport Way S., S. Forest Street, and S. Hanford Street; M1-D would affect only 1,500 ft of distribution line. Both options would also affect smaller sewer, storm, water, and intermediate pressure natural gas lines.

4.17.13.2 Mitigation

Potential mitigation measures for impacts to utilities would include these actions:

- Seek to establish formal agreements with local jurisdictions, including requesting enforcement of applicable provisions of existing franchise, license, and other utility agreements to allow light rail implementation.
- Provide utility relocation benefits associated with relocation of existing City-owned utilities in accordance with City code or charter provisions. Incremental costs of upgrades would be funded by the individual cities.
- Provide utility relocation benefits in accordance with the agency's Real Property Acquisition and Relocation Policy, Procedures, and Guidelines and applicable state and federal law if construction disrupts private utilities within the private utility's easement or on private property. Compensation for relocation of private utilities in public rights-of-way would be funded by the utility, unless it is agreed that the relocation costs constitute an "extraordinary expense" that would unfairly burden the utility.
- Establish general utility relocation and protection methods for crossings and installations.
- Use utility company base maps as the primary source of the utility information and conduct a limited program of field surveys and reconnaissance to check accuracy of utility locations before final design and construction. Sound Transit would conduct potholing activities at key locations in coordination with the affected utility. The agency would request that utility companies review the accuracy of the base maps.
- Continue to meet with and coordinate closely with both municipal and private utilities to ensure minimal impact to utilities during construction, including acceptable and safe relocation of manholes and other maintenance access points.
- Work with Seattle City Light and Puget Sound Energy to maintain energized electrical lines to provide continuous service to their customers during construction; and maintain clearances of temporary and permanent overhead lines and poles according to Washington Administrative Code safety standards.
- Develop a contingency plan to address any potential utility service disruptions during construction and notify utility customers of planned disruptions, if any.
- Comply with City and state requirements and procedures for utility construction, inspection, and operation; coordinate relocations and large service connections with Seattle's Utility Coordinating Committee and similar entities.
- Use pipe and conduit support systems, trench sheeting and shoring, and other precautionary measures during construction to minimize the potential for damage to exposed utilities.

4.17.14 Historic/Archaeological/Cultural Resources

4.17.14.1 Historic Resources

In Segment A the two Russell Houses (A05, A06) are located near a tunnel portal and would likely experience the short-term noise and traffic impacts associated with detours and truck activity explained at the beginning of this section. Construction of a vent shaft on the grounds of University Heights School (A09) and the possible use of approximately one-half acre of the site as a staging area would have short-term impacts associated with these activities.

For the preferred alternative, short-term construction impacts are confined to Segments B and D. Potential staging areas for the Pacific Station, located east of University Way N.E. and north of N.E.

Pacific Street, would be close to but would not significantly impact the Columbia Lumber Company Office (B55), which might experience similar short-term impacts. Excavation for station Option C at N.E. 45th Street could potentially cause settling and possible damage to the University State Bank, located across the street. At the Capitol Hill Station, a staging area has been identified using a parking lot adjacent to Lincoln Reservoir (B28). The resource would be affected by noise, dirt, truck traffic, detours, loss of access, and other short-term impacts associated with the cut-and-cover method of construction of the underground station beneath Broadway. Capitol Hill Station Option D, a cut-and-cover station beneath Nagle Place, is no longer preferred. It would also include temporary loss of use of a portion of the park and would remove a tree with potential historic importance, resulting in an adverse effect on this resource. The staging areas identified for construction of the First Hill Station could have short-term impacts on the adjacent Spring Street Apartments (B38) and San Marco Apartments (B39). A staging area in the parking lot west of the Paramount Theater (B53) may have short-term impacts on the theater. For Alternative B2.1, short-term construction impacts–including increased noise, dirt and truck traffic–associated with nearby staging areas, could affect the Lake Union Steam Plant (B69), Felder Houses (B70-72), Ford Motor Company (B75), McKay Auto Dealership (B81), as well as the Paramount Theater (B53), and Camlin Hotel (B54).

Construction of the McClellan Station in Segment D could cause temporary closure of Cheasty Boulevard, rerouted traffic, and other short-term impacts associated with station and guideway construction.

For Alternative B2.1, short-term construction impacts–including increased noise, dirt, and truck traffic–associated with nearby staging areas, could affect the Lake Union Steam Plant (B69), Felder Houses (B70-72), Ford Motor Company (B75), McKay Auto Dealership (B81), as well as the Paramount Theater (B53 and Camlin Hotel (B54).

For non-preferred alternatives, the most substantial construction impacts would occur in Segment D under Alternative D3.4. The cut-and-cover tunnel and station within the Columbia City Historic District would temporarily affect numerous contributing district buildings. Demolition and construction of trackway on the west side of Rainier Avenue S. under this alternative and Alternative D3.3 would affect four historic houses adjacent to the route.

Mitigation measures may be required for seven historic properties in the preferred alternative, or up to 12 historic resources, including two districts, in other alternatives. Section 4.15 identifies by segment the number of historic resources that would require mitigation measures because of adverse impacts caused by short-term audible, visual, and atmospheric elements that are out of character with the historic resource or which would alter its setting. In such cases, the construction methods would need to be modified to avoid or limit these impacts. Mitigation options include: protecting nearby building facades from excessive dirt by increasing the normal cleaning and maintenance program; phasing construction work to reduce noise and to limit physical obstructions that would disrupt access and/or normal daytime use of the resource; and placing temporary construction sheds, barricades, or material storage to avoid obscuring views of historic resources.

4.17.14.2 Archaeological Resources

Site preparation work would be the construction activity that would be most likely to affect archaeological sites. Grading/excavation to establish track grade and trenching to locate/relocate utilities can greatly harm archaeological deposits that might be present. Excavation to establish fittings for elevated track support columns can also harm such deposits. Impacts to traditional cultural properties occurring during construction are less problematic than long-term operational impacts to such properties (e.g., permanent change in land use, loss of access, increased noise levels and introduction of visual obstructions). The impacts associated with construction that are most likely to affect important paleontological deposits are similar to those that would result in adverse impacts to archaeological sites (e.g., grading, excavation/trenching, and other earth-disturbing operations).

Presently undetected archaeological (or paleontological) sites that may occur in high-probability areas would be subject to similar impacts during construction.

Table 4.15-2 summarizes known/recorded archaeological sites and important paleontological deposits located in Segment E. Traditional cultural properties and properties of cultural interest are present in Segment E and at Maintenance Base site M3.

Mitigation measures for known/recorded archaeological sites located in Segment E include subsurface testing prior to construction, data recovery prior to construction, and monitoring during construction. Mitigation measures for paleontological finds would consist of salvage during construction. Mitigation measures for traditional cultural properties would be determined in consultation with affected Tribes. High probability areas are present in Segments B, D, E, F, and at the Maintenance Base sites (see Table 4.15-2). Mitigation measures to lessen potential harmful impacts from construction at presently undetected archaeological sites include subsurface testing before construction and monitoring during construction as described in the Archaeological Resources Treatment and Monitoring Plan.

4.17.15 Parklands

In general, construction impacts are related to the proximity of the parklands to the construction of nearby tunnel portals, elevated sections across or near park facilities, cut-and-cover sections and stations, at-grade sections, TPSS, and vent shafts.

The resulting impacts can be direct (such as temporary easements within park facilities, temporary trail detours, or temporary access restrictions) or indirect (increased truck traffic in the vicinity, possible street closures and resulting traffic detours, increased noise and/or vibration related to the use of heavy equipment, and dust). This section summarizes short-term construction-related impacts to parklands that are of a sufficiently adverse nature to be considered significant.

4.17.15.1 Impacts by Segment

Segment B

The proposed barge facility to dispose of tunnel excavation wastes for Alternatives B1 (preferred alternative) and B2.1 would be located at a moorage site 75 to 100 ft offshore and west of Sakuma Viewpoint. This barge could be up to 275 ft in length and could result in view blockage and noise to Viewpoint users. A typical barge could also complicate kayak access to and from the Aqua Verde Paddle Club dock immediately east of Sakuma Viewpoint. The proposed conveyor system would extend from the barge facility along the western edge of the Viewpoint to construction staging areas in the Pacific Street Station area. The conveyor would be elevated approximately 18 to 20 ft over the water and the land, and could create visual and noise impacts to park users. The conveyor would cross the Burke-Gilman Trail and the Portage Bay Vista/Boat Street View Corridor. The possibility of debris falling from the conveyor belt could create safety impacts to trail and corridor users. Alternative B2.1 may require a trail detour during construction of the elevated section over the Burke-Gilman Trail. A construction staging area has been proposed in the vicinity of 7th Avenue, and N.E. 40th Street and immediately south of the Burke-Gilman Trail. Alternative B2.1 would impact North and South Passage Point Parks because they may be temporarily closed to ensure safe access and maneuverability for trucks and heavy equipment used for the construction of the pier footings and piers and bridge structure. Development of the B1 Capitol Hill (Broadway) cut-and-cover station and the potential associated construction staging area at the existing funeral home parking lot between Broadway and Nagle Place would create impacts in the vicinity of Bobby Morris Playfield, including potential temporary street closures, traffic detours, and construction noise and traffic. Cut-and-cover construction of the Capitol Hill Station along Nagle Place would result in the disturbance of a roughly 40-ft wide by 370-ft long strip along the northwestern edge of Bobby Morris Playfield/Lincoln Reservoir. It is assumed that an easement, rather than property acquisition, would be adequate to allow for the construction activities. During the construction, the entire strip of land between Nagle Place and the western edge of the reservoir would be closed to the public. Assuming that Nagle Place would be closed during construction, access to the western side of the playfield would be restricted. As a result, the existing pedestrian trail around the reservoir would be closed, requiring the existing trail to be shortened to the south of the reservoir. The construction activities would generate noise, vibration, dust and truck traffic that would have an adverse effect on the use and enjoyment of the playfield.

Segment C

With any of the C1 alternatives, the proposed western Beacon Hill tunnel portal would require some cut-and-cover excavation beginning under I-5 and extending approximately 70 ft east of I-5 within the WSDOT I-5 right-of-way, which is within the designated East Duwamish Greenbelt. This cut-and-cover excavation is required to provide adequate depth for initiating tunnel boring. Existing vegetation would need to be removed in the immediate vicinity of the cut-and-cover excavation to allow for construction activities. The proposed east Beacon Hill tunnel portal would be constructed immediately adjacent to the Cheasty Greenbelt. Proximity impacts would include noise, vibration, and dust from construction traffic and activity. Proximity impacts would include potential vibration from boring equipment, removal and hauling of tunnel spoils, dust and noise. Alternative C3 would impact the I-90 Trail and the western trail spur within the future Sister City Park. The trail could possibly be temporarily closed to ensure safe access and maneuverability for trucks and heavy equipment used to construct the I-90 (17th Avenue S.) Station, place the elevated structure foundation, and (potentially) re-locate the western trail spur.

Segment D

Construction of the D1.1, D1.3, D3.3, D3.4 at-grade and elevated sections, including removal of existing pavement, grading, track work, and construction of elevated structure foundation, may require temporary street closures and impede access to Cheasty Boulevard.

Segment E

Alternatives E1.1, E2, and E3 would impact the Duwamish/Green River Trail by requiring a possible temporary trail detour during work across the trail. Alternative E2 would affect the portion of the Foster Golf Course that lies within the Seattle City Light right-of-way. That area would be disturbed and fully used during construction for truck and heavy equipment movements and staging activities. Alternative E2 would also impact the proposed Log Cabin Park, which if developed prior to the light rail route, could impede access by construction activities along the access road to the park (removal of existing pavement, grading and track work).

Alternative E2 and E3 would impact the Interurban Trail by requiring a possible temporary trail detour during work across the trail.

Segment F

Angle Lake Park would be impacted by Alternative F1 to widen International Boulevard. A 25-ft-wide strip would be acquired and the existing landscaping and sidewalk within this strip would be removed to allow for construction.

4.17.15.2 Parkland Mitigation

In each case noted above, the impacts would be mitigated by restoring the site to pre-project construction conditions. This would involve re-landscaping disturbed areas, and providing new vegetation, where possible, to buffer the facilities from the light rail. In general, access to these facilities would be maintained (although in the case of Bobby Morris Playfield, Foster Golf Course, Log Cabin Park, and Angle Lake Park, special detour entrances would need to be established, and access to North and South Passage Point Parks may be temporarily closed). If necessary, trail detours would be developed during work across or above the trails. The conveyor belt envisioned as part of

Alternatives B1 and B2.1 would be covered or otherwise enclosed to prevent possible debris from falling on Burke-Gilman Trail users. Dust would be mitigated through use of dust control measures.

4.17.16 Significant Unavoidable Adverse Impacts During Construction

The potentially significant adverse impacts that would occur during construction, and may not be avoidable, are limited to temporary lane or roadway closures during peak hours, temporary increase in truck traffic, and temporary loss of parking in some construction staging areas. These are based on the current designs and construction assumptions. As the design process continues, Sound Transit would refine construction approaches and attempt to further reduce potential construction-related impacts.

Actual and perceived disruption during the construction phase could create economic hardships for some businesses. Small businesses could be more vulnerable to prolonged periods of construction activity, and could close permanently. Other businesses could experience a short-term decline in revenues due to reduced business activity. Construction activities could impact nearby residential and institutional land uses.

Construction staging areas will require temporary use of properties around tunnel portals, underground stations, vent shafts, and some river crossings. These activities will relocate any existing uses on these parcels.

Construction impacts in most wetlands would not be significant; however, construction impacts on forested wetlands (specifically AR-7 and AR-17 with Alternatives E1.1 and E1.2; AR-7 with Alternative E2; and AR-12, AR-23, AR-25, AR-32 and AR-33 with Alternative E3) are more difficult to mitigate and would be significant.

4.18 CUMULATIVE EFFECTS

4.18.1 Introduction

Cumulative effects are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions" (40 CFR S1508.7). The process of analyzing cumulative effects has influenced all components of the Link environmental review process, including scoping, describing the affected environment, developing alternatives, and evaluating environmental impacts.

Scoping

During the EIS scoping process and development of the EIS, Sound Transit solicited information from other agencies and the public to identify potential impacts and to develop alternatives for the EIS. For example, Sound Transit received information from the following:

- Local jurisdictions provided land use plans, transportation plans, neighborhood plans, and lists of known, major land use proposals;
- WSDOT, Federal Transit Administration, Federal Highway Administration, and the Port of Seattle provided information on planned transportation projects and developments;
- PSRC provided population and employment growth projections, travel forecasts, and land use projections; and
- Other organizations and the public provided information on planned private projects, community values, and concerns.

This information has been used to identify potential future actions by others, identify background growth projections, and define potential cumulative effects.

Describing the Affected Environment

This EIS's description of the affected environment reflects both past and present actions. This description includes the effects of historic actions (such as major changes in watersheds, land use patterns, and travel patterns), as well as more recent actions (such as revisions to International Boulevard in SeaTac). Project staff have used aerial photographs (historic and recent), historic mapping, geographic information systems, field reconnaissance, and other techniques to identify the existing conditions resulting from past and present actions.

Developing Alternatives

Sound Transit has developed and modified the range of alternatives being considered to reduce the potential for cumulative impacts. The initial set of alternatives incorporated some of these modifications. Local jurisdictions, other agencies, and the public gave input that resulted in other modifications. For example, Sound Transit has modified alternatives in the following segments to reduce the potential for cumulative effects: Segment A (modified station near Northgate and route along I-5); Segment B (modified routes and stations near University of Washington and stations on Capitol Hill and First Hill); Segment C (developed alternatives to reduce impacts from bus traffic growth in downtown Seattle, modified stations at Royal Brougham and Beacon Hill and routes along D-2 transit way, E-3 Busway, and Rainier Avenue S., and added maintenance base alternatives); Segment D (added McClellan and Henderson Station options and modified routes on MLK Jr. Way S. to reduce displacements, increase accessibility, and reduce overall noise impacts); Segment E (added station alternatives, modified route along Tukwila International Blvd., and modified stations at Longacres and Southcenter); Segment F (added station alternatives and modified routes on International Boulevard and 28th Avenue S.).

Evaluating Environmental Impacts

One key challenge in evaluating cumulative environmental effects is identifying the reasonably foreseeable future actions that will be taken by other agencies and persons. This Final EIS incorporates the effects of such future actions in a number of ways, including:

- Population and employment projections are based on PSRC's model, which projects future land use pattern changes at the local and regional levels.
- Future traffic volumes, vehicle miles traveled, ridership, and travel times are based on projections of future land use patterns, population and employment growth, and programmed future transportation improvements.

Those impact analyses that are derived from these forecasts and projections, therefore, incorporate the impacts from the light rail alternatives in combination with impacts from other reasonably foreseeable actions. These analyses include traffic and transit (Chapter 3), air quality (Section 4.5), energy (Section 4.9), population and employment (Section 4.1), and traffic noise (Section 4.6).

Although these forecasts incorporate specific programmed transportation improvements, they are less precise in forecasting specific land use projects. Future transportation improvements are predominantly publicly planned projects. As such, they are included in comprehensive and coordinated long-range plans and funding programs that are available to the public. The specific, major transportation improvements that are proposed over the next 10 to 20 years can be reasonably foreseen (see list in Appendix M.1).

Specific land use projects, however, are more often the result of private planning and investment. They are not centrally planned, coordinated, and funded, and, until local permit applications are submitted, these private plans are not typically available for public review. Therefore, many specific developments over the next 10 to 20 years cannot be reasonably identified. However, it is reasonable to forecast changes in land use patterns based on local jurisdiction land use plans, development trends, and population and employment projections. The impact analyses in this Final EIS incorporate these projections (as described above). In addition, specific major land use developments that are currently under construction or in the permitting process (see list in Appendix M.1) are also identified using input from the local jurisdictions and others.

4.18.2 Traffic and Transit

The analysis of traffic and transit impacts in Chapter 3 is a cumulative analysis, based on the results of traffic modeling and ridership modeling that incorporate past and future actions as well as projected growth that would result from development in the region. Overall, the regional cumulative impact of the light rail project would be less than the No-build alternative.

4.18.3 Land Use and Economics

The analysis of land use impacts in Section 4.1 incorporates known major development proposals in the vicinity of the alternatives and discusses compatibility and potential cumulative effects associated with these reasonably foreseeable developments, together with the proposed Link alternatives.

The population and employment projections discussed in Section 4.1 are based on the forecasted land use changes that would result from future development and growth. The light rail system has been planned to accommodate projected growth.

In addition, in Segment C there is concern that non-industrial uses and public industrial uses (such as the M1 Maintenance Base alternatives) are incrementally replacing the private industrial uses in the North Duwamish area. Although many of the new uses are industrial in character, and consistent with the relevant land use and zoning code, they are decreasing the amount of land in this area available to private industrial uses.

4.18.4 Visual and Aesthetics

In general, other reasonably foreseeable transportation and land use development projects near light rail facilities would be consistent with the cities' policies to concentrate and intensify urban development. In station areas where existing uses are auto-oriented and/or less dense than allowed by City plans and zoning, the visual impacts of reasonably foreseeable redevelopment would likely include larger buildings, greater visual scale, and higher pedestrian orientation than the existing conditions. In such locations, light rail facilities would be more visually compatible with these developments than with existing conditions, and the cumulative visual impacts would be less than those of the light rail facilities considered alone.

4.18.5 Air Quality

The air quality hotspot analysis is based on projected future traffic volumes. These future volumes are provided by traffic models that incorporate the effects of past and future actions affecting population, employment, land use, and changes to the transportation system. The regional burden analysis is based on regional modeling, which incorporates projected changes to land use, employment, population, and travel behavior.

4.18.6 Noise and Vibration

The traffic noise impact analysis in Section 4.6 is based on projected future traffic volumes with the project, as well as forecasted background traffic growth and programmed transportation improvements.

FTA noise criteria address cumulative impacts by using a sliding scale that allows less project-related noise increase where ambient noise levels are already high. The impacts from light rail project noise and vibration could be intensified in locations where (1) future sensitive receptors would be built near the system, and/or (2) where future noise-producing uses would be developed near sensitive receptors that would be impacted by light rail system noise and vibration.

In Segment D, the redevelopment of Holly Park and Rainier Vista could place residential uses nearer to the right-of-way, as identified in Section 4.6. Careful site planning and design could greatly reduce noise impacts below existing conditions. Sound Transit would coordinate with Seattle Housing Authority to promote site planning and project design that reduces impacts. Coordination with future development would help reduce the potential for cumulative impacts at other locations near the light rail system.

In Segment F, one of the primary noise sources is air traffic to and from Sea-Tac Airport. Although aircraft noise abatement programs have reduced noise impacts, projected growth in air traffic and changes in flight patterns could change the noise conditions in the future. Although no light rail noise or vibration impacts were projected in Segment F, future changes in the ambient noise levels due to air traffic growth could affect the cumulative noise levels.

4.18.7 Ecosystems, Water Quality, and Hydrology

With mitigation discussed previously in Chapter 4, the Link light rail alternatives would likely avoid or reduce direct, significant impacts to ecosystems, water quality, and hydrology. The following discussion considers the proposed action's direct and indirect impacts in the context of regional, cumulative effects from past, present, and forecasted future development. This regional perspective is followed by a discussion of cumulative impacts associated with other site-specific development proposals in the vicinity of the light rail alternatives. Because of the relationship between water quality, wetlands, and fish and wildlife habitat, these resources have been considered together in this analysis of cumulative impacts.

Regional Cumulative Impacts

Several wildlife and fish species in the project corridor (chinook salmon, coho salmon, bald eagle, and bull trout, as discussed in Section 4.7) are currently listed as threatened, endangered, or candidate species. The reduction in the numbers of each of these species is the result of many historic actions, including those actions that have directly or indirectly caused a substantial loss and degradation of habitat. Cumulative substantial loss of the region's wetlands has also occurred. Large-scale losses of habitat and wetlands can be traced to historic, major projects intended to provide flood control, irrigation, hydroelectricity, land reclamation, and navigational improvements, including channelizing and redirecting rivers and streams, filling Duwamish River intertidal habitat, and creating barriers to salmon spawning areas.

Widespread loss of wetlands and fish and wildlife habitat is also the result of the accumulated impacts of numerous smaller projects that, considered individually, would not be significant. These include both direct and indirect impacts resulting from farming, logging, and other resource extraction activities; roadway construction; and residential, commercial and industrial development. Such development has directly removed habitat and wetlands. It has also resulted in indirect effects, including increased stormwater runoff to streams and rivers.

Land use development patterns in recent decades have contributed to adverse effects on wetlands, water quality, and habitat. Dispersed, low-density growth has dominated development trends in the latter part of this century, consuming more land per capita than in the earlier periods of growth. Between 1970 and 1990, this region's population grew by about 30 percent, but the area of developed land grew by about 80 percent. In that same time frame, average daily vehicle miles traveled per person increased by more than 150 percent. Increased automobile travel and dispersed land use patterns adversely impact environmental quality, including air, water, and wildlife habitat. As more land is converted to buildings and parking lots, additional impacts on local water quality, hydrology, and ecosystems occur. These impacts include increased levels of pollutant loading and runoff; sediment entering streams, rivers and wetlands, which degrades fish habitat; and a shift in wildlife species composition to species adapted to human disturbance, open areas, and landscaped vegetation.

The extensive road network and increased automobile ownership have been significant factors in allowing the more dispersed development patterns to occur. In recent years, however, road capacity has not kept pace with increased travel demands. For example, in 1990, normal congestion caused about 45 million person hours of delay, an increase of 50 percent compared to just six years earlier.

In recent years, the Puget Sound region has been taking deliberate steps to change the way that it addresses population and travel demand growth. With the goals of accommodating growth projections and maintaining the environment and quality of life, the four-county Central Puget Sound region adopted Vision 2020 and the Metropolitan Transportation Plan. These plans establish integrated, long-range growth management, economic, and transportation strategies. The strategies are based on a vision of urbanized centers linked by a regional rapid transit system. Link light rail and other elements of the Sound Move plan are integral elements to achieving the region's vision. (See discussion of regional plans in Section 4.1.2.) The light rail project would provide a fast and convenient alternative to the automobile and would provide accessibility to centers that have been targeted to accommodate future growth and planned higher densities. Because of the large number of people that can be accommodated on a light rail system, light rail would allow the region to achieve densities that could not be achieved with heavy reliance on automobiles. By reducing land required for transportation facilities, reducing the need for parking facilities, and supporting growth within designated urban centers, the light rail alternatives would likely reduce both the direct, indirect, and cumulative impacts on water quality, hydrology, and habitat.

The proposed light rail line would have the same passenger capacity as a 10-lane highway but would occupy a significantly narrower right-of-way (approximately 30-ft-wide versus over 150-ft-wide). Direct impacts on habitat and water quality, therefore, would be substantially less with light rail. In addition, reducing the use of cars would lessen the need for parking facilities, another major consumer of land; within cities, nearly half of all urban space is used to accommodate automobiles (AltTrans). Reducing automobile use (approximately 130,000 fewer vehicle miles each day with the preferred light rail alternative by 2020) would also reduce pollutant loading in runoff from roadways and parking lots. Finally, as noted above, light rail would allow the region to better achieve its regional growth management strategy. Light rail would not directly prevent sprawl (low-density, dispersed patterns of growth), but it would provide mobility and access options that would allow the region and local jurisdictions to achieve higher densities and to reduce land consumption, consistent with regional and local plans and policies. In this context, both the direct and indirect cumulative impacts on water quality, wetlands, and habitat would be expected to be lower with the light rail alternatives than without.

Cumulative Impacts From Other Specific Projects

In addition to the discussion above of regional, cumulative impacts, the following discussion addresses the combined effects of light rail with other specific projects proposed near the light rail alternatives.

Segments A, B, C, and D. Most other projects proposed in Segments A, B, C, and D would occur on sites that are already developed. As such, the impacts from this development on habitat and water quality are expected to be minimal, as long as appropriate BMPs are employed during construction to prevent erosion and siltation. Where development would occur on currently undeveloped land (mostly Segment D), there would be potential habitat loss and an increase in impervious surfaces. In some areas development in station areas may occur sooner and at higher densities than would occur without the light rail project. Any new development would be subject to the City of Seattle regulations regarding critical areas protection and stormwater detention and treatment. In some cases, redevelopment of such sites will have a positive effect because higher standards will be applied to the redevelopment than were used for the original development.

Segment E. Currently, Segment E is the least developed of the six segments. Five other proposed public transportation projects in Segment E would or could contribute to impacts on water quality and ecosystems. These projects include widening SR 181 (West Valley Highway), adding commuter rail service to a bridge over the Black River, constructing the Pacific Highway Revitalization Plan, adding a possible new HOV connection for the I-5/I-405/SR 518 interchange and potentially adding HOV lanes to SR 518. Several miscellaneous private projects are also proposed in this segment.

Widening SR 181 to seven lanes could result in additional impacts to AR-33, a forested wetland that would also be impacted by Alternative E3. The highway widening would also add to pollutant loading in runoff from the highway. Cumulative impacts would likely include filling a larger portion of the wetland, removing portions of the forest canopy, loss of foraging and nesting habitat for wildlife, and a higher increase in runoff. Wetland impacts and stormwater runoff from this roadway project would presumably be mitigated in compliance with local regulations.

The proposed commuter rail service would run largely on existing freight rail tracks and would widen the existing BNSF bridge over the Black River, near the proposed light rail bridge associated with Alternative E3. The BNSF bridge is already above the 100-year floodplain and widening it will not encroach on the floodplain. Increased shading and runoff associated with bridge widening would be combined with the increased shading and runoff from the proposed light rail bridge and elevated trackway in this vicinity. The light rail alternative (E3) and the commuter rail project would manage and mitigate stormwater runoff and habitat impacts in compliance with local, state, and federal regulations.

The proposed Pacific Highway Revitalization Plan would increase the cross-section width of International Boulevard to 86 ft. Alternative E1.1, located on Tukwila International Boulevard, has been modified to accommodate many elements of the city's proposed road revitalization plan as well as the proposed light rail trackway. Alternative E1.1 would achieve most of the objectives of both projects within a 102-ft right-of-way. There would be more new impervious surfaces associated with the combination of the two projects than with either project considered individually, but less total new impervious surface than if the light rail were built in a different corridor through Segment E (such as Alternatives E2 or E3). Building the light rail line on Tukwila International Boulevard would increase the culvert extensions beyond that already proposed with the road revitalization project. If light rail Alternative E3 were built, along with the city's proposed Pacific Highway Revitalization Plan, culverts would be extended along both corridors. All of the light rail alternatives, as well as the proposed Highway Revitalization Plan, would be required to manage and mitigate stormwater runoff and habitat impacts in compliance with local, state, and federal regulations.

A proposed freeway-to-freeway HOV connection for the I-5/I-405/SR 518 interchange (northwest quadrant) could impact wetland AR-39 near Alternatives E2 and E3. This impact, if any, would be combined with the impacts from Alternative E2 or E3 in this area. Mitigation would be required for all impacts.

WSDOT is studying the potential addition of HOV lanes to SR 518 in the vicinity of light rail Alternatives E2 and E3. Depending on the location of the additional freeway lanes, construction of this project could impact Wetlands AR 37, 38, 39, 40, and/or 41, as well as Gilliam Creek. Because of the different timing of the HOV project compared to the light rail project, any impacts from the HOV construction would likely be added to impacts from Alternatives E2 or E3 in this area. Mitigation would be required for all impacts, in compliance with local, state, and federal regulations.

Other private projects in Segment E include proposed hotel/motels and business parks, primarily near the Southcenter and Longacres station areas, but also along the northern end of Tukwila International Boulevard. Some of these projects would occur on sites that are already developed or where little habitat or wetlands currently exist, but others would occur on currently undeveloped land. Projects on currently undeveloped property would increase impervious surfaces in this area and impact stormwater runoff. These impacts would be in addition to impacts from the light rail alternatives. Construction of new hotel facilities in the vicinity of light rail stations would provide potential transit riders and would support the reduction of reliance on auto travel. More hotel and office development is currently proposed near Southcenter and Longacres stations (E2 and E3) than near the E1 stations.

Segment F. In Segment F, several other proposed projects would occur on sites that are already developed or where little habitat or wetlands currently exist. New development on currently undeveloped property (for example, in the vicinity of the proposed South SeaTac Station near S. 200th Street) would increase impervious surfaces in this area and impact stormwater runoff. In addition, the large number of new parking facilities (7,800 spaces proposed) in and around the airport and SeaTac City Center would support auto-oriented land uses and auto travel to this area, contrary to the objectives of reducing reliance on the automobile. At the same time, proposed new high-density housing in the South Central SeaTac Station area would provide potential transit riders and would compliment light rail in reducing reliance on auto travel. Mitigation would be required for any impacts to water quality or wetlands from these projects, in compliance with relevant local, state, and federal regulations. In some cases, redevelopment of such sites will have a positive effect because higher standards will be applied to the redevelopment than were used for the original development.

4.18.8 Energy

The energy impacts described in Section 4.9 are based on projected VMT in the region. These projections incorporate projected land use pattern changes, programmed transportation improvements, and projected population and employment growth.

4.18.9 Public Services

Proposed projects and general growth in the light rail project area would increase the need for fire and emergency medical, law enforcement, and other public services. The light rail project, together with numerous proposed developments and major roadway changes, such as the Tukwila International Blvd. redesign (E1.1 and E1.2) and SR 509 and $28^{th}/24^{th}$ Avenue extension (F routes), will alter roadway infrastructure and may affect future traffic patterns. In turn, these changes may affect existing public service access and vehicle routes. The traffic volume projections incorporate effects of future transportation improvements and growth. Thus the effects on response times and routes analyzed in Section 4.13, Public Services, incorporate many of these future actions, as well as light rail.

4.18.10 Utilities

Continued growth in the project corridor would increase demand on all existing utilities, ultimately requiring service providers to increase their capacity and infrastructure. While not requiring significant new utility resources, the light rail project would add to this increased demand. In general, electrical, water, sewer, telecommunications, and other utilities currently have sufficient capacity or are adding additional capacity to serve the region in the future (based on local capital facilities planning). Local capital facilities plans are based on serving the projected population growth anticipated in regional and local land use and transportation plans. Considering the total growth anticipated in the region, the light rail project would not alter the forecasts of area service providers.

4.18.11 Historic and Archaeological Resources

Potential impacts to archaeological sites resulting from light rail construction would be combined with the potential impacts resulting from continued urban encroachment into the relatively less-developed portions of the project area and/or from redevelopment to improve or intensify existing land uses and transportation infrastructure. As other scheduled transportation improvement projects and land use changes are implemented, cumulative impacts to archaeological sites can occur from more intensive and ground-invasive landscape modification. Potential commercial and residential development in the vicinity of light rail stations could impact nearby historic properties unaffected by station operation alone.

Locating the Link maintenance base at the Atlantic Central A site (Site M1-C) could result in King County Metro's planned expansion of its bus base impacting the Sixth Avenue South Historic District to the west, since expansion to the south would be precluded.

4.18.12 Parklands

Projected population growth would increase demand and use of existing park and recreation facilities. Unrelated developments near the park facilities that would be impacted by light rail alternatives could potentially cause additional direct impacts. No other known, specific projects are proposed in the vicinity of parklands that would be affected by the light rail alternatives.

4.18.13 Cumulative Construction Effects

Temporary cumulative effects could occur where other projects in the vicinity of light rail would be built at the same time, or close in time, to light rail construction. This could increase the cumulative intensity or duration of construction-related impacts.

Such impacts could occur at or near the following locations, where other major projects would be built near light rail construction sites: Northgate (proposed mall expansion/redevelopment near light rail terminus); University of Washington campus (numerous projects, including a new Law School building near the N.E. 45^{th} Station); Capitol Hill (Lincoln Reservoir lidding project), Downtown Seattle (Convention Center expansion and numerous other projects); Royal Brougham and south industrial area (stadium development and roadway improvements); along MLK Jr. Way S., Rainier Avenue S., Tukwila International Blvd., and International Blvd. (roadway improvements/redesign); Southcenter and Longacres (hotels, Boeing campus, and related development); SeaTac Airport (third runway, NEAT, IMC, SR 509, and south airport access changes); and SeaTac City Center and South SeaTac (various hotel, multi-family housing, and parking facility developments).

Specific cumulative impacts would depend on the construction methods, phasing, and intensity of these other projects, in combination with light rail construction. As noted in the Construction Impacts section (4.17), detailed construction plans are not available at this (conceptual engineering) phase for light rail, nor for most other projects that would be constructed during the same time period (2001 to 2006). As the design progresses for light rail, Sound Transit will further define the construction approach and develop a construction plan. Construction will be coordinated with local jurisdictions and other agencies so that phasing and methods will minimize conflicts and potential cumulative effects. As noted above, these measures will be further developed as the design progresses into final design and construction contracting.

The following cumulative construction impacts could occur where other projects are constructed near light rail construction sites:

- Increased construction noise impacts and impacts from construction-generated dust and emissions.
- Increased risk of landslides, erosion, and water quality impacts where construction would occur in geologic hazard areas, near water bodies, or where construction phasing (to minimize conflicts between projects) would require earthwork during the wet season.
- Increased traffic congestion and delays and additional temporary parking loss.
- Broader temporary habitat and wildlife impacts due to temporary clearing, disturbance, and in-water work.
- Further compromised temporary fire and emergency medical and law enforcement response times. At times, emergency vehicles may need to take alternate routes to avoid major construction delays.
- Additional delays to school bus routes. Some school buses may need to be temporarily rerouted, and some bus stops temporarily relocated.
- Significant police and/or security personnel required to conduct traffic flow and provide general safety and security services.
- Options may be limited (i.e., available corridors) for relocating or installing new utilities during light rail construction.
- Increased temporary utility service interruptions.
- Coordinating construction schedules and activities among the various project sponsors will be key to minimizing cumulative construction impacts.

4.18.14 Mitigation

Mitigation is discussed in Chapter 3 and above in Sections 4.1 through 4.17.

4.18.15 Significant Unavoidable Adverse Impacts

With mitigation and coordination, no significant unavoidable adverse impacts would be expected to occur, other than those identified in Chapter 3 and previously mentioned in Chapter 4.

CHAPTER 5
FINANCIAL ANALYSIS

5. Financial Analysis

This chapter analyzes the financial aspects of constructing and operating the Central Link project. Section 5.1 discusses the concept of subareas and "subarea equity," which affects how local tax revenues are applied to projects in the *Sound Move* plan. Section 5.2.1 discusses capital cost estimates for each segment alternative. Section 5.2.2 discusses the operating and maintenance costs. Section 5.3 describes projected revenues; Section 5.4 presents a sources and uses of funds analysis; Section 5.5 discusses risks and uncertainties in the projections; and Section 5.6 presents the conclusions reached in the analysis.

5.1 SUBAREAS AND SUBAREA EQUITY

A unique feature of *Sound Move* is the concept of subareas and subarea equity. Within Sound Transit's three-county district are five designated subareas: Snohomish County, north King County, south King County, east King County and Pierce County. A key plan principle is the local tax revenue distribution method, which states that local tax revenues will benefit the five subareas, based on the share of revenues each subarea generates. Subarea benefits are defined by *Sound Move*'s Appendix A, which lists each subarea's projects.

Because of the subarea equity principle, it is important to evaluate Sound Transit's projected local tax revenues as well as capital and operating and maintenance costs by subarea and for the total project. Each subarea's local tax revenues must balance, by the end of the first decade, with the expenditures to which those revenues are applied. In practice, higher-than-projected costs for light rail or other projects in the north King or south King subarea would have to be covered by local revenues collected in that subarea, or by other sources of funds. The following financial analysis identifies costs and revenues by subarea, where appropriate.

5.2 COSTS

5.2.1 Capital Costs

The segment capital cost estimates include all the costs associated with constructing the light rail system, except for the costs for vehicles and the maintenance and operating base, which are documented separately. The capital costs include right-of-way costs (both full and partial property acquisitions), relocation costs where appropriate, and all construction costs, including such items as relocating utilities. Where identified mitigation measures have been assumed as part of a project alternative, they are included in the capital costs.

Capital Cost Estimation Methodology

The EIS capital cost estimates are generally based on the methods developed during the Regional Transit Project (RTP) work, prior to the regional vote on *Sound Move* (these methods are documented in the Capital Cost Estimating Methodology Report). Unit costs were derived by using historical data from other projects based on actual in-place costs that include labor, materials, equipment, and consumable supplies. The library of composite unit costs, developed during the RTP, serves as the framework for the EIS capital cost estimates. Where necessary, composite unit costs were modified or new costs were developed to more closely reflect current designs. For each alternative, capital cost estimates are based on relevant composite units and their corresponding quantities.

Design Contingencies and Administrative Costs

Composite units are subject to varying design contingencies that reflect levels of design uncertainties. Design contingency factors range from 10 to 35 percent. In addition, a fixed factor of 31 percent is applied to all construction costs (i.e., all costs other than right-of-way) to reflect administrative costs (for construction management, engineering design, and other program development activities). For light rail vehicles, 15 percent is added for administrative costs. For right-of-way acquisition, base property costs are increased by 20 percent to cover relocation costs and by 25 percent to cover administrative costs.

Rights-of-Way

Right-of-way costs are adjusted from current market values (1998) to reflect 1995 dollars, based on an average 4 percent annual growth rate. In fact, property costs have increased substantially more than 4 percent per year since 1995; if the actual 1995 right-of-way costs were assumed, the numbers would be much lower.

Cost Estimates

Separate cost estimates were prepared for each of the route alternatives. Where station options have significant cost differences, both costs are provided to permit cost comparisons. The costs of other station options are included in Appendix N, Table N-3. Potential stations, vehicles and maintenance base costs are not included in the route cost estimates.

All route alternatives have been brought to a common level of conceptual engineering. In addition, engineering for the alternatives that comprise the preferred alternative has been advanced beyond the level of conceptual engineering. The additional engineering for the preferred alternative has resulted in design and scope changes. These changes are reflected in the preferred alternative capital cost estimates presented in Table 5.2-1.

Table 5.2-1
Preferred Alternative: Capital Cost Estimates (1995$ in Millions)

Segment	Description	Total Cost
B	N.E. 45th Street to north end of downtown Seattle	$854.3
C	North end of downtown Seattle to east end of Beacon Hill	$244.4[1]
D	McClellan to Boeing Access Road	$259.9[2]
E	Tukwila	$176.8
F	SeaTac	$225.0

[1] Includes Beacon Hill Station "shell"
[2] Includes $50 million community investment fund

To offer a consistent comparison among alternatives, segment alternative capital cost estimates discussed in the remainder of this chapter reflect a common level of conceptual engineering. Where the additional engineering performed for the preferred alternative results in design modifications that can be applied consistently across all alternatives within a segment, corresponding cost refinements are incorporated into the route alternative comparison estimates. Where the additional engineering performed for the preferred alternative resulted in design and scope changes unique to those alternatives, they are not included in the segment alternative cost estimates.

Segment A (Northgate to University District)

While this segment is included in the *Sound Move* plan under the financial plan, there is no commitment to complete it in the initial phase. *Sound Move* states: "If the cost [of Link light rail] is lower than estimated and/or additional funds have been appropriated, the RTA (Sound Transit) will build the light-rail segment between the University District and Northgate." The $26 million in capital funds for this segment, identified in *Sound Move,* is intended to complete the environmental analysis and engineering, if capital funds would be available in the initial phase, it would be ready to be built.

The cost range in Segment A is from $303 million to $391 million (Table 5.2-2). Both of the route alternatives that emerge from a tunnel to an elevated station near I-5 (A2.1 and A2.2) cost less than the longer tunnel under the Roosevelt business district (Alternatives A1.1 and A1.2). The lowest cost alternative, A2.2 (Eighth Avenue Elevated) reflects the savings gained from having the shortest tunnel length.

Table 5.2-2
Segment A: Capital Cost Estimates (1995$ in Millions)

Alternative Number	Description	Total Cost
A1.1	12th Avenue N.E.-Tunnel	$ 364
A1.2	Roosevelt Way-Tunnel	$ 391
A2.1	8th Avenue-Short Elevated	$ 335
A2.2	8th Avenue-Elevated	$ 303

Note: The preferred alternative is indicated in italics.

Segment B (University District to Westlake Station)

The complex topography of this segment results in the highest per mile cost for any segment in the system, whether the line is built in a tunnel under Capitol Hill, or using a combination of tunnel and elevated sections via Seattle Center. The cost range in Segment B is from $794 million to $962 million, as shown in Table 5.2-3. The two Seattle Center alternatives without the Convention Place Station are lowest in cost primarily because of less tunneling. The Seattle Center via High-level Bridge alternative (B2.1) is slightly longer than the Seattle Center via Portage Bay Tunnel alternative (B2.2), and it has additional costs associated with the bridge and the necessary property acquisition and street rebuilds on the approaches. However, the Portage Bay Tunnel alternative (B2.2) has higher costs associated with the mined station at N.E. Pacific Street and 15th Ave. N.E., compared to the cut-and-cover Campus Parkway Station that would be built with the High-level Bridge alternative (B2.1).

Additional cost differences in this segment are accounted for by the reconstruction of the Convention Place Station and the construction of a mezzanines in the University District and First Hill subway stations (N.E. 45th Station Option A, Pacific Station Option A, and First Hill Station Option A). The reconstruction of Convention Place Station would add $59 million to either of the Seattle Center alternatives or the Capitol Hill Tunnel alternative.

Table 5.2-3
Segment B: Capital Cost Estimates (1995$ in Millions)

Alternative. Number	Alignment Description	Total Cost
Bla	Capitol Hill Tunnel (no Convention Place Station)	$ 862
B1b	Capitol Hill Tunnel (with Convention Place Station)	$ 975
B2.1a	Seattle Center High-level Bridge (no Convention Place Station)	$ 794
B2.1b	Seattle Center High-level Bridge (with Convention Place Station)	$ 889
B2.2a	Seattle Center Portage Bay Tunnel (no Convention Place Station)	$ 794
B2.2b	Seattle Center Portage Bay Tunnel (with Convention Place Station)	$ 889

Note: The preferred alternative is indicated in italics.

Segment C (Westlake Station to S. McClellan Street)

The lowest cost alternative (Table 5.2-4) for this segment is C2.3, West of Rainier Avenue S. – Elevated with a cost of $149 million. Its costs are lower because of the lower construction cost of building elevated track, as compared to the costs of tunneling. The C segment alternatives with tunneling range from $207 million for Alternative C3, S. Massachusetts Street Tunnel, to $241 million for C2.4, Rainier Avenue S. Tunnel. The Lander Street tunnel alternatives range in cost from $224 million to $237 million.

Downtown tunnel estimates cover all costs associated with converting the tunnel to accommodate rail operations, including modifications for train clearance, station platform heights, trackwork, OCS and signals. The cost for each route alternative assumes rail-only use of the downtown tunnel. With joint bus/rail tunnel operation, costs would increase between $1.1 million to $3.1 million. Replacement of the bus fleet for joint operation is assumed to be funded by King County Metro.

Table 5.2-4
Segment C: Capital Cost Estimates (1995$ in Millions)

Alternative Number	Description	Total Cost
C1.1	S. Lander Street Tunnel, at-grade in median of Lander Street	$ 227
C1.2	S. Lander Street Tunnel, at-grade north of Lander St.	$ 228
C1.3	S. Lander Street Tunnel, elevated north of Lander St.	$ 237
C1.4	S. Lander Street Tunnel, elevated south of Forest St.	$ 235
C1.5	S. Lander Street Tunnel, via S. Massachusetts and I-5 ROW	$ 224
C2.3	West of Rainier Avenue S. Elevated	$ 149
C2.4	Rainier Avenue S. Tunnel	$ 241
C3	S. Massachusetts Street Tunnel	$ 207

Note: Segment C alternatives do not include Beacon Hill Station. See Table 5.2-9 for potential station cost estimates. Preferred alternative cost in Table 5.2-1 includes a Beacon Hill "shell" for future station construction.
The preferred alternative is indicated in italics.

Segment D (S. McClellan to Boeing Access Road)

Costs for this segment have a $182 million difference between the highest and lowest cost alternatives, as shown in Table 5.2-5. The highest cost alternative, D3.4, at $356 million, includes a tunnel between Columbia City and MLK Jr. Way S. under 37th Avenue S. The alternatives other than the 37th Avenue S. Tunnel fall in a much narrower cost range, from about $174 million to $254. Right-of-way costs vary widely in this segment. Those alternatives that serve the west side of Rainier Avenue to Columbia City (D3.3 and D 3.4) reflect the high costs to acquire new off-street right-of-way. The combined profile alternative (D1.3) includes higher construction costs for elevated options. The alternatives that operate at-grade on MLK Jr. Way S. and assume a 104-ft street right-of-way, also reflect the higher costs for right-of-way acquisition along MLK, but the lower cost of at-grade construction offsets the higher right-of-way costs. Overall, the lowest cost alternative, D1.1d, combines an at-grade profile with a narrower street right-of-way (90-ft). The costs of these alternatives do not reflect a $50 million community investment fund, which is included in the preferred alternative cost in Table 5.2-1.

Table 5.2-5
Segment D: Capital Cost Estimates (1995$ in Millions)

Alternative Number	Alignment Description	Design Options	Total Cost
D1.1c A	MLK Jr. Way S. At-grade	4-lane street (104' cross section), at-grade onto MLK	$ 195
D1.1c B	MLK Jr. Way S. At-grade	4-lane street (104' cross section), elevated onto MLK	$ 206
D1.1d A	MLK Jr. Way S. At-grade	2-lane street (90' cross section), at-grade onto MLK	$ 174
D1.1d B	MLK Jr. Way S. At-grade	2-lane street (90'), elevated onto MLK	$ 185
D1.1e	MLK Jr. Way S. At-grade	4-lane street (93' cross section), elevated onto MLK	$ 201
D1.1f	MLK Jr. Way S. At-grade	2-lane (93' cross section), elevated onto MLK	$ 197
D1.3	MLK Jr. Way S. Combined Profile	Elevated onto MLK	$ 254
D3.3	Alaska St. Crossover	At-grade across MLK	$ 222
D3.4	37th Ave. S. Tunnel	Elevated across MLK	$ 356

Note: Segment D alternatives do not include the $50 million community investment included in Table 5.2.1-1 for the preferred alternative.
The preferred alternative is indicated in italics.

Segment E (Tukwila)

The segment alternatives in Tukwila show a $155 million difference between the highest cost alternative, E3, a route serving Southcenter via MLK Jr. Way S. costing $329 million, and the lowest cost alternative, E1.1, Tukwila International Boulevard At-grade, at $174 million (Table 5.2-6). Because the Tukwila International Boulevard routes (Alternatives E1.1 and E1.2) connect with the Segment F routes about a ½ mile further north than the SR 518 routes (Alternatives E2 and E3), the costs for the Tukwila International Boulevard routes would be between $7 to $14 million higher if all Segment E alternatives connected with Segment F alternatives at about the same location. This would reduce the cost differences between the alternatives following the different corridors, and the range between the highest (E3) and lowest (E1.1) cost alternatives would be $141 to $149 million instead of $155 million. Please see the additional discussion below. The two alternatives serving Southcenter cost less on a per-mile basis than the two Tukwila International Boulevard alternatives, but they are about three to three and one-half miles longer.

Table 5.2-6
Segment E: Capital Cost Estimates (1995$ in Millions)

Alternative Number	Description	Total Cost
E1.1	Tukwila International Boulevard At-grade	$ 174
E1.2	Tukwila International Boulevard Elevated	$ 213
E2	Interurban Avenue S.	$ 299
E3	MLK Jr. Way S.	$ 329

Note: There are costs for right-of-way acquisition, design, and construction for project elements inside the Tukwila city limits that are included in Segment F (SeaTac) alternatives.
The preferred alternative is indicated in italics.

Segment F (SeaTac)

The routes in the SeaTac segment have the narrowest range of costs, with a difference of about \$46 million (Table 5.2-7). Alternative F2.3 (Washington Memorial Park Elevated East of 28th) with design option A (SR 99 elevated connection) has the highest cost, at \$218 million. The lowest cost is \$172 million for F1 (International Boulevard) with Option C (SR 518 connection) or F2.1 Washington Memorial Park, City Center West with Option B (SR 518 connection). The difference in costs between the design options within each alternative results from connecting with the different Segment E alternatives (see below).

Table 5.2-7
Segment F: Capital Cost Estimates (1995\$ in Millions)

Alternative Number	Description	Design Option	Total Cost
F1a	International Blvd. in Median	SR 99 At-grade connection to E1.1	\$ 179
F1b	International Blvd. in Median	SR 99 Elevated connection to E1.2	\$ 181
F1c	International Blvd. in Median	SR 518 At-grade connection to E2 or E3	\$ 172
F2.1a	Washington Memorial Park	City Ctr. West to SR 99 connection	\$ 187
F2.1b	Washington Memorial Park	City Ctr. West to SR 518 connection	\$ 172
F2.2a	Washington Memorial Park	City Ctr. East to SR 99 connection	\$ 211
F2.2b	Washington Memorial Park	City Ctr. East to SR 518 connection	\$ 197
F2.3a	Washington Memorial Park	Elevated East of 28th to SR 99 connection	\$ 221
F3.1a	West side of International Blvd.	East of Parking Structures to SR 99 connection	\$ 190
F3.1a	West side of International Blvd.	East of Parking Structures to SR 518 connection	\$ 179
F3.2a	West side of International Blvd.	Main Terminal to SR 99 Elevated connection	\$ 198
F3.2b	West side of International Blvd.	Main Terminal to SR 518	\$ 188
F3.3	West side of International Blvd.	Intermodal Center	\$ 208
F4	West side of International Blvd.	International Blvd. to 28th/24th	\$ 210

Note: The preferred alternative is indicated in italics.

Combined Capital Costs of Segments E and F

The distinctly different route alternatives in Segment E, Tukwila, connect to Segment F, SeaTac, at different places. The Tukwila routes serving Tukwila International Boulevard connect to Segment F north of SR 518, while the two route alternatives serving Southcenter connect just south of SR 518. To better understand the cost implications of combining various Segment E and Segment F route alternatives, it is helpful to look at the alternatives in combination. Table 5.2-8 shows the combined costs of the E and F segment alternatives, with their different design options.

Table 5.2-8
Segments E & F: Combined Capital Cost Estimates (1995\$ in Millions)

Alternative	E1.1	Alternative	E1.2	Alternative	E2	Alternative	E3
F3.1a	\$364	F3.1 a	\$403	F3.1b	\$478	F3.1b	\$508
F2.1a	\$360	F2.1 a	\$400	F2.1b	\$472	F2.1b	\$501
F3.2a	\$372	F3.2a	\$412	F3.2b	\$487	F3.2b	\$517
F1a	\$352	F1b	\$395	F1c	\$471	F1c	\$501
F2.2a	\$385	F2.2a	\$424	F2.2b	\$497	F2.2b	\$526
F2.3a	\$395	F2.3a	\$435				
F3.3	\$382						
F4	\$384						

A $7 to $14 million cost is associated with the different match points for the Segment E Tukwila International Boulevard alternatives (E1.1 and E1.2) compared to connecting with the SR 518 alternatives (E2 and E3). The different match point decreases the cost by $7 to $14 million for those Segment F alternative options connecting to the Segment E SR 518 routes serving Southcenter. (see Table 5.2-8). Conversely, the Segment E Tukwila International Boulevard routes would cost $7 to $14 million more if they connected with the Segment F alternatives at about the same location as the SR 518 routes. Because they include a station at S. 154th Street, Alternatives F2.3, F3.3 and F4 cannot combine with Alternatives E2 or E3.

Station Alternatives

Segments B, C, D, and F all have potential stations and/or alternative station configurations. Potential stations are not currently included in the segment alternative capital cost estimates, but rather are costed separately. Additional at-grade stations would cost between $5.3 and $11.0 million, depending on the station configuration and the right-of-way requirements. Elevated stations range in cost from $13.2 million to $15.3 million, while additional tunnel stations would cost from about $59.3 to $80.0 million each. The cost to construct the "shell" for a future tunnel station to be completed later is about $43 million.

Table 5.2-9
Alternative and Potential Station Capital Cost Estimates (1995$ in Millions)

Alternative	Potential Station	Description	Total Station Cost
B1	Roy/Aloha	Mined Tunnel	$80.0
B1	Convention Place	Cut-and-Cover Tunnel	$59.4
C1	Beacon Hill[1]	Mined Tunnel	$79.4
D1.1/D3.3	Graham[2]	At-grade, staggered platforms	$7.3
D1.3	Graham	Elevated, side platform	$13.9
D3.4	Graham	Retained cut, side platforms	$9.4
D3.3	Edmunds[3]	At-grade, side platforms	$6.0
D3.3/D3.4	Charlestown[3]	At-grade, center platform	$5.3
D3.3	Genesee[3]	At-grade, center platform	($1.6)
F1 A	North SeaTac[4]	At-grade, center platform (at 154th Street)	$8.3
F1 B	North SeaTac	At-grade, staggered platforms (at 160th Street)	$10.5
F1 C	North SeaTac	At-grade, side platforms (at 160th Street)	$11.0
F3.2a	North SeaTac	Elevated center platform (at 154th Street)	$14.5
F3.2b	North SeaTac	Elevated center platform (at 160th Street)	$15.3
F2.3	North Central SeaTac[5]	North End Airport Terminal (NEAT)	$13.1
F2.3	South Central SeaTac	Elevated platform (at 184th)	$13.2

1 A Beacon Hill "shell" for future completion of a tunnel station is included in the preferred alternative cost estimate (Table 5.2-1).
2 A Graham Station is included in the preferred alternative cost estimate (Table 5.2-1).
3 In Alternative D3.3, the Edmunds/Charleston Station pair could replace the Genesee Station. Under this option, the combined cost of the Edmunds and Charleston stations would replace the cost of the Genesee Station included in the base alternative cost. (This does not apply to D3.4, where Charleston is a potential station to be added individually.)
4 A North SeaTac station is included with Alternative F2.3 and in the preferred alternative cost estimate (Table S.2-1).
5 A North Central SeaTac Station at the planned Sea-Tac Airport Intermodal Center (IMC) is included with Alternative F2.3 and in the preferred alternative cost estimate (Table 5.2-1).

Adjustment of Segment E (Tukwila) costs to North King Subarea

In dividing the Central Link light rail line into segments for management purposes, a decision was made to define the break between Segment D and Segment E just north of the Boeing Access Road. This division puts the Boeing Access Road Station in Segment E and in the south King subarea. However, *Sound Move* identifies the north King subarea as terminating at, and including, the Boeing Access Road Station. To fairly allocate capital costs between the two subareas, the costs of the Boeing Access Road Station and the line between it and the Segment D boundary, which is just to the north, must be moved from the south King subarea to Segment D in the north King subarea. For Segment E alternatives that include the Boeing Access Road Station (E1.1 and E1.2), this allocation results in a $37 million transfer of costs from the south King subarea to Segment D in the north King subarea. For Segment E alternatives without a Boeing Access Road Station (E2 and E3), the cost transfer from Segment E (south King subarea) to Segment D is reduced to $19 million.

Vehicles

Cost estimates for individual alternatives do not include the cost of vehicles, which is shown as a separate line item for the system as a whole. The Central Link Light Rail project anticipates operating with standard design low-floor vehicles to a maximum of four-car trains. The preferred alternative would require about 64 cars to operate between SeaTac and the University District, depending on train frequencies. Extending the preferred alternative to Northgate in 2010 would require 76 vehicles. By 2020, operating between SeaTac and the University District would require 83 cars. Year 2020 operating plans were developed and analyzed for the segment alternatives; they resulted in fleet requirements ranging from a low of 101 vehicles to a high of 106 vehicles for the full line from Northgate to SeaTac. (Although the Northgate segment only adds about 3.4 miles to the line, the additional ridership generated by that segment would require longer trains).

In Segments B and E, different alignment choices would change the number of cars needed to operate the line. In Segment B, University District to Westlake, the two Seattle Center alternatives (B2) are longer than the Capitol Hill Tunnel alternative. Alternative B2.1, (Seattle Center via High-level Bridge), would require an additional five cars, and Alternative B2.2, (Seattle Center via Portage Bay Tunnel) would require an additional four cars.

In Segment E, the two alternatives serving Southcenter (E2 and E3), are longer than the two alternatives serving Tukwila International Boulevard (E1). Alternative E2, (Interurban Avenue), would require an additional five cars, and Alternative E3, (MLK Jr. Way S.), would require an additional three cars.

The total cost for the fleet of 64 cars required for a University District to SeaTac line would be $211 million (1995$). Cost sharing between the north King and south King subarea is based on the car miles operating in each subarea. 78 percent and 22 percent of the overall car miles are attributable to the north and south King subareas, respectively, for the preferred alternative. With a full system from Northgate to SeaTac, the north King subarea share is 81 percent and the south King subarea share is 19 percent). Table 5.2-10 shows additional costs for alternatives requiring more cars. Additional costs for longer length alternatives in Segments B and E are also based on the car miles operating in each subarea. The two alternatives serving Southcenter increase the South King subarea share of car miles to 27 percent (E2) or 26 percent (E3). The alternatives serving the Seattle Center increase the North King subarea share of car miles to 82 percent (B2.1 and B2.2).

Table 5.2-10
Central Link Vehicle Costs (1995$ in Millions)

	No. Cars	North Subarea	South Subarea	Total Fleet Cost
University District to SeaTac				
2010 Fleet size	64	$165	$46	$211
2020 Fleet size	83	$214	$60	$274
Northgate to SeaTac				
2010 Fleet size	76	$203	$48	$251
2020 Fleet size	101	$270	$63	$333
Year 2020 Added car alternatives*				
B2.1	+5	$17	$0	$350
B2.2	+4	$12	$1	$347
E2	+5	-$16	$33	$350
E3	+3	-$16	$26	$343

Notes: * Includes only those alternatives that change car requirements by more than one car for a Northgate to SeaTac route.
Assumes a cost of $3,300,000 per low-floor vehicle, including contingency and design.

Maintenance Base

Seven maintenance base sites are under consideration; each is large enough to accommodate at least 100 cars, allowing for growth and future expansion. The cost to build a base is a combination of the base construction and right-of-way costs, plus cost for access. The access cost is the cost of providing track into and out of the base. This cost varies for the M-1 sites, depending upon the alternative chosen in Segment C; for the M-2 site, it varies depending upon whether an at-grade or elevated access is provided; and for the M-3 site, it varies depending on the alternative chosen in Segment E. The range of costs for a maintenance base, including access costs, for the N.E. 45th Street to SeaTac Alternative is $98 to $126 million, as shown in Table 5.2-11. As with vehicles, maintenance bases costs are shown as a separate line item.

Table 5.2-11
Central Link Maintenance Base Capital Costs[1] (1995$ in Millions)

	Maintenance Base Site		
	M-1 Sites	**M-2 Site (N.E. Boeing)**	**M-3 Site (S.W. Boeing)**
Cost for Base w/out access costs	$97-113	$96	$97
M1 Cost with access			
Via C1 Alternatives			
M1-A S. Lander Street at-grade connection	$115		
M1-A S. Lander Street elevated connection	$121		
M1-B S. Lander Street at-grade connection	$98		
M1-C Atlantic/Central A at-grade connection	$102		
M1-D Rainier Brewery/Roadway via elevated connection	$112		
M1-E Rainier Brewery/Airport Way via elevated connection	$116		
Via C2.3/C2.4 West of Rainier Ave. S./Rainier Ave. S. Tunnel			
M1-A S. Lander Street at-grade connection	$126		
Via C3 S. Massachusetts Tunnel			
M1-A S. Lander Street at-grade connection	$119		
M2 Cost with access			
All Alts. (elevated connection)		$118	
All Alts. (at-grade connection)		$99	
M3 Cost with access			
E1 Tukwila International Boulevard			$108
E2 Interurban Avenue S.			$98
E3 MLK Jr. Way S.			$126

Note: Bases sized for 100- to 104-car site.

Capital Costs by Cost Category

Table 5.2-12 shows a breakdown of capital costs by cost category for the preferred alternative extended to Northgate (Alternatives A2.2, B1a, C1.2, D1.1e, E1.1, and F2.3). These capital costs are based on the conceptual level of engineering used in the segment alternative capital cost estimates.

5.2.2 Operating and Maintenance Costs

Costs Included in Operating and Maintenance Costs

The operating and maintenance cost estimates include all of Sound Transit's costs to operate and maintain the light rail system. They include Sound Transit's light rail security and fare inspection costs, but do not include costs incurred by local cities for fire or aid services delivered to light rail stations.

Table 5.2-12
Capital Costs by Cost Category (1995$ in Millions)

Northgate-SeaTac	Total
Guideway	$911
Roadway/utilities/streetscaping, etc.	$138
Trackwork	$76
Stations and auxiliary facilities	$469
Parking and bus facilities	$39
Right-of-way [1]	$152
Building demolitions	$26
Systems	$154
Specialty items and mitigation	$64
Downtown tunnel-related costs	$27
Special structure (e.g., bridges, underpinnings)	$10
Maintenance base (w/o right-of-way)	$72
Vehicles (Year 2010 fleet of 76 vehicles)	$251
Grand Total	$2,389

Notes: Costs are for the preferred alternative extended to Northgate, plus Segment A.
[1] Right-of-way base costs include relocation and administrative costs.

Cost Estimation Method

An operating and maintenance (O&M) cost model was used to calculate the total operating cost of the preferred alternative, the minimum operating segments, and each segment alternative. The model includes not only all direct costs associated with light rail operation and maintenance, but also an assumed add-on of 15 percent for Sound Transit support departments (e.g., legal, personnel, accounting, etc.). Direct costs are based on experience from other light rail systems currently operating in the U.S., but these are adjusted for Puget Sound region wage and electric power rates.

Operating and Maintenance costs of the segment alternatives have been developed using an incremental approach. To apply the O&M cost model, a full end-to-end system (or systems) must be considered. The current segment alternatives can be combined to form over 3,800 end-to-end systems (not including the options); independent O&M cost estimates have not been developed for all possible combinations. Instead, a cost estimate was developed for a baseline system that consists of the original routes used in developing cost and ridership estimates for the *Sound Move* plan. For segments where a current alternative does not exactly match the *Sound Move* plan, the alternative most closely resembling *Sound Move* was used.

The baseline system consists of the following segment alternatives:

Segment A: A1.1, 12th Avenue N.E. Tunnel
Segment B: B1, Capitol Hill Tunnel (with Convention Place Station)
Segment C: C2.3, West of Rainier Avenue S. Elevated
Segment D: D3.3, Alaska Street Crossover
Segment E: E1.1, Tukwila International Boulevard, At-grade
Segment F: F3.2, West of International Boulevard, Main Terminal, Option A.

The baseline cost estimate also uses the M1-A maintenance base as a cost placeholder because it is a medium-high cost alternative. The cost model calculated the incremental cost of each of the segment alternatives, compared to the baseline system. For example, a segment alternative with an extra station would incur additional costs for station maintenance and the longer running times.

O&M Cost Estimate Results

Operating the preferred alternative between SeaTac and the University District would cost approximately $42.0 million per year, based on a 2020 level of service expressed in 1995 dollars. Operating the preferred alternative between SeaTac and Northgate would cost approximately $49.8 million per year. Operation of the baseline system between SeaTac and Northgate would cost approximately $50.2 million per year, based on a 2020 level of service expressed in 1995 dollars.

Table 5.2-13
2020 Light Rail Annual Operating Costs by Category of Northgate to SeaTac (1995$ in Millions)

Department	Labor	Service	Material	Fuel	Misc.	Insur.	Tax	Utilities	Gen. Admin	Total
Vehicle Ops.	$12.70	$0.54	$0.10	$0.00	$0.01	$0.00	$0.00	$2.42	$0.00	15.77
Vehicle Maint.	$9.72	$0.78	$3.80	$0.06	$0.05	$0.00	$0.00	$0.00	$0.00	$14.40
Facilities Maint.	$6.14	$1.10	$0.33	$0.00	$0.02	$0.00	$0.00	$0.00	$0.00	$7.59
Gen'l Admin.	$1.22	$2.20	$0.31	$0.00	$0.43	$1.29	$0.04	$0.82	$5.67	$11.98
Total Cost	$29.79	$4.62	$4.54	$0.06	$0.51	$1.29	$0.04	$3.24	$5.67	$49.75

Note: Costs are for the preferred alternative extended to Northgate. Assumes peak headways of 5 minutes in Segments A, B, C, D and 10 minutes in Segments E, F.

O&M Costs by Segment Alternative

The major determinants of operating costs are service levels, running time, and profile. The more frequent the service and the longer the line, the more vehicles it takes to maintain equivalent headways. In terms of line and station maintenance, at-grade is the lowest cost, elevated the next highest, and tunnel the highest. Table 5.2-14 summarizes the preferred alternative and minimum operating segment O&M costs along with the incremental costs (or savings) relative to the baseline for each of the segment alternatives.

Operating Costs by Subarea

The subarea shares of operating costs for the preferred alternative, based on shares of operating miles and 2020 levels of service are noted here:

	SeaTac/U Dist.		SeaTac-Northgate
Total Annual Operating Cost:	$42.0 million		$49.8 million
North King Subarea Share (78%)	$32.8 million	(81%)	$40.3 million
South King Subarea Share (22%)	$9.2 million	(19%)	$9.5 million

5.2.3 Summary: Costs by Subarea

Projected subarea costs for the Central Link light rail line combine capital costs for each segment, the costs of potential stations, costs for vehicles and the maintenance base allocated to each subarea. Table 5.2-15 summarizes the cost of the preferred alternative and each minimum operating segment. The total cost for the preferred alternative, as identified by the Board in February 1999 to carry forward into preliminary engineering, exceeds the revenues budgeted in *Sound Move*. The increases above the *Sound Move* budget are attributed to the inclusion of the Lander Street tunnel with a Beacon Hill station shell, the inclusion of a community investment fund in Rainier Valley, changes to respond to plans for a new passenger terminal at SeaTac airport, assigning all costs of a maintenance base to the initial phase, project enhancements as well as revisions of cost estimates, particularly for right-of-way.. With current revenue assumptions, a Central Link project that costs $1,850 is affordable, making the preferred alternative cost of $2,066 just over $200 million more than available revenues.

Table 5.2-14
2020 Light Rail Annual Operating Costs (1995$ in Millions)

Segment by Alternative	Description	O&M cost, change from base	Annual O&M cost
Preferred and Minimum Operating Segment Alternatives			
Pref. Alt.	*N.E. 45th to SeaTac*		$42.0
MOS A	N.E. 45th to McClellan		$24.3
MOS B	Capitol Hill to Henderson		$25.5
MOS C	N.E. 45th to Lander		$21.5
Northgate to SeaTac Segment Alternatives			
A1.1	12th Ave. N.E. Tunnel	$0.0	$50.2
A1.2	Roosevelt Way N.E. Tunnel	$0.0	$50.2
A2.1	8th Avenue N.E. Short Elevated	($0.1)	$50.1
A2.2	8th Avenue N.E. Elevated	($0.1)	$50.1
B1a	*Capitol Hill Tunnel*	$0.0	$50.2
B1b	Capitol Hill Tunnel, w/ Convention Place Station	$0.0	$50.2
B2.1	Seattle Center via High-level Bridge	$2.3	$52.5
B2.2	Seattle Center via Portage Bay Tunnel	$1.6	$51.8
C1.1	At-grade Center of Lander St.	$0.3	$50.5
C1.2	*At-grade North of Lander Street*	$0.3	$50.5
C1.3	Elevated North of Lander Street	$0.4	$50.6
C1.4	Elevated South of Forest Street	$0.5	$50.7
C1.5	Massachusetts and I-5 right-of-way	($0.1)	$50.1
C2.3	West of Rainier Ave. S. Elevated	$0.0	$50.2
C2.4	Rainier Ave. S. Tunnel	$0.1	$50.3
C3	S. Massachusetts St. Tunnel	$0.0	$50.2
D1.1	*MLK Jr. Way S At-grade*	($0.7)	$49.5
D1.3	MLK Jr. Way S. Combined Profile	($1.1)	$49.1
D3.3	S. Alaska St. Crossover	$0.0	$50.2
D3.4	37th Ave. S. Tunnel	($0.1)	$50.1
E1.1	*Tukwila International Boulevard At-grade*	$0.0	$50.2
E1.2	Tukwila International Boulevard Elevated	$0.0	$50.2
E2	Interurban Ave.	$4.9	$55.1
E3	MLK Jr. Way S.	$3.5	$53.7
F1	International Blvd. At-grade	($0.4)	$49.8
F2.1	Washington Memorial Park, City Center West	($0.1)	$50.1
F2.2	Washington Memorial Park, City Center East	($0.1)	$50.1
F2.3	*Washington Memorial Park, Elevated East of 28th*	0.0	$50.2
F3.1	West side of International Blvd., Grassy Knoll	($0.4)	$49.8
F3.2	West side of International Blvd., Main Terminal	$0.0	$50.2
F3.3	West side of International Blvd, IMC Airport Station	($0.4)	$49.8
F4	International Blvd. to 28th/24th	0.0	$50.2

Note: The preferred alternative is indicated in italics.

Tables 5.2-16 and 5.2-17 summarize the lowest and highest costs for each subarea and for the light rail line as a whole, both with and without service to Northgate. They do not consider variations in vehicle costs, maintenance base costs and operating costs—each of which depend on the alternatives selected.

Comparing the total costs to the *Sound Move* budget, in the north King Subarea, the highest capital cost segment alternatives combined with costs for vehicles and the maintenance base , results in a system about $450 million more than budgeted revenues. Combining the lowest capital cost alternatives in the north subarea results in a system that is $54 million less than budgeted revenues. In the south subarea, all of the possible combinations of alternatives result in a system that is at least $55 million more than budgeted revenues and potentially as much as $267 million more than budgeted revenues.

Because *Sound Move* did not include construction and operations cost for the Northgate segment, the following chart does not provide a budget comparison.

Table 5.2-15
Summary of Central Link Light Rail Costs by Subarea (Preferred Alternative and Minimum Operating Segments)(1995$ in Millions)

Capital Range	North King Subarea without Northgate				South King Subarea				Central Link
	Capital	Vehicles	Base	Total	Capital	Vehicles	Base	Total	
Preferred alternative	$1,448	$152	$81	$1,682	$319	$43	$23	$385	$2,066
MOS A: N.E. 45th to McClellan	$1,089	$108	$103	$1,300					$1,300
MOS B: Capitol Hill to Henderson	$925	$113	$103	$1,142					$1,142
MOS C: N.E. 45th to Lander	$879	$95	$103	$1,078					$1,078
Sound Move Budget				$1,411				$325	$1,736

Note: Preferred alternative and minimum operating segment costs reflects additional engineering beyond the conceptual design used to compare segment alternatives.

Table 5.2-16
Summary of Central Link Light Rail Costs by Subarea (N.E. 45th Street to SeaTac)(1995$ in Millions)

Capital Range	North King Subarea without Northgate				South King Subarea				Central Link
	Capital	Vehicles	Base	Total	Capital	Vehicles	Base	Total	
Highest	$1,609	$165	$90	$1,864	$521	$46	$25	$592	$2,456
Lowest	$1,139	$165	$90	$1,394	$309	$46	$25	$380	$1,774
Sound Move Budget				$1,411				$325	$1,736

Notes: For this table 64 light rail vehicles and the M1-A maintenance base site are assumed.
The totals shown take into account the transfer of $37 million for the Boeing Access Road line and station from the south Subarea to Segment D in the north Subarea.

Table 5.2-17
Summary of Central Link Light Rail Costs by Subarea (Northgate to SeaTac)(1995$ in Millions)

Capital Range	North King Subarea				South King Subarea				Central Link
	Capital	Vehicles	Base	Total	Capital	Vehicles	Base	Total	
Highest	$2,007	$ 203	$ 90	$2,300	$521	$ 48	$ 25	$594	$2,894
Lowest	$1,429	$203	$ 90	$1,722	$309	$ 48	$ 25	$ 382	$2,104

Notes: For this table 76 light rail vehicles and the M1-A maintenance base site are assumed.
The totals shown take into account the transfer of $37 million for the Boeing Access Road line and station from the south Subarea to Segment D in the north Subarea.

5.3 REVENUE SOURCES

Sound Move identifies some revenue sources and all project expenses by subarea, but does not allocate specific revenues to specific projects. For example, in the south King Subarea, a combined total of $396 million (1995$) in revenues is identified ($372 million in tax revenues and $24 million from operations). These revenues are earmarked, along with allocated bond proceeds and grants, to support five different projects, including Link light rail, plus debt service, reserves and the regional fund. Only fare revenues are specifically allocated to the service that generates them.

5.3.1 Operating Revenues

The primary light rail operating revenues source will be the farebox; *Sound Move* projected farebox revenues would cover approximately 55 percent of operating costs. Other revenues may be derived from advertising or private sources; however, no assumptions are made in *Sound Move* or in this EIS regarding such revenues.

Sound Transit's board has not adopted a fare schedule for light rail. For this EIS analysis, fare revenue was calculated based on the following assumptions, which are subject to change by the Board: light rail fares will compare to bus fares in the corridor, including zone fares; there will be no charge for bus-rail transfers; there will be discounts offered to seniors and youth; monthly passes and employer passes will be sold at a discount. In addition, fares will be assumed to increase with inflation over time. Assumptions about revenue allocation from transferring passengers are based on the fare integration agreement reached in 1999 between Sound Transit, Community Transit, Everett Transit, King County Metro, and Pierce Transit.

A model developed using these assumptions yields an average light rail fare revenue per rider of $0.69 in 1995 dollars for a SeaTac to Northgate system and $0.70 for a SeaTac to University District system. The average fare with a minimum operating segment (MOS) would be $0.65 in 1995 dollars. The average fare is lower with MOS because all trips are assumed to be within 1-zone.

Table 5.3-1 compares systemwide Fare Revenue and Farebox Recovery Ratio for the preferred alternative, the minimum operating segments, and each segment alternative that results in greater than 1 percent point difference from the baseline. (For systemwide comparisons, the same baseline methodology was used as developed for the O&M cost analysis - see Section 6.3) The year 2020 annual fare revenue with a SeaTac to Northgate system ranges from a low of $25.1 million with Alternative B2.1, the Seattle Center via High-level bridge alternative, to a high of $33.02 million with the S. Lander Street/Beacon Hill tunnel alternative with a Beacon Hill station. Similarly, the farebox recovery ratio—the percent of operating costs covered by fares—ranges from a low of 48 percent to a high of 65 percent. King County Metro currently has a policy that it will recover 25 percent of its operating costs from the farebox; other operators in the region recover a lower percentage.

The preferred alternative between SeaTac and the University District would generate $28.4 million in fare revenue in the year 2020 and have fare recovery ratio of 68 percent. The annual fare revenue of the minimum operating segments ranges from $15.2 million to $21.0 million and the fare recovery ratios range between 60 percent and 86 percent. Higher fare recovery ratios are associated with the University District to McClellan segment due to high ridership being coupled with shorter average trip lengths. This combination results in high fare revenue and low operating costs.

5.3.2 Local Tax Revenues

Sound Transit has two dedicated local tax sources: a 0.4 percent Retail Sales and Use Tax, and a 0.3 percent Motor Vehicle Excise Tax (MVET). Voters authorized both in November 1996 with an effective date of April 1, 1997. Both taxes have a long history within the state and are used for other governmental purposes. The state of Washington collects both and transfers the revenues to Sound Transit monthly. The existing administrative mechanism for collection and distribution minimizes collection risks.

The forecasts underlying the *Sound Move* financial plan assumed that growth rates for each tax base will be lower than the historical average, but would still produce considerable growth—5.9 percent growth annually in the Retail Sales and Use Tax, and 6.2 percent annually for the MVET. The 1999 financial plan revised the average annual growth rate of the Retail Sales and Use Tax base downward to 5.1 percent, while keeping the MVET growth rate unchanged.

Sales and Use Tax Revenue Projections

Over the ten-year initial phase, the sales and use tax is expected to generate $1,655 million total for all of Sound Transit (1995$).

Historically the sales and use tax revenue growth rates have varied considerably by Sound Transit subarea. The tax base in the south King subarea has grown steadily and at a higher average growth rate than that of the other subareas, while the tax base of the north King subarea has grown at the lowest rate. Between 1987 and 1998 the south King subarea was the fastest growing area of King County, with an average 8.5 percent annual growth in the Retail Sales and Use Tax base. The south King subarea is also the largest subarea, geographically, in King County, with a 1997 population of 453,000.

The north King subarea, by comparison, contains the cities of Seattle, Shoreline, and Lake Forest Park, is geographically constrained and is intensely built-out, having a 1997 population of 620,000. Between 1987 and 1998 its Retail Sales and Use Tax base grew 4.6 percent annually. Most of this growth in revenue occurred inside Seattle, which has a thriving downtown retail core. As a whole, the north King subarea has a much higher percentage of the region's commercial activity than its share of the regional population.

Table 5.3-2 contains the annual growth rate assumptions, extending beyond the initial phase to demonstrate the stability of these revenues to repay bonds.

Table 5.3-1
Systemwide Fare Revenue and Farebox Recovery Ratio by Segment
Revenues and Costs (1995 $ in Millions)

Description of Segment by Alternative		Year 2020 Systemwide Daily Link Boardings	Annual Revenue[1]	Annual O&M Cost	Farebox Recovery Ratio (%)
Preferred and Minimum Operating Segment Alternatives					
Pref. Alt.	N.E. 45th to SeaTac	133,000	$28.4	42.0	68
MOS A	N.E. 45th to McClellan	106,100	$21.0	24.3	86
MOS B	Capitol Hill to Henderson	76,900	$15.2	25.5	60
MOS C	N.E. 45th to Lander	87,300	$17.3	21.5	80
Northgate to SeaTac Segment Alternatives[2]					
	Northgate to SeaTac Baseline Alternative	149,000	$31.5	$50.2	63
B2.1	Seattle Center via High-Level Bridge	119,000	$25.1	$52.5	48
B2.2	Seattle Center via Portage Bay Tunnel	125,100	$26.4	$51.8	51
C1.1	At-grade Center of Lander St. w/ Beacon Hill Station	156,200	$33.0	$50.5	65
E2	Interurban Ave. S.	148,300	$31.3	$55.1	57
E3	MLK Jr. Way S.	150,600	$31.8	$53.7	59

Note: [1] Assumes average fare revenue per rider of $0.69 in 1995$ for SeaTac to Northgate systems, $.70 for SeaTac to University District, and $0.65 for minimum operating segments.

[2] Only alternatives which result in a greater than 1 percent point of difference from the baseline recovery ratio of 63 percent are displayed here.

Table 5.3-2
Growth Rate Projections for Sound Transit's Sales and Use Tax Revenues

Sales & Use Tax (Nominal)	Annual Growth Rate (%)			
	1998–2000	2001–2005	2006–2010	2011–2021
Sound Transit Total	4.7	5.0	4.9	4.4

Retail Sales and Use Tax revenue assumptions for the north and south King subareas and for the Sound Transit district as a whole are shown below.

Table 5.3-3
Sales & Use Tax Revenue Projections by Subarea (1995 $ in Millions)

Sales & Use Tax	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total 1997-2006
North King	34	43	44	44	44	44	45	46	47	48	$441
South King	22	31	32	32	32	33	33	34	35	37	321
Total, Sound Transit	118	159	164	166	166	168	171	176	181	186	1,655

Note: These projections are from the *Sound Move* plan and assume the same growth rate in all subareas.

Sales and use tax revenues to date are running slightly ahead of projections, after accounting for the April 1997 start date (*Sound Move* had assumed the taxes would start being levied in January 1997). For the entire initial phase planning period, Retail Sales and Use Tax revenues are now projected to be $117 million (1995$) higher than the original plan. This increase is due primarily to a slight understatement of the initial tax base and the use of conservative growth assumptions through 1997.

Motor Vehicle Excise Tax Revenue Projections

Over the ten-year initial phase, the MVET tax is expected to generate $444 million for all of Sound Transit (1995$).

Between 1975 and 1992, the MVET base grew at an average annual rate of 11.4 percent in the four-county Puget Sound region, reflecting a strong growth in automobile ownership rates and a 7.6 percent annual increase in the average automobile price. Between 1998 and 2021, the growth rate in Sound Transit MVET collections is projected to be about half the regionwide historical rate, or 5.8 percent annually. Auto ownership rates are projected to continue to rise as they have in the past. Auto ownership rates are commonly reported as the number of cars relative to the number of people aged 20 to 64 in the population. In 1975 this rate was 0.86 automobile per person aged 20 to 64; it rose to 0.97 in 1993; it is projected to rise to 1.07 by 2020. The reduced growth rate projected for the MVET reflects a projected decline in the growth of the driving age population to only 0.7 percent a year by 2020.

Table 5.3-4 contains the annual growth rate assumptions, extending beyond the initial phase, to demonstrate the stability of these revenues to repay bonds.

Table 5.3-4
Growth Rate Projections for Sound Transit's MVET Tax Revenues

MVET Tax (Nominal)	Annual Growth Rate Assumptions (%)			
	1998–2000	2001–2005	2006–2010	2011–2021
Sound Transit Total	6.7	5.5	6.1	5.7

The MVET collected to date is almost exactly as projected in *Sound Move*, after accounting for the April 1997 start date. In 1998, the first full year of tax collections, Sound Transit collected $46.3 million (nominal$) in MVET revenues. The original projection for 1998 was $44.6 million. Subarea tallies of MVET are recorded by the Department of Revenue (DOR), depending on the taxpayer's extended zip code (i.e., zip-plus-four). Likewise, the current projection for the entire planning period — $443.7 million (1995$) — is not significantly different from the original projection in *Sound Move* ($443.1 million). Subarea revenue projections have been modified, however, based on revised tax base estimates that reflect actual collections. Previously, Sound Transit had to rely on per-capita allocations of the MVET base to subareas. Now, with DOR reporting tax collections by subarea, using a taxpayer's extended zip code, a more accurate accounting of MVET revenue by subarea is possible.

Table 5.3-5
MVET Tax Revenue Projections by Subarea (1995 $ in Millions)

MVET	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total 1997-2006
North King	9	11	12	12	12	13	13	13	14	14	124
South King	4	5	5	5	5	5	5	6	6	6	51
Sound Transit	31	40	42	44	45	46	47	48	50	51	444

Other Revenue Sources—Bonds

Sound Transit anticipates issuing $1,102 million in bonds (1995$) between 1997 and 2006, with bond proceeds funding approximately 29 percent of the overall capital program. To date, Sound Transit has issued $350 million in bonds. The anticipated total bonding amount is relatively conservative in relation to other New Start projects. It is also far below Sound Transit's statutory debt limit, which is 1.5 percent of assessed valuation within the Sound Transit district (giving a bonding capacity of approximately $2.6 billion in 1997). Further evidence of the conservative nature of the bonded debt is provided by the coverage ratio. In 2007, the year after completion of the capital program, net revenues will exceed annual debt service by a factor of 2.6. Due to revenue growth, the coverage ratio is expected to grow to 6.3 by 2021. The financial plan also provides for adequate coverage during the construction period—the minimum average ratio is 2.4 in 2006.

Within subareas, bonding is not allocated to individual projects. Rather the bonding required is determined by balancing expenditures with all other sources of revenues, keeping within the subarea's ability to repay the bonds from its share of local tax revenues

Ability to Use Additional Debt Financing to Cover Shortfalls or Higher Costs

The financing plan assumes that all projects implemented by Sound Transit will be financed on a consolidated regional basis. Any bonds that Sound Transit issues will be secured by a pledge of the Retail Sales and Use Tax and MVET revenues collected within the district as a whole. Sound Transit's ability to weather negative financial outcomes must be evaluated on a regional basis. Because each subarea must generate adequate revenues to cover its share of bond repayments, negative outcomes could affect individual subareas differently, requiring a restructuring of subarea capital plans.

Sound Transit could implement several strategies to address negative financial outcomes; increasing bonding is just one of them. This analysis is presented to illustrate the flexibility of Sound Transit's Board to alter the financial program to respond to worst-case scenarios. Like any other major action of the Board, it would require a two-thirds majority vote to change the financial policies that guide bonding limits.

The financial policies adopted by the Sound Transit Board require a minimum 1.3 net coverage ratio (i.e., the ratio of pledged revenues, less O&M cost, to debt service) for financial planning purposes. Second, Sound Transit has a non-voted debt capacity of 1.5 percent of the assessed valuation (AV) within its district. Although Sound Transit's AV has not been officially tallied, a reasonable estimate can be developed from the AV in each of the counties lying partially within the Sound Transit district, and allocating the countywide AV on a per capita basis. In 1997, the total estimated AV was $171 billion, which translates to a non-voted debt limit of $2.6 billion.

Sound Transit could, theoretically, absorb large losses in income without violating the basic constraints on its debt capacity because the ongoing operating costs (post-2006) are much lower than the capital costs. After 2006, capital costs would be limited to replacement reserves, unless voters approve future extensions to expand the system. The main effect, should Sound Transit have to issue additional debt, would be a reduction in financial capacity for subsequent expansion of the system.

Federal Funding

Section 5309 New Start Funds

Section 5309 New Starts funds are discretionary federal funds available for new fixed guideway systems and extensions to existing fixed-guideway systems. A New Starts project can receive funding authorization by having an earmark in an authorization act, or by having a non-earmarked authorization committed to it by the FTA in a Full Funding Grant Agreement (FFGA). The FFGA is the principal means FTA uses to manage New Starts projects. The FFGA is a contract between the FTA and the local agency that defines the project. The contract includes cost and schedule; sets a maximum level of federal financial assistance (subject to appropriation); establishes the terms and conditions of federal financial participation; covers the period of time for project completion; and helps manage the project in accordance with federal law.

Even with an FFGA, a project needs to have funds appropriated annually to receive New Start funds. *Sound Move* assumed a total federal funding level, over the ten-year life of the plan for light rail, commuter rail and express bus, of $727 million (1995$). Of this amount, $550 million (1995$) was assumed for construction of the capital costs of light rail. The $550 million in total federal dollars converts to $694 million in year-of-expenditure (YOE) dollars. Achieving this federal funding level would require receiving funding over two or more authorization cycles.

Table 5.3-6 compares Sound Move assumptions for the light rail project, and the projected requests that would allow an alternative costing up to $1,850 (1995$) million to be constructed. As Table 5.3-6 illustrates, such an alternative would require an additional $249 million in year-of-expenditure federal funds beyond those assumed in *Sound Move.* Achieving this federal funding level within a ten-year time frame would require higher annual federal appropriations than have ever been appropriated to any single project over the same period. Historically, light rail projects have rarely received annual New Starts apportionments in excess of $100 million regardless of the amount of the total Federal commitment. To achieve this funding level, Sound Transit would anticipate requesting appropriations that extend beyond the project construction period. Therefore, Sound Transit would need to develop interim financing options, including pledging local dollars to interim borrowing costs in anticipation of federal funding in future years, a scenario that is within Sound Transit's financial capacity.

Table 5.3-6
Central Link Federal Funding Assumptions, Baseline and Request (Nominal$ in Millions)

	1997*	1998*	1999*	2000	2001	2002	2003	2004	2005	2006	Post 2006	Total
Baseline: Financial Plan												
Sound Move	0	7	26	74	75	91	97	100	110	114	0	$ 694
Goal: Request												
preferred alternative	0	9	5	70	70	70	100	100	100	70	349	$ 943

Note: The preferred alternative numbers reflect actual appropriations for these years. *Sound Move* numbers are converted from 1995$ to nominal $ using the most recent inflation forecast.

Other Federal Funding

Sound Transit qualifies for funding under a broad range of federal programs, not only for light rail but for its bus, HOV, commuter rail, and community connections projects as well. Federal funding may also be available for associated projects, including joint development, but no assumptions are made in this analysis about specific projects, programs, or amounts. No assumptions are made regarding federal operating assistance.

State funding

No state of Washington funds are assumed in the Central Link Light Rail project.

5.4 SOURCES AND USES OF FUNDS

The following tables show sources and uses of funds for all of Sound Transit and demonstrate the financial ability of the agency as a whole to support its programs. The financial policies call for maintaining a minimum of two months operating reserve and a $10 million minimum cash balance in the general fund. Sound Transit is expected to end its first ten-year phase with approximately $124 million in reserves (nominal$). Additionally, substantial capacity remains for new investments in future phases, should the region's voters decide to expand or enhance the initial phase programs.

Table 5.4-1
Sources and Uses of Funds by Program, For All of *Sound Move* (Nominal$ in Millions)

Sources		Uses	
Local taxes	$ 2,565	Sounder Commuter Rail	$ 789
Grants*	1,055	Regional Express Bus	1,246
Bonds	1,611	Link Light Rail	2,703
Operations	131	Regional Fund Activities	236
Interest	83	Debt Service	347
		Reserves	124
Total sources	$ 5,445	Total uses	$ 5,445

Note: * Excluding $349 million of Link grants expected after 2006. Numbers reflect Board-approved preferred alternative financial plan.

5.5 OPERATING STATEMENT AND SOURCES AND USES OF FUNDS

The long-term financial picture for Sound Transit is presented in the financial statements in Appendix N, Operating Statement and Sources and Uses of Funds. Because the program is financed primarily from local taxes, and because the tax rates were set with a mind toward financing extensions to the system, a large positive cash flow is anticipated in the year immediately following completion of the *Sound Move* capital program.

5.6 RISKS AND UNCERTAINTIES

Federal Funding

The most significant risk associated with the funding plan for Sound Transit's Central Link is the possibility that sufficient federal New Start funds would not be authorized or appropriated for the project. Until Sound Transit has negotiated an FFGA with the FTA, there are no guarantees that the funds projected in *Sound Move* will be forthcoming. If the New Start funds authorized and appropriated are significantly below those projected in *Sound Move*, Sound Transit's options would include: seeking other federal funds; issuing additional debt; extending the project schedule; redesigning elements of the project to cut costs; or defining a minimum operable segment that is shorter than the full project.

Even if Sound Transit is successful in negotiating an FFGA for the project, it is unlikely that Congress would appropriate New Starts funds for the project at the exact rate required to match annual project expenditures by Sound Transit. In this case, interim borrowing would be required in anticipation of future appropriations. The costs of this interim financing would increase the cost of the project, which could then be covered by additional borrowing to be repaid from local tax revenues. If the funds identified in the FFGA were never appropriated, (which is an unlikely worst-case scenario), Sound Transit would need to repay any interim borrowing from local tax revenues.

Local Revenues

Another risk is that local tax revenues from the Retail Sales and Use Tax or the MVET, or both, will be lower than projected. Historically, both tax bases have outpaced inflation. Between 1975 and 1995, the Retail Sales and Use Tax base grew at an average annual rate of 9.04 percent, and the MVET base grew at an average annual rate of 10.8 percent. These compare to a 5.6 percent average annual growth in the Seattle CPI.

The sales and use tax is sensitive to economic downturns, and the Seattle economy has been cyclic in the past. For example, whereas this tax base grew at a 9.9 percent average annual rate between 1985 and 1990, the annual growth rate fell to 4.0 percent between 1990 and 1995 as the Seattle economy climbed slowly out of the 1990-1992 recession. The MVET is less sensitive to economic downturns, since it is levied on the entire base of registered vehicles, rather than only new purchases. Between 1990 and 1995, the MVET grew at an average annual rate of 5.4 percent.

Forecasts of these tax basis derive from regression models, are tied to a regional economic forecast. These economic forecasts include variables such as personal income, unemployment, building permits, inflation, and driving age population. These forecasts, which serve as independent variables to the tax base models, have been and will continue to be refined by Sound Transit as more history becomes available, and as the economic outlook changes. Given the conservative nature of the projected growth rates in local tax revenues, it is unlikely that local tax revenues will fall significantly below those projected in *Sound Move*.

Initiative 695 (I-695) which has been certified for November 1999 ballot, repeals the state Motor Vehicle Excise tax (MVET) and would require voter approval for new or increased taxes or fees proposed by state, county, or local governments. I-695 does not expressly repeal Sound Transit's statutory authority to impose its MVET. However, I-695 would repeal the valuation schedule defined the taxable value of each vehicle. This is the basis for determining Sound Transit's share of the voter approved 0.3 percent MVET. Sound Transit is working with the Department of Licensing and expects to resolve issues related to continued collection of MVET, should I-695 be approved by the voters.

Construction and Rights-of-Way Costs

An additional risk is the construction and/or right-of-way costs will be higher than anticipated, due to unforeseen or adverse construction conditions—ranging from site problems to weather conditions—or unanticipated inflation resulting either from changes in the region's economy or project delay. Unanticipated construction inflation would be apparent when construction bids are opened, if not before. Unanticipated inflation of right-of-way costs would be apparent at the time property is purchased. Unforeseen conditions could arise at any time during the construction period. The further along the project when potential cost overruns appear, the greater would be the potential financial impacts. Additional delays to redesign or restructure the project could result in additional inflation-related construction cost increases. However, the options available to Sound Transit would be the same as for other risks: redesigning project elements to reduce costs, lengthening the project construction period, seeking additional funds, or issuing additional debt.

Interest Rates

Another financial risk, the possibility of unfavorable changes in interest rates, could affect either the rates at which Sound Transit borrows money or the interest received on cash deposits. The current financial plan assumes a tax-exempt bonding rate of 6.0 percent. This rate is equal to the long-term average borrowing rate for A- or AA- rated tax-exempt borrowers. However, the actual rate of borrowing is likely to be higher or lower than this rate, depending on prevailing market conditions. For example, the agency was able to issue long-term debt in December 1998 at an average borrowing rate of 4.97 percent. Sound Transit staff and the agency's financial advisors believe the 6.0 percent to be a slightly conservative borrowing rate assumption.

Meeting the Terms of the FFGA

Once the FFGA is entered into, Sound Transit is committed to deliver the project specified in the FFGA, regardless of unforeseen changes in its financial position such as reduced revenues or increased costs. While Sound Transit's Board would have policy options, Sound Transit would have the ability to issue additional debt to cover a major financial shortfall.

Ridership and Operating Revenue

The operating revenue budget for Link light rail assumes approximately 55 percent of the annual operating costs will be covered by passenger fares. Current projections indicate that the actual fare recovery ratio could be as high as 68 percent for the preferred alternative. Factors that could lower this percentage include: a fare policy that sets lower fares than assumed in the projections; lower ridership; and higher operating costs. The 1999 Financial Plan assumes in 2007 (the first year of full operations), fares will be about 5 percent of the total subarea revenues in the north King subarea and about 10 percent of the subarea revenues for the south King subarea. Therefore, ridership, and consequently fare revenues, lower than forecast would have only a small impact on total subarea revenues and would not jeopardize Sound Transit's ability to operate light rail. Similarly, on an ongoing basis, Sound Transit's total system operation requires about 30 percent of its projected income looking into the future. A significant increase in light rail O&M costs would not jeopardize the system's ability to operate.

5.7 CONCLUSIONS

Sound Transit will have adequate financial resources to build and operate light rail within the ten-year initial phase, provided it receives federal funding consistent with the Financial Plan assumptions or has the assurance, through an FFGA, of receiving the funds in future years. The financial analysis of the Central Link Light Rail project is consistent with the ability to deliver the program within budget.

The total cost of the lowest cost alternatives are within Sound Transit's costs affordable with current revenue for light rail, and there may be room in the *Sound Move* budget for the Board to select other than only the lowest cost alternatives. However, the total cost for the preferred alternative, as identified by the Board after the release of the Draft EIS, exceeds the costs affordable with current assumptions regarding local revenue and federal funding. This problem can only be addressed by the Sound Transit Board, in the context of their selection of the alternative to be built, which will be made after the release of the Final EIS. The Board has the ability to either modify the preferred alternative to reduce costs, seek additional grants or to modify the financial policies so as to increase revenue available to the light rail project. From an overall project standpoint, or from a federal-funding standpoint, the Central Link Light Rail Project can be built within the revenue currently affordable by Sound Transit .

CHAPTER 6
EVALUATION OF ALTERNATIVES

6. Evaluation of Alternatives

This chapter evaluates light rail alternatives relative to the goals and objectives developed for the project. Section 6.1 describes briefly the consistency of the preferred alternative with systemwide goals, as compared to other alternatives. Section 6.2 summarizes the project's rating according to FTA's cost-effectiveness index. Section 6.3 evaluates the impacts and trade-offs associated with each of the alternatives on a segment-by-segment basis. Section 6.4 evaluates impacts and trade-offs associated with the maintenance base sites. (Note: All costs in this chapter are in 1995$)

6.1 SYSTEMWIDE EVALUATION

Light rail is one element of a ten-year, $3.9 billion regional investment in High-Capacity Transit (HCT). It would provide a fast, reliable, cost-effective transportation alternative for over 38 million riders a year to travel to and from destinations in the region's densest central corridor. Below, the preferred alternative and the other length alternatives are reviewed for their potential to meet the goals established for the project, identified in Section 1.3.3.

Transportation Goal: Enhance Mobility

Objective: Provide an effective, high-quality transit system

A few years after opening day, the preferred alternative for the light rail line is projected to carry nearly 110,000 daily riders, which would make it among the busiest light rail lines in North America. By the year 2020, the preferred alternative would carry 133,000 daily riders. An extension of the preferred alternative to Northgate would carry up to 156,400 riders by 2020. MOS A (N.E. 45th Street to McClellan) would carry 106,100, MOS B (Capitol Hill to Henderson) would carry 76,900, and MOS C (N.E. 45th Street to Lander) would carry 87,300. Compared to riders on bus service operating in congested and ever-worsening traffic conditions in the corridor today, light rail's riders would experience average travel time savings of 9 to 18 percent. Because light rail would generally operate in its own right-of-way, service is expected to be reliable. During peak periods, Sound Transit expects light rail to operate in a 95 to 99 percent on-time range, regardless of traffic conditions on the surrounding roads and highways.

Objective: Design a system to accommodate future extensions and expansions

The design of the preferred alternative would allow extensions north to Northgate, and continuing north to Snohomish County from Northgate. The line can also be extended south from SeaTac to Tacoma, east from downtown Seattle across Lake Washington on I-90 or SR 520, and east on I-405 from SR 518. Local funding for the extensions in future phases would require a vote of the region's citizens. All of the MOS alternatives were developed to accommodate further expansions.

Objective: Integrate services and fare policies with local transit providers and provide convenient connections

Sound Transit has been working with all of the region's transit providers to develop an integrated regional fare policy. The first elements of the integrated system were introduced in fall 1999 for use on the region's local transit and Sound Transit's Regional Express bus services. Light rail stations are being designed to provide convenient transfers to other travel modes. Depending on the station, other modes include local and regional bus, commuter rail, Amtrak, park-and-ride, ferries, airline, monorail, walking and bicycling. Through workshops between Sound Transit, local jurisdictions and community groups, initial definitions of each station's access needs were developed. These efforts will continue through final design.

Objective: Enhance transportation equity

Light rail and all of Sound Transit's investments would greatly enhance the transportation access and mobility options of the transportation disadvantaged, including those who do not own cars and/or cannot drive because of age, economics, or disability. The preferred alternative and the other project alternatives are designed to meet this objective; since the Draft EIS, additional design modifications have been proposed to improve access to and around light rail facilities, particularly in at-grade sections of the route. The MOS alternatives do not all serve sections of the corridor with the highest concentrations of low income persons; of the shorter alternatives, MOS B provides more transportation benefits to low income persons.

Environmental Goal: Preserve Environmental Quality

Objective: Minimize potential adverse impacts to the natural and built environment

Through the development of the EIS, potential adverse impacts to the environment have been identified for all alternatives. Sound Transit has focused on minimizing potential impacts by avoiding project alternatives with significantly higher impacts, by modifying project designs to reduce or minimize impacts, and by developing and evaluating potential mitigation approaches for significant impacts. The preferred alternative would offer environmental improvements over No-build conditions in several areas. The total miles traveled daily by vehicles in the region would be slightly lower with light rail, as would the total number of hours the vehicles would spend in travel. Implementation of light rail between Northgate and SeaTac would support regional efforts to reduce CO and ozone-causing pollutants being emitted into the regional airshed. The preferred alternative is expected to reduce regional energy use for transportation by 934 x 10^9 BTU per day, compared to the No-build Alternative. The light rail construction could result in the clean-up of some existing hazardous materials sites that would otherwise remain contaminated. Or would not be cleaned up as soon.

In most areas, the impacts of the preferred alternative are less than or the same as other light rail alternatives considered. The ecosystem impacts of the preferred alternative would involve filling 2.13 acres of wetlands and 1.60 acres of wetland buffer, and removing 2 acres of other wildlife habitat. Fisheries in four locations could be impacted. The preferred alternative avoids greater impacts to ecosystems associated with several other routes, and incorporates design features that minimize ecosystem impacts. The MOS alternatives would not extend to several of the segments with higher levels of ecosystem impacts. For all alternatives, impacts could also be minimized through the use and monitoring of best management practices (BMPs). Where impacts are unavoidable, the project would seek opportunities to create, restore or enhance existing habitat.

In most segments, the preferred alternative would have fewer property acquisitions and business and residential displacement impacts than other light rail alternatives, although these impacts would be avoided by a No-build Alternative. Overall, the preferred alternative would fully acquire approximately 147 properties, which is more than would occur with a combination of segment route alternatives with the least amount of acquisitions (103) but less than half the maximum possible (348). The preferred alternative would affect one resource that is historic and a parkland. The route would be in areas of moderate to high probability for archaeological resources, but would affect no known resources. All the above impacts are within the same range or lower than other alternatives.

The regional and local land use and transportation plans are dependent on HCT. Failure to implement the project would likely reduce the ability to meet regional residential and employment density goals. Lack of implementation would put pressure on the urban growth boundary, and would potentially result in indirect impacts to ecosystems, water quality, air quality, and open space in other locations.

The MOS alternatives would have fewer direct impacts to natural and built resources, but they also offer reduced levels of transportation benefits.

Land Use Goal: Support Regional and Local Land Use Goals and Objectives

Objective: Support adopted land use and transportation plans.

Light rail is integral to the Metropolitan Transportation Plan (MTP), which is an element of Vision 2020, the region's integrated long-range growth management, economic and transportation strategy. The MTP calls for "light rail service along major regional corridors interconnecting the Seattle CBD with other regional centers in northern, eastern and southern suburban areas, as well as north-south centers in the eastern corridor." The preferred alternative is consistent with these plans. The No-build Alternative would be inconsistent with Vision 2020 and the MTP. King County and the cities of Seattle, Tukwila, SeaTac and Renton have all adopted comprehensive plans with light rail-related transportation provisions. Urban centers identified in Vision 2020 and the MTP are located along the proposed project routes. The preferred alternative would serve designated urban centers at the University District, Capitol Hill/First Hill, downtown Seattle and SeaTac. It would not directly serve Tukwila's urban center at Southcenter and would not serve the urban center at Seattle Center. Extension of the line to Northgate would provide service to that urban center. Light rail is consistent with local comprehensive plans in all segments, although Alternatives E2 and E3 would be most consistent with Tukwila's Comprehensive Plan.

Of the length alternatives, the preferred alternative and the Northgate to SeaTac alternatives are most supportive of regional plans. MOSs A, B, and C are compatible with the regional vision, but they do not meet the same level of regional connections.

Objective: Support pedestrian-friendly and transit-oriented development

Light rail would serve some of the densest neighborhoods on the West Coast, would support existing pedestrian-friendly developments, and would support future transit-oriented development elsewhere along the corridor. The cities of Seattle and SeaTac are engaged in station area planning in cooperation with Sound Transit. Each of these station area plans is intended to support opportunities for new mixed-use, higher-density development within walking distance of the light rail stations, which would tend to increase ridership on the line. In Segments D and E, additional pedestrian crossings and other pedestrian facilities have been proposed for the preferred alternative.

Objective: Enhance neighborhoods

Light rail would increase access and mobility and reduce reliance on the auto in the neighborhoods it serves. The station area planning efforts mentioned above are also targeted to ensure that stations fit into their neighborhoods and support individual neighborhood character.

Financial Goal: Achieve Financial Feasibility

Objective: Build a system within *Sound Move*'s budget

Sound Transit will have adequate financial resources to build and operate the Central Link Light Rail project within the ten-year initial phase, provided it obtains federal funding at levels consistent with the Financial Plan Assumptions. The total cost for the preferred alternative currently exceeds the original *Sound Move* budget and exceeds the cost affordable with current revenue. This issue can be addressed only by the Sound Transit Board in the context of their selection of the light rail alternative to be built. The Board has the ability to either modify the preferred alternative or to modify local financial policies so as to increase revenue available to the light rail project. From an overall project standpoint, and from a federal funding standpoint, the light rail project can be built within the revenue currently available to Sound Transit. Each of the MOS alternatives is well within *Sound Move's* budget.

Objective: Build a system that can be operated and maintained within available revenues

The projected operating budget for light rail is approximately $37.4 million a year for the preferred alternative; this can be funded within available resources. The analysis of farebox revenues presented for the EIS assumes that $28.4 million would be generated annually by 2020, allowing 68 percent of operating costs to be covered by fares. The fare recovery range for other length alternatives would range between 60 percent and 86 percent with MOS A (N.E. 45th Street to McClellan) recovering the largest share of operating costs from fare revenue.

Objective: Build a system that is cost-effective

Light rail offers a cost-effective way to provide major new capacity in the region's most congested corridor at a lower cost than other alternatives, including adding new highway capacity. The HCT elements of *Sound Move* (light rail, commuter rail and express bus) are projected to improve ridership while making the entire regional transit system operate more efficiently. Regional transit modes in 2010 under *Sound Move* would carry 52 percent more annual passenger miles than transit under the No-build Alternative and 33 percent more than a Transportation System Management (TSM) alternative. The operating costs per passenger mile would be $0.27 for *Sound Move* transit services compared to $0.56 for the No-build and $0.61 for a bus-only network (Sound Transit 1997). Light rail is a cost-effective rail technology (PB/K 1992) and is more cost-effective than heavy rail when evaluated on a system-wide basis. The projected FTA cost-effectiveness would range from $10.34 (1995$) with the Northgate to SeaTac Alternative to $3.30 for MOS C.

Community Support Goal: Maximize community support

Objective: Involve the community in the project development and design process

It is Sound Transit's objective to build support through continuing the cooperative design process with affected jurisdictions and through extensive community outreach.

Sound Transit's project development process has involved the community at every step. The focus has been on identifying issues or concerns that can be addressed early on through changes in the design, thus eliminating extensive mitigation and community dissatisfaction during later stages of the project. These issues are identified through an extensive array of outreach and involvement activities. Sound Transit's public involvement is described in Appendix B. These involvement activities include formal agreements with the cities of Seattle and SeaTac to assist with route and station area planning. Sound Transit has conducted numerous formal workshops and hundreds of meetings with community and business groups and affected property owners and individuals, as well as presentations and booths at fairs and community events. Multiple mailings have been sent to all residents, businesses and property owners within 1,000 ft of each route under study. A project office in Rainier Valley, open to the public, provides a convenient location for community members in that area to meet with project staff, view plans and collect project information. Sound Transit and FTA circulated over 1,500 copies of the Draft EIS to affected local jurisdictions, regional, state, and federal agencies, community organizations, environmental and other interest groups, and interested individuals. Using a variety of media targeted at communities throughout the corridor, Sound Transit published a notice of the Draft EIS availability and its public hearings. Public hearings for the project were held throughout the region during the Draft EIS 60-day comment period (45 days is the minimum required under NEPA and 30 days minimum under SEPA), allowing the public, agencies, and jurisdictions the opportunity to comment on the Draft EIS to Sound Transit and the FTA. Sound Transit will continue to engage the community in the station design process.

Objective: Enhance community support

Community support was first expressed in the strong positive vote for *Sound Move* in 1996. It is Sound Transit's objective to build support through continuing the cooperative design process with affected jurisdictions along with extensive community outreach.

Public support for the light rail project comes from an understanding of the many benefits that the project will bring. Sound Transit has engaged the community in a continuous dialog about those benefits in the form of door-to-door outreach, presentations to community organizations, regular mailings, advertisements in local media, public workshops, field trips, and participation in community events and celebrations.

- Sound Transit mailed two brochures (one describing the route and station option and one announcing the Draft EIS and opportunities for comment) to 122,000 households along the proposed routes.
- Sound Transit placed newspaper advertisements to publicize upcoming forums and opportunities to comment on the Draft EIS.
- Sound Transit held three informational open houses in Rainier Valley.
- Sound Transit held six community forums to educate the community on the EIS process, major findings of the EIS and how to comment on the document.
- Sound Transit aired video segments of field trips and the Draft EIS process on cable local access channels.
- Sound Transit made the Draft EIS, an executive summary, and a workbook describing route and station options available to the public.
- Sound Transit held five public hearings to give the the community opportunities to comment on the Draft EIS.
- Sound Transit led ten field trips to Portland Oregon and Vancouver British Columbia for participants to see an operating light rail system.

6.2 FTA INDEX

The FTA defines a Cost-Effectiveness Index as the incremental cost per rider (a person who did not previously ride any kind of transit), compared to a Transportation System Management (TSM) alternative. This index is used to compare light rail projects across the country and has become an important part of FTA's review of major transit projects. While the FTA index is important, it does not account for many of the project's other benefits. These benefits include the long-term reduction in public infrastructure costs and environmental benefits that would result from the more efficient land use patterns associated with light rail. There would be mobility improvements and travel time savings for all riders (the FTA index shows savings for new riders only). Qualitative criteria are also taken into account separate from the cost index, since generally accepted methodologies for monetizing these and other benefits does not exist and these factors are excluded from the captured index. The index also does not reflect a project's financial feasibility.

Table 6.2-1
FTA Index (1999$)

Annualized Capital Cost	$413.24 million
Annualized System Operating Cost	$500.18 million
Incremental Operating Cost Compared to TSM	($0.014) cost per passenger mile
Total Annualized Incremental Cost Compared to TSM	$185.72 million
Annualized Systemwide Ridership	138.2 million riders
Incremental Annual Systemwide Ridership Compared to TSM	17.85 million new riders
FTA Index	$10.40 incremental cost per new rider

Note: Central Link's FTA Index is $10.40 per new rider for Northgate to SeaTac corridor; $3.30 per new rider for MOS C; the range for other light rail systems recently reporting this index was $2.54 to $44.80 (FY 2000 New Starts Ratings). Link was equal to nationwide median index score last year at $10.39 in 1997$.

6.3 SEGMENT-LEVEL EVALUATION

6.3.1 Segment A (Northgate to University District)

Transportation Goal: Enhance Mobility

All of the alternatives in Segment A have nearly identical travel times and serve the same general markets. Slight variations in accessibility occur depending on the station location in the Roosevelt neighborhood.

At Northgate, station Options B and C would bring the station closer to the proposed mixed use expansion of the regional shopping mall and provide better pedestrian and bus connections.

The alternatives in this segment would attract 15,800 to 15,900 daily boardings in 2020, or about an 11 percent share of the systemwide total boardings.

The two tunnel alternatives that would serve the Roosevelt business district are one block apart and would have a station located at N.E. 65th Street and either 12th Avenue N.E. (A1.1) or Roosevelt Way N.E. (A1.2). The two elevated alternatives, which both have the same station location (N.E. 65th Street and Eighth Avenue N.E.), would move the station next to I-5 and provide closer service to the area between Greenlake and I-5, which is proposed to be zoned for high-density housing. There is an existing park-and-ride at this location that is well used by bus riders and car-poolers. Stations at Roosevelt Way N.E. or 12th Avenue N.E. are the most central to the business district.

All of the alternatives in this segment would provide equal service reliability because all are completely grade-separated or within exclusive rights-of-way. All station alternatives are either elevated or in tunnel, so access to and from the stations would require a grade change. All station locations connect to Metro bus routes, are close to bike lanes or bike routes, and are served by sidewalks. The station options at Northgate would both be adjacent to park-and-ride facilities with up to 1,300 spaces. Travel time savings for residents of this segment would be the second highest in the corridor, averaging about 10 to 12 minutes for P.M. peak trips, or a 21 to 24 percent time savings.

Environmental Goal: Preserve Environmental Quality

The major differences in environmental impacts between the various alternatives in Segment A are associated with the choice of a tunnel or elevated route through the Roosevelt District. Most impacts, however, can be at least partially mitigated. Of the seven major intersections in the study area, all the light rail alternatives would cause one intersection on First Avenue N.E. to operate at an unacceptable level (Level of Service [LOS] F) in 2010, and another to operate unacceptably in 2020 (LOS E). These intersections would operate acceptably in 2010 with the No-build alternative. However, one of the intersections would degrade to LOS F with the No-build alternative in 2020. The impacts of the light rail alternatives can be mitigated. From 10 to 18 on-street parking spaces and 140 and 196 off-street spaces would be displaced in all alternatives. Near the Roosevelt Station, all alternatives would have the potential for hide-and-ride parking by rail commuters parking on neighborhood streets.

At Northgate, station Options B and C would result in greater commercial displacements, while Station Option A would result in minor impacts to wetlands near Thornton Creek. Substantial redevelopment and increased density could occur around any of the Roosevelt Station alternatives.

The relatively few displacements that would occur would not change land use patterns in the area. Alternative A2.1 would displace 10 existing land uses, including eight housing units. The other alternatives would acquire three to seven parcels and no housing.

Alternative A2.2, the elevated route, would affect views of the Olympic Mountains and Green Lake from Rainbow Point Park and some nearby residences. Both A2.1 and A2.2 would cross Ravenna Boulevard, a city park and historic resource, in an elevated configuration.

Under all alternatives, light rail and traffic noise impact would be mitigated, with no significant residual impacts. After mitigation, the elevated routes would have no vibration impacts (A2.2) or vibration impacts on just one building (A2.1). The tunnel routes, after mitigation, would cause vibration impacts at four to nine buildings.

The construction impacts of the alternatives would vary. The routes elevated along Eighth Avenue N.E. (A2.1 and A2.2) would have localized construction noise and disruption impacts all along the elevated portions of the routes. For the two routes that tunnel under the Roosevelt District (A1.1 and A1.2) the station (either under 12th Avenue N.E. or under Roosevelt Way N.E., south of N.E. 65th Street) could be constructed using cut-and-cover techniques; this process would be disruptive to the adjacent business district and would affect traffic circulation during the construction period.

Land Use Goal: Support Regional and Local Land Use Goals and Objectives

The light rail alternatives and all of the proposed station locations are consistent with the City of Seattle's comprehensive and neighborhood plans and with the Northgate Area Comprehensive Plan. The Northgate shopping mall owners are proposing to redevelop the properties into an enlarged shopping mall with new, high-density housing, office, and hotel development. This redevelopment would reinforce Northgate as a strong regional urban center and support light rail transit. The Northgate Station Options B and C would most directly integrate with the new development.

Each of the Roosevelt Station alternatives would serve the Roosevelt urban village and commercial district. Alternatives A1.1 and A1.2 would place a tunnel station in the center of the commercial district. In alternatives A2.1 and A2.2, the elevated station would be about three blocks to the west and closer to the Greenlake neighborhood.

Financial Goal: Achieve Financial Feasibility

Segment A is not funded for construction in *Sound Move* and would be constructed in the initial phase only if additional funds are secured. The cost range in Segment A is from $303 million to $391 million. Both of the route alternatives that emerge from a tunnel to an elevated station near I-5 (Alternatives A2.1 and A2.2) cost less than the longer tunnel under the Roosevelt business district (Alternatives A1.1 and A1.2). The lowest cost alternative, A2.2 (Eighth Avenue elevated) reflects the savings gained from having the shortest tunnel length. There are no significant differences in operation and maintenance (O&M) costs for the different alternatives in this segment.

Summary of Trade-offs

Trade-offs in this segment involve the station location at Northgate, and the profile and station location in the Roosevelt neighborhood. Ridership and service levels are not significant distinguishing factors in the choice of alternatives or station options in this segment. The tunnel alternatives (A1.1 and A1.2) would have the highest cost and the Eighth Avenue Elevated (A2.2) would cost the least.

Northgate Station Options B and C (east location) would best serve the mixed-use expansion of the regional shopping center, although it would have greater commercial displacements. Option A would have less effective pedestrian-bus connections and would result in minor impacts to wetlands near Thornton Creek. A station at Roosevelt Way N.E. (A1.2), or 12th Avenue N.E. (A1.1), would be the most centrally located site for the Roosevelt business district. The elevated station (A2.1 or A2.2) would be closer to the existing park-and-ride lot and the Greenlake neighborhood, and would have the potential to serve the Roosevelt as well as the Greenlake area and an area of future high-density residential development.

Alternative A2.1 would remove six homes along Eighth Avenue N.E. and require additional displacements at station entrances (total acquisitions would be ten properties). Alternative A2.2 may obstruct views from Rainbow Point Park and some residences along I-5. Both tunnel alternatives (A1.1 and A1.2) would have similar vibration impacts (four to nine properties), and the short, elevated alternative (A2.1) would impact one property. The tunnel alternatives (A1.1 and A1.2) would require four to six acquisitions. Cut-and-cover construction for the tunnel stations in the Roosevelt commercial area (A1.1 and A1.2) would be the least expensive options but would cause the greatest disruption during construction.

The preferred alternative does not include an extension of the light rail to Northgate in the initial phase. However, an extension to Northgate would increase overall daily system ridership by 23,000 in 2020.

The 15,800 to 15,900 daily boardings in 2020 in the Northgate-to-University-District segment make it potentially the third highest ridership segment in the system. Systemwide ridership without service to Northgate is projected to be about 133,000 daily boardings by 2020, but with Northgate it is projected to be about 149,000 daily boardings. Northgate is a major regional destination as well as a significant transfer point for riders from the north.

Extending the line to Northgate would significantly reduce the long-term impacts of removing the buses from the DSTT and returning them to surface streets, as some of those buses would be replaced by light rail service from Northgate. It would also provide an opportunity to provide more efficient feeder bus connections outside of the University District and downtown Seattle.

Long term, it would be less expensive to construct a tunnel to a portal point north of the University District in a single phase, as compared to coming back in a subsequent phase and connecting to the tunnel while operating service in the already completed portions. The operating savings would also be less.

For several reasons, Northgate makes a better interim terminus to the light rail line than N.E. 45th Street. Northgate already has a major bus transit center to support connections to light rail, while the density of activities around N.E. 45th Street (University buildings, churches, commercial and retail buildings) and the limited street right-of-way widths there would make it very difficult to expand the already extensive network of buses serving the University District bus transit hub. Northgate is currently served by park-and-ride facilities that would allow people who come from north King County neighborhoods where bus service is not convenient to access the end of the light rail line; there is no possibility of providing park-and-ride spaces at N.E. 45th Street.

6.3.2 Segment B (University District to Westlake Station)

Transportation Goal: Enhance Mobility

Ridership and Markets Served

The preferred alternative (B1a) with a Capitol Hill route would serve the highest density residential neighborhoods in the region, and the third largest employment center. By 2010, First Hill/Capitol Hill is expected to become the region's second largest employment center, with slightly more jobs than the University District. The Seattle Center routes (B2.1 and B2.2) would serve a strong but smaller employment market and a much smaller number of residents; however, it would serve a major regional arts, recreation and sports destination. With a Capitol Hill route, Seattle Center visitors could connect to the light rail line via the Monorail at Westlake Station.

The preferred alternative in Segment B would account for about 46,200 daily boardings by 2020, or about 35 percent of the total system boardings. The preferred alternative includes the second highest ridership station, Capitol Hill, with about 15,300 daily boardings by 2020. Alternative B1b, which would include a Roy/Aloha Station, would have 400 more riders in the segment.

The Seattle Center alternatives would account for about 32,000 to 36,000 daily boardings in 2020, and would result in an overall reduction in system ridership by 24,000 to 30,000 riders, compared to the Capitol Hill tunnel.

Eliminating Convention Place Station would result in a slight increase of riders systemwide because the decrease in accessibility is balanced by the overall reduction in travel time for riders traveling through because of one less station stop. Most Convention Place Station ridership would shift to Westlake Station (which is captured in the Segment C ridership projections). However, eliminating the Convention Place Station would make light rail access to the Convention Center and the Denny Triangle neighborhood less convenient.

Reliability and Travel Time

All of the alternatives in this segment would provide equally reliable service because they are completely grade-separated. The travel times on the Seattle Center alternatives would be about one minute longer than for Capitol Hill, because the routes are longer and there is an additional station.

The travel time savings for residents in this segment would be higher with the preferred alternative, with savings averaging about 7 minutes for the P.M. peak trips or a 16 percent savings. The Seattle Center alternatives would provide an average 6 minutes, or 13 percent, travel time savings for the same trip.

Environmental Goal: Preserve Environmental Quality

The preferred alternative would have the fewest environmental impacts of alternatives in segment B, with impacts occuring primarily near station areas. The preferred alternative would acquire the fewest properties, with impacted properties clustered around station entrances; some loss of parking would occur in station areas. The project could support substantial redevelopment and increased density in the N.E. 45th Street and Campus Parkway Station areas. The preferred alternative (as well as Alternatives B1b and B2.2, and to a lesser extent B2.1), could impact sensitive research at the University of Washington Physics and Astronomy Building, due to electromagnetic interference and vibration, although these impacts can be mitigated. Of the two options considered by the preferred alternative for the N.E. 45th Station, Option B, which would be east of 15th Avenue N.E. avoids parking, street closure and property displacements that would occur with Option A.

The preferred alternative also includes several options for a Capitol Hill Station. All options would displace several retail and commercial businesses at station entrances. The cut-and-cover construction methods proposed for the stations at Nagle Place and at Broadway (Options B, C and D) would be more disruptive than a deep mined station option (Option A). The Broadway options would involve temporary lane closures of up to a block and a half of business frontages during construction. The preferred alternative's First Hill Station (Option B) avoids visual impacts that Option A would have to the historic Garrand Building at Seattle University.

The preferred alternative would close the Convention Place Station. Other alternatives could consider reconstruction of the Convention Place Station, which would likely require the closure of Pine Street during construction, and temporarily sever a major bus and general purpose traffic link between downtown and First Hill/Capitol Hill. Increased congestion on adjacent streets and longer travel times, particularly for bus riders, would occur.

The greatest environmental impacts within this segment are associated with Alternative B2.1 and the construction of a new high-level bridge across Portage Bay, which would result in 21 property acquisitions (including 41 individual residential units), park impacts, and several noise and vibration impacts. Mitigation would be required to minimize noise impacts on 23 buildings; vibration impacts would remain for two buildings after mitigation, out of 25 buildings requiring mitigation. Alternative B2.1 would result in visual impacts to the residential area north of Portage Bay from view blockage and a visually incompatible elevated structure. Along Campus Parkway, the mature trees known as "Campus Grove" would be removed from the center of the parkway. This alternative would also require the removal of the University Friends Meeting Hall, an historic structure.

Alternative B2.2, the Seattle Center via Portage Bay Tunnel, would also displace 21 properties. B2.2 would have no noise or vibration impacts after mitigation.

Land Use Goal: Support Regional and Local Land Use Goals and Objectives

Alternative B1, the preferred route identified in *Sound Move*, is compatible with City of Seattle's Comprehensive Plan, neighborhood plans, and with the relevant master plans for the major education and medical institutions in the corridor. Alternative B1 would serve the Capitol Hill urban center, while Alternative routes B2.1 and B2.2 would provide light rail service to the Seattle Center urban center. The Capitol Hill Station options would all offer similar opportunities for redevelopment. The draft Denny Triangle Neighborhood Plan, scheduled for adoption in 1999, identifies the Convention Place Station as an important transportation destination for that neighborhood. The preferred alternative would close the Convention Place Station, and all alternatives would involve substantial changes to the two-block site, including potential for redevelopment.

Financial Goal: Achieve Financial Feasibility

The preferred alternative in Segment B would cost $862 million, not including the difference in station options at N.E. 45th and Capitol Hill. The cost range for all alternatives in Segment B is from $794 million to $975 million. The reconstruction of the Convention Place Station would add $59 million to either of the Seattle Center alternatives or to the Capitol Hill Tunnel alternative. Other cost differences reflect the presence or absence of mezzanines in subway stations and the depth of tunneling.

The two Seattle Center alternatives without the Convention Place Station are lowest in cost primarily because of less tunneling. The Seattle Center via High-level Bridge alternative (B2.1) is slightly longer than the Seattle Center via Portage Bay Tunnel alternative (B2.2), and it has additional costs associated with the bridge and the necessary property acquisition and street rebuilds on the approaches. However, the Portage Bay Tunnel alternative (B2.2) has higher costs associated with the mined station at N.E. Pacific Street and 15th Ave. N.E., compared to the cut-and-cover Campus Parkway Station that would be built with the High-level Bridge alternative (B2.1).

The B2 Alternatives to Seattle Center, because of their longer lengths, would add significant annual O&M costs in this segment, ranging from $1.6 to $2.3 million, or about a 4 to 5 percent increase in the annual operating budget. Because of their lower ridership, they would contribute about $6 million less to annual fare revenue. The combination of higher O&M costs and lower fare revenue, would reduce the systemwide share of operating expenses covered by fares from about 63 percent to about 48 to 51 percent.

Summary of Trade-offs

The preferred alternative has the lowest impacts of the Segment B alternatives, and it avoids the environmental impacts associated with Alternative B2.1 (vibration, historic, visual, parks, and residential and commercial displacements).

The preferred alternative has a higher construction cost than the least cost options for the Seattle Center route alternatives, but it has significantly higher ridership both within the segment and systemwide. The preferred alternative would cost $862 million, which is more than the Seattle Center routes (B2.1 and B2.2) without a Convention Place Station. The preferred alternative would have 39,400 riders in Segment B in 2010 and 46,200 by 2020. This would result in systemwide ridership of about 24,000 to 30,000 more daily riders than the Seattle Center routes and a segment ridership with 12,000 to 15,000 more daily riders.

The Convention Place Station would cost $59 million without any gain in ridership.

The station options at N.E 45th Street involve a number of trade-offs between impacts and effectiveness. Options B and C would have higher costs than Option A (the shallow station). Option C would be physically closer to the commercial center of the University District, offering better transit and pedestrian connections to the area. However, it would close a street, displace several properties and off-street parking, and have the greatest construction-period impacts including the temporary displacement of a 120-unit apartment building. Option B would be located to the east of 15th Avenue N.E., avoiding many of the property and construction impacts of Option C. It would offer less effective pedestrian connections to businesses and transit along University Way N.E., but would serve the UW campus more directly.

The cut-and-cover Capitol Hill Station options for the preferred alternative would have lower costs than a mined station. All alternatives for a Capitol Hill Station would involve property acquisitions at station entrance areas. Construction impacts would be of longer duration and would affect more properties with the shallower cut-and-cover station options. The Nagle option (Option D) avoids the traffic and construction disruption that would occur along Broadway with Options B and C, but it would displace more businesses, residences, and off-street parking, and it would impact the historic Lincoln Reservoir site.

6.3.3 Segment C (Westlake Station to S. McClellan Street)

Transportation Goal: Enhance Mobility

Ridership and Markets Served

With a Northgate-SeaTac light rail line, Segment C would contribute about 40 percent of the total systemwide riders, with about 59,100 to 67,000 daily boardings in 2020 (the larger number is segment ridership with a Beacon Hill Station). The two busiest stations on the entire line would account for two-thirds of this ridership, with 22,800 daily boardings at Westlake Station and 16,600 at University Station, even without the potential Beacon Hill Station.

Although the different alternatives in this segment would serve different markets south of downtown Seattle, most of this segment's boardings are in the DSTT. Of projected boardings in this segment south of the International District Station, the largest gains occur with the preferred alternative and other C1 routes that would have a Beacon Hill Station. The Beacon Hill Station would contribute about 4,400 daily boardings, more than any other station south of downtown Seattle, and would increase systemwide ridership by 4,500 daily boardings. The lowest ridership in this segment is for the Royal Brougham Station, which would generate 500 daily riders, except during stadium events when it would be a high ridership station, and the Poplar Place Station with Alternative C2.4, which would generate 600 daily boardings.

Reliability and Travel Time

In the northern part of this segment, all of the alternatives would be in the DSTT, providing equally reliable service through downtown Seattle. South of downtown, Alternative C1.1 would operate light rail in the median of the busway and be less reliable for both rail and buses than C1.2 (at-grade north of Lander Street), C1.3 (elevated north of Lander), or C1.4 (elevated south of Forest). The preferred alternative (C1.2) and Alternative C1.1 would cross up to five active freight rail lines and would have several cross-street intersections. Alternatives C2.3 and C2.4 could operate in shared right-of-way with buses on the D2 (I-90) busway for a short distance, which also would affect both bus and rail reliability. Alternative C2.3 would operate at-grade along Rainier Avenue S. between S. Dearborn Street and S. Massachusetts Street.

The preferred alternative has light rail only in the DSTT, while other alternatives consider the option to allow bus and light rail operations in the tunnel together. Joint bus/rail operations in the tunnel would reduce the speed and reliability of both bus and rail operations in the tunnel. Rail only operations would provide optimal reliability and speed for light rail, but some bus routes could be impacted. Under joint bus/rail operations, the capacity of the downtown tunnel would be limited to trains running at 4-minute headways, with 30 buses per hour in each direction. This capacity is only sufficient for a two- to ten-year horizon, depending upon if and when light rail extension funding is approved by the voters. With joint bus/rail operations, rail travel times through the downtown tunnel would be over two minutes longer, and bus travel times would be up to four minutes longer than with current operations.

Currently the bus volumes on surface streets are close to estimated bus capacity for acceptable bus operations. Without light rail, transit trips would continue to increase to meet the regional travel demand. The introduction of light rail and commuter rail to the region would slow the need to increase the number of buses in downtown Seattle. Light rail use of the tunnel would also eliminate the need for King County Metro to replace its fleet of dual power coaches in early 2002 – 2004. Rail only use of the tunnel would increase the number of buses using surface streets, but a similar increase would also occur under the No-build Alternative.

The segment travel times are almost identical for all alternatives, although adding a station at Beacon Hill would increase travel time by one minute. The alternatives that provide a station at I-90 and Rainier (C2.3 and C3) would allow riders to transfer to and from bus service to the Eastside, while the others would require riders to transfer at the International District Station.

Travel time savings for the P.M. peak trips to Segment C would average about 6 minutes, or a 14 percent time savings.

Environmental Goal: Preserve Environmental Quality

The preferred alternative would have potential impacts involving transportation, property acquisitions, ecosystems, and parklands. Most of these impacts would be mitigated.

The preferred alternative would operate light rail only in the DSTT, with buses operating on surface streets. The Final EIS also considers the other scenarios that would allow bus and rail operations in the tunnel. In all cases, the DSTT would be closed for 24 to 27 months for construction of light rail improvements, and all buses that would normally operate in the tunnel would need to be accommodated on downtown streets. It is during construction when the impacts would be most significant.

Sound Transit analyzed options for addressing the effects of construction closure and subsequent light rail only operations in the DSTT. All scenarios showed that downtown intersections would operate acceptably (LOS D or better) under the light rail alternatives, with performances similar to the No-build alternative. Rail-only use of the DSTT could increase the number of buses using surface streets, but auto vehicle trips to downtown would be reduced. Surface changes such as increased capacity on downtown streets, on-street parking restrictions, a transit shuttle system, or transit-priority treatments for buses would be needed for all scenarios.

All C1 alternatives, including the preferred alternative (C1.2) would not significantly impact traffic operations in the study area, with all intersections operating at LOS D or better in 2020. Circulation and access impacts are found along at-grade and elevated sections on S. Lander Street (C1 alternatives), Rainier Avenue S. (C2.3 and C3), and S. Massachusetts Street (C3), with left turn prohibitions to and from unsignalized driveways and side streets. Alternative C1.1 would have impacts to both sides of S. Lander Street, which is an important east-west route in the area. The preferred alternative would minimize the access impacts along S. Lander Street by locating the track on the north side of the street, affecting streets and properties on one rather than both sides S. Lander Street. Alternatives C1.4 and C1.5 would completely avoid access impacts to S. Lander Street. For the preferred alternative and other at-grade alternatives, traffic signal preemption for at-grade light rail vehicles would increase vehicle delays for minor cross street approaches and major street left turn movements at all signalized intersections; these congestion impacts can be minimized with mitigation. Some trucks and other vehicles would be required to make U-turns at signalized intersections to reach their destinations. Overall, Alternative C2.3 would cause the largest overall impact to traffic access and circulation, followed by Alternatives C2.4, C3, and then the preferred alternative and other C1 alternatives along S. Lander Street (lowest access and circulation impact). The lowest impacts would occur with Alternatives C1.4 and C1.5.

All of the segment C alternatives have similar parking impacts, ranging from 200 to 250 total spaces, except for C1.5, C2.3, and C1.3, which would each have fewer than 50.

The preferred alternative would acquire 15 properties, which is within the same range as other C1 alternatives. Alternative C2.3 and C3 would each acquire more than 30 properties. Alternative C1.1 would acquire 12 properties.

Alternatives C2.3 and C3 would unavoidably obstruct views toward Mount Rainier from Rainier Avenue S., a designated scenic route. Additionally, both of these alternatives would obstruct views and substantially alter the setting of the Stewart Lumber Company, a structure eligible for local and federal historic listing. Alternative C2.3 would also require partial demolition of the structure.

Alternative C3 would locate the I-90 Station within the boundaries of the future Sister City Park, and the elevated guideway would pass over the park. Station design approaches, acquisition of replacement parkland, or implementing one of the other alternatives would reduce or eliminate this impact. All C1 alternatives, including the preferred alternative, would locate the Beacon Hill tunnel in the East Duwamish and Cheasty greenbelts, although the portals are outside the greenbelts; the removal of trees and other disruptions due to the tunnel construction would temporarily impact ecosystems, and parklands.

Land Use Goal: Support Regional and Local Land Use Goals and Objectives

All of the routes and proposed station locations are generally compatible with the city comprehensive plan and draft neighborhood plans and/or the expressed interests of neighborhood and community groups. Comments on the Draft EIS expressed concerns about displacement and transportation impacts to manufacturing and industrial businesses in the North Duwamish Industrial area. The preferred alternative and several additional Segment C alternatives were developed to minimize these impacts. Displacements from route or maintenance base alternatives in the industrial area would not significantly change land use patterns, but there is limited land available for businesses to relocate in the area. Stations at Poplar Place in Alternative C2.4, S. Royal Brougham in the C1.1 through C1.5 and C3 alternatives (located approximately one block east of the village boundary) and the Lander Station in Alternative C1 are located outside an urban village. However, these stations would serve existing populations and provide access to other transportation facilities. The North Rainier Neighborhood Plan assumes a light rail stop at I-90, which would not be provided with the C1 alternatives or C2.4 alternative.

Financial Goal: Achieve Financial Feasibility

The range of capital costs in Segment C is from $149 million to $241 million, a range of $92 million, or about 6 percent of the *Sound Move* light rail budget. Higher costs are associated with the alternatives that are partially in tunnel. Tunnel routes include the preferred alternative and other C1 routes with a Beacon Hill tunnel, C2.4 (Rainier Avenue S. Tunnel) and C3 (S. Massachusetts Street Tunnel). The lowest cost alternative for this segment is C2.3 (West of Rainier Avenue S. – Elevated) with a cost of $149 million, which does not have the higher costs for tunneling. The Segment C alternatives with tunneling range from $207 million to $241 million. The potential Beacon Hill Station in the C1 alternative would add about $79 million in capital costs to this segment.

The preferred alternative includes the cost for building the Beacon Hill Station shell only (mining the tunnel and excavating future station area), with a cost of approximately $43 million.

The O&M costs for all the Segment C alternatives are nearly identical because of their similar travel times.

Summary of Trade-offs

There are several significant trade-offs among the alternative choices in Segment C. Rail only operations in the Seattle transit tunnel would improve rail system travel times and reliability, but could increase travel times for bus riders, particularly those who must travel the length of downtown. Joint bus/rail operations in the tunnel would slow and reduce the reliability of both bus and rail operations in the tunnel, and long-term rail system plans would eventually require rail-only operations.

The preferred alternative and other C1 routes would serve Safeco Field, the planned new football/soccer stadium and south downtown, and would avoid nearly all the impacts on the residences and businesses in north Rainier Valley. All of the C1 alternatives would remove over 200 off-street parking spaces. However, at $228 million, the preferred alternative is $78 million more than the lowest cost alternative and would not provide service to the neighborhood around and north of Rainier Avenue S. and I-90. Similarly, the Royal Brougham Station, with a cost of $5 million, would serve 500 passengers daily, the lowest in the segment, but this figure does not include the "surge" demand of up to 3,000 passengers to Safeco Field or the new football stadium. The route and profile choices offered by the preferred alternative and other C1 routes using the E3 busway involve trade-offs primarily involving displacement, land use or transportation impacts, as well as operational issues related to maintenance base alternatives. In terms of the route choices only, the preferred alternative (C1.2) has similar displacement impacts to the other alternatives with a Beacon Hill tunnel, and has reduced the street circulation and access impacts found with Alternative C1.1. It has higher impacts to rail freight movement and to circulation and access than the two elevated alternatives (C1.3, elevated on S. Lander Street) and C1.4 (elevated south of S. Forest Street), but both of these alternatives are from $8 to $10 million higher in cost, not including the related costs of maintenance base sites. Alternative C1.5 (S. Massachusetts Street/I-5 right-of-way) also has slightly fewer impacts to access and circulation than the preferred alternative, and would be $4 million lower in cost, not including maintenance base costs, but it would not have a station in the S. Lander Street area.

Alternative C3 (S. Massachusetts Street Tunnel) would serve Safeco Field and the planned new football/soccer stadium, but it would not serve the industrial area to the south nor Beacon Hill. It has lower costs than C1.1, but would have the impacts associated with an elevated route along Rainier Avenue S., north of S. McClellan Street, including property acquisitions, historic resource, visual, access and parking impacts.

Alternative C2.3, the lowest-cost alternative ($149 million), would provide light rail access for the neighborhood around and north of Rainier Avenue S. and I-90. It would have many of the same adverse impacts as C3, including displacements and visual impacts, and would also affect many of the businesses between Dearborn Street and I-90. With this alternative, there would be no service to the industrial area south of downtown Seattle or to Beacon Hill, and the closest access to the new stadiums would be the International District Station. Alternative C2.4, the highest cost alternative ($241 million), would avoid the negative impacts of C3 and C2.3 south of I-90, and it is the only alternative to place a station as far north as Poplar Place, near the Jackson Place neighborhood. It would not provide service to the industrial area south of downtown, and would serve the new stadiums only from the International District Station. It would have the same effects on businesses between Dearborn Street and I-90 as Alternative C2.3, and would displace 200 off-street parking spaces. Alternative C2.4 would also result in an at-grade station south of S. McClellan Street, rather than an elevated station, which would complicate the transition to some of the Segment D alternatives and cause greater impacts (in Segment D) to Cheasty Boulevard, a historic resource.

6.3.4 Segment D (S. McClellan Street to Boeing Access Road)

Transportation Goal: Enhance Mobility

Ridership and Markets Served

There is very little difference between the ridership projections for the preferred alternative and other alternatives in this segment because all options have similar travel times and serve similar markets. This segment contributes about 15,300 (with Alternative D1.1e) to 16,000 (with Alternative D3.4) total daily riders, or about 10 percent of the total. The preferred alternative serves the edge of Columbia City with an Edmunds Station, providing improved pedestrian links to the core of the commercial district, while Alternative D3.4 would site a station in the core district itself. The preferred alternative includes a station at S. Graham Street, which is a potential station with other D1.1 alternatives.

Reliability and Travel Time

Because of their different profiles (tunnel, elevated, and at-grade) the alternatives in Segment D differ slightly in average speeds, travel times, and schedule reliability.

The preferred alternative along MLK Jr. Way S. would have a 9.8 to 10.5 minute segment travel time, which is one minute slower than an elevated route (Alternative D1.3 with 8.9 to 9.6 minutes). The slowest alternative in this segment, D3.3, would travel the segment in 10.1 to 11.3 minutes due to reduced speeds for tight curves at Rainier Avenue S., S. Alaska Street and MLK Jr. Way S. The alternative serving Columbia City, D3.4, and then heading to MLK Jr. Way S. via the 37th Avenue S. Tunnel, would be the second slowest alternative, at 10.2 to 11.4 minutes.

The travel time savings for Segment D area residents would be the highest in the system, with the preferred alternative and compared to No-build conditions. Travel time savings would be 18 minutes for the average P.M. trips in the P.M. peak, or an average savings of 31 percent. Transit reliability would also improve considerably over No-build conditions. At-grade operations for light rail would be affected by traffic conditions at signalized intersections, making it less reliable than a fully grade-separated route.

Environmental Goal: Preserve Environmental Quality

The preferred alternative (D1.1e) would have potential impacts to transportation, property acquisition, noise, historic resources, and parklands. Most of these impacts would be mitigated. The impacts of the other alternatives in these areas would be similar or greater.

Transportation effects for the preferred alternative involve congestion at intersections, access and circulation, changes to bicycle and pedestrian movements, and parking. All of the congestion impacts can be mitigated. Of the 28 major intersections analyzed, a worst-case analysis found that most signalized intersections in the project area would operate at acceptable levels in 2010 and 2020 with or without the preferred alternative or the other light rail alternatives. The worst-case analysis assumed a "signal preemption" system that would trigger signal changes as trains approach. The recommended strategy for light rail is for "signal progression" timed to scheduled train arrivals: this scenario would be least disruptive to traffic flows. However, the preferred alternative would reduce overall conditions to unacceptable levels at only one intersection (S. Alaska Street/MLK Jr. Way S.); all the other light rail alternatives would also impact this intersection, and would further impact from two to four other intersections. Light rail vehicles would increase average vehicle delays for east-west street approaches and major street left-turn movements at signalized intersections. With the recommended system (signal progression) and other improvements, the LOS impacts and intersection delays would be minimized.

Access and circulation impacts for the preferred alternative and other alternatives in the median of MLK Jr. Way S. are caused by street closures, and by restricting driveways and unsignalized intersections to right turns in and out only. Alternatives D1.1c, D1.1d, and D1.3 would restrict movements at 39 unsignalized intersections. Alternatives D3.3 and D3.4 would affect 16 unsignalized intersections along MLK Jr. Way S. An additional three sidestreet intersections for Alternative D3.3 and four sidestreet intersections for Alternative D3.4 would be closed along Rainier Avenue S. For Alternatives D1.1e (preferred alternative) and D 1.1f, mitigation features have been added after the Draft EIS was issued to minimize traffic access and circulation impacts. Seven new traffic signals on MLK Jr. Way S. are included in the preferred alternative. All of these new signalized intersections would provide full cross street access to MLK Jr. Way S., and four of the intersections would also provide northbound and/or southbound access from MLK Jr. Way S. to the cross street. U-turn movements for passenger vehicle would also be allowed at these new signalized intersections. In addition, the number of unsignalized intersections limited to right-in, right-out access only decreases from 40 in the Draft EIS to 34 with the preferred alternative. Some or all of these mitigation features could also be included with other Segment D alternatives.

Travel times for passenger vehicles would increase by an average of about one-minute. These travel time increases would be slightly higher for other alternatives. With or without the added mitigation features included with the preferred alternative, this impact is not considered to be significant.

For larger trucks unable to make a U-turn on MLK Jr. Way S., the maximum travel time increase for rerouting to other nearby arterial streets could be as high as 4 minutes. Since most businesses requiring large truck deliveries are already located at intersections with traffic signals, this impact is also not considered to be significant.

The elevated McClellan Station of the preferred and other alternatives would avoid the requirement for traffic to stop on MLK Jr. Way S. when trains pass.

Alternatives D1.1d and D1.1f, which would change MLK Jr. Way S. to a two-lane street, would have the highest impact on access and circulation; they would also have the potential to increase response times for emergency vehicles which may have limited room to maneuver around other vehicles. Emergency vehicles could be subject to delays crossing MLK Jr. Way S. for all D1.1 alternatives, although they would be able to make left-hand turns, but trackway curbing would allow emergency vehicles to cross. Emergency vehicles could also have signal priority over light rail train signal requests.

Currently, pedestrian crossings are allowed at all unsignalized intersections along MLK Jr. Way S. The preferred alternative and other light rail alternatives would allow crossings only where signal protection would be provided. While this potentially increases distances pedestrians must walk, it would improve crossing safety. Impacts to pedestrian movements has been minimized with the preferred alternative and Alternative D1.1f, because new signalized intersections or crossings have been added, reducing distances between crossings. Pedestrian improvements would be provided along Edmunds and Henderson streets to the Columbia City and Rainier Beach areas, respectively. Bicycle improvements would be provided on a parallel route to the preferred alternative. Parking impacts for the preferred alternative and other MLK Jr. Way S. alternatives involve few on-street losses, but off-street spaces would be displaced; overall parking displacements would be highest for Alternatives D3.3 and D3.4.

All of the alternatives in this segment would result in residential and business displacements. The preferred alternative would acquire 84 properties, D1.1d would acquire 63, D1.1f would acquire 77, and D1.1c would acquire 110. The most acquisitions in Segment D are 191 for D3.3 and 143 for D3.4, because a new light rail right-of-way west of Rainier Avenue S. would displace all the businesses and residences along the west side of the street. Overall, land use and economic impacts would be lower for the D1.1 alternatives and for Alternative D1.3, compared to D3.3 or D3.4. In all alternatives, displaced single-family residences would likely be replaced by multi-family and retail/commercial uses, increasing the density of development in the corridor. Each of the station areas in this segment may be developed or redeveloped into denser, more intensive, transit-supportive land uses, as proposed in the Draft Southeast Seattle Neighborhood Plans. For all Segment D alternatives, some businesses may incur economic losses as an indirect effect along MLK Jr. Way S. and Rainier Avenue S. These potential impacts could be countered by redevelopment in the vicinity of displacements and increased activity in station areas.

The preferred and other alternatives would have an elevated route across Cheasty Boulevard, which would obstruct views between Cheasty Boulevard and Mt. Baker Boulevard. However, other MLK Jr. Way S. alternatives with an at-grade station for McClellan would cross Cheasty, which could preclude the possible connection of Cheasty and Mt. Baker boulevards as historically planned. Alternatives D3.3 and D3.4 would require the removal of buildings on Rainier Avenue S. that are eligible for historic listing or are important community resources. The elevated structure and overhead wires of Alternative D1.3 would impose high visual contrast at the designated scenic routes of S. Columbia Way and S. Alaska Street, along the east frontage of the Rainier Vista housing development, and along MLK Jr. Way S.

All alternatives include a bus layover facility located at S. Henderson Street and MLK Jr. Way S., which will include approximately 10 bus bays and associated overhead catenary system (OCS). The OCS will begin at Rainier Avenue S. and run down S. Henderson Street to the new bus facility.

Without mitigation, several hundred traffic noise and light rail noise impacts would occur for all alternatives except D1.1d and D1.1f, but all impacts can be eliminated with mitigation. Vibration impacts would occur after mitigation for alternatives D1.1d (six structures), D1.3 (seven structures), D3.3 (seventeen structures), and D3.4 (eight structures). Alternative D1.1e, the preferred alternative, would avoid these impacts.

Construction of the cut-and-cover tunnel in Alternative D3.4 would cause substantial disruption of business and traffic in Columbia City and along 37th Avenue S.

Land Use Goal: Support Regional and Local Land Use Goals and Objectives

Light rail through southeast Seattle is consistent with the City's Comprehensive Plan. All proposed station locations would be within commercial/mixed use or multi-family areas within or on the edge of designated Hub or Residential Urban Villages. Each station alternative would reinforce the City's preferred development pattern and support development density that supports transit use. At-grade alternative profiles would provide greater opportunity to improve the streetscape and provide better connections to the existing community and new development. Only Alternative D3.4 would place a station in the heart of Columbia City, although it would also require displacing more properties in the district. The preferred alternative's Edmunds Station would serve the Columbia City district and would provide improved pedestrian links. The Henderson Station would provide similar benefits to the Rainier Beach community.

Financial Goal: Achieve Financial Feasibility

The preferred alternative would cost $196 million to construct. The highest cost alternative, D3.4, at $356 million, includes a tunnel between Columbia City and MLK Jr. Way S. under 37th Avenue S. The alternatives other than the 37th Avenue S. Tunnel cost between $173 to $254 million. Aside from tunneling, differences in costs are primarily due to the right-of-way required and elevated versus at-grade sections. The preferred alternative has lower right-of-way costs and is mostly at-grade, but has an elevated McClellan Station and track before crossing to MLK Jr. Way S.; the elevated crossing and station accounts for about $11 million of the cost. The Combined Profile alternative (D1.3) has similarly low right-of-way costs, but has higher construction costs because it is elevated. The at-grade alternatives on MLK Jr. Way S. with a limited right-of-way have the lowest costs, and the alternatives that assume a 104-ft street right-of-way have higher costs. Alternatives D3.3 and D3.4 along Rainier Avenue to Columbia City also have high costs for right-of-way. Overall, the lowest cost alternative, D1.1d, combines an at-grade profile with a narrower street right-of-way (90 ft). A $50 million community investment fund has also been proposed for southeast Seattle.

There are slight differences in length and travel time among the alternatives in this segment resulting in a difference of about $0.5 million in annual O&M costs between the lowest and highest cost alternatives.

Summary of Trade-offs

The preferred alternative (D1.1e) represents several significant choices in Segment D. It follows MLK Jr. Way S rather than Rainier Ave. S., providing less direct connections to Columbia City, but avoiding the higher displacements, construction impacts and costs of a Rainier Avenue route. It also reduces the higher impacts and costs for transitions from Rainier Avenue S. back to MLK Jr. Way S. in the south part of the segment. The preferred alternative route is primarily at-grade, and is within a narrower right-of-way than previous configurations that provided four lanes of through traffic; this reduces additional right-of-way costs, and reduces impacts. It includes a station at S. Edmunds Street (serving Columbia City) and S. Graham streets rather than at S. Alaska, but this has minimal impact to segment ridership, cost, or travel time.

Mitigation has eliminated most of the light rail and traffic noise impacts previously identified in the Draft EIS for all alternatives, particularly the D1.1 routes along MLK Jr. Way S. After mitigation, the preferred alternative (D1.1e) and Alternatives D1.1c and D1.1f would not have significant noise or vibration impacts. Mitigation would reduce vibration below FTA impact criteria. Noise impacts would be mitigated with a combination of building sound insulation, sound walls, and other measures. Light rail vibration impacts have been reduced for other alternatives, but impacts affecting 6 to 17 properties would remain for Alternatives D1.1.d, D1.3, D3.3, and D3.4.

The 37th Avenue S. tunnel (D3.4), which would provide a station in the heart of the Columbia City business district, would have higher property acquisitions and the greatest construction impacts, since it would involve a relatively shallow tunnel through a residential neighborhood.

Elevated light rail on MLK Jr. Way S. (D1.3) would be about $53 million more expensive than the preferred alternative, but would offer slightly faster and considerably more reliable service. Its visual impacts would be greater than the preferred alternative, and property acquisitions would be similar.

The preferred alternative (D1.1e) and D1.1f would provide more signalized intersections and pedestrian crossings than other MLK Jr. Way S. alternatives, and provides for the highest number of U-turns and right-turn movements at intersections. There is a moderate difference between the traffic access and circulation impacts of the other at-grade or elevated light rail routes on MLK Jr. Way S., but none of them were found to be significant. All alternatives prohibit left turns to and from driveways and unsignalized cross streets. All alternatives would allow area traffic to operate at acceptable levels at most area intersections.

A range of choices for the street characteristics and right of way are possible, with the preferred alternative maintaining MLK Jr. Way S. as a four-lane urban arterial, but minimizing the right-of-way required. The preferred alternative includes seven new signalized intersections on MLK Jr. Way S., 28 pedestrian-only signalized crossings and two new intersections on Rainier Avenue S. Bicycle travel would be accommodated on parallel streets. The other alternatives offer different choices including the number and width of through lanes (from two to four), and whether bike lanes, parking lanes or turn lanes will be required. The width of sidewalk or planting areas would vary slightly, although all would provide improved sidewalks and landscaping. The trade-offs from these features involve cost, neighborhood character, bicycle and parking lanes, the degree of right-of-way required, and a range of traffic operating factors. The traffic factors include the level of service to traffic that would be provided, the volume and speeds of vehicles on the roadway, whether emergency response times would be affected, and the ability in the future to modify the roadway to improve traffic conditions.

The preferred alternative and the other four-lane alternatives will provide a high-capacity arterial that will carry both local and through traffic, including freight traffic; major intersections will include two additional turn lanes. All the four-lane alternatives have similar costs (approximately $200 million), not including the preferred alternative's $50 million community development fund. Alternatives D1.1d and D1.1f, which convert MLK Jr. Way S. to a two-lane neighborhood arterial, would have lower speeds and maintain acceptable levels of service, but would have a capacity that could serve local traffic only, with diverted traffic moving to Rainier Avenue S. and other north-south arterials, or I-5. The two-lane street could also impact emergency response times. The preferred alternative, which would have higher average speeds and serve more traffic, would require the same or slightly more right-of-way than the two-lane alternatives.

The McClellan Station is included in all alternatives and would be a connecting point for both north/south and east/west bus service. An elevated McClellan Station (Options B or C) for the preferred alternative is higher cost, but it would provide a connection to MLK Jr. Way S. without requiring traffic to stop while trains cross, and it has fewer impacts to Cheasty Boulevard, an historic resource. An at-grade station (Option A) would block the east end of Cheasty Boulevard, and would also affect traffic on MLK Jr. Way S.

The Edmunds Station in the preferred alternative would be about a five-minute walk from either the heart of Columbia City or the Rainier Vista Garden Community. The Graham Station, with a cost of $7.3 million, would serve an active, mixed-use community and provide good bus connections north/south and east/west.

6.3.5 Segment E (Tukwila)

Transportation Goal: Enhance Mobility

Ridership and Markets Served

Segment E would account for about 2,300 to 4,800 daily boardings by 2020, or about 2 to 3 percent of the system wide total. The preferred alternative would have 2,300 riders, and the routes serving Longacres/Southcenter would have 3,700 to 4,800. The route alternatives in this segment would serve very different markets. Alternatives E1.1 and E1.2 would follow Tukwila International Boulevard in a fairly direct line between SeaTac and southeast Seattle. Alternatives E2 and E3 would be less direct to SeaTac but would serve the Longacres/Southcenter area, Tukwila's designated urban center and one of the region's urban centers identified in Vision 2020.

The Tukwila International Boulevard corridor has about 9,000 residents and 7,800 jobs. The corridor is characterized by auto-oriented uses, primarily strip commercial, although the area around the proposed 144th Station includes retail and high-density residential development, community services, a library and a high school. Most projected ridership in the corridor would occur at the station at Boeing Access Road, where a connection to commuter rail and a park-and-ride facility would be provided.

The Interurban Avenue corridor (E2) is home to about 8,400 people and 25,500 jobs, and the MLK Jr. Way S. corridor (E3) is home to 9,800 people and 29,900 jobs. The northern portion of both routes is characterized by low-density industrial uses, but density and development significantly increase in the Longacres/Southcenter area, where two stations would be provided. A Longacres Station, in an area that would also include commuter rail and Amtrak stations, bus connections and a major park-and-ride, would become part of a major transportation center. Substantial development is planned within ¼ mile of the station, including an expanded Boeing office complex and other campus-style offices. Alternatives E2 and E3 both provide a station near Southcenter, locating it either east or slightly south of the mall properties. Major development is not proposed in the immediate Baker or Strander Station areas, which is primarily parking for the mall and other retail outlets.

The preferred alternative (E1.1) and Alternative E1.2 would serve 2,300 to 2,400 riders in 2020. Alternative E2 would serve 3,700 riders, and Alternative E3 would serve 4,800 riders. Alternative E3 would have the highest systemwide ridership overall, but its longer travel times would also decrease ridership in other segments. Alternatives E2 and E3 would also reduce commuter rail ridership by 1,100 (E2) to 1,400 (E3) riders as compared to E1.1 in 2020. The longer travel times for E2 and E3 could reduce future ridership potential for north or south extensions of light rail.

Reliability and Travel Time

Three of the four alternatives in this segment (E1.2, E2 and E3) would be primarily grade-separated or, where they are at-grade, would operate without significant cross traffic. Travel time for E1.1 would be 7.6 minutes, about half a minute longer than Tukwila International Boulevard Elevated (Alternative E1.2). Both E3 and E2, the alternatives serving Southcenter, would have longer travel times, 11.0 and 14.6 minutes, respectively, because they are about 3 to 3.5 miles longer than the Tukwila International Boulevard alternatives, with a difference of 3.4 to 7.7 minutes between the four alternatives. Travel time savings for trips in this segment would average about 4 to 6 minutes, or an 7.9 percent savings for the P.M. peak trips.

Environmental Goal: Preserve Environmental Quality

Alternative E1.1 (the preferred alternative) and Alternative E1.2 would cause more potential transportation impacts than alternatives E2 and E3, but conditions overall in Segment E are generally similar between the No-build and the light rail alternatives. Most study area intersections would operate acceptably with Alternatives E1.1 (preferred), E1.2, E2, and E3. With the No-build Alternative and E1.1 and E1.2, three study area intersections would operate unacceptably in 2010 or 2020, including the S. 144th/Tukwila International Boulevard intersection, where a station is proposed. At that intersection, the preferred alternative and E1.2 would significantly worsen conditions, but, the impact can be mitigated. Alternatives E2 and E3 would have minimal effects on most study area intersections. All alternatives would increase average delays for movements to or from east-west streets along the light rail routes. Without mitigation, the impacts would be significant at two locations for the preferred alternative (MLK Jr. Way S./Boeing Access Road and S. 144th Street/Tukwila International Boulevard), but these impacts can be mitigated. Similarly, the impacts of Alternative E2 on two Interurban Avenue intersections can be mitigated, as can the impacts of Alternative E2 and E3 on the West Valley Highway/S. 156th Street intersection.

Alternatives E1.1 and E1.2 would restrict driveways and nine unsignalized intersections to right turns in and out only on Tukwila International Boulevard from S. 122nd Street to S. 150th Street. For Alternative E1.1 (preferred alternative), new traffic signals were included on Tukwila International Boulevard at S. 140th and S. 148th streets to minimize impacts from eliminating left turn access at other unsignalized intersections. Passenger vehicles would be allowed to make U-turns at these intersections. With these added traffic signals, travel time impacts from the preferred alternative would be minimized. Travel times would increase by up to two minutes per trip or an average increase of about one-minute. Alternative E2 would relocate access to the Foster Golf Course from Interurban Avenue S., and Alternative E3 would close 57th Avenue S. from MLK Jr. Way S. Alternatives E1.1 and E1.2 would increase the walking distances for some pedestrians crossing Tukwila International Boulevard because crossings would be allowed only at signal-controlled locations. However, three additional signalized pedestrian-only crossings and two new signalized intersections were added since the Draft EIS, minimizing the impact to pedestrians. Signal-protected crossings would also reduce risks for pedestrians who might otherwise cross Tukwila International Boulevard at unsignalized intersections or mid-block locations. Alternatives E1.1 and E1.2 would displace 124 to 112 on-street and off-street parking spaces, respectively along Tukwila International Boulevard; Alternative E2 would displace 314, and E3 would displace up to 460 off-street parking spaces; new station options for the Strander station have been developed to reduce the parking loss for E3 to 260 spaces.

Emergency vehicles could be subject to delays in crossing Tukwila International Boulevard under Alternatives E1.1 and E1.2, although these delays would be minimal because emergency vehicles would be able to cross the tracks at their discretion, and they would have priority control of the light rail system. The right turn in/right turn out restrictions at unsignalized cross streets and private driveways would create the need for trucks to make U-turns at signalized intersections, travel out-of-direction, or adjust their existing route before reaching a destination. Alternative E1.1 would cause the largest overall impact to traffic access and circulation followed by E1.2. Alternatives E2 and E3 would have the lowest access and circulation impacts.

Stations in Alternatives E2 and E3 would support the City's designated urban center in the Southcenter area. The Tukwila International Boulevard alternatives would not serve Southcenter (Tukwila's Urban Center), but could serve the commercial centers in the S. 144th and S. 154th Street areas. The potential for rail stations to directly induce new development is relatively low for all alternatives.

The preferred alternative would have 16 property acquisitions, the same as Alternative E3, but many of the properties are vacant for all alternatives. Alternatives E1.1 (preferred alternative) and E1.2 both displace a five-unit apartment building.

For Alternative E1.2, the elevated guideway and overhead catenary system (OCS) would obstruct scenic skyline views from Tukwila International Boulevard. Alternative E1.2 would impose high visual contrast within the Riverton Heights neighborhood. With implementation of Alternative E2, the I-5 flyover and transition segment would obstruct views, cast shadows, and impose high visual contrast along the Green River Trail, Lookout Park, and Foster Golf Links. For Alternative E3, the transition section from at-grade to an elevated profile would impose high visual contrast within the Skyway neighborhood. Alternative E2 would result in unavoidable impacts to Lookout Park where elevated guideways cross the park. The proximity of Alternative E2 to the Duwamish/Green River Trail would result in adverse proximity impacts to this recreation resource. Right-of-way needed for Alternative E2 would result in the loss of needed parking at the Foster Golf Course, but parking could be replaced.

Alternatives E1.1 and E1.2 would have the highest number of traffic and light rail noise impacts before mitigation, but all significant noise impacts in all alternatives would be avoided with mitigation. After mitigation, Alternative E2 would have two residual vibration impacts.

Alternatives E1.1 and E1.2 would require filling approximately 2.02 acres of wetlands, largely for the park-and-ride lot at Boeing Access Road Station, and Alternatives E2 and E3 would require filling just over 1 acre of wetland each. Alternative E3 would remove 12.4 acres of forest, E2 would remove 6.1 acres, and E1.1 and E1.2 would remove about 1.5 acres. Alternative E2 would cause greater fish habitat loss than other alternatives due to riparian vegetation removal and three new bridge crossings of the Duwamish/Green rivers. Alternatives E1.1 and E1.2 would potentially affect the Riverton Side Channel Project. Alternative E2 (and to a lesser degree E3) would remove potential bald eagle winter perch sites. Alternative E2 would adversely affect Gilliam Creek and the adjacent floodplain due to removal of vegetation and possible installation of piers in the floodway. Alternatives E1.1 (preferred alternative), E1.2, and E2 would pass near a hill south of Boeing Access Road that is a known traditional cultural property for the Muckleshoot and Duwamish Tribes.

Land Use Goal: Support Regional and Local Land Use Goals and Objectives

Tukwila's plans focus higher density land uses in areas served by mass transit, and encourage pedestrian-oriented and transit-oriented development in station areas. The Tukwila comprehensive plan includes Policy 13.4.14 requiring that "any light rail or commuter rail system shall meet the following objectives: . . . Such systems shall be located so as to allow for future extensions . . . to East King County and Southeast King County . . . and shall be located in a manner that serves the Tukwila Urban Center." The Tukwila Urban Center encompasses the Southcenter area. Service to the Southcenter Urban Center is a key element of the plan, which envisions light rail as a catalyst to support a denser, mixed-use center. While the Southcenter mall is a major regional destination, it is currently a combination of auto-oriented retail, with large areas of parking and warehouse, light industrial/suburban office uses.

Alternatives E1.1 (preferred alternative) and E1.2 would not be inconsistent with the City's plans to serve the Urban Center with light rail, as they do not preclude future service to the center, and they propose regular bus service to the Urban Center from the S. 154th Station. This interpretation is specifically supported by the Central Puget Sound Growth Management Hearings Board (Case No. 99-3-000) (Sept. 15, 1999) which found Policy 13.4.14 to be permissible under GMA. The Growth Board held that "[a]lthough this policy utilizes the mandatory word 'shall,' the policy does not obligate nor authorize the City to deny permits to light-rail route alignments that do not pass through the Tukwila Urban Center." (Decision at pp. 7-8). The Growth Board also ruled that the City's planning role is one of collaboration with Sound Transit in the decision-process. Once Sound Transit's routing decision is final, cities have a "duty to accommodate" the light rail facilities, and may impose only "reasonable" conditions and mitigations that will not preclude the facility or render it impracticable. (Decision at pp. 6-7).

The City's comprehensive plan and Pacific Highway Revitalization Plan promote improvement of the Tukwila International Boulevard corridor to a community "main street" emphasizing added pedestrian amenities and streetscape improvements. The plan identifies the 144th Street area and 154th Street area as neighborhood and regional commercial centers, respectively, where the preferred alternative would site stations. Alternatives E1.1 and E1.2 have been modified since the Draft EIS to include most of the plan's street, sidewalk, and landscaping improvements on Tukwila International Boulevard. They would also be compatible with plan elements such as enhancement of the commercial center in the S. 144th Station area. However, the City's revitalization plan does not envision light rail in the Tukwila International Boulevard corridor.

Financial Goal: Achieve Financial Feasibility

The costs of segment alternatives in Tukwila differ by $155 million. At $174 million, the preferred alternative (E1.1.) is the lowest cost, and Alternative E3 is the highest cost at $329 million. Alternative E1.2 (Tukwila International Boulevard Elevated) would cost $213 million, and Alternative E2 (Interurban Avenue S) would cost $299 million. (The costs for the Tukwila International Boulevard routes would be $7 to $14 million higher if they were extended to the same point where the Southcenter routes connect to Segment F, near SR 518.)

The longer distance and travel times for Alternatives E2 and E3 would require Sound Transit to operate 3 to 5 additional vehicles to maintain comparable service frequency, and would involve other operational changes that would increase systemwide annual operating costs $3.5 million to $4.9 million.

Summary of Trade-offs

The principal trade-off in Segment E focuses on the route choices. Alternative E1.1 (the preferred alternative) and Alternative E1.2 would follow Tukwila International Boulevard and provide stations at Boeing Access Road and S. 144th Street. (A station at S. 154th Street in Segment F would also be provided only with Alternatives E1.1 and E1.2). Alternatives E2 and E3 would locate stations at Longacres and Southcenter, with routes along Interurban Avenue S. (E2) or MLK Jr. Way S. (E3). The City of Tukwila prefers Alternative E3.

The preferred alternative would have the lower cost ($174 million), as compared to $329 million for Alternative E3 and $299 million for E2. Both E1.1 and E1.2 would be shorter by 3 to 3.5 miles, have lower travel times (about 3.4 to 7.7 minutes lower) and provide a more direct route to Sea-Tac Airport than E2 or E3. The alternatives serving Longacres and Southcenter would provide service to Tukwila's designated urban center, which encompasses an area with a growing employment base and a major regional shopping center. Alternatives E2 and E3 would have significantly higher ridership within Segment E, but E1.1 and E1.2 would achieve similar system ridership levels by attracting more riders from other segments. Alternatives E2 and E3 would also reduce commuter rail ridership by 1,100 (E2) to 1,400 (E3) riders as compared to E1.1 in 2020. Light rail is envisioned by the City's comprehensive plan as a major catalyst for redeveloping Tukwila's designated urban center at Southcenter into a pedestrian-oriented mixed-use center. Although the City's plans do not envision light rail on Tukwila International Boulevard, alternatives along this route could support the goals to revitalize and enhance this corridor. The preferred alternative has been revised to include most of the city's proposed improvements to Tukwila International Boulevard.

Impacts to the natural and built environment would be mixed between the two basic route choices. The Tukwila International Boulevard routes would have greater transportation impacts, while the E2 and E3 routes would have greater overall ecosystem impacts but less wetland impacts. Alternative E2 would impact parks and recreational facilities more than other alternatives. Alternatives E1.2, E2 and E3 would all have significant visual impacts. The Tukwila International Boulevard route would offer

Tukwila citizens increased regional access, while the other alternatives would provide the region with access to shopping and employment in the Southcenter area.

Stations at Boeing Access Road (E1.1 and E1.2) or Longacres (E2 and E3), would provide a direct connection to commuter rail and bus transit, and would provide park-and-ride facilities. Pedestrian and bike access is poor at the relatively isolated Boeing Access Road, and the station has wetland impacts. Longacres is near a multi-purpose regional trail, which also features an Amtrak Station and is close to major employment centers with high levels of projected growth.

The preferred alternative is for an at-grade route along Tukwila International Boulevard south of about S. 124th Street, while Alternative E1.2 would be elevated. Alternative E1.1 would be slightly slower and less reliable than an elevated route, but it is also about $39 million less expensive. The at-grade S. 144th Station would be more accessible to a pedestrian-oriented center around the station; however, there would be slightly greater displacements and parking impacts. All station options at S. 144th would significantly worsen operations at the intersection of S. 144th Street/Tukwila International Boulevard, but this can be mitigated. The elevated structure of Alternative E1.2 would result in visual impacts with parts of the neighborhoods along Tukwila International Boulevard. The preferred alternative includes 2 new traffic signals at S. 140th and S. 148th streets to minimize left-turn access impacts.

The MLK Jr. Way S. alternative (E3) would be shorter and faster than the Interurban route (E2) by 0.64 mile and 3.6 minutes but would cost approximately $30 million more. The Interurban route would have higher impacts on aesthetics, fisheries, wildlife, vegetation, and parklands. It also would cross the Duwamish/Green River three times compared to once for Alternative E3. Alternative E2 would have fewer vibration impacts and fewer acquisitions impacts than Alternative E3. While the station at Longacres is in a similar location for both Alternatives E2 and E3, the Strander Boulevard Station (E3) would better serve the regional mall area than would the Baker Boulevard Station (E2). Station options at the Strander Boulevard location also involve trade-offs between the number of parking spaces that would be displaced versus having on-site bus and passenger drop-off areas. Either station could be combined with either the E2 or E3 route alternatives.

6.3.6 Segment F (SeaTac)

Transportation Goal: Enhance Mobility

Ridership and Markets Served

The preferred alternative (F2.3, Washington Memorial Park, Elevated East of 28th) is based on elements of alternatives studied during the Draft EIS. It and all other alternatives in this segment would serve the City of SeaTac urban center and the airport, but they differ in terms of how directly they serve these travel markets. All alternatives would have very similar ridership levels by 2020, ranging from 6,200 to 8,200 (the preferred alternative would have 7,700 to 7,900). Variations in station placement do not markedly affect ridership forecasts, and total system ridership would range from 147,900 to 149,000 with a Northgate to SeaTac line.

The preferred alternative would provide a North SeaTac Station with a park-and-ride at Tukwila International Boulevard/S 154th Street (near SR 518), a North Central Station to serve Sea-Tac Airport's proposed intermodal center and to provide service to SeaTac's City Center, a potential South Central Station also serving the city center, and a South SeaTac Station including a park-and-ride at S. 200th Street/28th Avenue S.

The preferred alternative's North SeaTac Station (at S. 154 Street) has three options involving a 260-, 454-, or 670- stall park-and-ride. Other alternatives have options for a station at S. 160th Street with a 350-stall park-and-ride. The park-and-rides are intended for the use of light rail patrons traveling north, with year 2020 ridership forecasted between 2,500 to 2,600. The S. 154th Street options would serve an area designated as a regional commercial center, and the S. 160th options would serve a residential and mixed-use area with less potential for redevelopment.

The preferred alternative's North Central SeaTac Station at S. 170th Street, near International Boulevard, would serve the airport from the Intermodal Transfer Center (IMC) with a people mover connecting to the airport's north and main terminals. Another option would site the station near the future North End Airport Terminal (NEAT) to the west of Washington Memorial Park. While the station at the IMC would provide effective connections with bus transit and could also serve SeaTac's city center and airport passengers, it would have a less direct connection to the airport's future NEAT. The station at NEAT (which is preferred by the Port of Seattle and the City) would allow direct access to the NEAT and to the people mover to the main terminal, but the NEAT location would not provide direct connections to transit and would not serve the City Center; Link patrons would first need to take the people mover to the IMC site for transfers to bus transit.

The preferred alternative has a potential South Central SeaTac Station at S. 184th Street, which could also serve the City Center. Alternative F1 would allow for pedestrian access to the City Center via a surface crossing of International Boulevard. Alternatives F2.1 and F2.2 would have a station east of International Boulevard, with Alternative F2.2 capturing a larger potential residential market due to its easterly location on 32nd Street S. Alternative F3.1 could serve the city center via a potential pedestrian overpass from a station on the west side of International Boulevard. The preferred alternative station is forecasted to serve 200 patrons, while other city center options could serve 1,300 if a North SeaTac station were not built. Alternative F3.2 would not serve the city center and has no station at NEAT or IMC, instead directly serving a forecasted 3,000 patrons daily at the existing airport terminal.

All alternatives would have a station and park-and-ride facility at S. 200th Street, with virtually no difference in ridership or markets between the routes.

Reliability and Travel Time

The difference in travel time between the fastest and slowest alternatives in this segment is about one minute; the total segment travel time is about five to seven minutes. The preferred alternative would be among the fastest and most reliable routes. Alternative F1, which would operate in International Boulevard at-grade, would be the least reliable, but could maintain travel times similar to the other alternatives because of its slightly shorter length.

Sea-Tac Airport currently operates as a major transfer point; 50 percent of bus passengers passing through the airport currently transfer to other routes. This would likely continue if the IMC were built, because light rail, Regional Express bus, and King County Metro bus service would all come to the same point. The IMC Station would provide better connections to Regional Express and Metro services than if the station were at NEAT.

Travel time savings for residents of SeaTac would average about 7 to 8 minutes, or 11 to 12 percent for the work-to-home trips.

Environmental Goal: Preserve Environmental Quality

The preferred alternative (F2.3) would have fewer transportation impacts than the other alternatives, with mitigation all these impacts can be avoided or reduced below a level of significance. With the preferred alternative (F2.3), most intersections would operate at acceptable levels in the year 2020, when compared to No-build. The only exceptions include the International Boulevard/S. 154th Street, International Boulevard/160th Street, International Boulevard/170th Street, 32nd Avenue S./S. 176th Street, and International Boulevard/S. 200th Street intersections. Although these are all major intersections in SeaTac, signal or intersection improvements would mitigate the impacts of the preferred alternative. Depending on the station options, minor approaches to International Boulevard, 32nd Avenue S., and 28th Avenue S. would be impacted, but these effects can be mitigated. Other alternatives would have similar, or worse, impacts, particularly Alternative F1 which is at-grade on International Boulevard.

The preferred alternative would acquire 12 properties, similar to F2.1 and F4 (13 and 15). Alternative F1 would acquire the most properties (53), mostly businesses. Direct and indirect impacts to land use and economics would be lowest for the preferred alternative and other F2, F3, and F4 alternatives. They would be greatest for Alternative F1. The land use impacts of the preferred alternative and Alternatives F2.1, F2.2, F3.1, and F3.2 would be similar, with the most differences in impacts appearing in the station areas. The North SeaTac Station of the preferred alternative (at S. 154th Street) could help support increased pedestrian and commercial activities in that area. Station Option A offers the most opportunities for area redevelopment, and all the S. 154th Station options would have more redevelopment potential than a S. 160th Station. The preferred alternative currently includes a North Central SeaTac Station at the airport's proposed Intermodal Center (IMC) with a people mover connected to the existing airport terminal. Alternately, the station could be located at the airport's proposed North End Airport Terminal (NEAT), with a direct pedestrian connection to the new terminal and people mover access to the existing terminal and IMC. The preferred alternative's potential station at South Central SeaTac (S. 184th Street) would serve the City of SeaTac's designated City Center and support increased density and redevelopment, but Alternative F2.1 with a City Center Station would most directly serve the area and would have a higher potential to support increased density and redevelopment; the station in the main airport terminal for Alternative F3.2 would not serve the City Center area. The South SeaTac Station options for the preferred alternative and the other alternatives impact different properties around 28th Avenue S./S. 200th Street, but all options would impact fewer developed properties than the station on International Boulevard for Alternative F1.

The preferred alternative and most other alternatives with elevated sections would have minor visual impacts. Alternative F2.2 would obstruct views from the northeast shore of Bow Lake and impose high visual contrast. Alternative F1 would remove trees and vegetation at Angle Lake Park and relocate the park entry.

Land Use Goal: Support Regional and Local Land Use Goals and Objectives

SeaTac's comprehensive plan focuses higher-density land uses in areas to be served by mass transit and encourages high-density, transit-oriented development in station areas within its Urban Center along International Boulevard. Three city-designated HCT Districts are located within the center including the City Center, a high-intensity office, hotel, and a multi-family residential area east of the main airport terminal. In SeaTac, all of the alternatives are generally consistent with the City's plan. Most of the proposed stations coincide with the HCT districts and all lie within the Urban Center. City Center redevelopment potential would be most directly supported by Alternative F2.2, and less so by the City Center stations of the preferred alternative and Alternatives F1, F2.1 and F3.1. The Alternative F3.2 station in the existing airport terminal would provide the least support.

The Sea-Tac Airport Master Plan Update recommends several airport improvements through the year 2020, including a new runway, expansion of passenger service areas, development of the Intermodal Transportation Center at S. 170th Street, and development of a North End Airport Terminal (NEAT) immediately west of Washington Memorial Park. Light rail riders to the airport can be directly served by a station at NEAT or they can access the airport via people mover from the IMC. Alternative F3.2 also provides service directly into the main terminal.

The North SeaTac Station at S. 154th is in the City of SeaTac, in an area planned for continued development as a regional commercial center. While light rail is not proposed in the City's plans for that area, a station would support goals for redevelopment and densification.

Financial Goal: Achieve Financial Feasibility

The routes in the SeaTac segment have the narrowest range of costs, with a difference of about \$49 million. The highest cost, at \$221 million, is the preferred Alternative F2.3 (Washington Memorial Park. Elevated East of 28th) with design option A (SR 99 elevated connection). The lowest cost is \$172 million for F1 (International Boulevard) with Option C (SR 518 connection) or F2.1 Washington Memorial Park city center west with Option B (SR 518 connection). The difference in costs between the design options within each alternative results from connecting with the different Segment E alternatives. The differences in O&M costs between alternatives in this segment are small because of similar travel times.

Summary of Trade-offs

The route alternatives and variety of station locations in this segment would serve the same general corridor through SeaTac. The alternatives differ in their costs, their connections to Sea-Tac airport; their service to the City's urban center; the impacts to resources along International Boulevard and on Port of Seattle property, and the location and impacts of park-and-ride lots.

At \$221 million, the preferred alternative (F2.3) is over \$40 million more expensive than an at-grade route along International Boulevard (F1). The costs are higher due to the extent of elevated sections, but the preferred alternative avoids much of the property and traffic impacts of an at-grade route along International Boulevard (F1). It has three options for a station at North SeaTac (S. 154th Street) with a park-and-ride facility, which would improve transit access for residential neighborhoods to the east and west of the line. The park-and-ride facilities would displace commercial lands adjacent to the station, but Option A could offer the best economic and redevelopment benefits. Option B (with a structure located southeast of the station) would provide the most park-and-ride spaces (670).

The preferred alternative would serve the airport with a station at North 170th Street at the IMC or NEAT. The NEAT site would provide the most benefits for travelers to and from the airport, and the IMC site would provide more benefits to travelers headed elsewhere in the region and could also serve the City Center. Both options would integrate with the airport's proposed ground transportation system and would serve the airport's future expansion plans, although the Port prefers the NEAT site.

The preferred alternative also has provisions for a potential station at South Central SeaTac to serve the City Center at 184th Street. Alternative F2.2, (Washington Memorial Park City Center East), would place a station closest to the City Center, but would cross Bow Lake on an elevated structure, resulting in visual impacts for area residents. Alternative F3.2 would serve the airport only at the existing main terminal, would not serve the city center and, while providing a direct pedestrian connection, would be more disruptive to airport operations, and more costly than a NEAT or IMC Station. Alternative F3.1, with a station just east of International Boulevard, would impact port properties, while F.1 would have a station in the median of International Boulevard, resulting in traffic circulation and displacement impacts.

South of the City Center area, the preferred alternative, and all alternatives but F1, would be along 28th Avenue S. to S. 200th Street, a route that would have fewer impacts to traffic and businesses than F1, which continues along International Boulevard to S. 200th. Five options exist for a south SeaTac Station, involving different park-and-ride facilities, station configurations, and surface operations, varying the treatment of 28th Avenue S., and varying the property displacement impacts. A surface park-and-ride facility and/or structured parking is proposed in the various options, with Option E providing a public/private partnership opportunity involving a privately operated park-and-ride structure that would be sited south of S. 200th Street.

6.4 MAINTENANCE BASE SITES

The Final EIS examines five maintenance base sites in the south downtown industrial area (M1-A through M1-E). Two alternatives adjacent to the Boeing Access Road (M2 and M3) also continue to be evaluated. The additional sites in the south downtown area are in response to comments and an FTA request that each Minimum Operable Segment (MOS) be fully operational and include a maintenance base facility.

Cost

The capital cost of the M1 maintenance base options range from $97 to $113 million. These costs include construction and property costs for a base capable of accommodating 100 to 104 light rail vehicles and serving the demands of the system; this would include an extension to Northgate and growth in ridership demand during the project's initial phase. The cost for rail access between a route alternative and a maintenance base site would vary depending upon which route and base is selected, from a low of $1 million to a high of $9 million with the most logical route/base matches. Access costs for other matches could be considerably more expensive.

The base construction and right-of-way costs for the M2 N.E. Boeing Access Road site are estimated at $96 million. The site is served directly by all the light rail alternatives. Access costs would vary depending upon how the site is accessed. If the site is accessed by an elevated structure, the cost is estimated to increase by $22 million. An at-grade connection would add $3 million.

The capital and right-of-way costs to construct a maintenance base on the M3 site (S.W. Boeing Access Road) are estimated at $97 million. Access costs would vary depending upon which alternative is selected. The Tukwila International Boulevard alternatives (E1) would add $11 million. If Alternative E2 is selected, the cost would increase by $1 million. Alternative E3 (MLK) would require a special spur track across I-5, resulting in an additional $29 million.

Light Rail Access

Alternatives C1.1, C1.2, C1.3 and C1.4 could provide access to Sites M1-A, M1-B or M1-C. Sites M1-D and E would be directly accessed only through Alternative C1.4 on S. Forest Street. Alternative C1.5 would be able to directly access site M1-C only.

The primary light rail access to Sites M1-A or B would be via Lander Street, with either at-grade or elevated tracks to M1-A, and at-grade only for M1-B. The route alternatives that do not serve Lander (such as C1.5, C2.3, C2.4 and C3) would require additional access track to serve the M1 sites, although site M1-C would be accessed via S. Massachusetts Street (C1.5) with at grade tracks.

All M1 sites would be served by existing Burlington Northern Santa Fe (BNSF) or Union Pacific mainline or spur tracks, which could be used to directly deliver new vehicles and to bring Tacoma light rail vehicles to the site for heavy maintenance.

Site M2 does not provide direct connections to the freight rail tracks for maintenance of Tacoma's light rail vehicles or for the delivery of Central Link vehicles. Access to the site could be by an elevated structure over MLK Jr. Way S., or by an at-grade crossing of MLK Jr. Way S. with or without gates. An at-grade crossing would affect traffic operations on MLK Jr. Way S. early in the morning when the trains first entered service, at the end of the morning peak and beginning of the afternoon peak, and at the end of the evening peak. The return of trains to the site at the end of service would occur in the early morning hours and would not impacts street operations.

Site M3 could be readily accessed by all of the Segment E alternatives except E3, which would require a lengthy new access track. There is also access to the site from BNSF tracks for light rail vehicles from Tacoma and the delivery of vehicles to Central Link. There is only one vehicular access point.

Operations, Site Configuration and Expansion Capabilities

All of the M1 sites would be centrally located along the light rail corridor and would result in the shorter deadhead runs (largely empty or out of service trains that must travel to return to the site for service) compared to the Boeing Access Road Sites M2 and M3. All M1 sites are long enough and wide enough to accommodate a run-around track with better-than-minimum turn radii.

Site M2 is flat, and its shape accommodates and efficient maintenance facility. The site potentially could be expanded to accommodate limited additional maintenance needs for growth in the light rail system.

M3's L-shaped site is poorly shaped for the development of a maintenance facility. Circulation for trains within the site would be awkward. The site does not offer opportunities for expansion.

Permitting; Affected Jurisdiction; Existing Uses

All M1 sites are in a zoned commercial/industrial area, with a building height limit of 85 ft. This zoning can accommodate a light rail maintenance facility, but requires a conditional use permit. The M1 sites are all located entirely in the city of Seattle and their use by Sound Transit would displace private industrial uses.

Site M2 is partially in the City of Seattle and partially in the City of Tukwila. Permits from both jurisdictions would be needed. The site contains several established commercial/industrial uses that would need to be relocated.

Site M3 is completely within the City of Tukwila and zoning is appropriate for a light rail maintenance facility. This site would have the fewest business displacement impacts, but would require the relocation of a Seattle Police Association firing range.

Environmental Goal: Preserve Environmental Quality

All of the proposed M1 maintenance base alternatives in the North Duwamish area would displace existing businesses and their employees, and could affect property access and circulation. Any of the M1 base options would be consistent with the industrial land use in the North Duwamish area, although there is limited land available for displaced businesses to relocate. Most of the Duwamish area sites acquire similar amounts of land and displace 6 to 18 properties. The impacts in terms of businesses and employees affected are more varied, and the related number of jobs affected provide a basis for comparison. Sites M1-D and M1-E (with Alternative C1.4) would displace the fewest employees, cause the least disruption of property access, and the least traffic impacts. Sites M1-A, M1-B, and M1-C could have the highest impacts, depending on the route alternative and access route chosen. Site M1-B would also affect 1,026 employees, and it would have comparatively high impacts to property access, circulation, rail freight, and safety. Site M1-C would affect 581 jobs, and would also impact traffic operations in its immediate vicinity the most since it would divert traffic from Sixth Avenue S. Site M1-A would affect 621 jobs, and remove 3,500 ft of rail storage track, but the track could be replaced in other locations. Hazardous materials releases are known on all sites, with M1-A having the lowest potential for long-term impacts. The other sites have similar potential, although sites M1-D and M1-E include an historic landfill with unknown releases to groundwater.

The Boeing Access Road sites have fewer impacts overall, including lower impacts to transportation, property, or employment. Site M2 would acquire 14 properties and M3 would acquire 13. Most would be industrial or commercial parcels, although a large portion of the M3 site is a Seattle Police Athletic Association training facility. Each site includes known hazardous material releases (two on M2, and three on M3).

Construction of Site M3, S.W. Boeing Access Road, could affect a wetland, disturb an area with a high probability for archaeological resources, and affect a potential property of cultural interest to Indian tribes.

Trade-offs Among the Maintenance Base Sites

All M1 maintenance base sites are well situated relative to the overall light rail corridor, and would be in the North Duwamish Industrial area. They also connect to existing BNSF tracks and could provide heavy maintenance for Tacoma's light rail vehicles. The surrounding land uses are compatible to industrial uses. The most significant environmental impacts involve the number of employees and businesses that would be displaced by various site and route combinations. Site M1-B would have the highest impacts to jobs. As there is limited land available for relocation in the Duwamish Industrial and Manufacturing area, relocation could be difficult, particularly for businesses that require large sites or rail access. All sites would require a conditional use permit from the City of Seattle. Sites M1-D and M1-E overall would have the least environmental impacts, but they also would require the selection of Alternative C1.4 along S. Forest Street. (Alternative C1.4, while one of the highest cost route alternatives in Segment C, has among the fewest environmental impacts of the Segment C routes.) The base costs for the site vary by $16 million, and up to $28 million when access routes are considered. The lowest cost combinations are M1-B and M1-C with any of the C1 alternatives ($98 to $102 million). Sites M1-A, M1-D, and M1-E have costs ranging from $112 to $126 million.

Site M2 (N.E. Boeing Access Road Maintenance Base) is well configured for a light rail maintenance base, has no significant environmental impacts, and would allow limited expansion of the base for future phases. Its costs would range from $99 to $118 million, depending on the route alternative. Its disadvantages are that access would require a grade-separated structure or, with an at-grade access, traffic would be impacted on MLK Jr. Way S. a few times during the day. There is no connection to existing freight rail tracks for delivery of vehicles and access for Tacoma vehicles for heavy maintenance.

Site M3 (S.W. Boeing Access Road Maintenance Base) is the lowest cost site (ranging from $108 million if paired with the preferred alternative to $126 million if paired with Alternative E3), and it has direct access to freight rail tracks. A maintenance base at this site would change the character of the site but it would remain consistent with the surrounding uses. However, the site is poorly shaped and has a number of potential adverse environmental impacts including wetland impacts and an impact on a culturally sensitive site. It has poor access by road and does not allow the potential for expansion.

CHAPTER 7
RESPONSE TO COMMON COMMENTS ON DRAFT EIS

7. Response to Common Comments on the Draft EIS

Sound Transit received 935 public and agency letters and oral testimonies on the Central Link Light Rail Draft EIS during the public comment period. These letters and testimonies contained a total of 3,712 separate comments. The public comment period on the Draft EIS began December 4, 1998 and closed February 5, 1999. Comments on the Environmental Assessment on N.E. 45th Station, Capitol Hill Station, and North Duwamish Maintenance Base Alternatives were also taken from August 9, 1999 to September 8, 1999. Responses to comments on the Rainier Valley Tunnel Environmental Technical Report and EA are also provided in the Final EIS

Public comments, written and oral, were received from individuals, community groups, businesses, private organizations, tribes, and federal, state and local agencies. Public hearings on the Central Link Light Rail Draft EIS were held at the following times and locations:

- Wednesday, January 13, 1999, 6-9 P.M.
  Tukwila Community Center, 12424 42nd Avenue S., Tukwila
- Thursday, January 14, 1999, 6-9 P.M.
  SeaTac City Council Chambers, 17900 International Boulevard, Suite 401, SeaTac
- Wednesday, January 20, 1999, 6-9 P.M.
  Lake Washington Public School District Board Room, 16250 N.E. 74th, Redmond
- Tuesday, January 26, 1999, 6-9 P.M.
  Kane Hall, University of Washington campus, Room 110, Seattle
- Thursday, January 28, 1999, 6-9 P.M.
  Filipino Community Center, 5740 MLK Jr. Way S., Seattle.

The Rainier Valley Tunnel Environmental Technical Report was released February 1, 1999, during the public comment period on the Draft EIS. Subsequently, comments specifically pertaining to the Rainier Valley Tunnel were accepted through March 18, 1999, and have been included in the Final EIS. The public hearing on the Rainier Valley Tunnel Report was held at the following time and location:

- Thursday, February 11, 1999, 6-9 P.M.
  Filipino Community Center, 5740 MLK Jr. Way S., Seattle.

An Environmental Assessment (EA) of the N.E. 45th Station, Capitol Hill Station and North Duwamish Maintenance Base Alternatives was published on August 5, 1999. Written and oral comments on the EA were taken from August 9, 1999 to September 8, 1999, and are included in the Final EIS. Public meetings on the EA were held at the following times and locations:

- North Duwamish Maintenance Base
  Tuesday, August 24; 11 a.m. to 1 p.m.
  Seattle Public Utilities Operations Center
  2700 Airport Way S Seattle
- N.E. 45th Station
  Monday, August 30; 6 to 8 p.m.
  University Heights Center for the Communities, Room 209
  5031 University Way NE Seattle
- Capitol Hill Station
  Tuesday, August 31; 6 to 8 p.m.
  Seattle Central Community College
  1701 Broadway, Room 1110 Seattle

The Draft EIS Comments and Responses (Volumes 3, 4, and 5 of the Final EIS) include copies of the transcripts from each of the hearings, written comments from the hearings, comment letters received by Sound Transit, and responses to these comments. Each comment letter and commentors transcript was coded with a number, and then each comment within the letter or transcript was also numbered. Duplicates of received correspondences are only printed once. This appendix includes comments on the Draft EIS, Rainier Valley Tunnel Report, and EA.

Many of the comments received were on similar topics. These common topics or questions have been summarized as Common Comments in this chapter of the Final EIS. The following summarizes the Common Comments and provide a response.

1. ALTERNATIVES

1.1.1 How was the preferred alternative identified and how will the final be selected?

On February 25, 1999, the Sound Transit Board identified the preferred alternative from the alternatives considered in the Draft EIS. In identifying the preferred alternative, the Board considered the findings of the Draft EIS, public comments through an extensive public outreach effort, staff recommendations, and information to further clarify engineering, operations, ridership projections and cost estimates for the various alternatives. Subsequently, elements of the preferred alternative and other alternatives were developed or modified in response to public and agency comments and to respond to other information. All of the alternatives considered in the Draft EIS are also evaluated in the Final EIS.

Following completion of the Final EIS, the Sound Transit Board will make a final decision on the alternative to be built. For the purposes of the State Environmental Policy Act, the Board will adopt the final route alternatives, station locations, and maintenance base. Under the National Environmental Policy Act, the federal government will make its decision in the Record of Decision on the Final EIS. The evaluation and selection process is discussed further in Section 2.2 of the Final EIS. The decision making process and the preferred alternative are discussed in greater detail in Chapter 2 of the Final EIS. See Section 2.2 and 2.1.1, respectively.

1.1.2 How were the alternatives identified and narrowed for the EIS?

The light rail alternatives evaluated in the EIS are the result of over 20 years of regional planning and study. These studies formed the foundation of the Sound Move plan, and are discussed in Chapter 2 of the EIS (see Section 2.2).

Previous studies included analyses of various corridors and technologies. For example, an analysis of alternative technologies conducted in the early 1990s compared highways, light rail, heavy rail, automated guideway transit/people mover, monorail, magnetic levitation and terrafoil. These evaluations identified electric light rail as the most appropriate technology to meet this corridor's needs. Evaluation criteria included capacity, operating speeds, cost-effectiveness, community compatibility and reliability. Additionally, light rail is a "proven" technology with numerous examples in the U.S. and around the world.

Following additional planning, evaluations, and public input, Sound Transit completed a Major Investment Study (MIS) in May 1997, as required by the Intermodal Surface Transportation Efficiency Act. The MIS described the central light rail corridor alternatives as:

- University District to Northgate (to be built if funding were secured)
- Downtown Seattle to University District (from the existing transit tunnel, under Capitol Hill/First Hill and the Ship Canal to the University District)
- Downtown Seattle to Boeing Access Road (south from the existing transit tunnel, east along I-90 to Rainier Avenue, south through Columbia City and along MLK Jr. Way S., turning west at Boeing Access Road and crossing over I-5)

- Boeing Access Road to SeaTac (two primary alternatives were to be analyzed further, the SR 99 route and another along Interurban Avenue).

After receiving approval for the Major Investment Study, Sound Transit proceeded with project-level environmental review.

The potential alternatives to be evaluated in the EIS were further defined in a process that combined technical study with public outreach, including the formal scoping process for the EIS, which began in November 1997. The Scoping Information Report (March 1998) detailed the alternatives and environmental issues being considered for evaluation in the EIS. The two-month scoping period included 6 public meetings. Over 900 comment letters were received from agencies and the public.

After completion of scoping, and in consideration of comments received, a specific set of alternatives were defined. These alternatives were evaluated against two levels of criteria, as outlined in the EIS in Section 2.1.3.1. Based on the criteria and public comments received through community contacts, a series of six public meetings and two formal public hearings, Sound Transit finalized the set of alternatives to be evaluated in the Draft EIS. On May 18, 1998, the Sound Transit Board approved the route and station alternatives to be studied in the Draft EIS. These alternatives were further developed and refined through conceptual engineering studies, and are described in Section 2.1.2 of the EIS. Design work continued through the preparation of the EIS. The early stages of this work focused on developing the specific route and grade determinations of the alternatives and maintenance base sites. Later stages focus on refining profiles, routes and station designs and incorporating mitigation measures into project design and plans.

1.2 Why didn't Sound Transit look at the full-length Rainier Valley Tunnel alternative initially?

As discussed in the EIS, Section 2.1.3.1, tunnels were considered only where they would meet the "tunnel criteria", that is, where difficult topography, physical barriers, lack of available right-of-way or high ridership demands would make new at-grade or elevated routes infeasible or impractical. The criteria Sound Transit applied to select appropriate profiles by segment is described in more detail in Section 2.1.3.1 of the EIS.

Sound Transit has strived to involve the Rainier Valley community in the Central Link decision-making process. Sound Transit's outreach efforts have included the establishment of a community office in the Rainier Valley in order to provide the community with a convenient location to offer feedback on Sound Transit projects, participate in the environmental review and planning processes, and obtain information, numerous public meetings and neighborhood canvassing efforts, meetings with community leaders, and the translation of informational materials.

Prior to the release of the Draft EIS, public requests were made for consideration of an all-tunnel alternative through Rainier Valley. (A number of public comments on the Draft EIS repeat that request.) In response, and in consultation with Rainier Valley community members and tunnel proponents, Sound Transit developed and evaluated an all-tunnel alternative in Segment D. The Rainier Valley Tunnel Technical report was released on February 1, 1999 for public review, prior to the selection of Sound Transit's preferred alternative. The report concluded a tunnel would not be a reasonable alternative for several reasons. First, a Rainier Valley Tunnel would not meet criteria commonly used to warrant a tunnel, nor did it meet the criteria Sound Transit had applied in determining profiles throughout the rest of the project corridor. Further, a tunnel would create nearly $400 million in additional costs without providing significant additional transportation benefits, although it would reduce some adverse impacts. Finally, Sound Transit would face major constraints in obtaining additional funding for a Rainier Valley Tunnel (RVT), based on the factors above, and considering the voter-approved funding program for *Sound Move*.

Since issuance of the Draft EIS and the Rainier Valley Tunnel Environmental Technical Report, Sound Transit has further compared the impacts and benefits of the preferred alternative to an alternative that would require the construction of a tunnel the full length of Rainier Valley. The tunnel alternative does not meet Sound Transit's tunnel criteria and would require extraordinary costs. This comparison, along with a history of the light rail alignment in southeast Seattle, is set forth in Section G-7 of Appendix G, Environmental Justice Technical Report. Consistent with the findings set forth in the Rainier Valley Tunnel Technical Report, that section concludes that the preferred alternative's at-grade profile offers many benefits not provided by the RVT alternative. These benefits include streetscape improvements and greater potential for economic development. Although the tunnel would reduce some impacts, it would have greater construction impacts in station areas and portals, which may adversely affect residents, businesses and others, as well as greater vibration impacts. For these reasons, as well as the engineering and cost considerations discussed, the tunnel alternative is not a reasonable alternative.

The EIS evaluates tunnel profiles in three locations in the Rainier Valley area, including: the Beacon Hill crossing (C1 and C3, where steep grades would inhibit at-grade or elevated operations); Rainier Avenue north of MLK Jr. Way S. (C2.4) where I-90 presents a barrier and where narrow existing right-of-way would require extensive property displacements, loss of property access and impacts to historic resources; and, 37th Avenue S. through Columbia City (D3.4) where the available right-of-way was limited through the national historic district and commercial center, and where the route would encounter a hill just south of Columbia City.

1.3 Why doesn't Sound Transit consider monorails or other types of transit systems?

Other transit technologies and systems were previously considered and rejected. The Sound Move plan approved by the voters specified electric light rail technology, the impacts of which are analyzed in this EIS. Alternative technologies are no longer being considered for the Central Link Light Rail project. They were evaluated previously and not selected for further consideration, as discussed in Section 2.2 (Chapter 2) of the EIS and summarized below. Part of the decision to use electric light rail was based on its flexibility to operate at-grade with shared crossings, elevated or in tunnels as required. Monorail and Maglev do not have this flexibility.

In the early 1990s, two studies (Gannet-DeLeuw 1990, PB/K 1991, available for review at Sound Transit) took a comprehensive look at potential rapid transit technologies. Technologies examined included light rail, heavy rail, automated guideway transit (AGT)/people mover, and monorail. Alternative technologies such as Maglev, and Terrafoil were also examined. The technologies were evaluated for their ability to meet general performance requirements for the project corridors as well as needs specific to the system, such as compatibility with the downtown transit tunnel, Ship Canal crossing, at-grade crossings, and aerial structures. These studies concluded that conventional-tracked rail (light or heavy) would be most practical to implement in the Puget Sound area. This conclusion was reached largely because this technology has wide use and has stood the test of time in crucial issues such as switching, crossing lines, and carrying large passenger loads between urban stations. Also, some of the facilities that would likely be used for the long range system, including the downtown transit tunnel and the I-90 floating bridge, were specifically designed to accommodate a conventional-tracked rail system. Other technologies would be more difficult to accommodate on these facilities.

Light rail was considered the most appropriate rail technology to implement over the range of conditions that would be encountered in the system. The major constraints of heavy rail were considered to be the use of high level platforms and third rail power pickup (although overhead catenary can be used). One of the reasons for the light rail choice was the need to run the system at-grade within street rights-of-way in less dense sections of the system. Light rail also was more cost-effective than heavy rail when evaluated on a system-wide basis.

The choice of electric light rail technology was reflected in the 1993 System Plan Environmental Impact Statement, which analyzed in detail the impacts of various system alternatives, including conventional tracked rail (heavy or light). The decision to select electric light rail as the transportation mode for further analysis was made by the Regional Transit Authority Board in 1994, when it adopted a plan that included 68 miles of light rail connecting Lynnwood to Tacoma and across I-90 to Bellevue and Redmond, and again in 1996 when it adopted the *Sound Move* plan. *Sound Move* includes the 1.6 mile electric light rail system in Tacoma and approximately 25 miles of electric light rail in the SeaTac to Seattle corridor that will be fully compatible with the System Plan.

Following voter approval for financing for the Sound Move plan in 1996, the plan was incorporated into the Puget Sound Regional Council's Metropolitan Transportation Plan (MTP), the federally required plan for projects receiving federal funding. Finally, the light rail mode was confirmed in a May 1997 Major Investment Study for the Sound Move plan, which reviewed the prior planning and community involvement efforts leading to the adoption of a preferred transportation strategy. The Major Investment Study was approved by the Puget Sound Regional Council (PSRC) in April 1997, concluding that it "clearly documents how [Sound Transit] identified and evaluated a range of alternatives together with a chronology of decisions leading to the preferred alternative."

With the approval of the Major Investment Study, the proposal proceeded into the current, project-level environmental review.

1.4 Why isn't a Roy/Aloha Station on Capitol Hill part of the Preferred Alternative?

The Roy/Aloha Station is not part of the preferred alternative because of ridership and cost considerations. Capitol Hill residents would be served by the Capitol Hill Station at John Street, which is only a half-mile away. Although a Roy/Aloha station would attract 600 more daily riders on Capitol Hill, the time it takes to dwell at the station would result in decreased ridership in other segments. Overall, system-wide ridership would not increase. It would cost $85 million to build a complete station as part of the current project and $38 million to build just a station shell.

2. MITIGATION

2.1 How and when will detailed mitigation commitments be made part of the project?

The National Environmental Policy Act (NEPA) and the State Environmental Policy Act (SEPA) require that the EIS describe reasonable mitigation measures addressing project impacts for the decision-makers to consider. These acts and their implementing regulations allow mitigation commitments to be made in the EIS, however, they do not require it. Where the current level of design, information and coordination allow it, the Final EIS does identify where mitigation has been incorporated into project design and other mitigation commitments. Where additional design, information and/or coordination are necessary, the Final EIS identifies potential mitigation measures to be considered by decision-makers. The Mitigation Plan is in Appendix O of the Final EIS. Additional design will be required to further define mitigation and will be developed through preliminary engineering and final design. The Record of Decision (ROD) will include a list of committed mitigation measures for the preferred alternative. Mitigation measures can range from specific design items like noise walls to plans or programs to develop the mitigation details (e.g. parking mitigation monitoring). Mitigation commitments may also include performance standards that commit to meeting certain measurable standards (such as a maximum vibration level) but do not yet commit to the precise means through which that standard will be met. This approach allows the on-going design work and community and agency consultation and coordination work to better define the precise approach to mitigating impacts. Sound Transit is working with agencies with jurisdiction and other interested parties to determine appropriate mitigation commitments. These commitments may be documented through a formal agreement, as conditions for required permits, or through some other mechanism.

3. TRANSPORTATION

3.1 How will local access and circulation be maintained along surface segments?

There are several segments where the preferred light rail line would operate at-grade or elevated in the median or along the side of arterial streets, including S. Lander Street in Segment C., MLK Jr. Way S. in Segment D, Tukwila International Boulevard in Segment E, and 28th Avenue S. in Segment F. Access in these areas could be affected. Generally, it is expected that trucks and other vehicles will adapt their routes based on distance and convenience. In all these areas,

- Access to adjacent properties would be maintained from the street.
- Vehicular access may be restricted to right-in, right-out movements
- Left turns and U-turns would be accommodated at signalized intersections
- Facilities for pedestrians and bicycles would be improved in some locations, including new signalized crossings pedestrian-only, and new or improved sidewalks/crosswalks.

The configurations of the at-grade routes in all three of the at-grade sections of the preferred alternative have been modified since the Draft EIS to reduce impacts to access and circulation. The major changes have been to increase the number of signalized crossings provided, and to adjust signal timing strategies that minimize vehicle delays at intersections. In Segment C, the Lander Street route has been moved to the north side of the street, reducing overall access restrictions; an elevated alternative has also been developed that would avoid most of the access restrictions and delays. The preferred alternative in Segments D and E both include additional signalized intersections, modified signal strategies, and other mitigation measures.

3.2 Explain how the Sound Transit ridership model works. Does it include transfers from buses, regional express, and commuter rail?

Sound Transit uses an incremental planning model to produce detailed forecasts of transit patronage resulting from changes in transit service levels between two locations within a corridor. The primary purpose of developing an incremental transit model was to have a special planning tool, which was capable of providing detailed forecasts of transit riders. The traditional multi-modal regional travel forecasting models are not designed to provide detailed ridership forecasts. The Sound Transit model was initially developed in 1991 and subsequently refined in 1993 as new transit survey data became available. The development and refinement of the Sound Transit model, its databases, and the underlying assumptions was overseen by an Expert Review Panel (ERP) which was comprised of regional and national transportation experts. The ERP was established to satisfy Washington State law under the auspices of the Governor, Legislative Transportation Committee, and Secretary of Transportation.

The Sound Transit model includes three distinct ridership-forecasting stages. In the first stage of ridership forecasting analysis, changes in demographics are taken into consideration. Base year (1992) transit trips are increased to estimate 2010 and 2020 transit trips using district-to-district estimated growth in regional travel from the PSRC regional model.

In the second stage, other changes in travel are taken into consideration: highway travel time (congestion), costs (including parking costs and transit fares), and household income. A mode choice model is used to estimate zone-to-zone transit ridership based on the sensitivity of travel demand behavior to the factors of time, cost and income. The mode choice components of the Sound Transit model are nationally-accepted measures of travel demand behavior sensitivity (elasticity) with respect to travel time and cost changes. PSRC uses similar sensitivity measures in their regional mode choice analysis. Results from the first two stages of the ridership forecasting were used to develop a forecast of zone-to-zone transit trips within and to/from the Sound Transit boundaries for 2010 and 2020 classified by time of day, trip purpose and mode of access (i.e., walk or auto access to transit).

The third and final stage of the ridership forecasting analysis considers the incremental changes in transit level-of-service (i.e., access, wait, and ride travel times). The mode choice parameters use nationally accepted measures of travel demand sensitivity with respect to transit travel times. Finally, the resulting transit trips from this stage of the ridership forecasting analysis are assigned to the future year transit network reflecting characteristics of transit service between any two areas/locations.

A more detailed description of the ridership model process is documented in the "Transit Ridership Forecasting Methodology and Results Report" produced for the Regional Transit Project by Parsons, Brinckerhoff, Quade & Douglas in July 1999, which is a technical report to the Central Link Final EIS.

3.3 How will at-grade light rail affect pedestrian and traffic safety?

Light rail alternatives with at-grade sections would introduce some light rail accidents with motor vehicles and pedestrians but would also decrease mid-block and left-turn vehicle accidents and mid-block pedestrian crossing accidents. Analysis of accident records along the three major routes proposed for at-grade operations found that the same number or fewer accidents would occur with at-grade light rail as would occur on the same streets under No-Build conditions. To assess the potential for future motor vehicle accidents on MLK Jr. Way S., estimates were made of future collisions between motor vehicles and between motor vehicles and light rail vehicles. These estimates indicate that there would be fewer collisions involving motor vehicles, pedestrians, and bicycles with the light rail alternatives compared to a No-build Alternative.

At-grade light rail within a roadway could create the potential for new accidents because a new kind of vehicle would be introduced, and street operations would be changed. However, light rail can also result in reduced risk for accidents at mid-block and existing unsignalized intersection locations. New accidents would primarily be caused by collisions between light rail vehicles and pedestrians or autos, and due to rail/bus transfer activity at station areas that require bus stops and layover zones across the street from a rail station. There would be reduced risk for certain types of accidents where an at-grade light rail route would be in the center of a roadway, particularly collisions between motor vehicles, and collisions between motor vehicles and pedestrians or bicyclists. With operations in the center of the road, traffic movements from driveways and unsignalized intersections would be restricted to right-in, right-out movements only, and pedestrian crossings would be authorized only at signal-protected locations. Under these conditions, at-grade light rail could reduce risks of mid-block left-turn conflicts, midblock head-on collisions, and midblock pedestrian crossing accidents.

As part of the EIS process, Sound Transit commissioned a study (Korve July 1999) of the impact that other light rail systems nationwide had on pedestrian safety, focusing on comparable systems to light rail. The study found that between four to five light rail/pedestrian accidents have occurred in a typical year at comparable systems. The majority of these incidents occurred in station areas, where risk could be further minimized by design approaches, appropriate signage, and public education to encourage safe behavior. The remainder of the accidents occurred along the right-of-way, where design features and public education could also further reduce risk.

The Final EIS Section 3.3 includes a more detailed discussion of specific transit safety issues by segment, and proposed mitigation measures.

3.4 Will Sound Transit improve pedestrian/bike access to station areas?

Sound Transit assumes that bicycling and pedestrian access will be a common means of travel to and from Sound Transit facilities, as described in Bicycle Access to Sound Transit: A Policy Review and Recommendations (Sound Transit, October 1998). Sound Transit has been working with local jurisdictions, transit agencies, and interested groups to identify needs and opportunities for improving access in station areas, and to incorporate features and strategies that enable and encourage non-motorized access to Sound Transit stations. Sidewalks on or adjacent to the light rail station properties would be provided, and sidewalk widths would be wide enough to accommodate pedestrian volumes from light rail and conform with city standards. Stations would be designed to provide ample space for maneuvering and or storing bicycles, based on projected patronage.

The preferred alternative and other alternatives have been refined since the Draft EIS to include project features that promote walk and bicycle access to light rail. These features include improved connections between station areas and nearby activity or commercial centers and bicycle storage facilities at the stations.

To improve bicycle access to Link stations, Sound Transit has incorporated the following projects: trail and/or signage improvements to the Burke-Gilman Trail near Pacific Station (segment B); creation of a Class I trail parallel to the light rail route and Metro busway in the North Duwamish area (segment C); development of a bicycle facility through the Rainier Valley parallel to the light rail corridor including the Chief Sealth crossing of the MLK Jr. Way S. and S. Henderson Street (segment D); improved signage for an existing on-street bicycle route through the Rainier Valley (segment D); and design of a 14-foot outside lane on Tukwila International Boulevard that will accommodate bicycle travel. In addition, there would be street and urban design enhancements on Edmunds Street to Columbia City and on Henderson to Rainier Beach in Southeast Seattle, and on South 144th Street in Tukwila.

The McClellan Station would have improved pedestrian crossing facilities at MLK Jr. Way S. and Rainier Avenue S. With the at-grade light rail route on MLK Jr. Way S., the street would be redesigned to encourage pedestrian access to the stations. The number of signalized intersections would increase from 14 today to 28 with Link, including nine pedestrian-only crossings. The preferred alternative on Tukwila International Boulevard would incorporate most of the pedestrian improvements and street design features that are proposed in the City of Tukwila's plans. In SeaTac (segment F), grade-separated pedestrian crossings are proposed, including at a potential South SeaTac station that would serve the city center.

3.5 How will bicyclists use the system?

Sound Transit will make provisions to encourage bicycle access to the system, at the stations, and on train vehicles – taking into account safety, convenience, and comfort of patrons, security of bicycles, capacity goals, and impact on service.

Sound Transit will provide secure bicycle racks and/or lockers at stations to encourage bicyclists to use the Link system and to store their bicycles at the stations. The EIS identifies the initial number of bicycle racks and lockers to be provided at each station, and additional area for bicycle storage facility expansion if needed. This information is summarized in the Final EIS Transportation Section (3.2) and in the Transportation Technical Report.

In addition, as described in Bicycle Access to Sound Transit: A Policy Review and Recommendations, Sound Transit will provide bicycle access on Link vehicles. Initially, bicycles will be accommodated on trains during off-peak hours. Within the first six months of start-up, the feasibility of providing peak-hour access to Link should be demonstrated. During the start-up of the system's operation, Sound Transit will work with the local community to assess procedures and equipment issues to plan effective service for both bicyclists and other patrons.

3.6 What are the potential impacts of ending the line at N.E. 45th Street and other potential terminus stations?

The preferred alternative identifies a light rail line terminus at N.E. 45th Street for the initial phase of the light rail project, with future phases extending the terminus farther north to Northgate or beyond. Similarly, a number of the MOS alternatives would provide north or south termini at other locations, including at the Capitol Hill Station in Segment B, or at the McClellan or Henderson Station in Segment C. The EIS analysis determined that the impacts around these "initial phase" terminus stations would be similar to the impacts that would occur at these locations with a longer system. In general, bus routes would not be significantly rerouted to feed these interim terminus stations, and added park-and-ride facilities are not proposed. The following summarizes the analysis of the NE 45th Street terminus:

The addition of light rail will attract high ridership by people who start or end their trips in the University District and by people who will be transferring by bus to or from the rail station.

Bus trips would increase by 18 per hour in the P.M. peak period if N.E. 45th Street is the light rail terminus. After light rail is extended to Northgate, bus trips would decline by 26 buses per hour to eight less than existing.

The N.E. 45th Street vicinity would attract 46 more vehicle trips during the P.M. peak hour in 2020 than with the Northgate terminus. Based on the experience of similar light rail systems, passengers dropped off at the station by automobile are not expected to be a significant percentage of total ridership.

The overall intersection LOS would remain at LOS D with station Option B even with the N.E. 45th Street terminus, however, it would decline to LOS E under station Option C due to closure of N.E. 43rd Street. Either option provides an acceptable LOS.

The University District's high parking utilization and the existence of residential parking zones are expected to prevent hide-and-ride parking from becoming a major problem. Sound Transit has committed to monitor and mitigate impacts on neighborhood parking.

Expected pedestrian volumes around the station area will not exceed existing sidewalk capacity.

Additional construction activities including truck traffic, traffic detours, and construction staging would affect the N.E. 45th Street terminus area, compared to the station with a Northgate extension, because additional construction staging areas would be required near the station area.

Parking impacts would not be expected to differ if the Capitol Hill, Henderson or McClellan stations would be the terminus because forecasted ridership would be similar or lower, the same parking supply conditions would exist, and the same measures to assess and mitigate potential hide-and-ride activities would be used. For more details, see the parking impact discussion of the Final EIS Section 3.3.

3.7 How will Link connect to other modes (Commuter Rail, Ferries, etc.)?

The Central Link Light Rail system would connect conveniently to the corridor's web of federal, state, regional and local transportation facilities and services, including King County Metro, Community Transit, Pierce Transit, Washington State Ferries, Amtrak, Sea-Tac International Airport, and Sound Transit's Sounder commuter rail and Regional Express buses. Transfers between transit modes are expected to increase, especially between buses and Link light rail. Despite the increase in transfers, frequent rail service is expected to reduce travel times.

- Connections with bus service would occur at virtually all light rail stations. Bus routes will be adjusted to reduce long-haul routes to destinations served by light rail (especially downtown Seattle), allowing greater local bus service in its place.
- Convenient connections between Link light rail, Amtrak and Sounder commuter rail trains would be available at the south end of downtown Seattle. Light rail will serve the International District station, just across Fourth Avenue S. from King Street station where

both Amtrak and Sounder platforms will be located. A second joint Link/Sounder commuter rail station is planned at Boeing Access Road, which would also include an adjacent park-and-ride facility with convenient access from I-5 and SR 99. A station at Longacres, which would be provided in Alternatives E2 and E3, would also provide connections to commuter rail, Amtrak and regional and express bus services.

- The Colman Dock ferry terminal for Washington State Ferries is located within walking distance of both the Pioneer Square and University Street stations in downtown Seattle, and the Waterfront Trolley also provides convenient routing from the ferry terminal to the International District station.
- A North Central SeaTac station would connect with the planned Intermodal Center (IMC), which would be connected by people mover to the planned Sea-Tac Airport North End Airport Terminal (NEAT). A station option would place the station directly adjacent to NEAT, with a people mover connection to the IMC.

3.8 How will Link affect transit service to downtown?

The impacts of the closing of the transit tunnel to buses to downtown has been updated and expanded in the Final EIS. The analysis includes the findings of a supplemental report (the Downtown Seattle Surface Street Report, Sound Transit April 14, 1999) that identified and evaluated potential alternatives for managing bus volumes that would occur during construction and operation of the light rail system. Transit impacts of the tunnel closure are assessed in Section 3.2 of the EIS, and traffic impacts are summarized in Section 3.3. Impacts would be greatest during the construction period of the project, when the tunnel would be closed and light rail would not yet be available to alleviate the demand for bus travel. The Surface Street Report analysis evaluated a variety of strategies to improve surface street bus flow on downtown streets and improve bus travel times, including changes to street capacity, bus routing, and signal operations. With some route, surface and operational improvements, many of the downtown bus routes are projected to operate as fast as current conditions, even with a doubling of transit volumes. However, buses would experience increased travel times as they pass through the north and south downtown areas. Some passengers would benefit from shorter walk times to bus stops on the surface, versus the time it takes them to access the tunnel today. Riders who travel the entire length of downtown would experience the greatest increases in travel times. The downtown routes would not be as reliable as routes that operate in the tunnel today. After light rail service begins in 2006, the number of buses on downtown streets would decrease compared to the construction period, as would the number of motor vehicles, as travelers shift to light rail.

3.9 How can Link be considered "a rapid transit system" when its average travel speeds range from 24 to 28 mph?

The projected average light rail operating speed includes the time stopped in stations. This average is faster than the average peak hour speed on regional freeways and arterial streets, and is faster than bus service speeds. Average highway speeds are projected to continue to drop due to congestion. Peak-hour traffic speeds on freeways and major arterials are estimated to drop from 26 mph in 1990, to 14 mph in 2020. Bus service speed is also decreasing as buses are caught in traffic congestion. Average 1998 Metro bus operating speeds are 10.4 mph on Rainier Avenue S., 9.5 mph on Eastlake Avenue, and 4.8 mph along Broadway Avenue on Capitol Hill. In contrast, the light rail system will operate on its own right-of-way for most of its length, unaffected by traffic congestion, resulting in:

- Reliable schedule adherence
- Stable operating costs
- Improved mobility and travel time for riders

3.10 How many new riders will Link attract?

With the preferred alternative, the projected number of light rail daily transit riders is 105,000-110,000 in the year 2010 and 125,300 to 133,000 in 2020, for light rail service between the University District (N.E. 45th Street) and SeaTac. If the system were completed to Northgate by 2010, daily light rail ridership would increase to 124,000 in 2010, and that number is projected to increase to 150,000 by the year 2020. The light rail system would attract 36,000 new daily riders by 2010 and 55,000 by 2020. Regional transit ridership has been declining for decades as a percentage of total trips. Light rail would reduce that trend.

3.11 How would Alternative C1 affect freight movement in the South Downtown (SODO)/North Duwamish Industrial Area?

As a result of comments about freight movement impacts and related business and economic impacts in the Duwamish Industrial area, Sound Transit developed several new or modified route and maintenance base alternatives in Segment C. These alternatives were evaluated in an Environmental Assessment (August 1999), which has been incorporated into the Final EIS. The preferred alternative for this portion of the line places the light rail alignment on the north side of S. Lander Street. Other alternatives would feature elevated sections above S. Lander Street, or would take another route to reach a Beacon Hill tunnel portal.

At-grade and elevated portions of the routes would have similar impacts to truck circulation and access. Where the routes are in the center of the roadways, all left-turn movements to and from unsignalized cross streets and driveways would be prohibited, which could create the need for trucks to make U-turns at signalized intersections or travel out-of-direction before reaching a destination. The at-grade route along the north side of S. Lander Street between the E3 Busway and Airport Way S. would preclude access to some businesses on the north side of the street. The elevated routes would maintain access to most businesses, with a few exceptions. Several of the segment C at-grade alternatives would impact the schedule of freight rail delivery on BNSF railroad spur tracks, while the elevated routes would avoid this impact.

An active traffic control system will be employed to control auto and truck arterial movements crossing the light rail line to and from the north side of S. Lander Street. Access to properties on the north side of S. Lander Street would be limited to Sixth Avenue S. and Airport Way S. Driveway access across the light rail line will not be provided. Auto and truck turning movements to and from the south side of S. Lander Street would be unaffected.

4. LAND USE AND ECONOMICS

4.1 Why isn't Sound Transit's preferred route serving Tukwila's urban center at Southcenter?

The Sound Transit Board has identified the E1.1 route, on Tukwila International Boulevard, as the preferred alternative. The Board identified this preferred route not because it is opposed to serving Southcenter, but rather, because the disadvantages of the Southcenter routes outweigh the advantages in this phase of system development. The primary disadvantages of the E2 and E3 routes are higher cost, longer travel time and lower long-term ridership, as described below and in Section 6.3.5 of the EIS. The E2 and E3 routes would have the advantage of directly serving Tukwila's designated urban center at Southcenter. However, not all urban centers could or would be directly served with light rail in the initial phase of the system. Long-term planning for the system suggests that if there is to be direct light rail service to Southcenter, it would be best, from a regional perspective, to serve that area in a future phase of system construction.

Routes E2 and E3 have higher 2010 ridership within Segment E, but the preferred alternative (E1.1) is faster and attracts more riders from outside Segment E, largely because of the increased speed between the stations in SeaTac and all other stations in the system. As a result, all routes in Segment E have similar system wide 2010 ridership. In subsequent phases, if light rail is extended north or south, longer travel times (associated with the E2 and E3 routes) would affect all of the riders travelling through the southern corridor. This effect would likely result in lower system-wide ridership compared to alternatives that offer faster travel times.

Both E3 and E2, the alternatives serving Southcenter, would have longer travel times and higher costs than the E1 alternatives.

The Southcenter area is an employment and retail center, but currently has no residential land use. Most of the current activities in the potential station areas are "Big-Box" retail and other auto-oriented businesses. Planned development in the Southcenter area is relatively dispersed and auto-oriented.

Although the preferred alternative for the first phase does not include direct light rail service to Southcenter, this preference does not preclude future extensions to Southcenter. A logical future extension alternative would include light rail along SR 518 from SeaTac to Southcenter and possibly continuing into Renton and the east side of Lake Washington. As noted by the Puget Sound Regional Council, "This future rail connection should be supported by a specific redevelopment plan that guides the center's transformation from a regional shopping center into a major activity area that includes a broader mix of land uses, has less land devoted to surface parking, and demonstrates a commitment to a land use pattern that supports walking as a convenient and attractive way to travel" (PSRC letter 2/5/99).

4.2 How can Link serve both the Sea-Tac Airport and the City of SeaTac's Urban Center?

Two of the recommended stations (at the Intermodal Center (IMC) and at S. 200th Street) are within SeaTac's designated urban center and will have good pedestrian connections to other parts of the city center. The IMC station or the NEAT station plan would provide convenient access to the airport. Air passenger access to the airport from the light rail station will be accomplished with an internal automated people-mover.

If no stations are located on the east-side of International Boulevard, local transit service along International Boulevard can provide good access to other areas in the City Center east of the airport. The shuttle vans currently operated by hotels and parking services provide an example of how this area can be served by local transit. The City has also considered investing in a Personal Rapid Transit system since 1990.

Although the predominant uses in the City Center area are commercial services for air travelers, the City is planning for a transition to an urban center with a broader range of activities and services in the future. The transitional nature of the area provides an opportunity for the new City Center to incorporate the light rail stations. Sound Transit is working with the City and the Port to continue refining station options so that light rail can serve both the airport and the urban center in the future. The preferred alternative (Alternative F2.3) also includes a potential city center station at S. 184th Street that would provide service to the city center area.

4.3 Will the surface route on MLK Jr. Way S. damage existing businesses along that section?

Modifications to the preferred alternative have reduced property and business impacts from levels identified in the Draft EIS. Some businesses along MLK Jr. Way would be impacted under any of the alternatives. The narrower right-of-way, analyzed in the Final EIS, reduces the number of property acquisitions but would still result in 84 properties acquired compared to 110 properties for the 104 ft right-of-way. Non-residential displacements for the preferred alternative would be 48, versus 68 for the 104 ft right-of-way alternative. Property owners that are displaced would receive fair value for their property; businesses that are displaced would receive relocation assistance to help them identify and move to new locations in the community if so desired. Sound Transit will also work with affected businesses, the City of Seattle, and the community in order to relocate displaced businesses to other underdeveloped and vacant properties in the area. For more detail, see the discussion of the Central Link Light Rail relocation program in the Displacements and Relocations section of the EIS (4.1.2).

To minimize impacts on businesses during construction, Sound Transit would sequence and time construction, and work closely with affected businesses, to ensure necessary access is maintained or temporarily replaced, and that other temporary impacts are minimized, as discussed in Section 4.17 of the Final EIS.

Further, existing businesses could benefit from the surface route and the potential economic development benefits it could bring to the area. When combined with favorable zoning, financing incentives, and a strong economy, light rail projects have increased station-area development. When successful, the benefits of transit-oriented economic development can include improved mobility, access, and environmental conditions within communities; increased supplies of affordable housing; more efficient urban form; and urban redevelopment. Sound Transit is taking steps to realize the economic development potential associated with the Central Link project. Specifically, Sound Transit is working with the City of Seattle to engage the community in station area planning in order to develop neighborhood plans, policies, and zoning conducive to transit-oriented development. Further, streetscape improvements associated with the project make the area more attractive and pedestrian friendly. The increased number of people in station areas, as well as passing through the area on the train, will increase the visibility of commercial uses to riders; such a change could encourage economic development. Businesses in the area would benefit from transit-related economic development, as well as the project attributes that would tend to support it.

4.4 Will Link cause a change in land use character around station areas? How will changes in land use be managed?

Light rail stations are generally located to serve existing or planned centers of high activity, including employment, services, commercial uses and residential uses. In particular, land uses that encourage or support pedestrian and transit access result in higher light rail ridership. In most developed areas, a new light rail station is not expected to significantly change the character of the surrounding area, but may strengthen or support the continuation of existing land patterns. However, with the presence of supportive market conditions, including appropriate land available at a feasible price; local land use policies supporting development or redevelopment; and appropriate real estate and financial markets, changes can be expected and desired. Land use changes near stations will be managed by local jurisdictions as part of station area planning.

4.5 Is Link consistent with local land use plans?

The light rail project is consistent with land use plans at state, regional and local levels. The Land Use Section (4.1.2) of the EIS discusses light rail's consistency with the state, regional and subarea planning documents. The Draft EIS considered plans that had been approved or adopted by July 1998. The Final EIS considered any additional plans or amendments that have been adopted or approved by April 1999, including several recently completed neighborhood plans. Section 4.1.2.1 covers state and regional land use plans, and 4.1.2.2 covers local land use plans, and lists the neighborhood plans and major institutional master plans that were considered in the review. (The Land Use Technical Report also provides a more detailed discussion of the project's consistency with each of these plans.)

4.6 My property is near the Link project but will not be acquired. How will my property value be affected by the project?

The light rail project has the potential to affect the value of properties close to station areas and light rail facilities through direct and/or indirect changes in local characteristics that affect property value. In general, property values are determined by market forces which are driven by rules of supply and demand. For residential properties, the results of recent research (Chen et. al., 1998) suggests there are four categories of housing attributes that are important in influencing housing prices:

6. Physical attributes of the house, including lot size, house size, number of bedrooms and bathrooms, basement, and age.
7. Neighborhood attributes such as median household income, occupation structure, ethnic mix, school quality, and perceived crime rate.
8. Accessibility and locational attributes such as distance to the central business district and other major business and employment centers.
9. Fiscal and economic characteristics such as property taxes, public facilities, zoning, air quality, proximity to undesirable land uses, and traffic congestion.

Similar characteristics help determine the value of commercial property. These include, for example:

1. Location to markets, access, and parking availability.
2. Neighborhood characteristics such as location, development trends, accessibility to nearby services, and other physical, economic and social factors.
3. Site and building characteristics such as lot size, frontage, zoning and other land use regulations, legal form of ownership, and age and condition of the structure.

In general, the light rail system has the potential to exert two opposing forces on property values: improved transit access and business activity can increase property values, and increased nuisance effects (noise, visual, privacy, reduced vehicle access or parking) can reduce property values. Potential negative property value impacts to adjacent properties will be minimized through appropriate siting of station areas in neighborhood commercial centers and implementation of specific mitigation measures for avoiding or reducing nuisance impacts.

4.7 Will the surface routes damage existing businesses along the rail corridor?

Some businesses along the corridor would be impacted by the alternatives. Property owners that have their property acquired would receive fair value for their property; and businesses that are displaced would receive relocation assistance to help them get established elsewhere. In instances where primary property accesses cannot be maintained or if new access cannot be developed, Sound Transit would also acquire such property. Sound Transit would make every effort to relocate displaced businesses to other properties in their community.

To minimize impacts on businesses during construction, Sound Transit would sequence and time construction, and work with affected businesses, to ensure necessary access and parking is maintained or temporarily replaced, and that other temporary impacts are minimized, as discussed in Section 4.17 of the EIS.

Further, existing businesses could benefit from the surface route and the potential economic development benefits it could bring. When combined with favorable zoning, financing incentives, and a strong economy, light rail projects have increased station-area development. When successful, the benefits of transit-oriented economic development can include improved mobility, access, and environmental conditions within communities; increased supplies of affordable housing; more efficient urban form; and urban redevelopment. Sound Transit is taking steps to realize the economic development potential associated with the Central Link project. Specifically, Sound Transit is working to engage neighborhoods and local jurisdictions in station area planning in order to develop neighborhood plans, policies, and zoning conducive to transit-oriented development. Further, streetscape improvements associated with the project, and the increased visibility of businesses located along the alignment would also encourage economic development. Businesses in the area would benefit from transit-related economic development, as well as the project attributes that would tend to support it.

Other specific benefits may occur as a result of the reconstruction of MLK Jr. Way S. At stations and along the line segment, pedestrian improvements, landscaping, and other amenities would enhance the street, and could support more varied, intensive, pedestrian-oriented urban nodes. This change would be consistent with neighborhood plans, and would be most evident where station areas coincide with existing activity centers. A discussion of individual station area indirect impacts and benefits is found in Section 4.1.2.4 of the EIS.

4.8 What is the Community Investment Fund?

The Sound Transit board proposed the creation of a $50 million Community Investment Fund when it identified a preferred route alternative. The Board's motion read, in part, as follows: "Sound Transit shall establish within the North King subarea budget a $50 million Transit Oriented Community Development Fund to be available to mitigate any impacts of the implementation and operation of light rail in the southeast Seattle Link light rail corridor. The Fund shall be used exclusively to increase transit ridership on the region's high capacity transit system and/or to address project impacts. The Fund shall be used to leverage local, State and Federal dollars for transit-related and transit supportive investments in the southeast Seattle Link light rail corridor" (Sound Transit February 25, 1999). The specific uses of the fund have not been determined at this time. Sound Transit is coordinating with the southeast Seattle community, the City of Seattle, and others to identify specific applications of the fund.

5. ACQUISITIONS, DISPLACEMENTS AND RELOCATIONS

5.1 What will happen to the owners and tenants of acquired properties?

Sound Transit would assist displaced residents and businesses in relocating. The light rail project is being planned and designed to recognize problems associated with the displacement of individuals, families, businesses, and others and to develop solutions to minimize the adverse displacements impacts. Where displacements are unavoidable, Sound Transit would provide relocation advisory services and benefit payments to qualifying families, individuals, businesses, and nonprofit organizations in accordance with federal and state requirements and adopted Sound Transit displacement and relocation policies.

Sound Transit has begun developing a program that is not only consistent with federal and state laws and regulations, but that will fairly and pro-actively address the concerns of owners and tenants. This program, administered by the Sound Transit Legal and Real Estate Department, will include the following characteristics:

- Advance planning with the affected property owners and tenants. Long before any relocation takes place, Sound Transit will work closely with the affected families, businesses, and organizations to understand their desires, concerns, and special circumstances. Sound Transit's Small Business Assistance program will be called upon as needed and desired to help businesses with their logistical, financial, and operational planning. Interpreters will be used to assist those who do not feel comfortable speaking English to provide understanding of what their choices and options are.

- While the ultimate choice of relocation site will be up to the affected family or business, Sound Transit will help with detailed investigation of possible locations. Every effort will be made to relocate those who desire it within their present community or neighborhood.
- The application of regulations and statutes to individual cases will be by the spirit and intent of the law, not by the letter. Special circumstances will be recognized, and pro-active help to solve problems will be the standard required, not the exception. The timing and magnitude of purchase payments and relocation assistance payments will be adjusted to fit circumstances and fundamental concepts of fairness. Sound Transit believes the parameters required to protect the use of public funds are broad enough to allow creative solutions for real problems.

5.2 In regard to property acquisition, what does Sound Transit mean by "partial encroachment" and "full displacement"?

A "partial encroachment" requires acquisition of part of a parcel, but would not dislocate the existing use. An example includes acquiring the front two to three feet of a parcel fronting a roadway, in order to move the sidewalk back and accommodate light rail in the roadway.

A "full displacement" requires that Sound Transit acquire the entire parcel to construct the project, thus displacing the current use. Property owners, tenants, businesses, and others on the property would no longer be able to live on or use the property. Residents, business owners, property owners, and others displaced by full acquisitions are entitled to compensation and other benefits required by law and in accordance with Sound Transit policies. The Final EIS has replaced these terms with "partial acquisition" and "full acquisition" to be more precise.

5.3 I've been notified that my property may be acquired. What will happen next? What should I do about needed improvements to my property?

After a final siting decision is made, Sound Transit will contact all property owners whose property will be directly affected and will answer questions and provide additional information about relocation assistance services, payments, and reimbursement eligibility. Sound Transit's relocation assistance advisory services will include, but are not limited to, measures, facilities, or services that may be necessary or appropriate to determine the relocation needs and preferences of each person, business, and nonprofit organization to be displaced. Sound Transit will provide current information on the availability, purchase prices, and rental costs of comparable replacement dwellings.

Sound Transit is committed to working closely and proactively with families and businesses to help them plan ahead for relocation, assist them to find a new home or sites, and help solve problems as they may occur. Sound Transit has also developed a Small Business Assistance Program that will offer additional means of helping businesses that may be affected by the light rail project. Sound Transit will assist those who wish to remain in their neighborhood find a new location close to their current site. For more details, see Section 4.2.3 of the EIS.

Owners are not required to surrender possession of their property until they have been paid the agreed purchase price or an amount equal to Sound Transit's established estimate of just compensation has been deposited with the court. Owners and tenants will not be required to move their businesses without first being given at least 90 days written notice by Sound Transit.

Regarding needed improvements, it is generally recommended that property owners proceed with planned improvements to their properties or facilities as they deem necessary.

5.4 How will impacted property owners be compensated?

Sound Transit will compensate affected property owners consistent with Sound Transit's adopted Real Estate Property Acquisition and Relocation Policy, Procedures, and Guidelines. These provisions are largely based on the federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 and Uniform Relocation Act Amendments of 1987 and on the State of Washington's relocation and property acquisition regulations (468-100 WAC). These benefits vary depending on the level of impact, available options, and other factors.

Property owners whose entire or partial property will be acquired by Sound Transit will receive just compensation for their land and improvements. Just compensation is an amount paid to a property owner for property acquired for public purposes which is not less than the market value of the property acquired, including damages or benefits to the remaining property. Compensation will include any measurable loss in value to the remaining property as a result of a partial acquisition.

Sound Transit will pay for all normal expenses of sale, including escrow fees, title insurance, pre-payment penalties, mortgage release fees, recording fees, and all typical costs incurred incident to conveying title. The sale will be exempt from real estate excise tax and no real estate commissions are involved. All funds remaining at the end of sale closing will be released to the seller.

Other benefits and compensation may include payment of residential moving expenses and replacement housing payments, nonresidential moving expenses, and reestablishment expenses. Sound Transit's Business Acquisition and Relocation Handbook and Residential Acquisition and Relocation Handbook outlines compensation and acquisition procedures in detail.

To minimize impacts on businesses during construction, Sound Transit will sequence and time construction, and work with affected businesses, to ensure necessary access is maintained or temporarily replaced, and that other temporary impacts are minimized, as discussed in Section 4.17.

5.5 If I lose access to my property, what happens?

If primary property accesses cannot be maintained, Sound Transit will work with property owners to determine if secondary access is available or if new access can be developed. If sufficient access cannot be provided, Sound Transit will acquire the property. All federal, state, and Sound Transit acquisition and relocation services and reimbursement policies and requirements would then apply to the displaced property owners, residents, tenants, and others affected by the displacement.

5.6 What will happen to the Filipino Community Center?

Based on current engineering plans for the preferred alternative, Sound Transit would need to acquire all of the Filipino Community Center's property. As a displaced property owner, the Filipino Center would receive fair market value for their property and improvements. In addition, they would be entitled to relocation assistance which includes moving of personal property, re-establishment cost, and advisory services to help them locate a replacement site. A complete list of assistance available to the property owner would be discussed by Sound Transit's relocation specialist prior to making a formal offer to purchase their property.

The Filipino Community Center in particular has historically played a critical role in the community providing childcare, senior activities, recreational activities, a resource and learning center, a location for diplomacy (for visiting dignitaries and elected officials from the Philippines), and a meeting place for the diverse population of the Rainier Valley. Relocation to a site within the valley would be important in allowing these types of community activities and services to continue. The removal of community facilities can pose barriers to social interaction, if not relocated within the community.

6. NEIGHBORHOODS AND ENVIRONMENTAL JUSTICE

6.1 How will the project affect minority and low income populations?

A comprehensive evaluation of the project's potential effects on minority and low-income populations is described in Appendix G - Environmental Justice, as required under Executive Order

12898 and the U.S. Department of Transportation's order on environmental justice (DOT Order 5610.2). This analysis considers whether the project would have a disproportionately high and adverse affect on minority and low-income populations. Consistent with the DOT Order, offsetting benefits to the affected populations and mitigation and enhancement measures are also considered.

A number of impacts identified in the Final EIS would not be differentially distributed among minority or low-income segments of the population. These include impacts to ecosystems, including wetlands, freight movement, water resources, and geology and soils. Other impacts considered in the Final EIS would be minor or beneficial. These include hazardous materials, public services, visual resources, parklands, historic and archeological resources, and electromagnetic fields.

Some impacts identified in the Final EIS, however, could be distributed differentially among the minority or low-income populations. Further evaluation of these effects indicates that, for the preferred alternative, neighborhood, noise, and vibration, and transportation impacts would be minimized through design modifications and the use of mitigation measures. These modifications and mitigation measures include reducing the right-of-way for at-grade alternatives to reduce displacements; the installation of residential sound insulation and, where desired, sound walls; and additional traffic signals, pedestrian signals, parking mitigation, and streetscape improvements. Many of these modifications were developed after issuance of the Draft EIS.

Impacts that could have statistically greater effects on minority and low-income residents are residential and non-residential displacements, and construction impacts. Sound Transit's provision of relocation assistance and other measures would substantially mitigate displacement impacts. Temporary construction impacts would be mitigated through a variety of measures, including preparation of detailed construction traffic plans, providing notice of temporary street closures and changes in transit service, and scheduling traffic lane closures during off-peak hours to minimize traffic delays.

Appendix G also analyzes the substantial benefits that would accrue to minority and low-income populations as a result of the project. These benefits include improved access to transit, transit travel times savings, and expanded access to employment, education, health care and other amenities. An improvement program for existing street rights-of-way, including upgraded pedestrian amenities, street improvements, landscaping and other beautification features, is built into the preferred alternative. Many of these improvements would be concentrated along MLK Jr. Way S., S. Edmunds Street, S. Henderson in Segment D and Tukwila International Boulevard in Segment E. These benefits would accrue more significantly to minority and low-income populations.

Further, because light rail exposes riders to new areas and businesses and increases pedestrian activity in station areas, being located near the rail line may be economically beneficial. These secondary benefits would likely be provided principally to those located near stations. Finally, Sound Transit has also proposed a $50 million Transit Oriented Community Development Fund (Motion M99-14, adopted February 25, 1999) to benefit the Southeast Seattle light rail corridor. This fund would benefit the minority and low-income residents in that area.

The project effects on the minority and low-income populations are limited when viewed in the context of the Central Link project as a whole and would be subject to effective mitigation measures. The project would not have disproportionately high and adverse effects on the minority and low-income populations of the Sound Transit District. Further, the benefits of light rail discussed above are substantial and would accrue more significantly to minority and low-income populations. These benefits support the conclusion that the project would not have disproportionately high and adverse effects.

6.2 How will Link affect neighborhood character?

The light rail project would likely have both beneficial and adverse effects on neighborhood character, including changes in neighborhood quality, social interaction, safety and security and impacts, and benefits to minority, and low income populations. Displaced or relocated homes and businesses, the presence of light rail facilities (especially along at-grade sections), traffic and parking impacts, increased noise, altered views and visual features from the light rail project could affect neighborhood quality. The light rail project would also provide improved transit accessibility on urban design amenities along at-grade sections such as street trees and sidewalks. Generally, neighborhoods in areas where the light rail route is underground or located along freeways (Segments A, B, and C) would be affected very little. Impacts would be low to moderate in the Rainier Valley and Tukwila where the route would be at-grade (Segments D and E). In Segment F, impacts would be low because the route would be primarily elevated on airport property.

All neighborhoods served by the light rail stations would benefit from increased transit access. Also, where surplus properties can be redeveloped, the neighborhoods may benefit from the new uses and activity. This access and development would take place in coordination with the neighborhoods and in a manner consistent with neighborhood planning goals. Improvements to street features could include; street trees, pavers, widened sidewalks, street furniture, and turn-out lanes. With proposed mitigation, neighborhood plans, and improved transit access, social interaction opportunities, general neighborhood quality, and other important community elements could improve in the long-term.

It is important to note that many of the locally adapted neighborhood plans also call for changes in neighborhood uses or character that require replacing some existing land uses and redeveloping some properties. These types of changes can be disruptive, but are nevertheless consistent with the neighborhood plans developed by the neighborhood residents.

6.3 Will Link running on the surface divide neighborhoods, particularly along MLK Jr. Way S. and Tukwila International Boulevard?

The at-grade light rail sections on MLK Jr. Way S. in southeast Seattle and on Tukwila International Boulevard and International Boulevard S. in Tukwila and SeaTac will include a dedicated, 4- to 6-inch curbed trackway with trains running down the middle of the streets. Unsignalized cross streets and driveways on MLK Jr. Way S. or Tukwila International Boulevard would be allowed right-in/right-out access only, making local access more circuitous in some areas on or near the route. Similarly, pedestrian crossings would be allowed only at signal-controlled locations.

While some access impacts would occur, the at-grade light rail sections were not found to further divide neighborhoods. MLK Jr. Way S., Tukwila International Boulevard, and International Boulevard S. are all major north-south arterial routes that act as dividers themselves. Neighborhoods are generally built along these natural dividers. This is especially true on Tukwila International Boulevard/International Boulevard S., where the highway currently defines the edges of Tukwila and SeaTac neighborhoods. Some of the neighborhood divisions along MLK Jr. Way S. are not as distinct; some parts of the MLK Jr. Way S. at S. Holly Street neighborhood are located along both sides of MLK.

Design and mitigation measures such as adding new signalized intersections and turn lanes, adjusting signal timing, and providing additional or improved pedestrian crossing features will help minimize these access impacts, not further divide existing neighborhoods. Also, light rail stations can reinforce existing activity centers and support developing, pedestrian-oriented activity centers. This activity, in turn, can support community cohesion and identity of place in a community. The potential impacts and benefits of light rail on neighborhoods is described in more detail in Section 4.3.2 of the EIS.

In response to public and agency comments, the preferred alternative in Segment D (D1.1e) and Segment E (E1.1) include new signalized intersections and pedestrian-only crossings. For more detail on the improvements and other changes to minimize impacts of the preferred alternative, see Section 2.1.3.2 of the EIS, and the related definition of the alternatives in Section 2.1.3.3.

6.4 What will happen to churches and other community gathering places that are affected by the project?

Churches and other community gathering places that are displaced or partially acquired will receive just compensation and other services under federal and state law and Sound Transit policies just like other displaced properties. In addition, Sound Transit is committed to working closely and proactively with churches and community groups to help them plan ahead for relocation, assist them to find new sites, and help solve problems as they may occur. Sound Transit will assist those who wish to remain in their neighborhood find a new location close to their current site. Sound Transit will work closely with neighborhood groups and churches to identify the most appropriate locations for relocating community facilities and to notify the affected community well in advance of relocation or other impacts. Sound Transit will also provide interpreters and translated materials as needed for non-English-speaking populations, most notably in the Rainier Valley.

If a church or community gathering place is affected but not displaced, Sound Transit will strive to provide access to these existing facilities is maintained so that these groups and facilities can continue to function as normally as possible in their community. Sound Transit will work with these groups to address issues and find possible solutions to other potential impacts, including parking impacts, pedestrian access, noise, and general neighborhood and community social impacts. Proposed design efforts and mitigation such as station planning, parking control measures, public education, pedestrian access and safety measures, noise and vibration solutions, and others will help minimize the potential impacts from the light rail system.

Sound Transit has worked with the local groups and churches along MLK Jr. Way to reduce, as much as possible, the need to acquire properties occupied by churches and community facilities.

7. VISUAL

7.1 Will elevated Link trackway block views?

The majority of the Link trackway, especially the preferred alternative, would be either at street level or underground. In these areas, there would be very little view blockage. Some elevated sections would block existing views, as described in the EIS, Section 4.4. In Segment A, the track height has been reduced to minimize view impacts of the alternatives being considered.

7.2 What are the visual impacts of noise walls?

To be effective, noise walls must block the line-of-sight between the noise source and the receiver. This means the height would vary depending on whether the track is elevated, the distance from the walls to the track, and topography. Where used along elevated sections, noise walls would only need to be about 4 ft high to block wheel noise, which is the same height as proposed railings. Along at-grade sections, noise wall height would typically be 6 to 40 ft high. However, it is important to note that Sound Transit does not intend to install sound walls where the walls would adversely impact access, views, or community character. Other mitigation options, such as residential sound insulation would be used to mitigate noise without impacting views or access. Sound Transit will work with affected property owners to determine appropriate noise mitigation measures. See the Response to Common Comment 8.3 below.

8. NOISE

8.1 Will tunneling cause vibration damage to structures at the surface?

It is highly unlikely that tunneling will cause vibration damage. Tunneling is proposed for the construction of portions of the route in segments B and C. A tunnel-boring machine would be used in each of these segments. The depth of the tunnel under the surface would exceed 100 ft in most of these areas, including the University District, Capitol Hill, First Hill and Beacon Hill. The locations where the tunneling has the potential to affect structures on the surface are near portals, where the tunnel would be less deep, such as in portal areas on the east side of Beacon Hill. Although structural damage is not typical, it can happen in rare circumstances due to encountering unexpected geologic conditions. Buildings where tunneling has the potential to affect structures will be photo documented prior to construction and will be monitored during construction to document potential vibration effects.

8.2 How will noise mitigation be determined?

Potential mitigation measures are described in the Final EIS, which further evaluates noise impacts and clarifies mitigation commitments and potential mitigation. Noise mitigation decisions will be made during the on-going design process, which will include community input from affected residents and businesses and relevant jurisdictions and agencies. Mitigation decisions will be based on effectiveness, cost, impacts, and community and property owner input.

8.3 What are the noise mitigation options? Will noise walls be used? What are the impacts of noise walls?

Noise mitigation options include:

- Installing sound walls between the source and the receivers
- Providing sound insulation in affected residential buildings
- Using ballast and tie track in place of tracks imbedded in a concrete slab
- Placing strict noise limits on the specifications for the light rail vehicles
- Proper maintenance of rails and LRV wheels
- Reduce train lengths or frequency of service
- Reduce train speed

Noise walls would be used only in locations where they would not significantly impact access and where they would be compatible with neighborhood character and urban design.

- Low noise walls along sections of elevated tracks can help to reduce noise impacts for adjacent land uses
- Noise walls need to interrupt the line-of-sight between the LRV and adjacent land uses and must be continuous in order to provide an effective noise shield
- The impacts of noise walls can include blocking views and interfering with access and circulation. Residential building sound insulation will be used where noise walls are unacceptable or inappropriate.
- At-grade noise walls would be designed to aesthetically fit the character of the surrounding area. Design treatments could include varied color, texture, and shape or contour. Community-based design efforts can also be used to integrate community elements into the wall designs.

8.4 What are the noise mitigation measures for residences impacted in Rainier Valley?

Noise mitigation in Rainier Valley would include adding sound insulation in the buildings. Sound walls are proposed at limited locations if supported by property owners. The EIS describes mitigation measures in greater detail.

9. ECOSYSTEMS

9.1 Will the E1.1 and E1.2 alternatives impact the Riverton Side Channel Joint Restoration Project?

Based on preliminary designs for the elevated tracks in the vicinity of the Riverton Side Channel project, at least one pier may be located in riparian wetlands associated with Riverton Creek. The elevated tracks at the project area are likely to be 50 ft to 70 ft above the average ground elevation.

The most important issue at the Riverton Side Channel Joint Restoration project site is coordination between the Restoration team and Sound Transit. Coordination of the designs for both projects would result in their successful implementation. Sound Transit is currently coordinating with the restoration project proponents to identify potential conflicts so designs for both projects could be refined to minimize potential conflicts and maximize habitat benefits.

Because the Riverton Side Channel project is likely to be completed prior to the start of construction for this segment of the light rail, the second most important issue is construction of the light rail in the vicinity of the Riverton Side Channel project. Construction impacts would be temporary and would be reduced by:

- Prescribed sequencing and timing of construction in this area to minimize erosion potential and cumulative effects, and to avoid fish migration periods.
- Implementing a Temporary Sediment Erosion Control Plan including routine sampling of water quality at the project site
- Implementing best management practices
- Locating staging areas outside the Riverton Side Channel project area
- Using a debris tarp to catch materials from construction of the pilings and tracks when work is conducted over or near the Riverton Side Channel project area.

Long-term impacts to the Riverton Side Channel project resulting from the operation of the light rail are expected to be minimal. Because the tracks at the Riverton Side Channel project would be elevated 50 ft to 70 ft above ground, vegetation would still grow below the structure. Trees would likely represent a problem under the light rail elevated guideway, but shrubs and herbs, which also provide important riparian habitat could be planted in sections where the projects overlap. The amount of stormwater runoff generated from the elevated tracks would be minimal. Proper collection and disposal would eliminate potential impacts to water quality associated with runoff from the trackway.

9.2 How will the project affect the efforts to "daylight" Thornton Creek?

Constructing an extension of Thornton Creek in the vicinity of the Northgate Mall has been proposed as an element of plans to redevelop the area. The General Development Plan for the mall property, approved by the City, does not include construction of a creek on mall property. If the channel is extended, the light rail project in this area would be designed to avoid impacts or, if impacts are unavoidable, to mitigate impacts to the extended channel.

9.3 How can impacts to wetlands and sensitive areas be reduced?

Impacts to wetlands and sensitive areas are being reduced by:

- Planning the project to avoid or minimize wetlands and sensitive areas
- Designing alternatives to reduce their direct impact on wetlands and sensitive areas (i.e., elevating versus at-grade through wetlands)
- Choosing the alternative with the least direct or indirect impacts to wetlands and sensitive areas where possible.
- Requiring stringent construction sequencing to limit the exposure of resources
- Implementing temporary erosion and sediment control plans and other best management practices that aim to reduce impacts on biological resources.

Means to reduce impacts on biological resources proceed through a hierarchy of avoidance, minimization, and compensation for unavoidable impacts. Avoiding impacts on wetland and sensitive areas begins at the earliest stage of preliminary design development. During the preliminary design phase, existing information on sensitive areas, including wetlands, wildlife habitat corridors, erosion and landslide hazards, streams, and rivers were mapped on photos for the design team's use. Sensitive areas were considered to the extent possible in identifying the initial alternatives. Alternatives located within or near sensitive areas were then refined to minimize impacts to the greatest extent reasonable. These measures include:

- Spanning river crossings from bank to bank rather than placing pilings in the channel or 100-year floodway
- Locating pilings for elevated portions of the tracks adjacent to wetlands rather than in them
- Elevating an alternative rather than constructing it at-grade to reduce wetland impacts
- Installing stormwater collection facilities
- Using pre-cast girders for the bridge spans to reduce the amount of work necessary over major waterways
- Timing construction near rivers, streams, and wetlands to the low-flow season when fish are not migrating through the channel.

When direct unavoidable impacts occur, compensation is required at a minimum ratio of 1:1 acre. The type of compensation is determined with local, state, and federal agencies with jurisdiction at the point of impact. The light rail project is currently developing mitigation plans that incorporate compensation for resource impacts. The mitigation plan would ideally provide compensation to the resource affected. In the case of impacts associated with river crossings, suitable mitigation would occur near the point of impact, and would compensate for wetland, flood storage, riparian habitat, and in-stream habitat losses.

10. ELECTROMAGNETIC FIELDS (EMF)

10.1 How will EMF affect nearby areas?

As discussed in the EIS and EMF Technical Back-up Report, human health impacts are not expected to be significant, and do not differ among the alternatives, based on:

- EMF measurements on similar transit systems; and
- Guidelines – International Commission of Non-ionizing Radiation Protection (ICNIRP) Guidelines (based on best available health information with a safety factor built in due to uncertainties of effects);

- Distance of external receptors from source – MBTA (Massachusetts Bay Transportation Authority) measurements within system facilities are below ICNIRP guidelines, so that external receptors, which are at greater distances, would experience even lower exposures.

The electromagnetic fields produced by the project could impact research activities at the University of Washington Physics and Astronomy building in the vicinity of NE 15th and NE Pacific. Sound Transit and university staff and faculty have identified these impacts and has developed measures to mitigate these impacts. No other non-health (electromagnetic interference) impacts are expected. The EIS and EMF Technical Back-up Report provides additional detail.

11. PUBLIC SERVICES

11.1 How will the surface sections affect emergency response time?

Passing trains could briefly delay emergency vehicles attempting to cross the light rail tracks. Sound Transit estimated emergency vehicle delays at signalized at-grade intersections, assuming that emergency vehicles can preempt the light rail train. At intersections with no light rail station, 88 percent of emergency vehicle trips moving through signalized intersections would not be delayed, 4 percent would be delayed by 0 to 10 seconds, and 8 percent would be delayed by 10 to 30 seconds. At intersections where a station platform is located just past the street crossing, a train that is reducing speed to stop at the platform will take longer to clear the crossing. In these cases, 81 percent of emergency vehicle trips would not be delayed, four percent would be delayed by 0 to 10 seconds, and 15 percent would be delayed by 10 to 45 seconds.

Restricting left-hand turns to signalized intersections would delay emergency vehicles by requiring them to use the next signalized intersection and possibly backtrack to emergencies occurring on the opposite side of the road. However, Sound Transit is proposing to allow left-hand turns for emergency vehicles only, thereby preventing significant delays during emergencies. In addition, proposed measures to design at-grade tracks and curbs that would physically allow emergency vehicles to cross the tracks immediately if deemed necessary would minimize delays. Portland, Oregon's MAX system does not appear to affect response time for police, fire, or medical emergencies. Sound Transit's Fire-Life Safety Committee is currently working with local police and fire departments to identify specific response time problems and develop solutions to minimize or prevent potential delays.

11.2 How will school bus routing and safety be affected?

School buses traveling along, crossing, or making turns from some major roadways in the light rail project area could experience some delays during light rail operation. Passing trains, restrictions on left-hand turns on at-grade and elevated sections, and general road and intersection level-of-service degradation in some areas would be the primary causes of these delays, especially on roads such as MLK Jr. Way S., Tukwila International Boulevard, and International Boulevard S. However, traffic mitigation proposed at intersections that could experience the greatest delays, such as adding turn lanes and traffic signals, re-striping, and adjusting signal timing, would substantially reduce potential delays. Delays during light rail construction could be more substantial in certain areas depending on the location affected and construction duration. Sound Transit will work with the school districts to inform them of construction schedules so that alternative routes can be planned for during construction.

Ensuring that school children in the project vicinity are safe during light rail construction and operation will be of highest priority. Design measures such as installing signalized pedestrian crossings at strategic locations; adding sidewalks; continuing to discourage or disallow children to cross MLK Jr. Way S., Tukwila International Boulevard, and International Boulevard; and working closely with the Seattle, Tukwila, and Highline school districts to educate school officials and students about safe crossing practices would help ensure the safety of school children.

11.3 What will Sound Transit do to prevent increases in criminal activity and vandalism at station areas and park-and-ride lots?

Incidents of crime and vandalism could occur in certain areas of the light rail system, such as around stations and parking facilities. Light rail operation could provide additional opportunities for attempted car thefts, robberies, loitering, and general mischief, particularly at night. To help minimize these potential impacts, Sound Transit is developing a security plan in coordination with local police departments to address security and policing efforts in the vicinity of light rail stations, tunnels, and park-and-ride facilities. At a minimum, the security plan requires Sound Transit to do the following:

- Provide security personnel to rove between stations. These personnel would likely be contracted with local law enforcement or private agencies, but could be provided by Sound Transit.
- Install closed circuit television at selected stations.
- Provide methods to allow vehicle operators and fare inspectors to be able to identify and report security problems.
- Lock or otherwise prevent access to tunnel and elevated stations when the light rail system is closed.

In addition, Sound Transit will continue to work with local police departments to implement crime prevention through environmental design (CPTED) principles. This could include design elements such as installing appropriate lighting around the station areas, tunnels, parking facilities, and other facilities, and incorporating other design features to deter crime.

11.4 How will Sound Transit evacuate the light rail system in the event of emergency, especially emergencies in the tunnel or on elevated sections?

The preferred method of evacuation is by use of a second train on the non-incident track. Throughout the system's tunnel sections, passageways will connect the two tunnel bores to permit passengers to reach the non-incident tunnel in the event of an emergency. For those unusual cases where it is not practical to use a second train, Sound Transit light rail is following the requirements for evacuation and areas of safety set out in the Washington State Building Code, Washington State Fire Code, and National Fire Protection Association's Standard for Fixed-guideway Transit Systems. The latter standard, from the National Fire Protection Association, is of particular importance because it was developed especially for transit systems. The standard considers the evacuation of elevated, tunnel, and at-grade stations and trainways. In addition to having safety specialists on our staff and consultants' staffs, Sound Transit has formed a Fire-Life Safety Committee comprised of fire marshal representatives from King County, Port of Seattle, Renton, SeaTac, Seattle, and Tacoma, with support from others with fire-life safety responsibilities. This Committee advises on fire-life safety criteria and identifies issues of concern, which Sound Transit must resolve to that Committee's satisfaction. The emergency procedures developed in conjunction with the Committee will address the circumstances calling for evacuation from elevated and tunnel sections, and how the evacuation is to be conducted. Train operators and emergency-response personnel will be trained and drilled in exercises based on these procedures.

12. CONSTRUCTION

12.1 What is the projected construction schedule? How will that differ for station areas and type of trackway, i.e., cut & cover, at-grade, elevated, tunnel?

Light rail construction is expected to begin in late 2000. Light rail vehicle testing would begin in 2005 and light rail operations would begin in 2006. See Section 4.17 for a detailed discussion of construction time-frame, sequencing and techniques for various types of trackway and profiles.

12.2 Where will staging areas be located for tunnel sections?

Building the light rail system will require staging areas for the temporary storage and transfer of materials and equipment. Staging areas for tunnel construction will typically be located at tunnel portals and may also be located at vent and station shafts. As design progresses, Sound Transit and contractors are further refining staging needs and areas. As noted in the Final EIS, Section 4.17, construction staging areas have been identified and are shown in Appendix H.

12.3 How will construction impacts be mitigated?

The Final EIS, Section 4.17, discusses potential construction mitigation measures. The mitigation measures vary considerably according to the type, extent and location of impact. Mitigation measures have been refined and are discussed in more detail throughout the Final EIS.

The EIS process has also included the development of a mitigation plan, incorporating available information from preliminary design activities to date. The mitigation plan will continue to be refined throughout project design and construction. Sound Transit is also continuing its public outreach activities to provide more information about construction sequencing, duration, equipment to be used, work force, their impacts, and mitigation measures.

12.4 Where will spoils from tunneling go?

Although disposal sites cannot be finalized at this time, numerous existing and potential future locations have been identified throughout the Puget Sound area. The Link Light Rail Tunnel Excavation Disposal Study (Reid Middleton 1999) lists the existing and potential sites that have been considered. These sites are summarized in Section 4.17 – Construction Impacts. The disposal site(s) will be selected as the disposal dates draw nearer so that any decisions can be based on the latest information regarding site capacities, disposal costs, hauling options, permitting requirements and other needs.

Section 4.17 – Construction Impacts identifies and evaluates likely stockpile areas, truck haul routes and a potential barging plan (for spoils removed from the Pacific Station shafts).

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