South North
Transit Corridor Study

South/North Corridor Project

DEIS Executive Summary

April 1998

SOUTH/NORTH CORRIDOR PROJECT
CLACKAMAS AND MULTNOMAH COUNTIES, OREGON
CLARK COUNTY, WASHINGTON

DRAFT ENVIRONMENTAL IMPACT STATEMENT

Submitted Pursuant to the National Environmental Policy Act
42 U.S.C. 4322(2)(c)

by the

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL TRANSIT ADMINISTRATION

and

METRO

and

THE SOUTHWEST WASHINGTON
REGIONAL TRANSPORTATION COUNCIL

In Cooperation with

U.S. ARMY CORPS OF ENGINEERS, PORTLAND DISTRICT
FEDERAL HIGHWAY ADMINISTRATION
U.S. COAST GUARD
TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON

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Date of Approval

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Abstract

The proposed action would be an improvement to the existing urban transportation system in the Portland, Oregon/Vancouver, Washington metropolitan region. Alternatives considered include the No-Build Alternative, four light rail length alternatives, 16 light rail alignment alternatives and 22 light rail design options. Locations for transit stations, park-and-ride lots and a light rail operations and maintenance facility are also evaluated. The analysis and impact assessment considered potential long-term and short-term effects on transit service, ridership, accessibility, regional and local roadways, freight movements, navigable waterways, land use, economics, neighborhoods, visual and aesthetic resources, ecosystems, water quality and hydrology, geology, noise and vibration, energy, hazardous materials, parklands, historic and cultural resources and public services. The analysis also considered the financial feasibility and cost-effectiveness of the alternatives. The information resulting from these studies will be used to select a Locally Preferred Strategy for the South/North Corridor.

Comments on this document may be submitted in writing or may be made orally at a public hearing. Written comments should be submitted to Mr. Leon Skiles, South/North Project Manager, at the above address. Information on the public hearing and public comment period can also be obtained from Mr. Leon Skiles.

Comments due by: Friday, April 24, 1997.

This document has been revised to reflect the corrections indicated in the April 14, 1998 Executive Summary Errata Sheet.

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TABLE OF CONTENTS

LIST OF TABLES

Executive Summary

Appendix A

LIST OF FIGURES

LIST OF PROJECT NOMENCLATURE

This DEIS discusses the South/North Transit Corridor alternatives and options, including the No-Build Alternative, four light rail length alternatives and several light rail alignment alternatives, design options and terminus options.

The following provides summary definitions of selected study nomenclature, including the types of alternatives and options that define the range of alternatives for the South/North Corridor. The Glossary near the back of this DEIS provides definitions of other terms used in the Draft Environmental Impact Statement (DEIS). More complete descriptions of each alternative and option, are included in Chapter 2 of this DEIS.

South/North Transit Corridor Study. The full collection of the studies and processes associated with the proposed South/North Light Rail Project. Those studies and processes include the Preliminary Alternatives Analyses, Tier I Narrowing of Alternatives, Design Option Narrowing, Major Investment Study, Cost-Cutting, DEIS, Locally Preferred Strategy, Final EIS, Preliminary Engineering, Final Design and other steps.

South/North Alternatives and Options. Includes all actions being considered in the DEIS, including the No-Build Alternative (All-Bus) and light rail length alternatives (Full-Length and Minimum Operable Segments), alignment alternatives, terminus options and design options.

South/North Light Rail Alternatives. Includes the Full-Length Alternative and all MOSs.

Length Alternatives. Length alternatives specify alternatives that vary in the designation of south and north terminus points (and thus, the overall length of the project) for the proposed light rail line. Length alternatives other than the Full-Length Alternative are considered to be interim phases of the full South/North Project and are termed Minimum Operable Segments (MOSs).

Minimum Operable Segment (MOS). A shorter segment of the Full-Length Alternative that could be successfully operated on an interim or long-term basis and that could be extended to the Full-Length Alternative at a later time. Three MOSs are discussed in this DEIS (MOSs 1, 2 and 5). MOS 3 and 4 were removed from further study as a result of the Cost-Cutting process.

Alignment Alternatives. Alignment alternatives specify the general location of light rail alignment choices within a given segment of the South/North Corridor.

Design Options. Design options specify detailed route choices within an alignment alternative.

Terminus Options. Terminus options are alternate sites or facility configurations for the northern or souther terminus location associated with a length alternative.

Full-Length Alternative – a proposed 21-mile, double-tracked light rail alignment, stations, park-and-ride lots and bus and light rail service improvements that would extend from the Clackamas Regional Center, through Milwaukie, southeast Portland, downtown Portland, north Portland and downtown Vancouver to Clark College.

MOS 1 (Bi-State) – a proposed 18-mile, double-tracked light rail alignment, stations, park-and-ride lots and bus and light rail service improvements that would extend from the Milwaukie Regional Center, through southeast Portland, downtown Portland, north Portland and downtown Vancouver to Clark College.

MOS 2 (Rose Quarter) – a proposed 12-mile, double-tracked light rail alignment, stations, park-and-ride lots and bus and light rail service improvements that would extend from the Clackamas Regional Center, through downtown Milwaukie, southeast Portland and downtown Portland to the Rose Quarter.

MOS 5 (Lombard) – a proposed 16-mile, double-tracked light rail alignment, stations, park-and-ride lots and bus and light rail service improvements that would extend from the Clackamas Regional Center, through downtown Milwaukie, southeast Portland, downtown Portland, to North Lombard Street in north Portland.

Clackamas Regional Center Segment. Refers to the segment beginning east of the Clackamas Town Center, extending west along SE Sunnyside and SE Harmony Roads to SE Cedarcrest Drive.

East Milwaukie Segment. Refers to the segment extending west from SE Cedarcrest Drive along the UPRR line and SE Railroad Avenue, or along SE Harmony Road and Highway 224.

Milwaukie Regional Center Segment. Refers to the segment from where Highway 224 crosses over the UPRR line in Milwaukie, extending north along the UPRR line to SE Tacoma Street.

McLoughlin Boulevard Segment. Refers to the segment extending north from SE Tacoma Street along SE McLoughlin Boulevard and along the UPRR line to SE 20th Street.

South Willamette River Crossing Segment. Refers to the segment extending north from SE 20th Street, extending north across SE McLoughlin Boulevard and crossing the Willamette River via a new bridge in the vicinity of either Ross Island or south of the Marquam Bridge to SW Front Avenue and SW Harbor Drive.

Downtown Portland Segment. Refers to the segment that extends SW Harbor Drive and SW Front Avenue through downtown Portland, on SW 5th and 6th Avenues, and across the Willamette River on the existing Steel Bridge to the Rose Quarter.

Eliot Segment. Refers to the segment that extends from the Rose Quarter, north along I-5 including the Eliot Neighborhood to the Edgar Kaiser Medical Facility.

North Portland Segment. Refers to the segment extending north from the Edgar Kaiser Medical Facility, along N Interstate Avenue and I-5, to the Portland Expo Center, just south of the North Portland Harbor.

Hayden Island/Vancouver Segment. Refers to the segment that crosses the North Portland Harbor, Hayden Island and the Columbia River, and extends north through downtown Vancouver to the Vancouver VA Medical Center/Clark College area.

LIST OF ACRONYMS

AA - Alternatives Analysis
ACHP - Advisory Council for Historic Preservation
Btu - British Thermal Unit
CBD - Central Business District
CCC - Clackamas Community College
CCTMP - Central City Transportation Management Plan
CERCLIS - Comprehensive Environmental Response, Compensation and Liability Information System
C-TRAN - Clark County Public Transportation Benefit Area Authority
CTC - Clackamas Town Center
dBA - A-weighted decibel
DEIS - Draft Environmental Impact Statement
ECSI - Environmental Clean-up Site Information
EIS - Environmental Impact Statement
FEIS - Final Environmental Impact Statement
FFGA - Full Funding Grant Agreement
FTA - Federal Transit Administration
FY - Fiscal Year
HCT - High Capacity Transit
LOS - Level of service
LPS - Locally Preferred Strategy
LRT - Light Rail Transit
LRV - Light Rail Vehicle
MAX - Metropolitan Area Express (existing eastside LRT system)
MIS - Major Investment Study
MOA - Memorandum of Agreement
MOS - Minimum Operable Segment
N - North
NE - Northeast
NW - Northwest
NEPA - National Environmental Policy Act
O&M - Operations and Maintenance
OAHP - Office of Archaeology and Historic Preservation
ODOT - Oregon Department of Transportation
OMSI - Oregon Museum of Science and Industry
P&R - Park and Ride
Pre-AA - Preliminary Alternatives Analysis
ROW - Right-of-Way
RTC - Southwest Washington Regional Transportation Council
RTP - Regional Transportation Plan
SE - Southeast
SHPO - State Historic Preservation Officer
SW - Southwest
TIP - Transportation Improvement Program
Tri-Met - Tri-County Metropolitan Transportation District of Oregon
UGB - Urban Growth Boundary (Oregon)
UPRR - Union Pacific Railroad
VA - Veterans Administration Medical Center in Vancouver
V/C - Volume to Capacity Ratio
VHT - Vehicle Hours Traveled
VMT - Vehicle Miles Traveled
YOE - Year of Expenditure

2040 - Region 2040 Growth Concept

S. EXECUTIVE SUMMARY

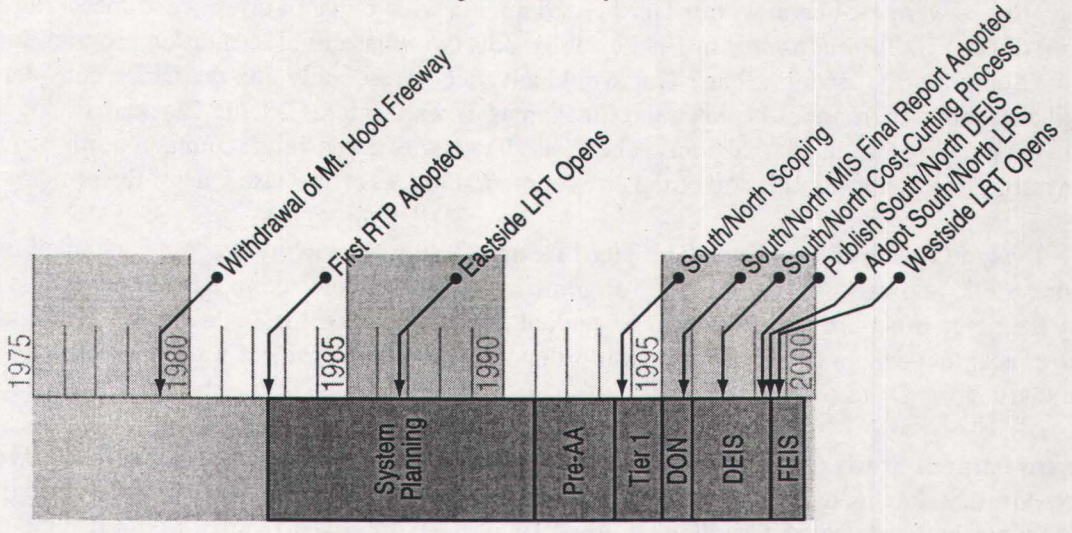
This document summarizes the South/North Project Draft Environmental Impact Statement (DEIS): the project history and decision-making process; the alternatives considered; the anticipated transportation impacts of the alternatives; the anticipated environmental consequences of the alternatives; and the financial and cost-effectiveness evaluation of the alternatives. It also lists a series of issues to be resolved in subsequent phases of the project.

The South/North DEIS has been prepared in compliance with the National Environmental Policy Act (NEPA). The Federal Transit Administration (FTA) is the Federal lead agency for the DEIS. Metro and the Southwest Washington Regional Transportation Council (RTC) are the local lead agencies. Preparation of the DEIS is a step in the Federal transportation project development process that is intended to be an integral part of a metropolitan area's long-range transportation planning process in order to provide decision makers and the public with better and more complete information before final decisions are made. The purpose of the DEIS is to summarize the benefits, costs and impacts associated with the proposed alternatives, and to provide citizens, agencies and jurisdictions with information needed to make an informed judgement when selecting the preferred alternative to advance into the next stages of project development.

S.1 Project History and Decision-Making Process

The need to examine high capacity transit (HCT) options in the South/North Corridor was established over two decades of system and sub-area planning studies. Following is a description of the study stages that have culminated in the development of the DEIS (see Figure S.1-1 for a time line illustrating these project phases).

Figure S.1-1
South/North Project Development Time Line



List of Acronyms

DEIS - Draft Environmental Impact Statement	LRT - Light Rail Transit
DON - Design Option Narrowing	MIS - Major Investment Study
FEIS - Final Environmental Impact Statement	Pre-AA - Preliminary Alternatives Analysis
LPS - Locally Preferred Strategy	RTP - Regional Transportation Plan

- **System Planning Studies.** Since the mid-1980s, there has been a series of major transportation analyses and actions taken that implemented the region's basic policy shift away from constructing radial freeways and toward a greater emphasis on meeting travel demand through improvements in public transit. Between 1984 and 1986, Metro, in cooperation with its regional partners, conducted a Phase I study of transitway alternatives in the region that recommended that Phase II (i.e., an EIS) studies of light rail be undertaken in the I-5, McLoughlin Boulevard and I-205 corridors. In Clark County, Washington, the *Columbia River Accessibility Study* determined there was a capacity deficiency across the Columbia River, but recommended that a transit solution be pursued rather than another highway crossing.

- **Preliminary Alternatives Analyses (Pre-AA).** From 1990 to 1993, Metro and several participating jurisdictions conducted two concurrent Pre-AAs to evaluate and select the priority corridor for the south and north portions of the study area from among the I-5 North, I-205 North, I-205 South and the Milwaukie Corridors. The Metro Council and the C-TRAN Board of Directors found that the Milwaukie Corridor and I-5 North Corridor best satisfied the region's evaluation criteria and goals established for the Pre-AA process. The two priority corridors were combined into the single South/North Corridor.

- **Scoping.** In 1993, the South/North Project's Federal Scoping process was undertaken to identify the range of mode and alignment alternatives to be studied further within the project's two-tiered narrowing process. Within Scoping, the high capacity transit alternatives were narrowed to one preferred mode: light rail transit. When compared to other modal alternatives, LRT was found to provide the highest quality of transit service and the greatest assurance of effective transit system operations. In addition, LRT was found to best meet financial, growth accommodation, land use and environmental sensitivity objectives adopted for the corridor. The Scoping process also concluded by identifying a wide range of alignment and terminus alternatives to be evaluated and narrowed in the Tier I step, prior to initiating the DEIS.

- **Tier I – Narrowing of Terminus and Alignment Alternatives.** The alternatives identified in the Scoping process were evaluated within Tier I based upon a wide range of criteria and measures. Adoption of the *Tier I Final Report* in 1994 established a two-phase implementation program for light rail in the South/North Corridor: Phase One would advance immediately into the DEIS, considering light rail alignment alternatives between the Clackamas Town Center (CTC) in Clackamas County and Vancouver, Washington, in Clark County; and Phase Two, with extensions south and north, would be studied further following completion of the environmental process for Phase One of the project.

- **Tier I – Design Option Narrowing.** The Tier I Design Option Narrowing process concluded in December 1995, and was used to refine the alignment alternatives selected in the Tier I analysis and to identify the range of length alternatives to be studied further in the DEIS. In downtown Portland, a specific conceptual design for the downtown Portland transit mall alignment was also selected for further study in the DEIS.

- **Major Investment Study (MIS).** In November 1995, the Metro Council adopted the *South/North MIS Final Report* that documents the selection of the design concept and scope for the locally preferred alternative for the South/North Corridor. In April 1996, the FTA concurred that Metro had met the MIS requirements for the South/North Corridor and approved Metro's request to advance the South/North Corridor into preliminary engineering.

- **Tier II DEIS and Cost-Cutting.** Metro began work on the Tier II DEIS in January 1996. The purpose of Tier II is to evaluate the alternatives defined in Tier I and Design Option Narrowing, to prepare and publish a DEIS, to initiate Preliminary Engineering and to select a Locally Preferred Strategy (LPS).

The Cost-Cutting process began December 1996 and concluded in May 1997, when the Metro Council adopted amendments to the range of alternatives to be studied in the DEIS to reflect the most promising cost-cutting measures.

S.2 Purpose and Need

The need to consider light rail transit options in the South/North Corridor was identified through a series of system and corridor studies of transportation problems: growth in the corridor; the growing dependence of the land use and economic development goals of the bi-state region on the implementation of a regional high capacity transit system; capacity and operational deficiencies in the corridor's highway and transit network; and the need to increase the transit system's operating efficiency.

The South/North Corridor is part of the rapidly growing Portland/Vancouver metropolitan region. The South/North Corridor consists of the travel shed connecting the cities of Oregon City and Milwaukie, the Clackamas Regional Center area, the Central City and areas of southeast, north and northeast Portland, and the City of Vancouver, Washington. The population of the region has grown by approximately 45 percent over the past twenty years, from 1,100,900 residents in 1975 to 1,596,100 residents in 1995. The region's employment growth rate, almost 40 percent higher than the national average, increased from 672,800 jobs in 1980 to 995,700 jobs in 1995.

Metro's *Region 2040 Growth Concept* and its implementing document, the *Regional Framework Plan*, determine the overall pattern and densities of development within the boundary for the next 50 years. The plan is designed to absorb an additional 720,000 residents into the Oregon portion of the metropolitan region by the year 2040, in part by designating the Portland's Central City as the high-density employment hub of the Portland metropolitan region, and the area around the Clackamas Town Center and the central areas of Milwaukie and Oregon City as Regional Centers. The plan also identifies the regional goal of linking the Central City of Portland to Regional Centers with light rail. In Clark County, the *Community Framework Plan* seeks to concentrate growth in urban centers in the county to reduce reliance on the single-occupant vehicle. Transit expansion and the associated implementation of transit-supportive land uses are also important elements of the region's air quality maintenance plan approved by the Environmental Protection Agency in 1997.

Topographic features, suburbanization, a deficient road network and economic conditions fostering growth in Clackamas and Clark Counties have combined to make congested traffic conditions typical of daily travel to, from and within the South/North Corridor. Population and employment growth in the corridor will produce a 64 percent increase in vehicle miles traveled in the corridor by the year 2015. Increases in travel will lead to a 268 percent increase in the miles of congested roadway in the corridor and to a 720 percent increase in the amount of hours drivers in the corridor must sit in congested traffic. As a result of traffic congestion, transit travel times within the corridor have increased in recent years, requiring Tri-Met to increase service hours, operating costs and the size of the bus fleet just to maintain a constant level of service, resulting in a loss of operating efficiency.

In response to these problems and opportunities, the South/North Steering Committee has adopted the following goal for the project: *To implement a major transit expansion program in the South/North Corridor that supports bi-state land use goals, optimizes the transportation system, is environmentally sensitive, reflects community values and is fiscally responsive.* The Steering Committee also adopted the following objectives for the project: 1) provide high quality transit service; 2) ensure effective transit system operations; 3) maximize the ability of the transit system to accommodate future growth in travel; 4) minimize traffic congestion and traffic infiltration through neighborhoods; 5) promote desired land use patterns and development; 6) provide for a fiscally stable and financially efficient transit system; and 7) maximize the efficiency and environmental sensitivity of the engineering design of the proposed project.

S.3 Alternatives Considered

The transportation alternatives for the South/North Corridor reviewed in the DEIS include an all-bus No-Build Alternative and several light rail length and alignment alternatives.

S.3.1 No-Build Alternative

The No-Build Alternative would include a bus service network expanded from existing 1994 Tri-Met and C-TRAN service and 1995 service improvements. Service would be increased on primary transit network trunklines, urban transit routes, commuter express routes and on bus routes serving the Westside MAX light rail line. Annual service level improvements would increase systemwide average weekly revenue vehicle hours by 39 percent by 2015. Road improvements with the No-Build Alternative would be those included in the *1995 Interim Federal Regional Transportation Plan* (Metro: July 1995) highway network and the *Metropolitan Transportation Plan* (RTC: 1994).

S.3.2 Light Rail Alternatives

The light rail alternatives include a range of length alternatives, alignment alternatives, design options and terminus options (see Figure S.3-1). Length alternatives specify alternatives that vary in the designation of south and north terminus points. Alignment alternatives specify the general location of light rail alignment choices within a given South/North Corridor segment. Design options specify detailed route choices within an alignment alternative. Terminus options are alternate sites or facility configurations for the northern or southern terminus location associated with a length alternative.

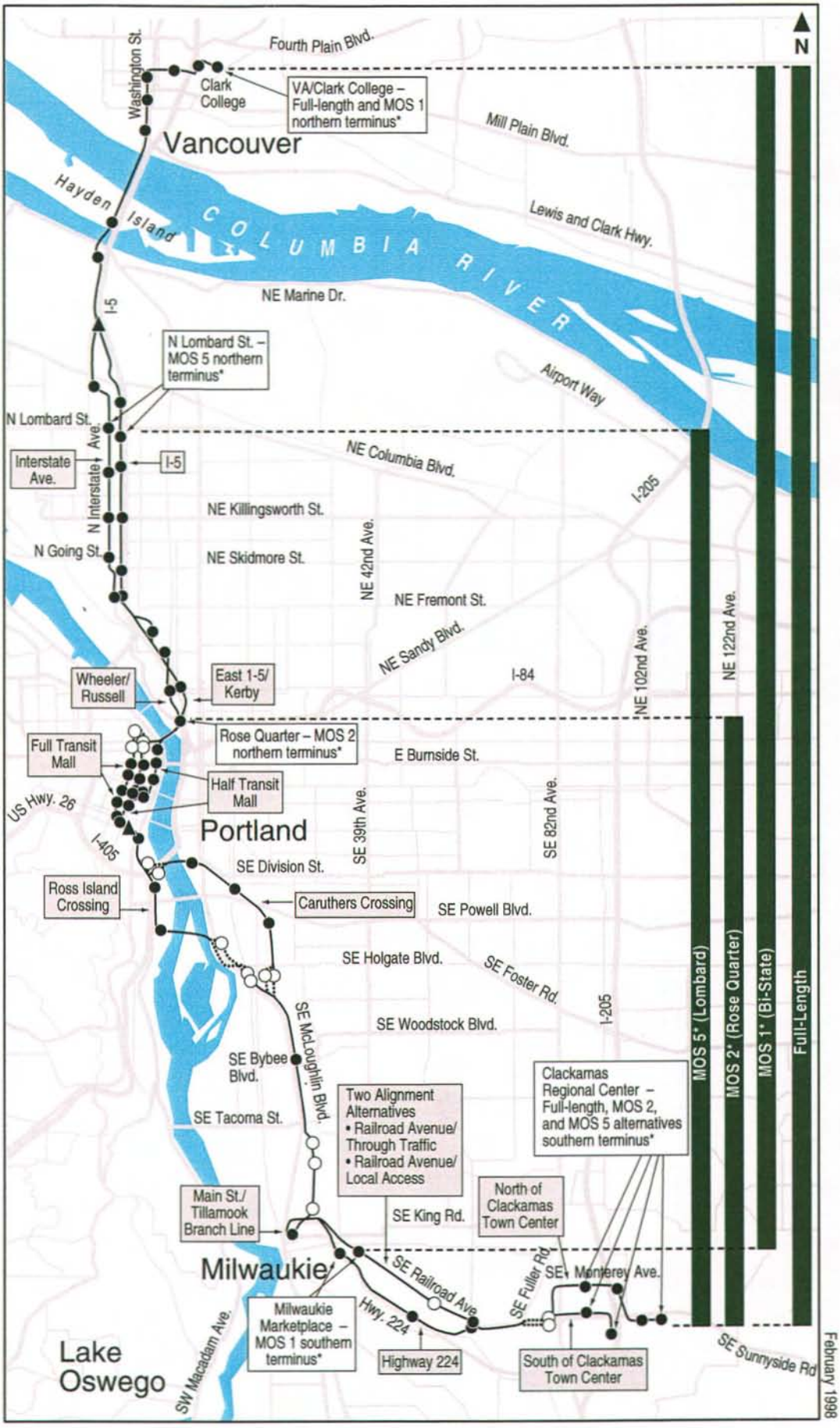
S.3.2.1 Length Alternatives

Following is a brief description of the light rail length alternatives (see Table S.3-1). Note that a minimum operable segment (MOS) would be a shorter segment included within the Full-Length Alternative. MOS 3 and MOS 4 were eliminated from further study as a result of the Cost-Cutting Process.

- **Full-Length.** An approximately 21-mile light rail alignment from the Clackamas Regional Center to the VA Medical Center/Clark College in Vancouver, connecting the downtowns of Milwaukie, Portland and Vancouver, Washington. Park-and-ride capacity would include up to 4,100 parking spaces in the southern portion of the corridor and up to 3,900 parking spaces in the north. Project capital costs and annual corridor operating and maintenance (O&M) costs for the Full-Length Alternative would be approximately $1,309 million and $102 million, respectively, in 1994 dollars.

- **MOS 1 (Bi-State).** An approximately 17-mile light rail alignment from the Milwaukie Marketplace to the VA Medical Center/Clark College in Vancouver. Stations, transit centers and park-and-ride lots would be the same as for corresponding Full-Length Alternative segments. Park-and-ride capacity would include 1,300 parking spaces in the southern portion of the corridor and up to 3,900 parking spaces in the north. Project capital costs and annual corridor O&M costs for MOS 1 would be approximately $1,122 million and $97 million, respectively, in 1994 dollars.

- **MOS 2 (Rose Quarter).** An approximately 12-mile light rail alignment from the Clackamas Regional Center to the Rose Quarter Transit Center. Stations, transit centers and park-and-ride lots would be the same as for corresponding Full-Length Alternative segments. Park-and-ride capacity would include up to 4,100 parking spaces in the southern portion of the corridor only. Project capital costs and annual corridor O&M costs for MOS 2 would be approximately $748 million and $93 million, respectively, in 1994 dollars.



South North Transit Corridor Study

METRO

Figure S.3-1
Light Rail Alignment and Length Alternatives

Note: Alignment and station locations are currently under study and may change.

*MOS refers to a segment of the full-length alternative called a Minimum Operable Segment.

- Extent of Length Alternative
- LRT Alignment Alternative
- LRT Design Option
- ● Station
- ○ Station Options
- ▲ Station Access Under Study

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February 1998

Table S.3-1
Description of No-Build and Light Rail Length Alternatives Summary[1]

Characteristic	No-Build	Full-Length	MOS 1 (Bi-State)	MOS 2 (Rose Quarter)	MOS 5 (Lombard)
Highway Improvements	1995 RTP	1995 RTP & LRT Related	1995 RTP & LRT Related	1995 RTP & LRT Related	1995 RTP & LRT Related
Length of New LRT Line (miles)	N/A	20.6	16.7	11.7	15.3
Number of New LRT Stations	N/A	37	32	22	28
Number of New LRT P&R Spaces					
Southern Portion of the Corridor	N/A	4,100	1,300	4,100	4,100
Northern Portion of the Corridor	N/A	3,900	3,900	0	0
Corridor Transit Vehicles[2]					
Tri-Met Buses	433	398	386	406	410
C-TRAN Buses	114	103	108	111	115
Light Rail	0	59	50	36	41
Weekday Corridor Transit VMT					
Bus	50,300	49,100	49,300	49,800	49,600
Light Rail	N/A	4,910	3,670	2,800	3,190
Weekday Corridor Place Miles[3]					
Bus	3,319,800	3,240,600	3,253,800	3,286,800	3,273,600
Light Rail	N/A	1,630,120	1,218,440	929,600	1,059,100
Weekday Transit VHT					
Bus	3,290	3,100	3,090	3,170	3,180
Light Rail	N/A	298	238	176	198
Capital Cost (1994$)					
Bus (Savings from No-Build)	N/A	-$10.2	-$11.3	-$5.9	-$5.4
Light Rail	N/A	$1,309.4	$1,121.6	$748.4	$915.3
Annual Corridor O&M Cost[4] (1994$)	$81.5	$102.1	$96.9	$93.4	$96.2

Source: Metro, February 1998.
Note: MOS = minimum operable segment; RTP = Regional Transportation Plan; LRT = light rail transit; P&R = park-and-ride; N/A = not applicable; VMT = vehicle miles traveled; VHT = vehicle hours traveled; O&M = operating and maintenance.
[1] Length alternatives are based upon a common set of alignment alternative and options (see Section 2.3.2.1.1 in Chapter 2 of the DEIS for a description). Other alignment alternatives and options are also under study and would change the characteristics of the length alternatives summarized in this table (see Section 2.3.2.1.2 in Chapter 2 of the DEIS for more detail).
[2] Vehicles in service with spares.
[3] Calculated by multiplying the seated and standing capacity of a vehicle type by the miles traveled for that vehicle type.
[4] Operating and maintenance costs for both light rail and buses at 2015 service levels.

- **MOS 5 (Lombard).** An approximately 15-mile light rail alignment from the Clackamas Regional Center to N Lombard Street in north Portland. Stations, transit centers and park-and-ride lots would be the same as for corresponding Full-Length Alternative segments. Park-and-ride capacity would include up to 4,100 parking spaces in the southern portion of the corridor only. Project capital costs and annual corridor O&M costs for MOS 5 would be approximately $915 million and $96 million, respectively, in 1994 dollars.

S.3.2.2 Alignment Alternatives and Design Options

The South/North Corridor is divided into the following segments, each with a variety of alignment alternatives, design options and terminus options.

Clackamas Regional Center Segment. The Clackamas Regional Center Segment includes the Clackamas Town Center shopping mall, and extends from the vicinity of SE 105th Avenue east of the Clackamas Town

Center (CTC), to approximately SE Harmony Road and SE Cedarcrest Drive. The Clackamas Regional Center Segment has two alignment alternatives, (North of CTC and South of CTC), and two terminus options (North of CTC Transit Center and 105th Avenue Terminus; and South of CTC Transit Center and 93rd Avenue Terminus, respectively). Two design options are also under consideration within this segment (North of Clackamas Community College/Oregon Institute of Technology (CCC/OIT) and South of CCC/OIT). One to three park-and-ride lots would be located within this segment with the Full-Length, MOS 2 and MOS 5 alternatives.

East Milwaukie Segment. The East Milwaukie Segment extends from SE Cedarcrest Drive and SE Harmony Road to just east of the Tillamook Branch Line near Highway 224 and the southern portion of the North Milwaukie industrial area. The East Milwaukie Segment includes three alignment alternatives (Railroad Avenue/Through Traffic, Railroad Avenue/Local Access and Highway 224). With MOS 1, the light rail line would terminate at the Milwaukie Marketplace at the west end of this segment. There would be two park-and-ride lot lots within this segment with the Full-Length, MOS 2 and MOS 5 alternatives, and one with MOS 1.

Milwaukie Regional Center Segment. The Milwaukie Regional Center Segment includes downtown Milwaukie and extends from north of Highway 224 just east of the Tillamook Branch Line near the north Milwaukie industrial area to SE Tacoma Street in the City of Portland. One alignment is proposed for the Milwaukie Regional Center Segment (the Main Street/Tillamook Branch Line). There would be one park-and-ride lot within this segment, and the segment includes two of the three potential sites for a proposed light rail O&M facility.

McLoughlin Boulevard Segment. The McLoughlin Boulevard Segment extends from SE Tacoma Street to SE McLoughlin Boulevard at SE 20th Avenue. There is one proposed light rail alignment within the McLoughlin Boulevard that would be located between the existing highway and UPRR freight line. No park-and-ride lots would be located in this segment.

South Willamette River Crossing Segment. The South Willamette River Crossing Segment is generally located in southeast Portland and extends from SE McLoughlin Boulevard at SE 20th Avenue to the east side of SW Front Avenue at SW Harrison Street, in the vicinity of RiverPlace. The South Willamette River Crossing Segment includes two alignment alternatives (the Ross Island Crossing and the Caruthers Crossing), each with two design options (the East and West of McLoughlin Design Options, and the South Marquam and Moody Avenue Design Options, respectively). No park-and-ride lots would be located in this segment, and the segment includes one of the three potential sites for a proposed light rail O&M facility.

Downtown Portland Segment. The Downtown Portland Segment extends from SW Front Avenue at SW Harrison Street to the east end of the Steel Bridge. The Downtown Portland Segment includes two alignment alternatives (Full Transit Mall and Half Transit Mall). The Full Transit Mall Alternative includes two design options (Irving Street and Glisan Street). No park-and-ride lots would be located in this segment.

Eliot Segment. The Eliot Segment includes the Rose Quarter and portions of the Lloyd District and Eliot Neighborhood, and extends from the east end of the Steel Bridge to the Edgar Kaiser Medical Facility. The Eliot Segment includes two alignment alternatives (East I-5/Kerby and Wheeler/Russell). In addition, MOS 2 would terminate within the Eliot Segment at the existing Rose Quarter Transit Center. Both alignment alternatives include the At-Grade and the Multi-Level Rose Quarter Transit Center design options. The East I-5/Kerby Alternative has two additional design options: the Grade-Separated and At-Grade design options at NE Broadway and NE Weidler Street. No park-and-ride lots would be located in this segment.

North Portland Segment. The North Portland Segment extends from the Edgar Kaiser Medical Facility to N Marine Drive. The North Portland Segment includes two alignment alternatives (I-5 and Interstate

Avenue), with two design options for the I-5 Alternative (the Modify Alberta Street Ramps and the Retain Alberta Street Ramps). MOS 5 would terminate in this segment at N Lombard Street. No park-and-ride lots would be located in this segment.

Hayden Island/Vancouver Segment. The Hayden Island/Vancouver Segment extends from N Marine Drive north of the Expo Center, across Hayden Island and the Columbia River, through downtown Vancouver to the vicinity of Clark College in Vancouver, Washington. The Hayden Island/Vancouver Segment includes one alignment (I-5/Washington Street) with four design options (the East of Washington Street and the West of Washington Street Design Options; and the Surface Veteran's Administration (VA) Park-and-Ride and the Structured VA Park-and-Ride Design Options).

S.4 Transportation Impacts

This section summarizes the transit, highway, freight and navigable waterway impacts of the alternatives.

S.4.1 Transit Impacts

The No-Build Alternative would include new bus routes and improved headways on existing routes that would result in a 46 percent increase in transit vehicle miles and a 40 percent increase in transit vehicle hours, compared to existing transit service (see Table A-1). In spite of the improved transit service levels in the corridor, transit in-vehicle travel times would increase with the No-Build Alternative, compared to the in-vehicle travel times with the existing transit network (see Table A-2). The slower transit times with the No-Build Alternative would result from buses operating on increasingly congested roadways in the corridor.

The light rail alternatives would include many of the same bus service improvements included in the No-Build Alternative. With the light rail alternatives, bus service in the corridor would be modified to eliminate or reduce the frequency of bus routes that would run parallel to and duplicate light rail service. In addition, bus routes would be modified and/or their frequencies increased to feed proposed light rail stations.

The four light rail length alternatives, compared to the No-Build Alternative, would provide a 27 to 47 percent additional increase in the amount of transit place miles (the capacity of a vehicle multiplied by the miles it would travel) provided in the corridor (see Table S.4-1). The light rail alternatives would increase the number of residents and jobs that would have one-quarter mile access to a light rail station, compared to the No-Build Alternative. The light rail alternatives would also improve the transit travel times between major activity centers in the corridor, compared to the No-Build. For example, the light rail alternatives that serve the Clackamas Regional Center (Full-Length, MOS 2 and MOS 5) would reduce peak-hour, transit in-vehicle time between downtown Portland and Clackamas Regional Center by 14 minutes in 2015, a 33 percent reduction compared to the No-Build Alternative. The light rail alternatives that would serve downtown Vancouver (Full-Length and MOS 1) would reduce peak-hour, transit in-vehicle time between downtown Portland and downtown Vancouver by 13 minutes in 2015, a 33 percent reduction compared to the No-Build Alternative.

Transit reliability is measured by the number of miles of reserved right-of-way and the percent of the corridor's average weekday passenger miles that would travel on that reserved right-of-way in 2015. In addition, the number of protected intersections was calculated as a measure of reliability. The light rail alternatives would all substantially increase the amount of reserved right-of-way and protected intersections in the corridor, compared to the No-Build Alternative. The result would be that from 20 to 40 percent of the corridor's passenger miles would be on reserved right-of-way with the light rail alternatives, compared to 2 percent with the No-Build Alternative (see Table S.4-1).

Table S.4-1
Summary of Transit Impacts [1]

Characteristic	No-Build	Full-Length	MOS 1 (Bi-State)	MOS 2 (Rose Quarter)	MOS 5 (Lombard)
Measures of Transit Service					
Corridor Place Miles [2]	3,319,800	4,870,700	4,472,200	4,216,400	4,332,700
Population with LRT Access [3]	0	32,550	29,000	19,330	29,340
Employment with LRT Access [3]	0	102,640	90,510	74,660	87,140
Peak-Hour Transit Travel Time [4] from Downtown Portland to:					
Milwaukie Regional Center	28	20	20	20	20
Clackamas Regional Center	42	28	30	28	28
N Lombard St.	27	17	17	26	17
Downtown Vancouver	40	27	27	40	40
Measures of Reliability					
Miles of Separated ROW	1.0 [5]	20.6 [6]	16.7 [6]	11.7 [6]	15.3 [6]
% of Corridor Passenger Miles in Reserved ROW	2%	40%	34%	20%	22%
Protected Intersections	0	108	95	50	75
Measures of Downtown Portland Transit Mall Operations					
LRT Average Speed (mph)	NA	5.7	5.7	5.6	5.6
Bus Average Speed (mph)	3.7	3.8	3.8	3.7	3.7
Peak-Hour Volume (LRT/Bus)	N/A / 136	10 / 118	10 / 116	8 / 128	8 / 124
Measures of Ridership					
Total Corridor Transit Trips [7]	125,900	163,700	152,500	134,400	140,100
South/North LRT Trip	N/A	68,030	56,220	27,655	40,210
% of Trips on Transit to Portland CBD	22%	31%	27%	26%	27%

Source: Metro, February 1998.
Note: MOS = Minimum operable segment; LRT = light rail transit; CBD = central business district; ROW = right-of-way.
1 For the year 2015.
2 Calculated by multiplying the seated and standing capacity of a vehicle type by the miles traveled for that vehicle type.
3 Change in the corridor's population or employment that would be located with a quarter-mile radius of either a bus stop or a light rail station, compared to the light rail access that would be provided with the Eastside and Westside light rail lines.
4 In-vehicle travel time in the p.m. peak-hour, peak direction.
5 Downtown Portland transit mall.
6 Entire South/North light rail alignment.
7 On bus and light rail.

The transit ridership impacts of the light rail alternatives are assessed in two ways: the impact on total corridor transit trips and the number of light rail trips with each alternative. The Full-Length Alternative would generate total corridor transit ridership of approximately 163,700 rides per average weekday in 2015, a 30 percent increase in total corridor transit trips over the No-Build Alternative. Compared to the No-Build Alternative, MOS 1 would generate 26,600 more total weekday corridor transit trips, for a 21 percent increase. MOS 2 would generate 8,500 more total weekday corridor transit trips than the No-Build Alternative, for a 7 percent increase. MOS 5 would generate 14,200 more total weekday corridor transit trips than the No-Build Alternative, for an 11 percent increase. There are several key reasons for these differences in ridership between the No-Build and the light rail length alternatives. Total corridor transit ridership would increase over the No-Build due to improved transit travel times within the South/North Corridor and between the corridor and downtown Portland. Further, the increased capacity of park-and-ride lots located in both the southern and northern portions of the corridor would lead to increased transit ridership.

Average weekday light rail ridership in the corridor in 2015 would vary by length alternative, ranging from 68,030 rides with the Full-Length Alternative to 27,655 with MOS 2. Light rail ridership would be highest with the Full-Length Alternative because it would serve the largest portion of the corridor and would have the greatest number of park-and-ride spaces of the length alternatives. Light rail ridership would vary by alignment alternative generally due to differences in light rail run times and differences in station access opportunities. The following summarizes the major light rail ridership differences among the alignment alternatives in segments with multiple alignment alternatives (see Table A-3).

Clackamas Regional Center Segment. The North of CTC Alignment Alternative would result in 180 more daily light rail rides than the South of CTC Alignment Alternative, when comparing a 105th Avenue Terminus (North of CTC) with a 93rd Avenue Terminus (South of CTC). The South of CTC Alignment Alternative would result in 85 more rides than the North of CTC Alignment Alternative, when comparing a terminus at the CTC Transit Center. A north or south CTC Transit Center Terminus would result in 1,175 to 1,450 fewer light rail rides than a 105th Avenue or 93rd Avenue Terminus, respectively.

East Milwaukie Segment. The Highway 224 Alternative would have stations in different locations than the Railroad Avenue alternatives and travel times through the segment would be approximately one minute longer with the Highway 224 Alternative. As a result, the Highway 224 Alternative would attract 415 to 430 fewer daily light rail rides than the Railroad Avenue alternatives.

South Willamette River Crossing Segment. The Caruthers Crossing Alternative would have two more stations in southeast Portland and would serve more trips at southeast Portland stations than the Ross Island Crossing Alternative. The Ross Island Crossing Alternative would include two more North Macadam stations and would serve more light rail rides at those North Macadam stations than the Caruthers Crossing Alternative. As a result of the difference in service patterns and markets, the Caruthers Crossing Alternative would carry from 710 to 865 more daily light rail rides than the Ross Island Crossing Alternative.

Downtown Portland Segment. The Full Transit Mall Alternative would serve trips traveling through the entire length of downtown Portland from the Union Station area to Portland State University. The Full Transit Mall Alternative would result in 490 to 700 more average weekday South/North light rail trips in 2015 and would provide direct light rail access to the north transit mall for approximately 11,000 more light rail rides than the Half Transit Mall Alternative. Lower ridership with the Half Transit Mall Alternative would be due primarily to the loss of direct light rail access to employment and retail centers in the northern portion of downtown Portland.

Eliot Segment. The East I-5/Kerby Alternative would result in 480 to 910 more daily LRT trips than the Wheeler/Russell Alternative. This difference would be due to differences in the markets served by stations under the two alternatives and a faster light rail run time with the East I-5/Kerby Alternative.

North Portland Segment. With the Full-Length Alternative, the I-5 Alternative would serve 1,270 more daily light rail trips than the Interstate Avenue Alternative. This differential would be due primarily to the light rail travel time for the I-5 Alternative, which would be two minutes faster than the travel time for the Interstate Avenue Alternative. With a terminus at N Lombard Street (MOS 5), the I-5 Alternative would have 360 more daily LRT trips than the Interstate Avenue Alternative. This difference in ridership would also be due primarily to faster light rail travel times. The difference would be smaller with the N Lombard Street terminus because MOS 5 would not provide light rail service for trips traveling through from Clark County.

S.4.2 Traffic, Parking and Freight Impacts

Systemwide changes in traffic volumes that would result from the No-Build and light rail length alternatives would include changes to: regional vehicle miles and hours of travel (VMT & VHT, respectively); vehicle hours of delay; the number of lane miles with a volume-to-capacity ratio greater than 0.90; and the change in peak-hour vehicle trips (see Table S.4-2). The light rail length alternatives would all have fewer VMT, VHT, vehicle hours of delay and congested lane miles than the No-Build Alternative. For example, compared to the No-Build Alternative, the Full-Length Alternative would reduce regional VMT and VHT by 213,700 miles and 14,900 hours, respectively (based on average 2015 weekday conditions). Relative to the No-Build Alternative, the Full-Length Alternative would also reduce peak-hour regional vehicle hours of delay and lane miles of congested roadway by 17 percent and 2 percent, respectively. Compared to the No-Build Alternative, the Full-Length Alternative would reduce peak-hour vehicle trips by 4,200 trips. The reduction of these measures associated with the other light rail length alternatives would be less than with the Full-Length Alternative, generally in proportion to the transit ridership associated with each length alternative.

Table S.4-2
Summary of Highway Impacts [1]

Characteristic	No-Build	Full-Length	MOS 1 (Bi-State)	MOS 2 (Rose Quarter)	MOS 5 (Lombard)
Measures of Regional Travel					
Vehicle Miles of Travel [2]	33,022,500	32,808,800	32,861,500	32,971,600	32,909,000
Vehicle Hours of Travel [2]	1,255,700	1,240,800	1,244,500	1,253,400	1,244,600
Vehicle Hours of Delay [3]	27,000	22,500	22,600	23,100	22,600
Lane Miles with V/C > 0.90 [3]	746	730	740	738	732
Reduction in Peak-hour Vehicle Trips [4]	N/A	-4,200	-2,800	-1,050	-1,450
Automobile Travel Time [5] from Downtown Portland to:					
Milwaukie Regional Center	23	21	22	21	21
Clackamas Regional Center	32	31	32	31	31
N Lombard Street	14	13	13	14	14
Downtown Vancouver	34	31	31	34	34
Measures of Parking					
Parking Spaces Removed [6]	0	405	405	129	155
Reduction in Portland CBD Parking Demand [7]	0	3,790	2,030	2,120	2,220

Source: Metro, February 1998.
Note: MOS = minimum operable segment; V/C = volume-to-capacity ratio; CBD = central business district.
[1] For the year 2015.
[2] Average weekday.
[3] Based upon p.m. peak one-hour conditions on freeways, major and minor arterials and collector streets.
[4] Reduction in average weekday p.m. peak-hour vehicle trips taken regionwide, 2015.
[5] In-vehicle travel time in the p.m. peak-hour, peak direction.
[6] On-street parking displacements that would occur due to the construction of the project.
[7] Parking space reduction is based on one parking space for every two average weekday auto vehicle trips, that would not enter or leave downtown Portland (1.26 vehicle occupancy).

Localized traffic impacts are measured in terms of level of service (LOS) or volume-to-capacity changes at intersections or on key roadway segments. These impacts could be the result of changes in traffic volumes related to the provision of light rail service (particularly the access to and egress from park-and-ride lots), light rail priority treatments at intersections, modifications to existing roadway cross-sections that would reduce roadway capacity, or at-grade street crossings by light rail. Following is a summary, by segment, of

the anticipated impacts that the alignment alternatives and design options would have on local traffic (see Tables A-4 to A-11 for a summary of the level of service at intersections within each segment).

Clackamas Regional Center Segment. With the No-Build Alternative, LOS E conditions would occur along I-205, south of SE Johnson Creek Boulevard, and LOS F conditions would occur from the SE Sunnyside Road area southward and along much of Highway 224. No changes in levels of service on regional highways within this segment would occur with any of the light rail length alternatives, compared to the No-Build Alternative. With the South of CTC Alignment, no intersections would experience a deterioration of level of service due to the South/North Light Rail Project relative to the No-Build Alternative. With the North of CTC Alternative, the intersection of SE Sunnyside Road with SE Stevens Road would operate at a worse level of service with light rail than with the No-Build Alternative. The North of CTC Alternative with the CTC Transit Center Terminus Option would result in level of service E at SE Sunnyside Road and SE 90th Avenue, compared to level of service D with the No-Build Alternative.

East Milwaukie Segment. With the light rail length alternatives, no change would occur to the level of service on regional highway facilities located within the East Milwaukie Segment, compared to the No-Build Alternative. At one intersection on the local street system, all light rail alignment alternatives would result in a deterioration in level of service, compared to the No-Build Alternative: at the intersection of SE Harmony Road with SE Lake/International Way (due to new trips that would travel to and from the Linwood Park-and-Ride Lot). With the Railroad Avenue/Through Traffic Alternative, the intersection of SE Railroad Avenue at SE 37th Avenue would deteriorate from LOS C to LOS F. Several intersections that would operate at LOS F with the No-Build would experience an increase in their volume-to-capacity ratios: the intersections of Highway 224 with SE Rusk Road; Highway 224 at the westbound ramps at SE Lake Road, Highway 224 at SE Oak Street and Highway 224 at SE Harrison Street (Railroad Avenue/Through Traffic and Railroad Avenue/Local Access alternatives only); and the intersections of SE Monroe Street at SE Linwood Avenue, SE 37th Avenue, and SE 42nd Avenue (Railroad Avenue/Local Access Alternative only).

Milwaukie Regional Center Segment. With the light rail length alternatives, no significant change would occur to the level of service on regional highway facilities located within the Milwaukie Regional Segment, compared to the No-Build Alternative. The length alternatives would worsen conditions at one intersection, which would operate at LOS F with the No-Build Alternative (SE McLoughlin Boulevard at SE Harrison Street and SE 17th Avenue). Three sites, Hanna-Harvester, South of Ochoco and Tacoma Street, were evaluated as potential sites for a North Milwaukie park-and-ride lot. The Tacoma Street site was found to have the fewest traffic impacts because it would provide grade-separated access to SE McLoughlin Boulevard southbound via the SE Tacoma Street overcrossing.

McLoughlin Boulevard Segment. Very little difference in local traffic would occur between the No-Build and light rail length alternatives within the McLoughlin Boulevard Segment.

South Willamette River Crossing Segment. The Ross Island Crossing would result in no significant change in traffic, compared to the No-Build Alternative. The Caruthers Crossing Alignment Alternative would worsen two intersections (SE Holgate Boulevard at SE 17th Avenue and SE Milwaukie Avenue at SE Powell Boulevard), and would improve two others (SE 11th and 12th Avenues at SE Clinton Street), compared to the No-Build Alternative. The Caruthers Crossing Alternative would also result in changes to truck routing that could affect neighborhood traffic.

Downtown Portland Segment. Conditions under the Full Transit Mall and Half Transit Mall Alignment Alternatives would be similar to the No-Build Alternative in many areas of downtown Portland, although there would be notable differences at several key locations. In the southern Downtown area, the two alignment alternatives would result in a deterioration of level of service at the intersections of SW Front Avenue at SW Clay Street, SW Front Avenue at SW Harrison Street and SW 6th Avenue at SW Clay Street.

At one intersection, SW 1st Avenue at SW Harrison Street, level of service would be improved. Both alignment alternatives would result in the loss of on-street parking in the southern area of downtown Portland. In Central Downtown, level of service at SW Yamhill Street at SW 4th Avenue would deteriorate with the Half Transit Mall Alternative, compared to the No-Build or Full Transit Mall Alternative (from LOS C to LOS E). In North Downtown, the Full Transit Mall Alternative would increase delays on W Burnside Street, including W Burnside Street at NW/SW Broadway that would already be at LOS F under the No-Build. It would also result in some loss of on-street parking in North Downtown. The Half Transit Mall Alternative would worsen conditions at the intersection of NW 1st Avenue at NW Everett Street, from LOS C with the No-Build Alternative, to LOS F.

Eliot Segment. When compared to the No-Build Alternative, the alignment alternatives and design options in the Eliot Segment would result in similar overall conditions. However, there would be localized differences in congestion, parking, station access and Rose Quarter event-related impacts among the alternatives. At the N/NE Broadway/Weidler Street couplet, the light rail alternatives would generally reduce traffic volumes in the area compared to No-Build Alternative. With the At-Grade Broadway/Weidler Street Design Option, conditions would worsen from LOS B/C to LOS F at two intersections (NE Weidler Street at NE Victoria Avenue/I-5 ramp and N Broadway Street at N Williams Avenue/I-5 ramp), and would double to triple queue lengths in several locations. The Grade-Separated Design Option would avoid many of these longer queues. The Wheeler/Russell Alternative would increase queues near the N/NE Broadway/Weidler Street couplet compared to the No-Build Alternative, and one intersection (N Russell Street at N Vancouver Avenue) would worsen from LOS C to F, compared to the No-Build Alternative. Both alignment alternatives would reduce on-the street parking supply in the area.

North Portland Segment. Northbound I-5 would experience LOS F at several locations under all alternatives. With the I-5 Alternative with the Retain N Alberta Street Ramps Design Option, one intersection (N Lombard Street at N Montana Avenue) would improve to LOS B as a result of the installation of signal improvements. The Modify Alberta Ramps Design Option would improve two intersections (N Interstate Avenue at N Alberta Street and N Alberta Street at N Minnesota Avenue) from LOS D/E to LOS B, but would worsen conditions at other intersections and add up to two minutes to trips accessing I-5 southbound from points east of I-5 in the vicinity of N Killingsworth Street and N Alberta Street. The Interstate Avenue Alignment Alternative would reduce capacity on N Interstate Avenue by narrowing portions of the arterial to one lane in each direction, and would divert some traffic from N Interstate Avenue to parallel roadways. With light rail operating in the median of N Interstate Avenue, two intersections (N Interstate Avenue at N Alberta Street and at N Portland Boulevard) would degrade from LOS D to LOS E, compared to the No-Build Alternative. The Interstate Avenue Alternative would eliminate approximately 93 on-street parking spaces on N Interstate Avenue.

Hayden Island/Vancouver Segment. With the I-5/Washington Street Alignment, the intersection of W 8th Street and Washington Street would experience an LOS F, compared to LOS B with the No-Build Alternative. The intersection of E Fourth Plain Boulevard and the northbound I-5 ramps, would experience LOS F and a volume-to-capacity ratio of 1.96 with the Structured VA Park-and-Ride Lot option, compared to 1.65 and 1.54 for the Surface VA Park-and-Ride Option and the No-Build Alternative, respectively. The Structured Park-and-Ride Design Option at the VA station would result in LOS F operations at the lots access point onto E Fourth Plain Boulevard. The satellite park-and-ride lot at NE 88th Street with the Surface VA Park-and-Ride Design Option would improve local traffic operations in the Hazel Dell area over the No-Build Alternative because of street access improvements. The light rail alignment would reduce the on-street parking supply in downtown Vancouver by 250 spaces.

S.4.3 Freight Movement

The freight movement system in the South/North Corridor is comprised of two primary transportation modes: freight railroads and trucking. Of the freight rail lines operating in the corridor, four locations would be most likely to be affected by the South/North Project: the UPRR mainline at SE Harmony Road, where a roadway and light rail grade separation would be constructed with the Railroad Avenue/Through Traffic and Local Access Alternatives; in north Milwaukie near SE Mailwell Street, where the project would rearrange several industrial spur tracks to allow an at-grade crossing; in SE Portland, where light rail tracks would cross a freight spur track at grade; and just east of OMSI, where a light rail crossing of the East Portland Traction Company spur line would occur. The proposed light rail O&M facility at Brooklyn Yard would be located on UPRR right-of-way and could affect freight rail and truck-to-rail operations at that location. Impacts to truck movements in the South/North Corridor would include potential delays due to increased congestion or out-of-direction travel associated with changes in the local street network, and due to the possible loss of on-street loading zones in some locations. Regional truck travel would benefit from reduced travel times on regional arterials and highways due to a reduction in congested lane miles and hours of delay associated with the light rail alternatives (see Section S.4.2).

S.4.4 Navigable Waterways

The DEIS provides a description of the vertical and horizontal clearances for the proposed South/North light rail crossings of navigable waterways and addresses the potential long-term and short-term impacts to navigable waterways. Primary factors affecting navigation include horizontal and vertical clearances provided between bridge piers and between the surface of the water and the bottom of the 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. Following is a summary of the three primary proposed crossings of navigable waterways within the corridor.

Ross Island Crossing. The Ross Island Alignment Alternative would cross two navigational channels in the Willamette River, the primary channel west of Ross Island, and a secondary channel east of Ross Island through the Holgate Slough. For vessels requiring horizontal clearances of less than 100 feet, the proposed light rail bridge would reduce vertical clearances in the primary channel by 21 feet. However, surveys of current river use indicate that the proposed light rail bridge and the change in vertical clearances would have no adverse impact on navigational activity in this area.

Caruthers Crossing. Based upon the current concrete segmental design, the Caruthers Crossing Alternative would reduce vertical clearances upstream to the Sellwood Bridge by 30 to 48 feet. Surveys of current and anticipated future river users indicate that the proposed light rail bridge could have a limited adverse impact on navigation in this area. Mitigation could include increasing the bridge's vertical clearances. A detailed study of increasing the Caruthers Bridge height found that regular river traffic could be accommodated with a change in design of the proposed light rail bridge that would increase capital costs by approximately $1 million (1994$). The remaining potentially impacted river traffic generally consists of machinery (dredges, cranes, etc.) that could be lowered or partially dismantled to reduce vertical clearance requirements.

Columbia River Crossing. The proposed light rail bridge across the Columbia River would be located approximately 90 feet downstream of the existing Interstate Bridges. Based upon the current bow string design, the proposed light rail bridge would match the existing fixed spans, lift spans and pier placement of the Interstate Bridges and would not adversely impact navigation on the Columbia River.

S.5 Environmental Consequences

This section summarizes several types of environmental impacts that would occur with the South/North alternatives.

S.5.1 Land Use and Economic Development

The economy of the Portland/Vancouver metropolitan region has been growing and diversifying since the 1980s. While transit has not been shown to directly affect the amount of regional economic growth, the quality of the overall transportation system does influence economic activities. Each of the light rail alternatives would contribute to the effectiveness of the overall transportation system, and would therefore help to maintain the economic growth of the region. Direct long-term economic impacts, while beneficial, would be nominal (see Table S.5-1). Short-term economic benefits related to construction employment would be significant for the light rail alternatives, with the greatest benefits coming with the Full-Length Alternative, and the least with MOS 2 (14,760 to 8,190 short-term person-year jobs, respectively).

All of the light rail alternatives would be compatible with Oregon, Washington and local and regional plans and policies. For example, the light rail length alternatives would include an increase of 319 to 431 additional acres of developable land that would be located within one-quarter mile of light rail stations, compared to the No-Build Alternative. Increases in mixed and higher-density use would occur around many light rail stations under regional and local land use plans, ans would thereby reduce the pressure to expand the region's urban growth boundary, compared to the No-Build Alternative (see Table S.5-1).

At the segment level, the alignment alternatives and the design options differ in their potential for local land use and economic impacts. Because land use impacts would be primarily related to development focused around station areas, the differences between design and alignment options typically involve businesses/employers and households served, and the amount of vacant and redevelopable land available (see Tables A-12 and A-13).

S.5.2 Displacements and Social and Neighborhoods

Adverse impacts to neighborhood cohesion and neighborhood quality could result from displacements of businesses or residences, from increased noise and from visual impacts. The LRT alternatives also provide potential benefits by improving neighborhood access to community facilities and services. At the regional level, the Full-Length Alternative would provide the most benefits from improved access, and MOS 2 or 5 would provide the fewest access improvements of the light rail length alternatives.

The No-Build Alternative would result in no displacements of residents or businesses. Of the light rail alternatives, the Full-Length Alternative would result in the highest number of total displacements (413), and MOS 2 would have the least (240) (see Table S.5-1). Most of the potential displacements along the corridor would be residential. Table A-14 summarizes displacements by segment, alignment alternative and design option. The segments that would have the greatest number of potential displacements would be: East Milwaukie Segment (the Railroad Avenue/Through Traffic Alternative would have 104 displacements compared to 32 with the Local Access Alternative and 26 with the Highway 224 Alternative); the Downtown Portland Segment (69 with the Full Transit Mall Alternative and the Glisan Street Design Option, compared to 12 with the Irving Design Option and seven with the Half Transit Mall Alternative); the North Portland Segment (the I-5 Alternative with Retain Alberta Ramps Design Option would have 109 and the Interstate Avenue Alternative would have 98 displacements, compared to 45 with the Retain Alberta Ramps Option).

Table S.5-1
Summary of Environmental Impacts [1]

Characteristic	No-Build	Full-Length	MOS 1 (Bi-State)	MOS 2 (Rose Quarter)	MOS 5 (Lombard)
Economic Impact					
Long-Term Annual Employment [2]	1,320	1,600	1,530	1,490	1,530
Short-Term Employment [3]	0	14,760	12,740	8,190	9,740
Change in Acres of Developable Land Within ¼-mile of LRT Stations [4]	0	430	319	336	412
Displacements					
Business	0	77	70	51	64
Institutional/Public	0	3	2	1	2
Residential	0	333	232	188	304
Regional Air Quality (tons/year)					
Carbon Monoxide	147,092	146,276	146,485	146,915	146,723
Nitrogen Oxides	22,286	22,148	22,182	22,253	22,216
Nonmethane Hydrocarbons	18,483	18,381	18,407	18,461	18,437
Noise and Vibration [5]					
Impacts Without Mitigation	0	66	47	37	60
Impacts With Potential Mitigation	0	15	10	10	14
Ecosystems					
Wetland Filled/Spanned (acres)	0	2.87/0.09	1.53/0.08	1.51/0.01	1.51/0.01
Non-Wetland Waters Filled (acres)	0	0.51	0.47	0.13	0.13
Water Quality/Hydrology					
Fill in Flood Plain (cubic yards)	0	22,300	9,600	21,200	21,200
Energy					
Regional Daily Vehicle (10^9 Btu)	268.04	266.61	266.95	267.81	267.33
Construction (10^{12} Btu)	0	11.02	9.55	5.74	7.00
Hazardous Materials					
CERCLIS/ECSI Sites Displaced	0	4	4	3	3
Historic and Parkland					
Historic Resources Adversely Affected	0	7	3	7	7
Archaeological Resources Adversely Affected (known/probable)	0	1 / 6	1 / 4	0 / 5	0 / 5
Number of Parklands Used	0	3	2	3	2
Acres of Parkland Used (displaced)	0	1.95	1.49	0.74	0.74
Number of Parks Impacted by Noise [6]	0	3	2	2	2

Source: Metro, February 1998.
Note: LRT = light rail transit; MOS = minimum operable segment; Btu = British thermal unit; CERCLIS = Comprehensive Environmental Response, Compensation and Liability Information System; ECSI = Environmental Clean-up Site Inventory.

[1] For the year 2015, unless noted. Length alternatives are based upon a common set of alignment alternative and options (see Section 2.3.2.1.1 in Chapter 2 of the DEIS for a description). Other alignment alternatives and options are also under study and would change the characteristics of the length alternatives summarized in this table
[2] Full-time equivalent, at year 2015 service levels.
[3] Person-year jobs during construction.
[4] Change in comparison to the Eastside and Westside light rail lines, vacant land is undeveloped land without development limitations such as excessive slope or floodplain. Redevelopable land is land where the land value exceeds the improvement value, taking into account the surrounding land and building values.
[5] The total number of properties that would be impacted by traffic and/or light rail noise and/or light rail vibration.
[6] The noise impact would constitute a constructive use of a parkland.

S.5.3 Visual and Aesthetic Resources

Potential changes to visual and aesthetic resources along the South/North Corridor could result from new light rail facilities and changes to area landscape patterns, features and views. While the relative scale of the change was evaluated, the actual extent of an adverse visual impact will depend largely on later project design decisions. The No-Build Alternative would have no visual and aesthetic impacts, and the Full-Length Alternative would have the most potential visual impacts. For several segments, alignment alternatives would result in varying visual impacts including:

- **Clackamas Regional Center Segment.** The South of CTC Alternative would have greater visual impacts than the North of CTC Alternative. The North of OIT/CCC Design Option would have greater visual impacts than the South of OIT/CCC Option.

- **East Milwaukie Segment.** The Highway 224 Alternative would have fewer visual impacts than the Railroad Avenue Alternatives.

- **South Willamette River Crossing Segment.** The Ross Island Crossing Alternative would have more visual impacts than the Caruthers Crossing Alternative.

- **Eliot Segment.** More visual impacts would occur with the Wheeler/Russell Alternative than with the East I-5/Kerby Alternative.

- **North Portland Segment.** The visual/aesthetic impacts of the I-5 Alternative would be similar in scale to impacts that would occur with the Interstate Avenue Alternative, although they could be more difficult to mitigate.

S.5.4 Air Quality

Regional and localized air quality impacts of the South/North Project would be related to changes in regional pollutant emissions and localized impacts at intersections. All of the light rail alternatives would reduce automobile usage and would result in an improvement over the No-Build Alternative in regional air quality (see Table S.5-1). The Full-Length Alternative would provide the most improvement, and MOS 2 would provide the least. At the localized level, none of the alternatives would cause an exceedance of national air quality standards, and all would conform to air quality implementation plans (see Table A-15).

S.5.5 Noise and Vibration

Table S.5-1 summarizes the number of properties that would be impacted by traffic and/or light rail noise and/or light rail vibration. Of the length alternatives, the Full-Length Alternative and MOS 5 would result in the greatest number of noise and vibration impacts (66 and 60, respectively), and MOS 2 the least (37). With mitigation, the potential impacts could be reduced to 15 for the Full-Length Alternative, and ten for MOS 2. There would be several segments in the corridor with few or no noise and vibration impacts: McLoughlin Boulevard, South Willamette River Crossing, Downtown Portland, Eliot and Hayden Island/Vancouver segments (see Table A-16). In the North Portland Segment, 118 unmitigated impacts would result from the Interstate Avenue Alternative, compared to three to four with the I-5 Alternative. The unmitigated impacts associated with the Interstate Avenue Alternative would be due to traffic noise that would be similar to noise levels with the No-Build Alternative and would be difficult to effectively and efficiently mitigate. In the East Milwaukie Segment, the Highway 224 Alignment Alternative would have no noise and vibration impacts, compared to 18 to 33 impacts with the Railroad Avenue Alignment Alternatives (potential mitigation could eliminate or reduce this to four impacts).

S.5.6 Ecosystems

None of the project alternatives would significantly impact wetlands, vegetation, fisheries or wildlife, including threatened, endangered or sensitive species. Potential project effects would include bridges over the Willamette and Columbia Rivers, removal of vegetation, removal or fill of wetlands, and habitat loss or disruption. With mitigation, none of the impacts would be significant. Under state and Federal regulations, wetlands losses must be mitigated to achieve "no net loss." Federal regulatory agencies have concurred that, based on the conceptual design, the South/North Project would not have a significant adverse effect on threatened or endangered species. The length alternatives would result in 1.5 to 2.9 acres of wetlands filled and less than half an acre of non-wetland waters filled. MOS 1 would avoid wetland and habitat impacts east of the Milwaukie Marketplace, MOS 2 would avoid impacts north of the Rose Quarter, and MOS 5 would avoid impacts north of Kenton in north Portland. The Caruthers Crossing Alternative would have fewer ecosystem impacts than the Ross Island Crossing Alternatives. Continued efforts would be made in subsequent phases of the project to avoid, minimize and mitigate ecosystem impacts.

S.5.7 Water Quality and Hydrology

With mitigation, none of the light rail alternatives would result in significant hydrologic, flooding or water quality impacts. Some low to medium-level impacts were identified: in the Clackamas Regional Center, the SE 105th and SE 93rd Terminus Options would increase stormwater runoff; in the East Milwaukie Segment, the Railroad Avenue alternatives would have some stormwater quantity and quality impacts; and in the Hayden Island/Vancouver Segment, the Surface Park-and-Ride Option would increase stormwater runoff somewhat.

S.5.8 Energy

Compared to the No-Build Alternative, the light rail alternatives would reduce regional energy consumption by 0.23 to 1.43 x 10^9 British thermal units per weekday, which is equivalent to 1,840 to 11,400 gallons of gasoline (see Table S.5-1). Energy consumption for construction would be higher with the Full-Length Alternative than with the shorter length alternatives.

S.5.9 Geology

None of the alternatives would have long-term impacts to geology or soils. Minor effects would include changes in topography and drainage patterns, slight settlement of near surface soils, and changes in slope stability. The corridor does contain soils at some locations that could amplify seismic (earthquake) events. Detailed site-specific geotechnical engineering analyses would be conducted to allow project designs that address and minimize the risk of potential seismic effects.

S.5.10 Hazardous Materials

Hazardous waste sites and facilities on or near the proposed alignments for the light rail alternatives pose a low-level risk of adverse impacts to human health and the environment. However, such sites could result in construction delays and increased costs to the project and could be subject to complex regulatory and permitting requirements. There are six classifications of hazardous materials sites and facilities. Of these, the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) tracks Federal superfund sites. Environmental Clean-up Site Inventory (ECSI) is the state of Oregon's equivalent to the Federal CERCLIS list. These sites generally have multiple contaminants or contaminated media (soil and groundwater for example) and would generally present the greatest risk of construction delay and/or increased costs. The number of CERCLIS and ECSI sites that would be displaced by the alignment

alternatives is summarized in Table S.5-1. Table A-17 summarizes all known hazardous materials sites that would be displaced by, or that would be located near, each alignment alternative.

S.5.11 Historic, Archeological and Parkland Resources

Within the South/North Corridor's area of potential effect, there are 66 individual historic resources and three historic districts currently listed in the *National Register of Historic Places* and an additional 66 resources eligible for listing. Twenty-six planned or existing public parks and recreation areas are also located in the vicinity of the proposed project. The current set of length and alignment alternatives and design options were selected based, in part, on previous efforts to avoid or minimize impacts to these resources.

The Full-Length Alternative would adversely affect the greatest number of historic and archaeological resources (eight), and MOS 1 the least (four). Impacts (i.e., use or constructive use) to parklands would be similar for all the length alternatives (two to four resources). The Full-Length Alternative would use the most acres of parkland (1.95 acres), followed by MOS 1 with 1.44 acres of parklands used. MOS 2 and MOS 5 would use 0.74 acres of parkland. While the Full-Length Alternative would expose three parks to excessive noise levels (i.e., constructive use), MOS 1, MOS 2 and MOS 5 would result in noise impacts to only two parks. As summarized in Tables A-18 and A-19, the Highway 224 Alternative in the East Milwaukie Segment would avoid the noise impact on the Hector Campbell playground, while the Interstate Avenue Alternative would have an effect, but not an adverse effect, due to increased noise levels at three parks.

S.5.12 Construction Impacts

Following is a summary of the short-term and temporary impacts that would result from construction of the South/North Project.

Traffic. Construction of light rail within the South/North Corridor would result in temporary impacts to local and regional traffic operations. These impacts would likely involve increased congestion on many of the major trafficways in the corridor attributable to full or partial lane closures or increased truck activity associated with construction activity. Impacts may also involve intrusion of non-local traffic into residential areas as a result of temporary street closures and traffic detours, disruptions to vehicular and pedestrian access to businesses and community services, and temporary loss of on or off-street parking.

Transit. Transit impacts during construction could include substantial service delays, relocation of bus stops, street detours, and poor service reliability for bus routes using certain roadways and facilities within the corridor. A construction reroute plan for the downtown Portland transit mall will be prepared during Preliminary Engineering. This plan will identify both the construction sequencing for the mall and the temporary bus rerouting that would be necessary to bypass the area under construction.

Land Use and Economic Development. Construction-related land use and economic impacts would typically consist of short-term, temporary increases in construction employment and temporary disruptions to existing land use. During the preparation of Preliminary Engineering and the FEIS, specific mitigation plans will be developed that address short-term land use and economic impacts. With the adoption of the *Downtown Portland Tier I Final Report* (Metro: December 1995), the Metro Council identified construction mitigation measures for the Downtown Portland Segment, and concluded that during final design a detailed construction management and mitigation plan should be developed for the central city area that would create a Downtown Portland Construction District.

Social and Neighborhoods. Temporary construction-related impacts to neighborhoods could result from increased traffic congestion, truck traffic, noise, vibration and dust. Temporary street closures, traffic reroutes and detours could increase traffic within neighborhoods.

Noise and Vibration. The operation of machinery used in construction (e.g., bulldozers, scrapers and pavers pile drivers) would occur with all alternatives. Maximum noise levels for general construction equipment generally range from 85 to 89 dBA at 100 feet and pile driving could generate 101 dBA at 50 feet.

Geology and Soils. Construction impacts to geology and soils would generally be limited to erosion and slope stability. Settlement of soils during construction would be possible, but would have less impact on completed structures than long-term settlement of soils.

Water Quality and Hydrology. Construction of the South/North Project would remove existing vegetation in some locations, causing potential short-term increases in erosion and sedimentation of adjacent waterways and temporary increases in runoff rates. Other water quality impacts could result from release of oil, grease, fuel or hydraulic fluids from construction equipment. Implementation of best management practices during construction would avoid most of these water quality and hydrology construction impacts.

Ecosystems. Potential short-term impacts to ecosystems could result from water-quality related impacts. Temporary habitat removal would occur where construction activities would be adjacent to existing habitat and a construction easement outside the right-of-way could be required. Potential in-water construction activity would occur at some of the stream crossings and all of the river crossings.

Hazardous Materials. In order to minimize impacts associated with either unidentified contamination encountered during construction or known hazardous substances, concerns need to be addressed during construction and various mitigation measures would be employed.

S.6 Evaluation of Alternatives

The DEIS evaluates the alternatives for the South/North Corridor from the following perspectives: financial feasibility, the effectiveness of each alternative in meeting the project's objectives; the cost-effectiveness of the project alternatives; equity considerations; and the major trade-offs between the alternatives.

S.6.1 Financial Feasibility Analysis

The financial feasibility analysis for the South/North Project has been divided into the following two elements because each element would have a different financing plan:

A. The Project Capital Financial Feasibility Analysis focuses on whether there are adequate project capital resources currently available to construct each alternative, and if not, the options for resolving the project capital need for additional resources. Project capital costs are only those capital costs associated with the implementation of the South/North light rail alternatives.

B. The System Fiscal Feasibility Analysis focuses on whether there are adequate resources to operate and maintain the entire transit system, including operations of the South/North Light Rail Project, between now and the year 2015, and if not, the options for resolving the system financial need. System costs include all transit operation and maintenance (O&M) costs and all transit capital expenditures to the year 2015, except for those incorporated in the South/North capital costs accounted for in the Project Capital Financial Feasibility Analysis.

S.6.1.1 Costs

Table S.6-1 presents the South/North Light Rail Project capital costs in year-of-expenditure dollars for the light rail length alternatives. The project's capital costs would include all facility improvements and vehicle purchases required by each length alternative in excess of the capital costs that are currently committed and included within the No-Build Alternative. The table includes a range of capital costs for each length alternative because each light rail length alternative has various alignment alternatives and design options, each with different capital costs. The majority of the differences in these cost ranges would be the result of alignment alternatives and design options within Clackamas Regional Center, East Milwaukie, Downtown Portland, Eliot and North Portland segments. Year of expenditure project capital costs would range from the lowest cost length alternative, MOS 2 ($936 to $1,228 million) to the highest cost length alternative, the Full-Length Alternative ($2,034 to $2,508 million).

Table S.6-1
Summary of Project and System Financial Feasibility Analysis [1]

Finance Plan Element		Full-Length	MOS 1 (Bi-State)	MOS 2 (Rose Quarter)	MOS 5 (Lombard)
Project Capital Finance Plan [2]					
Year of Expenditure Cost	Low	$2,034.3	$1,737.0	$935.8	$1,191.0
	High	$2,507.8	$1,963.7	$1,228.4	$1,648.6
Available Revenue	Low	$540.0	$530.0	$467.9	$540.0
	High	$540.0	$530.0	$515.0	$540.0
Existing Revenue Need	Low	$1,494.3	$1,207.0	$467.9	$651.0
	High	$1,967.8	$1,433.7	$713.4	$1,108.6
Proposed New Start Federal Funds	Low	$1,094.3	$867.0	$467.8	$651.0
	High	$1,547.8	$1,033.7	$713.4	$1,108.6
Proposed Regional Compact Funds	Low	$400.0	$340.0	$0.0	$0.0
	High	$420.0	$400.0	$0.0	$0.0
Interim Borrowing Need [3]	Low	$129.7	$38.7	$39.9	$44.1
	High	$480.6	$162.6	$257.4	$407.5
System Finance Plan:					
Total System O&M and Capital Costs		$7,240	$7,140	$7,110	$7,140
Total System O&M and Capital Revenues		$7,350	$7,300	$7,260	$7,280
Low Year Working Capital [4]		2.7	2.7	2.7	2.7
Years With Working Capital Below 3.0 / 2.0		1 / 0	2 / 0	1 / 0	1 / 0

Source: Metro and Tri-Met, February 1998.
Note: MOS = minimum operable segment; O&M = operations and maintenance.
[1] Costs are in millions and year-of-expenditure dollars.
[2] Low = the cost or revenue that would result from selecting the lowest cost alignment alternative and design option in each segment; High = the cost or revenue that would result from selecting the highest cost alignment alternative and design option in each segment.
[3] These estimates are for end-of-year borrowing; peaks within a year are possible, which would increase the amount of credit guarantees that would be required. This issue will be addressed further in the Final Environmental Impact Statement.
[4] After 1997, as measured in months of working capital.

As noted previously, system costs include all capital and O&M expenditures by Tri-Met over a 21-year period (between fiscal years 1995 and 2015), except the South/North Project capital costs. The total system cost, summarized in Table S.6-1, is the aggregate of system capital costs and system operating costs. System operating costs would include all annual transit O&M costs, including the cost of operating the customary increases in transit service hours throughout the transit system that would be required to maintain transit headways and capacity. For the LRT alternatives, system operating costs include costs associated with the

phase-in of the South/North Corridor bus network expansion and the O&M costs of the South/North light rail line. System costs would range from $7,110 million with MOS 2 to $7,240 million with the Full-Length Alternative (in year of expenditure dollars).

S.6.1.2 Currently Available Revenues

As summarized in Table S.6-1, under the current project finance plan, up to $540 million in capital revenues are available for the South/North Light Rail Project, depending on the length alternative; not all sources or amounts would be available for all length alternatives. The currently available project capital revenues consist of the following:

- **$475 Million from Tri-Met Light Rail General Obligation Bonds** approved by Tri-Met district voters in November 1994, subject to the availability of Federal matching funds. The approval authorizes Tri-Met to issue the bonds and to levy ad valorem taxes to repay the debt. For those project alternatives and options that would not require the full bond authority to be used to achieve a 50 percent local match, such as MOS 2, the remaining bond authority that would not be required for the initial construction segment of the project would be reserved for a project segment that would be constructed at a later date.

- **$55 Million in Flexible Funds** (Surface Transportation Program funds) were approved in January 1997 by the Joint Policy Advisory Committee on Transportation and the Metro Council for the South/North Light Rail Project. Surface Transportation Program funds are allocated to the Oregon Department of Transportation (ODOT) on the basis of a Federal formula. ODOT, in turn, allocates a portion of the funds to metropolitan regions within Oregon by formula.

- **$10 Million in Tax Increment Funds** approved by the Clackamas County Board of Commissioners, acting as the urban renewal agency for the County, for the construction of the South/North Light Rail Project.

- **Interest Earnings** from the investment of general obligation bond proceeds from the time of issuance until they are expended would likely yield significant interest earnings for the project, even accounting for tax code restrictions regarding arbitrage and spend-down requirements. These funds would be used to establish a capital reserve account, as security for interim borrowing capacity or to fund project capital costs.

System revenues are estimated from a series of sources, each with its own escalation rate. As shown in Table S.6-1, these revenue sources would provide between $7.26 and $7.35 billion (YOE$) cumulatively between FY 1995 and FY 2015, depending on the length alternative. The difference between alternatives reflects differences in passenger revenues and interest earnings. The major sources of available system revenues as shown in Table A-20 include: payroll tax revenues; self-employment tax revenues; State of Oregon in-lieu revenues; Federal Section 5307 Operating and Capital Assistance; and passenger revenues.

S.6.1.3 Existing Revenue Needs

This section discusses the amount of additional project capital revenues and system revenues that would be needed to make each alternative fiscally feasible. As shown in Table S.6-1, MOS 2 would require $467.9 to $713.4 million of additional revenue, depending on the alignment alternatives selected, and MOS 5 would require $651.0 million to $1.11 billion in additional funds (YOE$). The Full-Length and MOS 1 alternatives would require between $1.21 and $1.97 billion in currently unavailable funds (YOE$). The table also illustrates that there are currently available system revenues sufficient to cover system costs between fiscal year 1997 and 2015 for all light rail length alternatives.

S.6.1.4 Proposed Additional Revenues

As illustrated in Table S.6-1, the region plans to meet the project capital revenue needs for MOS 2 and MOS 5 with Federal funds, while the region plans to meet the capital revenue needs for the Full-Length Alternative and MOS 1 with a combination of Federal and additional regional funds.

- **Section 5309 New Start Funds.** Section 5309 grants are discretionary Federal funds available for bus capital improvements, new fixed guideway transit systems and extensions to existing fixed guideway systems. The amount of New Start authorization that would be needed would vary among the alternatives. Based on the anticipated $100 million per year Federal appropriation limit, the availability of the additional local funds discussed below (i.e., Regional Compact funds), and the alignment options selected: MOS 2 would require between $467.8 and $713.4 million in New Start authorization; MOS 5 would require between $651.0 and $1,108.6 million; MOS 1 would require between $867.0 and $1,033.7 million; and the Full-Length Alternative would require between $1,094.3 and $1,547.8 million (YOE$). The authorization of these funds could occur over one (MOS 2) or two (Full-Length, MOS 1 and MOS 5) Federal authorization cycles (typically every five to six years).

- **Regional Compact Funds.** The Full-Length Alternative would require an additional $400 to $420 million of funds beyond the Federal New Start funds identified above, and MOS 1 would require an additional $340 to $400 million (YOE$). The exact source of these additional funds is currently unidentified, but could include: flexible transportation funds allotted to Oregon and/or Washington; contributions by local governments that are served by the project; and/or the establishment of a development-related tax, a benefit district and/or other levy or fee, the proceeds of which would be committed to the project.

S.6.1.5 System Fiscal Feasibility Conclusions and Risk Assessment

In this study, an alternative is fiscally feasible if:

- Project capital revenues would be sufficient to meet the needs of the capital financing plan to fund construction of the South/North Project; and

- On-going revenues would be sufficient to meet the estimated total system costs and to maintain a sufficient beginning-year working capital to meet two months of operating costs (the analysis also looks at meeting Tri-Met's goal of maintaining three months of working capital).

A detailed analysis of the capital finance plan concluded with two critical points. First, to keep the project on the optimal construction schedule, independent of Federal appropriations. Most, if not all, of the non-New Start funds committed to the project would be advanced to construct the first construction segment. Second, because all local funds would be expended by FY 2004 and Federal appropriations may not keep up with the project's demand for New Start funds (given the anticipated annual limit of $100 million on Federal appropriations), the finance plan would use interim borrowing to maintain its optimum construction schedule. Funds that would be borrowed on an interim basis would be repaid with later appropriated New Start funds, but in the interim the project would incur some interest costs.

The fiscal feasibility analysis also found that, provided the project is capable of securing the new Federal and regional capital funding sources, Tri-Met would have sufficient revenues to meet the project capital requirements of all alternatives. Further, Table S.6-1 summarizes the results of a year-by-year analysis that demonstrates that all light rail length alternatives would meet the minimum standard of maintaining sufficient beginning-year working capital to meet two months of operating costs.

The most significant risk associated with the funding plan for the South/North Project is the possibility that sufficient New Start funds would not be authorized for the project. In such a case, either: 1) the project and/or the initial construction segment would need to be truncated; 2) additional local resources would need to be added; 3) a contingent commitment of New Start funds would be sought; 4) elements of the project could be re-designed, deferred or deleted to reduce costs or 5) implementation of the entire project could be delayed by several years. Another risk associated with the funding plan for the South/North Project is that even if the project is authorized to receive New Start funds, Congress would not appropriate New Start funds in the annual amounts anticipated in the capital finance plan. To respond to this risk, the South/North Project would seek a provision to permit local and non-New Start funds programmed for later construction segments to be advanced to earlier segments (or earlier years within a segment) and to be reimbursed in the future by New Start appropriations.

In addition to project capital uncertainties, there are uncertainties inherent in the systems analysis. Computer simulations of the impact of various economic scenarios that were statistically correlated to historical data showed that the minimum working capital standard was always met. If short-term system deficits were to occur they could be managed through: additional fare increases; adjustments to the rate of customary service expansions; other operating cost containment measures; and/or enactment of an additional revenue source.

S.6.2 Effectiveness Evaluation

Effectiveness is measured on the basis of an alternative's ability to meet the South/North Project objectives.

S.6.2.1 Ability to Provide High Quality Transit Service

The effectiveness of the alternatives to provide high-quality transit service is evaluated on the basis of: coverage; reliability; transferability; travel times; and corridor transit ridership.

Coverage. Transit coverage for the alternatives is measured by the change in the number of residents and jobs in the South/North Corridor that would be within one-quarter mile of a proposed light rail station. The Full-Length Alternative would provide the greatest amount of light rail coverage in the corridor, followed by MOS 1 (93 percent of the combined resident and job coverage of the Full-Length Alternative), MOS 5 (approximately 92 percent) and MOS 2 (approximately 83 percent). The No-Build Alternative would not increase the number of residents or jobs with one-quarter mile access to light rail.

Reliability. In transit service, reliability is measured by the percentage of on-time arrivals. Factors that affect reliability include the amount of reserved right-of-way, percent of protected trunk-line intersections and percent of passengers on exclusive transit right-of-way. All of the light rail alternatives would provide improved reliability over the No-Build Alternative. The Full-Length Alternative would provide the highest level of reliability, followed by MOS 1, MOS 5 and MOS 2, respectively.

Transferability. All of the alternatives, including the No-Build Alternative, would offer a transit service configuration that would be dependent on transfers. The Full-Length Alternative would require the fewest transfers overall, although all of the LRT alternatives would require transit users from the Oregon City and Gladstone areas to transfer in Milwaukie. MOS 1 would also require transit users from Clackamas Regional Center and East Milwaukie to transfer from bus to rail in Milwaukie. However, given the higher reliability of the light rail length alternatives, these transfers would generally be well timed.

Travel Times. All of the light rail length alternatives would result in improved peak-hour in-vehicle and total weighted travel times between major destinations in the corridor, compared to the No-Build Alternative. The Full-Length Alternative would offer the most comprehensive improvement with a 29 to 38 percent decrease in p.m. peak-hour, in-vehicle transit travel time for trips between the Portland CBD and other major

destinations, including the Milwaukie Regional Center, the Clackamas Regional Center , N Lombard Street and the Vancouver CBD. MOS 1 would offer travel time savings similar to the Full-Length Alternative, except for the Portland CBD to Clackamas Regional Center trip. MOS 5 would be similar to the Full-Length Alternative except for travel between downtown Portland and downtown Vancouver. Transit travel time improvements with MOS 2 would be similar to the Full-Length Alternative and MOS 5 between downtown Portland and the Milwaukie and Clackamas Regional Centers, but would be similar to the No-Build Alternative for trips to other major destinations in the corridor.

Transit Ridership. Due to its increased light rail transit coverage, faster travel times and improved reliability, the Full-Length Alternative would generate 163,700 average weekday transit trips within the South/North Corridor in the year 2015, an increase of 30 percent (37,800 trips) over the No-Build Alternative. The Full-Length Alternative would increase the transit mode split for peak-hour radial trips by 52 percent (from 25 percent to 38 percent), compared to the No-Build. MOS 1 would produce the second largest increase in corridor transit ridership, a 21 percent increase over the No-Build Alternative (2015). MOS 1 would produce 11,200 fewer daily transit rides and 11,810 fewer daily light rail rides than the Full-Length Alternative (2015). MOS 5 would produce an 11 percent increase in corridor transit ridership and a 32 percent increase in radial mode split over the No-Build Alternative, but 23,600 less daily transit rides and 27,800 less light rail rides than the Full-Length Alternative. MOS 2 would produce the lowest amount of transit ridership improvement of the build alternatives, but still would attract 7 percent more rides and a 32 percent increase in radial mode split, compared to the No-Build Alternative.

Notable differences in the average weekday (2015) light rail ridership with the alignment alternatives and terminus options include Clackamas Regional Center Segment where the longer terminus options (105th Avenue and 93rd Avenue Terminus Options) would attract approximately 1,175 to 1,450 more rides than the shorter (CTC Transit Center) terminus options, respectively. In the South Willamette River Crossing Segment, the Caruthers Crossing Alternative would attract 710 to 865 more daily light rail rides, depending on the length alternative, than the Ross Island Crossing Alternative. In the Downtown Portland Segment, for MOS 2 and MOS 5, the Full Transit Mall Alternative would attract 490 and 700 more daily light rail rides, respectively, than the Half Transit Mall Alternative. In the Eliot Segment, for the Full-Length Alternative and MOS 1, the East I-5/ Kerby Alternative would attract approximately 900 more daily light rail rides than the Wheeler/Russell Alternative. For MOS 5, the difference in light rail ridership would be 480 rides. In the North Portland Segment, for the Full-Length Alternative and MOS 1, the I-5 Alternative would attract 1,270 more daily light rail rides than the Interstate Avenue Alternative. For MOS 5, the light rail ridership difference between the North Portland Segment alignment alternatives would be approximately 360 daily rides.

S.6.2.2 Ensure Effective Transit System Operations

The relative effectiveness of the light rail alternatives in providing effective transit system operations is qualitatively assessed in terms of: downtown Portland operations; safety considerations; and maintenance facility requirements.

Downtown Portland Operations. By locating the South/North light rail alignment on the downtown Portland transit mall, all length and alignment alternatives would allow for easy transfers to other transit routes serving most of the metropolitan region. With the Half Transit Mall Alternative, the light rail lines would share existing tracks between SW 6th Avenue and the Rose Quarter in the Eliot Segment, a situation that could create the potential for light rail service delays. The Half Transit Mall Alternative would essentially be at capacity in the year 2015 due to the constraints on the shared segment of the existing MAX line.

Safety Considerations. Safety considerations are primarily measured by the number of light rail at-grade crossings because, while they meet a high design and safety standard, they do slightly increase the risk of light rail conflicts with other vehicles. There would be several significant (arterials or freight rail spurs) crossings by the alignment alternatives. The North of CTC Alternative would cross SE 82nd Avenue at grade. The Caruthers Crossing Alternative would have two at-grade railroad and one at-grade street crossing. The Ross Island Crossing Alternative would have three at-grade street crossings. All alternatives would have an at-grade crossing of several streets in the Downtown Portland Segment. The Wheeler/Russell Alternative would have one at-grade crossing of the N/NE Broadway/Weidler Street couplet. The East I-5/Kerby Alternative would provide either an at-grade or grade-separated crossing of these streets. The Interstate Avenue Alignment Alternative would operate in the median of N Interstate Avenue and would cross several high-traffic arterials at grade. In comparison, the I-5 Alternative would grade separate the light rail crossing of two of these arterials.

Operations and Maintenance Facility Requirements. Three sites have been identified as possible locations for a new light rail O&M facility. There is little difference among the length and alignment alternatives in relationship to these O&M facility site alternatives, except that the Brooklyn Yard facility would have four more business displacements and would cost $5.6 million less (1994$) with the Ross Island Crossing than the Caruthers Crossing.

S.6.2.3 Maximize the Ability of Transit to Accommodate Growth in Travel Demand

This criteria is measured by how well the alternatives would accommodate growth in population, employment and travel demand to the year 2015 and by the future expansion capability.

Year 2015 Growth Accommodated by Transit. The Full-Length Alternative would have the greatest ability to accommodate growth. It would attract 49 percent of new peak-hour radial trips in the corridor in the year 2015 (eight times higher than the No-Build). In addition, the Full-Length Alternative would carry 47 percent more transit passenger miles in the corridor than the No-Build by attracting 30 percent more trips. MOS 1 would have the second largest ability to accommodate growth (by providing over 880,000 passenger-miles on transit and by attracting 32 percent of the new radial trips in the corridor to transit), followed by MOS 5 and MOS 2. The No-Build Alternative would have the least ability to accommodate growth in the corridor.

Future Expansion Capability. The ultimate capacity of the light rail alternatives would be restricted by the two-car train limitation resulting from the 200-foot blocks in downtown Portland, and by the three-minute headway capacity of the train signal system. With these constraints, the ultimate capacity of the light rail alternatives would be 6,640 persons per hour at the peak-load point (based upon the Full Transit Mall Alternative in the Downtown Portland Segment). This would be two to two and one half times the peak-hour capacity provided in the year 2015 service plans. With the Half Transit Mall Alternative, the light rail system would essentially be at capacity because of operational constraints on the existing segment from Pioneer Square to the Steel Bridge that would be shared by the East/West and South/North light rail lines. Besides their capability to provide additional capacity at peak-load points, the light rail alternatives could be extended, both north and south, to accommodate additional transit demand.

S.6.2.4 Minimize Traffic Congestion and Traffic Infiltration Through Neighborhoods

The criteria to minimize traffic congestion and traffic infiltration through neighborhoods is assessed by regional highway system measures.

Highway System Use. All of the light rail length alternatives would help reduce traffic congestion and related problems, compared to the No-Build Alternative. The Full-Length Alternative would result in the

greatest traffic relief benefits. It would: remove almost 133,000 vehicle miles of travel per average weekday from the corridor road system; eliminate 16 lane-miles of congested roadways; and avoid 4,500 hours of traffic delays each weekday (compared to the No-Build Alternative in the year 2015). It would reduce weekday, p.m. peak hour travel in the region by 4,200 vehicles, in 2015. MOS 5 would provide the second greatest overall improvement to traffic conditions, followed closely by MOS 1, with MOS 5 providing more relief in Clackamas County and MOS 1 providing greater relief in the northern part of the corridor.

Neighborhood Infiltration. All of the light rail alternatives would reduce the amount of traffic infiltrating Portland and Clackamas County neighborhoods. The Full-Length Alternative would provide the greatest capability, particularly in the north, close-in northeast, close-in southeast and Milwaukie neighborhoods. MOS 1 would provide the second largest capability to help reduce traffic infiltration, particularly in the northern portion of the corridor. MOS 2 and MOS 5 would exhibit similar potential to reduce neighborhood traffic infiltration in the southern portion of the corridor.

S.6.2.5 Facilitate Efficient Land Use Patterns

Facilitating efficient land use patterns is measured by the alternatives' ability to support: development objectives; local land use policies and major activity centers; and regional land use and related policies.

Support Development Objectives. The light rail alternatives would influence the quality of the access to vacant developable and redevelopable parcels of land in the corridor. The Full-Length Alternative would provide the greatest increase in light rail station access among the length alternatives to both vacant (142 acres) and redevelopable (288 additional acres) land within the corridor. MOS 5 would serve the second largest amount of developable land, providing light rail station access to 8 percent less vacant land and 3 percent less redevelopable land than the Full-Length Alternative. MOS 1 and MOS 2 would support less vacant and redevelopable land than the Full-Length Alternative (26 and 22 percent less, respectively). Viewed in the aggregate, the southern and downtown portions of the corridor (MOS 2) would serve approximately 78 percent of the vacant and redevelopable land served by the Full-Length Alternative.

Support of Local Land Use Policies and Activity Centers. The ability of the alternatives to support local land use policies and to provide increases in the labor and consumer pools within 45-minute weighted transit travel time access to the major activity centers are summarized below.

In the Clackamas Regional Center, the Full-Length Alternative, MOS 2 and MOS 5 would be most supportive of the *Clackamas County Comprehensive Plan*. Each would provide the regional center with access to approximately 18 percent more households than the No-Build Alternative. MOS 1 would improve transit access to the area by 3 percent above the No-Build Alternative.

In Downtown Milwaukie, the City of Milwaukie's adopted Comprehensive Plan designates the majority of the central business district area for commercial uses with residential uses in the surrounding areas. The Full-Length Alternative, followed very closely by MOS 2 and MOS 5, would provide the greatest improvement in the size of the labor and consumer pools accessible to downtown Milwaukie. MOS 1 would produce a 6 percent smaller improvement than the Full-Length Alternative.

In Downtown Portland, the Full-Length Alternative and MOS 5 (and to a lesser degree, MOS 1 and MOS 2), would provide increased transit capacity needed to support the *Central City Plan's* development objectives, which include designating the majority of downtown Portland and several surrounding districts for high density commercial and residential uses. The plan depends on high quality transit to provide regional access to the Central City and a high quality pedestrian environment to support trips within the downtown. Also, the Full-Length Alternative, which would reduce projected parking demand by approximately 3,790 spaces in downtown Portland, would provide the highest support of the City of Portland's *Central City Transportation*

Management Plan's (CCTMP) very restrictive parking development ratios. MOS 5 would provide the second largest reduction in parking space requirements, approximately 41 percent less than the Full-Length Alternative, followed by MOS 1 and MOS 2, respectively.

In the Lloyd District, the *Central City Plan* calls for relatively high-density commercial and residential development, the expansion of major entertainment and public assembly uses and severe controls on new parking development. All of the length alternatives would serve the southwest corner of the district and the Full-Length Alternative would provide the greatest improvement in 45-minute weighted transit travel time access to the district (8 percent more than the No-Build) followed by MOS 5 (2 percent lower than the Full-Length Alternative) and MOS 1 and MOS 2 (both slightly lower than MOS 5).

In Downtown Vancouver, the Full-Length Alternative and MOS 1 would be most supportive of the *Vancouver Comprehensive Plan* and would substantially enlarge the labor and consumer pools that would reside within a 45-minute weighted transit travel time from the Vancouver CBD. Both of these length alternatives would produce a 43 percent increase compared to the No-Build Alternative. MOS 2 and MOS 5 would afford the same accessibility to downtown Vancouver as the No-Build Alternative.

Support of Regional Land Use and Related Policies. Each of the light rail length alternatives would support the region's growth management strategy and the urban growth boundary (UGB) by: providing access to vacant and redevelopable in-fill properties; providing transportation capacity to the Portland Central City that would enable the region's core to accommodate the high growth levels expected of it; providing the high quality transit needed to make regional centers function in accordance with the growth strategy; establishing new station communities to be developed as mixed-use areas; and instituting a pattern of growth that conforms to the goals, objectives and policies of local land use and infrastructure plans. Overall, the Full-Length Alternative would best support the regional growth management strategy. MOS 5 would provide the second best support for the regional growth management strategy, but would not provide the bi-state light rail service offered by MOS 1. MOS 1 would not provide light rail service to the Clackamas Regional Center. MOS 2 would serve the Clackamas Regional Center but would not serve the redevelopment sites in north Portland and would not provide bi-state light rail service.

In comparison, the No-Build Alternative would not encourage the change in the existing development patterns in the corridor that is envisioned in the state, regional and local plans. As a result, the No-Build Alternative would increase the pressure to expand the urban growth boundary because less land may be made available by regional and local jurisdictions for more intense and mixed uses than is currently envisioned by those plans. An expansion of the urban growth boundary would result in increased costs to jurisdictions to provide new and/or expanded services to newly urbanized areas.

All of the alternatives would meet Federal and state air quality standards and would therefore be consistent with the Air Quality Maintenance Plan for the Portland-Vancouver region. The Full-Length Alternative would generate the least amount of the indicator air pollutants, followed by MOS 1, MOS 5 and MOS 2, respectively. Air quality emissions would be highest with the No-Build Alternative.

S.6.2.6 Balance the Efficiency and Environmental Sensitivity of the Engineering Design

Indicators of environmental sensitivity include displacements, noise and vibration impacts, parkland impacts, floodplain impacts, wetland impacts and historic and archaeological resources impacts. These impacts are summarized in Section S.5 and Table S.5.1.

S.6.3 Cost Effectiveness

Three measures of cost-effectiveness are summarized in Table S.6-2: operating cost per corridor transit ride; net operating subsidy per corridor transit ride; and boarding rides per revenue hour. Additionally, FTA has established an index as a standardized measure for comparing light rail projects throughout the country that measures the incremental cost per incremental rider of a light rail alternative compared to the No-Build Alternative. Ridership, capital costs and O&M costs have been annualized using FTA approved annualization factors, discount rates and estimated economic life of cost components.

Table S.6-2
Summary of Cost Effectiveness Measures [1]

	No-Build	Full-Length	MOS 1 (Bi-State)	MOS 2 (Rose Quarter)	MOS 5 (Lombard)
Cost Effectiveness Measures:					
Operating Cost Per Corridor Transit Ride	$2.24	$2.05	$2.10	$2.34	$2.29
Operating Subsidy Per Corridor Transit Ride	$1.58	$1.34	$1.39	$1.66	$1.59
Corridor LRT Boarding Rides Per Revenue Hour	N/A	228	236	157	203
FTA Index [2]	N/A	$8.99	$10.34	$21.18	$15.77

Source: Metro: January 1998.

[1] In 2015, reported In 1994 dollars. These measures do not include any dollar values for the benefits resulting from the alternatives such as reduced infrastructure costs, travel time savings, etc. These measures would vary by alignment alternative and design option.

[2] The incremental cost per incremental ridership of the light rail alternatives compared to the No-Build Alternative ridership. Capital costs and O&M costs are annualized using FTA approved annualization factors, discount rates and estimated economic life of cost components.

The Full-Length Alternative would also have the lowest operating cost and operating subsidy per transit ride, and MOS 2 would have the highest. The number of light rail boarding rides in the corridor per revenue hour would range from 228 per hour with the Full-Length Alternative to 157 per hour with MOS 2. The FTA index for the light rail length alternatives would range from $8.99 with the Full-Length Alternative to $21.18 for MOS 2. It is important to put these measures in context. Cost efficiency does not address financial feasibility or the value of any benefit other than transit ridership. While cost efficiency is an important factor, these results must be considered in light of the relative benefits of the alternatives that are not monetized nor incorporated in these measures, and also in light of the financial feasibility of the alternatives.

S.6.4 Social Equity Considerations

The percentage of minority populations in nearly one half of the neighborhoods in the South/North Corridor is higher than the regional average of 8.6 percent. Nearly two-thirds of corridor neighborhoods have a percentage of low-income households that is higher than the regional average (1990 US Census). The low-income neighborhoods are dispersed throughout both the southern and northern portions of the corridor, while minority neighborhoods are primarily concentrated in the central and northern portions of the corridor. Therefore, the Full-Length Alternative, MOS 1 and MOS 5 would serve both low-income and minority neighborhoods, while MOS 2 would primarily serve low-income neighborhoods. However, none of the length or alignment alternatives would result in negative consequences to low-income or minority neighborhoods that would not be served and benefitted by that alternative, nor would the impacts to those neighborhoods be disproportionate to the benefits they would receive.

S.6.5 Significant Trade-Offs Between Alternatives

This section identifies the major trade-offs that would be involved in the selection of the Locally Preferred Strategy (LPS) from among the length alternatives, alignment alternatives, design options and terminus options. All estimates are for year 2015 and the capital and operating cost estimates are in 1994 dollars. Estimates shown for the alignment alternatives are based on the Full-Length Alternative.

S.6.5.1 Trade-Offs Between the No-Build and Light Rail Length Alternatives

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 in relation to the No-Build Alternative. These benefits would be weighed against the cost and impacts of the light rail alternatives.

Growth Management. A balanced transportation system, that would in part be achieved through the expansion and improvement of transit service proposed within the South/North Project, would help to assure that state, regional and jurisdictional land use plans are realized. By using South/North light rail as a tool to help shape growth, regional and local jurisdictions would tend to focus future development in regional centers and around light rail stations with the greatest opportunities for new development and redevelopment. In comparison, the No-Build Alternative would not encourage the change in the existing development patterns in the corridor that is envisioned in the state, regional and local plans. As a result the No-Build Alternative would increase the pressure to expand the region's urban growth boundary because less land than is currently envisioned by those plans may be made available by regional and local jurisdictions for more intense and mixed uses. An increase in the urban growth boundary would result in increased costs to jurisdictions to provide new and/or expanded services to newly urbanized areas.

Transit System Capacity. The light rail alternative would also increase the transit system's capacity to accommodate the growth anticipated within those plans. The light rail alternatives would provide 27 to 47 percent more transit service capacity (measured by place miles in the corridor), and 4,100 to 8,000 more park-and-ride spaces than the No-Build Alternative.

Transit Reliability. The light rail alternatives would improve the reliability of transit in the South/North Corridor. Compared to the No-Build Alternative, the light rail alternative would provide approximately 12 to 20 more miles of exclusive right-of-way for transit. Additionally, 50 to 108 intersections along the light rail right-of-way would have a transit preferential treatment. As a result, 20 to 40 percent of all corridor transit passenger miles in the year 2015 would be on an exclusive, preferentially treated trunkline with the light rail alternatives, compared to 2 percent with the No-Build Alternative. Therefore, the light rail alternatives would allow much more reliable and faster trunkline service to corridor travelers than the No-Build Alternative.

Transit Travel Times. Peak-hour, peak-direction, in-vehicle transit and automobile travel times between downtown Portland and major activity centers in the corridor would be quicker with the light rail alternatives than with the No-Build Alternative. Those transit times would generally be reduced by 29 to 37 percent with the light rail alternatives, and automobile travel times would be reduced by 3 to 9 percent, compared to the No-Build Alternative.

Transit Ridership. As a consequence of its faster, more reliable and higher capacity transit service, the light rail alternatives would attract 8,500 to 37,800 (7 to 30 percent) more daily corridor transit rides than the No-Build Alternative in the year 2015, and would provide the capacity to accommodate more transit trips in future years. Fourteen to 47 percent more daily transit passenger miles would be served by light rail in the year 2015 than by the No-Build Alternative. The light rail alternatives would attract 32 to 49 percent of the

new radial trips in the corridor (new compared to existing conditions), compared to 6 percent of new radial trips in the corridor that would be attracted to transit by the No-Build Alternative.

Highway System Operations. Due to their greater ability to attract transit rides, all of the light rail alternatives would help reduce traffic congestion and the amount of traffic infiltrating neighborhoods in the corridor, compared to the No-Build Alternative. The light rail alternatives would reduce daily regional vehicle miles of travel by 50,900 to 213,700 miles, regional daily vehicle hours of delay by 3,900 to 4,500 hours and the lane-miles of regional congested roadways by six to 16 miles. In addition, the light rail alternatives would provide the infrastructure needed to support regional growth management policies.

Air Quality and Downtown Portland Parking Demand. The reduction in automobile use associated with the light rail alternatives would result in a reduction of 232 to 1,056 tons of air pollution emissions per year, compared to the No-Build Alternative (2015). A reduction in automobile use would also result in a demand for 2,100 to 3,800 fewer parking spaces in downtown Portland, compared to the No-Build Alternative.

These benefits of the light rail alternatives relative to the No-Build Alternative would be achieved at the cost to construct each alternative and the resulting impacts associated with each alternative as described in the DEIS. The light rail length alternatives would displace 188 to 333 residential units and 51 to 77 businesses, depending upon the alternative and option. In addition, the light rail alternatives would result in noise, parks, historic resource, floodplain and wetlands impacts.

S.6.5.2 Trade-Offs Between Length Alternatives

Generally, the major trade-offs among length alternatives weigh the lower costs and lower impacts of the shorter length alternatives against the greater benefits and better cost-effectiveness of the longer length alternatives. The following paragraphs describe the major trade-offs by progressing from the most expensive length alternative to the least in pairs of comparisons.

The major trade-offs between the **Full-Length Alternative and MOS 1:** The Full-Length Alternative would have 3.9 additional miles of exclusive transit right-of-way, 2,800 more park-and-ride spaces, 11,200 more daily corridor transit riders, 11,800 more light rail rides, 52,700 fewer daily regional vehicle miles of travel, 100 fewer daily regional vehicle hours of delay, ten fewer congested lane-miles, 113 more acres of developable land gaining light rail access, 13 percent lower (better) FTA index (change in cost compared to change in ridership) and $0.05 lower (better) operating subsidy per ride of the Full-Length Alternative. MOS 1 would have a $188 million lower capital cost, $5.2 million lower year 2015 operating cost, fewer ecosystem impacts east of the Milwaukie Regional Center Segment, and 101 fewer residential and seven fewer business displacements.

The major trade-offs between **MOS 1 and MOS 5:** MOS 1 would have 1.4 additional miles of exclusive transit right-of-way, 1,100 more park-and-ride spaces, 12,400 more daily corridor transit rides, 16,100 more light rail rides, 47,500 fewer daily regional vehicle miles of travel, 72 fewer residential displacements, fewer ecosystem impacts east of the Milwaukie Regional Center Segment, a lower (better) FTA index and $0.20 lower operating subsidy per ride. MOS 5 would have a $206 million lower capital cost, $0.7 million lower year 2015 operating cost, six fewer business displacements, eight fewer congested lane-miles of traffic, 93 more acres of developable land served by light rail, and fewer ecosystem impacts north of N Lombard Street.

The major trade-offs between **MOS 2 and MOS 5:** MOS 2 would have $167 million lower capital cost, $2.8 million lower year 2015 operating cost, 116 fewer residential and 13 fewer business displacements. MOS 5 would have 3.6 additional miles of exclusive transit right-of-way, 5,700 more daily corridor transit rides, 12,555 more daily light rail rides, 62,600 fewer daily vehicle miles of travel, 500 fewer daily vehicle hours of

delay, six fewer congested lane-miles, 76 more acres of developable land with light rail access, 26 percent lower (better) FTA index and $0.07 lower operating subsidy per ride.

S.6.5.3 Trade-Offs Between Alignment Alternatives and Terminus Options in the Clackamas Regional Center Segment

The major trade-offs between the CTC Transit Center Terminus Options and the longer southern terminus options include: The **CTC Transit Center Terminus** would have $31.7 to $55.0 million lower capital cost, $0.6 to $2.1 million lower year 2015 operating cost, 15 to 18 fewer residential displacements than the longer southern terminus options. The longer **105th Avenue and 93rd Avenue Terminus Options** would have light rail access to 250 to 2,120 more residents and 3,420 to 9,420 more jobs, 1,175 to 1,450 more daily light rail rides, and 14 to 33 more developable acres served by light rail than the CTC Transit Center Terminus options.

The major trade-offs between the South of CTC and North of CTC Alignment Alternatives with the longer terminus options include: the **South of CTC Alternative** would have $16.1 to $21.1 million lower capital cost, $1.9 to $2.0 million lower year 2015 operating cost and up to 17 fewer displacements than the North of CTC Alternative. The **North of CTC Alternative** would have 8,380 more jobs and 2,640 more residents served by light rail, 175 to 190 more daily light rail rides and better light rail access to higher-density residential areas than the South of CTC Alternative.

The major trade-offs between the South of CTC and North of CTC Alignment Alternatives with the shorter terminus options include: the **South of CTC Alternative** would have $558,000 to $607,000 lower year 2015 operating cost and 85 more daily light rail rides than the North of CTC Alternative. The **North of CTC Alternative** would have $1.9 to $7.2 million lower capital cost, 2,380 more jobs and 760 more residents served by light rail and better light rail access to higher-density residential areas than the South of CTC Alternative.

S.6.5.4 Trade-Offs Between Alignment Alternatives in the East Milwaukie Segment

The major trade-offs between the Railroad Avenue/Local Access, the Railroad Avenue/Through Traffic and the Highway 224 alternatives include: The **Railroad Avenue Alternatives** would have $9.4 and $21.0 million lower capital cost, $0.7 million lower year 2015 operating cost and 415 additional daily light rail rides than the Highway 224 Alternative. The **Highway 224 Alternative** would have six to 78 fewer residential displacements, fewer (zero) impacts to historic or parkland resources, a lower risk of hazardous materials impacts, and fewer neighborhood and local traffic circulation impacts than the Railroad Avenue alternatives. The **Railroad Avenue/Local Access Alternative** would have $11.6 lower million capital cost, and 72 fewer residential displacements than the Railroad Avenue/Through Traffic Alternative. The **Railroad Avenue Through Traffic Alternative** would have fewer local traffic and neighborhood impacts than the Railroad Avenue/Local Traffic Alternative.

S.6.5.5 Trade-Offs Between Alignment Alternatives in the South Willamette River Crossing Segment

The major trade-offs between the Ross Island Crossing and the Caruthers Crossing alternatives include: The **Ross Island Crossing Alternative** would have $0.4 to $0.5 million lower year 2015 operating cost, 44 to 61 more acres of developable land served by light rail, less risk of hazardous materials impacts and 16 to 17 fewer business displacements than the Caruthers Crossing Alternative. Capital costs for the Ross Island Crossing would range from $4.3 million less to $1.2 million more than the Caruthers Crossing Alternative, depending upon design options. The **Caruthers Crossing Alternative** would have 865 to 1,515 more daily light rail rides, nine to 26 fewer residential displacements, less potential impact to vegetation, wildlife,

wildlife habitat and fisheries, and would provide better light rail access to east Portland neighborhoods and activity centers than the Ross Island Crossing Alternative.

S.6.5.6 Trade-Offs Between Alignment Alternatives in Downtown Portland Segment

The major trade-offs between the Full Transit Mall and the Half Transit Mall alternatives include (note that this comparison is based upon MOS 2 and 5 only, because The Full-Length Alternative and MOS 1 would not be operationally feasible with the Half Transit Mall Alternative due to capacity constraints): The **Half Transit Mall Alternative** would have a $74 to $84 million lower capital cost and zero to 60 fewer residential displacements than the Full Transit Mall Alternative. The **Full Transit Mall Alternative** would have 700 more daily light rail rides, 11,000 more direct light rail trips to the north transit mall, greater long-term transit capacity, and higher redevelopment opportunities (17 to 21 more acres) in the north downtown area than the Half Transit Mall Alternative.

S.6.5.7 Trade-Offs Between Alignment Alternatives in the Eliot Segment

The major trade-offs between the East I-5/Kerby and the Wheeler/Russell alternatives include: The **East I-5/Kerby Alternative** would have $6.6 to $10.5 million lower capital cost and 910 more corridor light rail trips than the Wheeler/Russell Alternative. The **Wheeler/Russell Alternative** would have 12 to 13 fewer displacements, better neighborhood access to light rail than the East I-5 Kerby Alternative and, when compared to the Grade Separated Design Option at NE Broadway and NE Weidler Street, would have fewer visual impacts.

S.6.5.8 Trade-Offs Between Alignment Alternatives in the North Portland Segment

The major trade-offs between the I-5 and the Interstate Avenue alternatives include: The **I-5 Alternative** would have $44.2 to $48.0 million lower capital cost, $0.7 million lower year 2015 operating cost, 1,270 more daily light rail rides, 27 to 28 fewer business displacements, and would provide better light rail access to neighborhoods and businesses located east of I-5 than the Interstate Avenue Alternative. The I-5 Alternative with the Modify Alberta Ramps Design Option would have 25 fewer residential displacements than the Interstate Avenue Alternative, and with the Retain Alberta Ramps Option, the I-5 Alternative would have 38 more residential displacements than the Interstate Avenue Alternative. The **Interstate Avenue Alternative** would have better access to businesses and commercial activities on N Interstate Avenue and residential areas west of N Interstate Avenue than the I-5 Alternative.

S.7 Issues to Be Resolved

The analysis and preparation of the DEIS represent one phase, albeit an important one, in the course of the South/North Project. There are numerous issues still to be resolved, and this section addresses some of the more important and immediate landmarks ahead.

S.7.1 Selection of the Locally Preferred Strategy

The DEIS, related technical documents and comments received during the public review period will provide a basis for local jurisdictions to recommend and adopt a set of length alternatives, alignment alternatives, design options and terminus options that will collectively comprise the Locally Preferred Strategy (LPS). There are many points of view that must be brought to bear on these important decisions. The length alternatives, alignment alternatives, terminus options and design options presented in the DEIS offer a wide range of possibilities.

The Project Management Group, CAC, Steering Committee and participating jurisdictions will have the opportunity to develop independent recommendations on project elements to be included in the LPS. The Downtown Oversight Committee will have the opportunity to develop and adopt recommendations relating to the Downtown Portland Segment and alternatives. Those recommendations will be forwarded to the RTC and Metro's Joint Policy Advisory Committee on Transportation, and to the Metro Council who will adopt the final LPS. Metro will prepare an LPS report that documents the selection and will forward the LPS report to FTA to complete the local decision step in the Federal environmental process.

S.7.2 Implementation of the Financing Plan

The financial analyses in the DEIS and supporting results reports show that the light rail alternatives will require, in varying degrees, significant revenue that is currently not available. The financial analysis also identifies required new levels and proposed sources of revenue. New Federal funds would be secured through the Federal Section 5309 authorization and appropriations cycles and through the normal FTA grant process. If needed, new local funds will be secured through the execution of a Regional Compact.

Finally, implementation of the financial plan includes completing all Federal NEPA and FTA requirements and the execution of a Full Funding Grant Agreement (FFGA) with FTA. Definition of all items that are considered eligible for Federal funding must be identified in the FFGA. In order to construct some associated facilities that would be funded by others concurrently with the light rail project, ODOT and/or local jurisdictions would need additional revenues not currently committed to in the Transportation Improvement Plan (TIP) and ODOT's existing Six Year Program. These additional funds must be committed by the appropriate jurisdiction or agency during the periodic updating of the Six Year Program or their local capital improvement plans.

S.7.3 Completion of the Proposed Mitigation Plan

Design, determination of impact, and estimates of costs for any major project such as the South/North Project proceed from conceptual to preliminary to final as the project advances to construction. At this DEIS stage of the process, numerous impacts have been identified and many mitigation measures have already been incorporated into the preliminary design and cost estimates or committed to by the project. Examples include: conformance with applicable state and Federal policy concerning relocation assistance; initial coordination with the Oregon State Historic Preservation Officer (SHPO), Washington State Office of Archaeology and Historic Preservation (OAHP), the Advisory Council on Historic Preservation (ACHP) and other affected parties to ensure compatible design of light rail facilities with historic resources; avoidance, minimization of impacts and appropriate mitigation for impacts to wetland areas; and mitigation for (100-year) floodplain encroachment.

In addition, the South/North Project has committed to further ways to mitigate or finalize the mitigation of certain impacts. Examples of areas requiring further study and commitment include: final designs regarding landscaping and architectural design treatment of project facilities; traffic capacity problems at intersections where there would be significant project impacts on traffic; final definitions (e.g. location, height, extent, type) of noise and vibration mitigation measures for selected alignment alternatives and design options; final wetland replacement plan; selecting the final bridge type and navigational requirements for river crossings; a Memorandum of Agreement (MOA) negotiated between the Project, SHPO, OAHP and reviewed and concurred with by the ACHP; demonstration of compliance with all Federal "Section 4(f)" requirements concerning parklands and historic properties through completion of a formal "Draft 4(f) Statement"; and development of traffic management plans for the construction phase.

Depending on input during the public comment period and on selection of the LPS, the South/North Project will develop a series of more detailed mitigation plans for inclusion in the FEIS.

Appendix A

Tables

Table A-1
Summary Table for Average Weekday Corridor Transit Service Characteristics, by Existing, No-Build and LRT Length Alternative [1,2]

	Existing		No-Build		Full-Length		MOS 1 (Bi-State)		MOS 2 (Rose Quarter)		MOS 5 (Lombard)	
Characteristics	**Bus**	**LRV**	**Bus**	**LRV**	**Bus**	**LRV**	**Bus**	**LRV**	**Bus**	**LRV**	**Bus**	**LRV**
Transit VMT [3]	34,400	N/A	50,300	N/A	49,100	4,910	49,300	3,670	49,800	2,800	49,600	3,190
Transit VHT [4]	2,350	N/A	3,290	N/A	3,100	298	3,090	238	3,170	176	3,180	198
Transit Place Miles [5]	2,270,400	N/A	3,319,800	N/A	3,240,600	1,630,120	3,253,800	1,218,440	3,286,800	929,600	3,273,600	1,059,100

Source: Metro, 1997.
Note: LRV = light rail vehicle.
[1] MOS 3 and 4 were eliminated from further study during Cost-Cutting.
[2] Length alternatives are based upon a common set of alignment alternatives and terminus and design options, see Section 2.3.2.1.1 in Chapter 2 of the DEIS. Characteristics will vary depending upon which alignment alternatives and terminus and design options are selected as a part of the LPS.
[3] VMT = Vehicle miles traveled in revenue service.
[4] VHT = Vehicle hours traveled in revenue service.
[5] Place Miles = Transit Vehicle Capacity (seated and standing) multiplied by VMT.

Table A-2
Current and 2015 Bus Travel Times [1] between Downtown Portland and Select Locations in the South/North Corridor

Location	1994	2015 [2]	% Change
Clackamas Regional Center	35	42	20%
Milwaukie Regional Center	24	28	17%
N Lombard Street (North Portland)	22	27	23%
Downtown Vancouver	24	40	67%

Source: Metro, 1997.
[1] In-vehicle time, in minutes during the p.m. peak hour in the peak direction.
[2] Based upon the No-Build (All-Bus) Alternative.

Table A-3
Adjustments to Light Rail Length Alternative Ridership, by Alignment Alternative and Design Option: Average Weekday – Year 2015

By Length Alternative [1]	
Full-Length	68,030
MOS 1 (Bi-State)	56,220
MOS 2 (Rose Quarter)	27,655
MOS 5 (Lombard)	40,210

Notes:
The ridership adjustment figures below indicate how a length alternative's ridership would change as a result of different alignment alternatives and options. "0" indicates that that alternative and/or option was used to calculate the ridership for the associated length alternative.

Segment	Alignment Alternative	Terminus Option	Full-Length	MOS 1 (Bi-State)	MOS 2 (Rose Quarter)	MOS 5 (Lombard)
Clackamas Regional Center	South of CTC	93rd	0	N/A	0	0
		CTC TC	-1,175	N/A	-1,200	-1,185
	North of CTC	105th	+190	N/A	+175	+180
		CTC TC	-1,260	N/A	-1,280	-1,270
East Milwaukie	Railroad Avenue [2]		0	0	0	0
	Highway 224		-415	-250	-430	-420
Milwaukie Regional Center	Main Street/ Tillamook Branch		0	0	0	0
McLoughlin Boulevard	McLoughlin Blvd.		0	0	0	0
South Willamette River Crossing	Ross Island [3]		0	0	0	0
	Caruthers [4]		+865	+815	+710	+765
Downtown Portland	Full Mall [5]		0	0	0	0
	Half Mall		N/A	N/A	-490	-700
Eliot	East I-5/Kerby		0	0	N/A	0
	Wheeler/Russell		-910	-900	N/A	-480
North Portland	I-5		0	0	N/A	0 [6]
	Interstate Avenue		-1,270	-1,260	N/A	-360 [7]
Hayden Island/ Vancouver	I-5/Washington St.	Structured P&R	0	0	N/A	N/A
		Surface P&R	-3,890	-3,860	N/A	N/A

Source: Metro, 1997.
Note: CTC = Clackamas Town Center; TC = transit center; N/A = not applicable; P&R = park-and-ride lot; MOS = minimum operable segment.

[1] Length alternatives are based upon a common set of alignment alternatives and terminus and design options, see Section 2.3.2.1.1 in Chapter 2 of the DEIS.

[2] For both alternatives, without a Wood Avenue Station, ridership for the Full-Length, MOS 2 and MOS 5 alternatives would decrease by approximately 500 rides.

[3] Based on the East of McLoughlin Boulevard Design Option. With the West of McLoughlin Boulevard Design Option, ridership would decrease by approximately 500 rides for all length alternatives.

[4] Based on the Moody Avenue Design Option. With the South Marquam Design Option, the ridership associated with the Caruthers Crossing Alternative would increase by approximately 150 rides.

[5] Based on the Glisan Street Design Option. Ridership differences between the Glisan Street and Irving Street Design Options were calculated using a methodology developed for the North Entry Station Access Study (see Section L.2 in Appendix L of the DEIS for more detail on the methods). Based upon that methodology, the Glisan Street Design Option would have 950 to 1,175 more light rail rides than the Irving Street Design Option.

[6] Based on a N Lombard Street Terminus. An alternate terminus located in Kenton adjacent to I-5 would increase ridership by approximately 600 rides. An alternate terminus in Kenton adjacent to N Interstate Avenue would increase ridership by approximately 1,000 rides. An alternate terminus at the Expo Center would increase light rail ridership by 1,100 to 1,500 rides over the terminus as N Lombard Street, depending upon the alignment alternative.

[7] Based on a N Lombard Street Terminus. An alternate terminus located in Kenton adjacent to N Interstate Avenue would result in a positive ridership adjustment for MOS 5 of approximately 1,000 rides. An alternate terminus located at the Expo Center would result in a positive ridership adjustment for MOS 5 of approximately 1,500 rides.

Table A-4
Clackamas Regional Center Segment, 2015 P.M. Peak Hour Intersection Levels of Service by No-Build and Light Rail Alternative [1]

Intersection	No-Build Alternative	South of CTC		North of CTC	
		CTC TC	93rd	CTC TC	105th
SE Sunnyside Rd. at SE 105th Ave.	D	D [2]	D	C	D
SE Sunnyside Rd. at SE 101st Ave.	D	C [2]	C	C	C
SE Sunnyside Rd. at SE Stevens Rd.	D	D [2]	D	D	F
SE Sunnyside Rd. at SE 97th Ave.	B	C [2]	C	C	C
SE Sunnyside Rd. at I-205 NB Ramps	C	C [2]	C	C	C
SE Sunnyside Rd. at I-205 SB Ramps	F	F [2]	F	F [2]	F
SE Sunnyside Rd. at SE 93rd Ave.	C	C	C	C [2]	C
SE Sunnyside Rd. at SE 90th Ave.	D	D	D	E	D
SE Sunnyside Rd. at SE 86th Ave.	D	D	D	D	D
SE Harmony Rd. at SE 82nd Ave.	F	E	E	E	E
SE Monterey Street at SE 90th Ave.	A	A [2]	A	D	D
SE Monterey Street at SE 86th Ave.	A	A [2]	A	D	D
SE Monterey Street at SE 82nd Ave.	D	D [2]	D	D	D
SE Harmony Rd. 200' west of SE 80th Ave.	E	E [2]	E	E [2]	E [2]
SE Harmony Rd. at Aquatic Center	D	D [2]	D	D [2]	D
SE Harmony Rd. at SE Fuller Rd.	F	F [2]	F	F [2]	F

Source: *South/North Local and Systemwide Traffic Impacts Results Report* (Metro: February 1998).
Note: CTC TC = Clackamas Town Center Transit Center; 93rd = 93rd Avenue Terminus; 105th = 105th Avenue Terminus; NB = northbound; SB = southbound; LOS = level of service.

[1] Based upon the Full-Length Alternative; Level of service (LOS) for MOS 2 and MOS 5 would be similar to the Full-Length Alternative. LOS with MOS 1 would be similar to the No-Build Alternative.

[2] LOS estimated based on intersection screening procedure.

Table A-5
East Milwaukie Segment, 2015 P.M. Peak-Hour Intersection Levels of Service by No-Build and Light Rail Alternative [1]

Intersection	No-Build	Railroad Ave./ Through Traffic	Railroad Ave./ Local Access	Highway 224
SE Harmony Rd. at SE Railroad/Linwood Ave.	E	N/A[5]	N/A[5]	E
SE Harmony Rd. at SE Linwood Ave.[3]	N/A	D	D[2]	N/A
SE Harmony Rd. at SE Lake Rd./International Way	D	E	E[2]	E
SE Railroad Ave. at SE Linwood Ave.[4]	N/A	D	N/A	N/A
SE Railroad Ave. at SE Stanley St.	A	A	N/A[5]	A[2]
SE Railroad Ave. at SE Wood St.	A	A	N/A[5]	A[2]
SE Railroad Ave. at SE 37th Ave.	C	F	N/A[5]	C[2]
Highway 224 at SE Lake/SE Webster	F	F	F[2]	F
Highway 224 at SE Rusk St.	F	F	F[2]	F
Highway 224 WB Ramps at SE Lake Rd.	F	F	F[2]	F
Highway 224 EB Ramps at SE Lake Rd.	B	B	B[2]	B
Highway 224 at SE Freeman Way	F	F	F[2]	F
Highway 224 at SE 37th Ave.	F	F	F[2]	F
Highway 224 at SE Oak St.	F	F	F[2]	F
Highway 224 at SE Monroe St.	D	D	D[2]	C
Highway 224 at SE Harrison St.	F	F	F[2]	F
SE Monroe St. at SE Linwood Ave.	E	F	F	E[2]
SE Monroe St. at SE Stanley Ave.	A	A	A	A[2]
SE Monroe St. at SE Home Ave.	A	A	B	A[2]
SE Monroe St. at SE 42nd Ave.	B	C	F	B[2]
SE Monroe St. at SE 37th Ave.	E	F	F	E[2]
SE Monroe St. at SE Oak St./Railroad Ave.	F	B	B[2]	F[2]
SE Harrison St. at SE 34th Ave.	A	B	B[2]	B[2]
SE Harrison St. at SE 32nd Ave.	B	B	B[2]	B[2]
SE King Rd. at SE 37th Ave.	B	C[6]	C[2]	C[2]

Source: *South/North Local and Systemwide Traffic Impacts Results Report* (Metro: February 1998).
Note: WB = westbound; EB = eastbound; LOS = level of service.
[1] Based on the Full-Length Alternative, except as noted.
[2] LOS estimated based on intersection screening procedure.
[3] New intersection with the Railroad Avenue alternatives.
[4] New intersection with the Railroad Avenue/Through Traffic Alternative.
[5] Intersection eliminated by alternative.
[6] LOS D with MOS 1.

Table A-6
Milwaukie Regional Center Segment, 2015 P.M. Peak Hour Intersection Levels of Service by No-Build and Light Rail Alternative [1]

Intersection	No-Build Alternative	Main Street/Tillamook Branch Alternative [2]
SE Monroe Street at SE 25th Avenue	A	A
SE Monroe Street at SE 21st Avenue	A	A
SE Monroe Street at SE Main Street	C	C
SE Harrison Street at SE 21st Avenue	C	C
SE Harrison Street at SE Main Street	F	F
SE McLoughlin Blvd. at SE Harrison/17th	F	F
SE McLoughlin Blvd. at SE Milport Street	F	F
SE McLoughlin Blvd. at SE Ochoco St.	F	F
SE Tacoma St. at NB SE McLoughlin Blvd. Ramps	C	D
SE Tacoma St. at SB SE McLoughlin Blvd. Ramps	A	A
SE Johnson Creek Blvd. at SE 32nd Ave.	F [3]	F [3]

Source: *South/North Local and Systemwide Traffic Impacts Results Report* (Metro: February 1998).
[1] Based on the Full-Length Alternative.
[2] Analysis is based on a North Milwaukie park-and-ride lot that would be located adjacent to SE Tacoma Street.
[3] Unable to analyze as an all-way stop. Analyzed as a two-way stop.

Table A-7
South Willamette River Crossing Segment, 2015 P.M. Peak Hour Intersection Levels of Service by No-Build and Light Rail Alternative [1]

Intersection	No-Build Alternative	Ross Island Crossing	Caruthers Crossing
SE McLoughlin Blvd. at SE Harold St.	C	C	C [2]
SE McLoughlin Blvd. at SE Holgate Blvd.	F	F	F [2]
SE Holgate Blvd. at SE 17th Ave.	F	F	F
SE Holgate Blvd. at SE Milwaukie Ave. (a.m.) [3]	N/A	D	N/A
SE Holgate Blvd. at SE Milwaukie Ave. (p.m.)	C	C	C
SE Powell Blvd. at SE Milwaukie Ave.	F	F	F
SE Milwaukie Ave. at SE Woodward St.	A	A	B [4]
SE 12th Ave. at SE Clinton St.	C	B	A [5]
SE 12th Ave. at SE Division St.	B	B	B
SE 11th Ave. at SE Clinton St.	F	F	A [5]
SE 11th Ave. at SE Division St.	C	C	C
SE 8th Ave. at SE Division St.	B	B	C
SW Moody Ave. at SW Sheridan St.	B	B [2]	B
SW Moody Ave. at SW Harbor Drive	D	D [2]	D

Source: *South/North Local and Systemwide Traffic Impacts Results Report* (Metro: February 1998).
Note: LOS = level of service.
[1] Based on the Full-Length Alternative.
[2] LOS estimated based on intersection screening procedure.
[3] Analyzed only for the Ross Island Alternative.
[4] Based upon reconfiguration of the intersection by the South/North Project (see Section 2.3.2.1.2 in Chapter 2 of the DEIS for more detail).
[5] Intersection would be signalized by the South/North Project.

Table A-8
Downtown Portland Segment, 2015 P.M. Peak Hour Intersection Levels of Service by No-Build and Light Rail Alternative [1]

Intersection	No-Build Alternative	Full Transit Mall Alternative	Half Transit Mall Alternative
SW Front Ave. at SW Harrison St.	C	F	F [2]
SW Front Ave. at SW Market St.	F	F	F [2]
SW Front Ave. at SW Clay St.	F	F	F [2]
SW Front Ave. at SW Columbia St.	F	F	F [2]
SW Harrison St. at SW 1st Ave.	E	C	C [2]
SW Harrison St. at SW 4th Ave.	D	C	C [2]
SW Harrison St. at SW 5th Ave.	D	D/E	D/E [2]
SW 6th Ave. at SW Mill St.	C	A	B [2]
SW 6th Ave. at SW Market St.	B	C	C [2]
SW 6th Ave. at SW Clay St.	E	F	F [2]
SW 6th Ave. at SW Jefferson St.	C	D	D [2]
SW 4th Ave. at SW Yamhill St.	C	C	E
SW 4th Ave. at SW Alder St.	C	B	C [2]
W Burnside St. at SW/NW Broadway	F	F	F [2]
W Burnside St. at SW/NW 6th Ave.	B	C	B [2]
W Burnside St. at SW/NW 5th Ave.	B	C	B [2]
NW Everett St. at NW 1st Ave.	C	C	F
NW Glisan St. at NW 3rd Ave.	B	D	B

Source: *South/North Local and Systemwide Traffic Impacts Results Report* (Metro: February 1998).
Note: LOS = level of service.
[1] Based on the Full-Length Alternative (only intersections with identified problems or LOS change are included in this table).
[2] LOS estimated based on intersection screening procedure.

Table A-9
Eliot Segment, 2015 P.M. Peak Hour Intersection Levels of Service by No-Build and Light Rail Alternative [1]

Intersection	No-Build Alternative	East I-5/Kerby Alternative [2,3]	Wheeler/Russell Alternative [3]
N Multnomah St. at N Interstate Ave.	E	C	C [4]
N Multnomah St. at N Wheeler Ave.	B	B [4]	B
NE Multnomah St. at NE 1st Ave.	B	B	B [4]
NE Holladay St. at NE 1st Ave.	C	C [4]	C [4]
NE Holladay St. at NE ML King Jr. Blvd.	D	D [4]	D [4]
NE Holladay St. at NE Grand Ave.	B	B [4]	B [4]
N Wheeler Ave./N Williams Ave. at I-5 SB Ramp	B	B	B
N Weidler St. at N Vancouver Ave.	D	D	D
N Weidler St. at N Williams Ave./I-5 Ramp	A	A	A
NE Weidler St. at NE Victoria Ave./I-5 Ramp	B	F	B
N Broadway St. at N Larrabee Ave.	D	D	D
N Broadway St. at N Vancouver Ave.	B	B	B
N Broadway St. at N Williams Ave.	B	F	B
N Russell St. at N Vancouver Ave.	C	C [4]	E
N Kerby Ave. at N Graham St.	A	B	A [3]

Source: *South/North Local and Systemwide Traffic Impacts Results Report* (Metro: February 1998).
Note: SB = southbound.
[1] Based on the Full-Length Alternative.
[2] Based on the At-Grade Design Option at the Broadway and Weidler Streets, with the Grade Separated Design Option the following level-of-service changes would occur: NE Weidler Street, NE Victoria Ave/I-5 Ramp, LOS B; N Broadway at N Williams Ave./I-5 Ramp, LOS B.
[3] Based on the Grade-Separated Rose Quarter Transit Center Design Options, with the At-Grade Transit Center Design Option the following level-of-service change would occur: N Multnomah Street at N Interstate Avenue, LOS E.
[4] LOS estimated based on intersection screening procedure.

Table A-10
North Portland Segment, 2015 P.M. Peak Hour Intersection Levels of Service, by No-Build and Light Rail Alternative [1]

Intersection	No-Build Alternative	Interstate Avenue	I-5	
			Retain Alberta Ramps	Modify Alberta Ramps
N Interstate Ave. at N Skidmore St.	B	C	B [2]	B [2]
N Interstate Ave. at N Going St.	F	F	F	F
N Interstate Ave. at N Alberta St.	D	E [3]	D [2]	B
N Interstate Ave. at N Killingsworth St.	E	E [4]	E [2]	F
N Interstate Ave. at N Ainsworth St	C	D	C [2]	C [2]
N Interstate Ave. at N Portland Blvd.	D	E	D [2]	D
N Interstate Ave. at N Buffalo St.	B	B	B [2]	B [2]
N Interstate Ave. at N Lombard St.	F	F	F [2]	F [2]
N Interstate Ave. at N Fenwick Ave.	A	B	A [2]	A [2]
N Interstate Ave. at N Willis St.	A	A	A [2]	A [2]
N Denver Avenue at N Willis St.	A	B	A [2]	A [2]
N Denver Avenue at N Argyle St.	F	F	F [2]	F [2]
N Alberta St. at I-5 SB Ramps/N Minnesota Ave.	F	F [2]	F [2]	B
N Portland Blvd. at I-5 SB Ramps/N Montana Ave.	C	C [2]	C [2]	C [2]
N Lombard St. at I-5 SB Ramps/N Montana Ave.	F	F [2]	B	B [2]

Source: *South/North Local and Systemwide Traffic Impacts Results Report* (Metro: February 1998).
Note: SB = southbound; LOS = level of service.
[1] Based on the Full-Length or MOS 5 Alternative.
[2] LOS estimated based on intersection screening procedure.
[3] Level of service D with MOS 5.
[4] Level of service F with MOS 5.

Table A-11
Hayden Island/Vancouver Segment, 2015 P.M. Peak Hour Intersection Levels of Service by No-Build and Light Rail Alternative [1]

Intersection	No-Build Alternative	I-5/Washington Street [2]	
		Structured	Surface
Columbia St. at W 5th St.	A	A	A
Columbia St. at E 6th St.	B	B	B
Washington St. at E 5th St.	A	A	A
Washington St. at E 6th St.	B	B	B
Washington St. at E 8th St.	B	F	F
Washington St. at E Evergreen Blvd.	B	B	B
Washington St. at E Mill Plain Blvd.	C	C	C
Washington St. at E 15th St.	B	B	B
E McLoughlin St. at Main St.	B	B	B
E McLoughlin St. at Broadway St.	B	B	B
E McLoughlin St. at Ft. Vancouver Way	B	C	C
E Fourth Plain Blvd. at I-5 SB Ramps (a.m.)	B	D	B
E Fourth Plain Blvd. at I-5 SB Ramps (p.m.)	B	B	B
E Fourth Plain Blvd. at I-5 NB Ramps (a.m.)	B	B	B
E Fourth Plain Blvd. at I-5 NB Ramps (p.m.)	F	F	F
E Fourth Plain Blvd. at St. John's Blvd.	B	C	B
E Fourth Plain Blvd. at Ft. Vancouver Way	D	D	D
NE Hazel Dell Avenue at NE 78th St.	D	D	D
NE Hazel Dell Avenue at NE 99th St.	D	D	D
Highway 99 at NE 78th St.	E	E	E
Highway 99 at NE 88th St.	E	E	D
Highway 99 at NE 99th St.	D	D	D

Source: *South/North Local and Systemwide Traffic Impacts Results Report* (Metro: February 1998).
[1] Based on the Full-Length Alternative.
[2] For either the East or West side of Washington Street Design Option.

Table A-12
Existing Comprehensive Plan Land Use Designations [1] in Proposed Station Areas [2] by Corridor Segment, Alignment Alternative and Design Option [3]

Alignment Alternatives (# of stations; station area) [4]	Residential [5] SF	Residential [5] MF	Mixed Use	General Commercial	Industrial	Park	Public Facility [6]	Water
Clackamas Regional Center Segment								
North of CTC (5; 520 acres)	20%	24%	0%	44%	4%	7%	0%	0%
South of CTC (3; 350 acres)	11%	7%	0%	70%	12%	0%	0%	0%
East Milwaukie Segment								
Railroad Avenue [7] (3; 380 acres)	45%	12%	0%	8%	35%	0%	0%	0%
Highway 224 (3; 370 acres)	35%	19%	0%	11%	35%	0%	0%	0%
Milwaukie Regional Center Segment								
Main Street/Tillamook with:								
Tacoma Street Station (2; 250 acres)	15%	12%	19%	11%	25%	9%	0%	5%
Hanna/Harvester Station (2; 210 acres)	1%	20%	16%	13%	40%	4%	0%	6%
Ochoco Station (2; 250 acres)	21%	10%	13%	15%	35%	6%	0%	5%
McLoughlin Boulevard Segment								
McLoughlin Boulevard (1;120 acres)	20%	8%	0%	0%	0%	72%	0%	0%
South Willamette River Crossing Segment								
Ross Island Crossing with:								
East of McLoughlin Blvd. (5; 600 acres)	8%	13%	6%	46%	6%	10%	0%	10%
West of McLoughlin Blvd. (4; 470 acres)	1%	14%	3%	57%	8%	11%	0%	8%
Caruthers Crossing (5; 610 acres)	10%	5%	13%	20%	40%	3%	0%	9%
Downtown Portland Segment [8]								
Full Transit Mall Alignment with:								
Glisan Street (6; 510 acres)	0%	12%	2%	75%	0%	7%	0%	3%
Irving Street (6; 530 acres)	0%	12%	7%	74%	0%	6%	0%	1%
Half Transit Mall Alignment [9] (7; 510 acres)	0%	10%	0%	62%	0%	10%	0%	17%
Eliot Segment								
East I-5/Kerby (3; 350 acres)	0%	8%	7%	48%	25%	2%	0%	6%
Wheeler/Russell (3; 350 acres)	0%	13%	6%	52%	23%	4%	0%	6%
North Portland Segment								
Interstate Avenue (7; 860 acres)	25%	24%	8%	12%	15%	15%	0%	1%
I-5 (7; 800 acres)	21%	25%	9%	14%	13%	17%	0%	1%
Hayden Island/Vancouver Segment								
I-5/Washington St. (7; 650 acres)	11%	2%	0%	52%	0%	4%	24%	8%

Source: *Land Use and Economics Impacts Results Report* (Metro: February 1998). The existing comprehensive plan land use designations are illustrated on the maps in Appendix D of the DEIS. See Table 3.1.5 in the DEIS for existing land use in proposed station areas. However, the existing land use and the data in this table are not directly comparable because they are developed from different data sets.

1 The comprehensive plan designations adopted by the local jurisdictions have been generalized for consistency throughout the corridor. The local jurisdiction plans have broader sets of land use designations.

2 Station areas are defined as a ¼-mile radius circle around the proposed stations associated with each alternative or option.

3 Where design options would have the same impacts they are not shown separately.

4 For each alignment alternative, the number of stations and the total acreage within the station areas is indicated.

5 SF = single family; MF = multi-family.

6 Public facilities are identified in Clark County only.

7 The station locations and station areas are the same for the Through Traffic and Local Access Alternatives.

8 Inbound and outbound stations on the transit mall are counted as one station. An additional station in the south entry area is not included in these totals; see Appendix L of the DEIS for more detail.

9 Includes five existing MAX stations.

Table A-13
Vacant [1] and Redevelopable [2] Lands in Proposed Station Areas [3], by Corridor Segment, Alignment Alternative and Design Option

Segment/Alignment Alternative	Number of Stations	Acres of Vacant Lands [1]	Redevelopable Lands [2,4] (acres)		Total
			Large Parcels	Small Parcels	
Clackamas Regional Center Segment					
North of CTC with SE 105th Terminus	5	31	10	53	93
North of CTC with Transit Center Terminus	2	13	7	41	60
South of CTC with SE 93rd Terminus	3	16	35	39	90
South of CTC with Transit Center Terminus	2	10	28	38	76
East Milwaukie Segment					
Railroad Avenue (with Wood Ave. Station) [5]	3	19	18	7	43
Highway 224	3	22	17	16	55
Milwaukie Regional Center Segment					
Main Street/Tillamook Branch Line with:					
Tacoma Street Station	2	4	12	13	29
Hanna-Harvester Station	2	2	8	13	23
Ochoco Station	2	3	4	12	19
McLoughlin Boulevard Segment					
McLoughlin Boulevard	1	1	0	0	1
South Willamette River Crossing Segment					
Ross Island Crossing					
East of McLoughlin Design Option	5	59	63	20	141
West of McLoughlin Design Option	4	54	59	16	130
Caruthers Crossing with:					
Moody Avenue Design Option	5	33	25	29	87
South Marquam Design Option	5	32	32	29	93
Downtown Portland Segment [6]					
Full Transit Mall					
Glisan Street Design Option	6	4	6	63	73
Irving Street Design Option	6	7	7	65	77
Half Transit Mall [7]	7	3	3	50	56
Eliot Segment					
East I-5/Kerby	3	15	7	17	38
Wheeler/Russell	3	12	8	15	34
North Portland Segment					
Interstate Avenue	7	27	29	23	79
I-5	7	26	16	16	58
Hayden Island/Vancouver Segment					
I-5/Washington St. [8]	7	4	3	0	7

Source: Metro Data Resource Center; *Land Use and Economics Impacts Results Report* (Metro: February 1998).
Note: CTC=Clackamas Town Center. Totals may not sum due to rounding.

[1] Vacant land has been determined using the 2040 method, and represents undeveloped land without development limitations such as excessive slope or floodplain.
[2] Redevelopable land has been determined using the 2040 method and includes land where the land value exceeds the improvement value, and takes into account the surrounding land and building values.
[3] Station areas are defined as a one-quarter mile radius circle around the stations associated with a specific alignment or option.
[4] Large parcels are redevelopable lands, as described in footnote 2 above, that are greater than 1 acre in size and may include multiple parcels under common ownership. Small parcels are one acre or smaller.
[5] The station locations and station areas would be the same for the Through Traffic and Local Access Alignment Alternatives.
[6] Inbound and outbound stations on the transit mall are counted as one station. An additional station in the south entry area is not included in these totals; see Appendix L of the DEIS for more detail.
[7] Includes five existing MAX stations.
[8] The base data and the method for defining vacant lands, small and large parcels and redevelopable lands are different for land area within the City of Vancouver. Refer to the *Land Use and Economics Impacts Results Report* for more information.

Table A-14
Summary of Displacements, by Segment, Light Rail Alignment Alternative and Design Option

Alignment Alternative	Design Option	Business				Inst./Pub.			Residential			Total[1]
		Comm.	Ind.	Retail	Total	Inst.	Pub.	Total	SF	MF	Total	
Clackamas Regional Center Segment												
South of CTC	South OIT/CCC, All Term.	1	0	2	**3**	0	0	**0**	4	0	**4**	**7**
	North OIT/CCC, All Term.	0	0	5	**5**	0	0	**0**	20	0	**20**	**25**
North of CTC	South OIT/CCC, 105th Term.	2	1	1	**4**	1	0	**1**	19	0	**19**	**24**
	South OIT/CCC, TC Term.	2	0	1	**3**	0	0	**0**	6	0	**6**	**9**
	North OIT/CCC, 105th Term.	2	1	1	**4**	1	0	**1**	35	0	**35**	**40**
	North OIT/CCC, TC Term.	2	0	1	**3**	0	0	**0**	21	0	**21**	**24**
East Milwaukie Segment												
Railroad Ave/Through Traffic[2]		3	3	0	**6**	0	1	**1**	25	72	**97**	**104**
Railroad Ave/Local Access[2]		2	3	1	**6**	0	0	**0**	10	16	**26**	**32**
Highway 224		4	5	3	**12**	0	0	**0**	3	11	**14**	**26**
Milwaukie Regional Center Segment[3]												
Main Street/Tillamook Branch Line with:												
	Tacoma Street P&R	4	3	2	**9**	0	0	**0**	0	0	**0**	**9**
	South of Ochoco P&R	4	4	2	**10**	0	0	**0**	0	0	**0**	**10**
	Hanna Harvester P&R	4	3	2	**9**	0	0	**0**	0	0	**0**	**9**
McLoughlin Boulevard Segment												
McLoughlin Blvd.		0	0	0	**0**	0	0	**0**	0	0	**0**	**0**
South Willamette River Crossing Segment[3]												
Ross Island	East McLoughlin	5	17	2	**24**	0	0	**0**	23	4	**27**	**51**
	West McLoughlin	3	18	2	**23**	0	0	**0**	10	0	**10**	**33**
Caruthers	All Options	12	28	0	**40**	0	0	**0**	1	0	**1**	**41**
Downtown Portland Segment												
Full Transit Mall	Glisan	7	0	2	**9**	0	0	**0**	0	60[4]	**60**	**69**
	Irving	7	2	2	**11**	0	1	**1**	0	0	**0**	**12**
Half Transit Mall		6	0	1	**7**	0	0	**0**	0	0	**0**	**7**
Eliot Segment												
Wheeler/Russell	All Options	1	7	0	**8**	0	2	**2**	5	11	**16**	**26**
East I-5/Kerby	At-Grade Broad/Weidler	4	2	5	**11**	0	1	**1**	0	26	**26**	**38**
	Grade-Sep. Broad/Weidler	5	3	4	**12**	0	1	**1**	0	26	**26**	**39**
North Portland Segment												
I-5	Retain Ramps	1	1	0	**2**	0	0	**0**	59	48	**107**	**109**
	Modify Ramps	0	1	0	**1**	0	0	**0**	36	8	**44**	**45**
Interstate Avenue		9	6	14	**29**	0	0	**0**	7	62	**69**	**98**
Hayden Island/Vancouver Segment												
I-5/Washington St.	Structured P&R[5]	2	0	10	**12**	0	1	**1**	12	0	**12**	**25**
	Surface P&R[5]	3	3	10	**16**	0	1	**1**	12	0	**12**	**29**

Source: *Displacement and Relocation Impacts Results Report* (Metro: February 1998).
Note: Term. = Terminus Option; Comm. = Commercial; Ind. = Industrial; Bus. = Business; SF = Single-family; MF = Multi-family; Res. = Residential; Inst. = Institutional; Pub. = Public Facility; P&R = park-and-ride lot. All displacements are reported as units rather than buildings.

[1] Totals are for each alignment alternative and/or design option. Cumulative totals for the length alternatives are presented in Table 5.2-1 in the DEIS.

[2] Removal of the Wood Avenue Station would reduce displacements by six residential units with the Through Traffic Alternative and four units with the Local Access Alternative.

[3] The number of displacements in the South Willamette River Crossing Segment includes those that would be associated with a Brooklyn Yard Operations and Maintenance Facility. The number of displacements in the East Milwaukie Segment does not include the number of displacements from an alternate north Milwaukie operations and maintenance facility. See Appendix G of the DEIS for more detail.

[4] Single resident occupant rooms within the Beaver Hotel plus a transient shelter.

[5] Displacements would be the same for both the East and West of Washington Street Design Options.

Table A-15
Estimated Average Weekday[1] Regional Pollutant Emissions (tons/day), by Existing, No-Build and Light Rail Length Alternative

Alternative	Daily VMT	Nonmethane Hydrocarbons	Carbon Monoxide	Nitrogen Oxides
Existing Conditions	20,971,100	77.5	499.8	71.0
No-Build	33,022,500	50.7	403.3	61.1
Full-Length	32,808,800	50.4	401.1	60.7
MOS 1 (Bi-State)	32,861,500	50.5	401.7	60.8
MOS 2 (Rose Quarter)	32,971,600	50.6	402.8	61.0
MOS 5 (Lombard)	32,909,000	50.6	402.3	60.9

Source: *Air Quality Impacts Results Report* (Metro: February 1998).
Note: VMT = vehicle miles traveled.
[1] Year 2015, except existing.

Table A-16
Summary of Noise and Vibration Impacts to Structures and Facilities by Segment, Alignment Alternative and Design Option

Segment Alignment Alternatives and Options	Traffic Noise		LRT Noise [1]		LRT Vibration		Total [2]	
	w/o Mit.	w/ Mit.	w/o Mit.	w/ Mit.	w/o Mit.	w/ Mit.	w/o Mit.	w/ Mit.
Clackamas Regional Center Segment								
South of CTC (South of OIT/CCC) [3]	0	0	1	0	1	0	1	0
South of CTC (North of OIT/CCC) [3]	7	0	1	0	1	0	9	0
North of CTC (South of OIT/CCC) [3]	0	0	7	2	4	0	7	2
North of CTC (North of OIT/CCC) [3]	7	0	6	1	3	1	13	1
East Milwaukie Segment [4]								
Railroad Avenue/Local (w/ Wood)	0	0	21	0	22	0	30	0
Railroad Avenue/Local (w/o Wood)	0	0	26	0	25	0	33	0
Railroad Avenue/Through (w/ Wood)	8	3	10	0	11	1	18	4
Railroad Avenue/Through (w/o Wood)	12	4	17	0	18	0	22	4
Highway 224	0	0	0	0	0	0	0	0
Milwaukie Regional Center Segment								
Main Street/Tillamook	0	0	6	1	5	3	6	4
McLoughlin Boulevard Segment								
McLoughlin Boulevard	0	0	0	0	0	0	0	0
South Willamette River Crossing Segment								
Ross Island (East of McLoughlin Blvd.)	0	0	10	0	0	0	10	0
Ross Island (West of McLoughlin Blvd.)	0	0	5	0	0	0	5	0
Caruthers (Moody Avenue Option)	0	0	1	1	0	0	1	1
Caruthers (South Marquam Option)	0	0	0	0	0	0	0	0
Downtown Portland Segment								
Full Transit Mall (Glisan Street Option)	0	0	1	1	0	0	1	1
Full Transit Mall (Irving Street Option)	0	0	1	1	0	0	1	1
Half Transit Mall	0	0	3	3	0	0	3	3
Eliot Segment								
East I-5/Kerby [5]	0	0	0	0	1	0	1	0
Wheeler/Russell [5]	0	0	1	1	3	0	3	1
North Portland Segment								
Interstate Avenue [6]	118	118	2	0	26	0	118	118
I-5 (Retain Alberta Ramps Option) [7]	5	3	9	0	25	3	27	3
I-5 (Modify Alberta Ramps Option) [7]	0	0	16	0	24	4	32	4
Hayden Island/Vancouver Segment								
I-5/Washington St. (Eastside Option)	0	0	1	1	1	0	2	1
I-5/Washington St. (Westside Option)	0	0	1	1	0	0	1	1

Source: *Noise and Vibration Impacts Results Report* (Metro: February 1998).
Note: w/o Mit. = without mitigation; w/Mit. = with mitigation; CTC = Clackamas Town Center; OIT = Oregon Institute of Technology; CCC = Clackamas Town Center; w/Wood = with the Wood Avenue Station; w/o without the Wood Avenue Station; LRT = light rail transit; MOS = minimum operable segment.

[1] Includes structures that would be impacted by LRT wayside noise and/or LRT wheel squeal.
[2] The total does not equal the sum of the columns because some structures are impacted by more than one type of noise and/or vibration.
[3] Impacts would be the same for both terminus options in this alignment alternative.
[4] "Wood" = Wood Avenue Station.
[5] Impacts would be the same for all design options in this alignment alternative.
[6] With the MOS 5 (N Lombard Terminus), the Interstate Avenue Alignment would have 28 fewer structures impacted by traffic noise, four more by LRT noise, six fewer by vibration impacts and 28 fewer by all sources combined.
[7] With the MOS 5 (N Lombard Terminus), the I-5 Alternative would have three fewer vibration impacts.

Table A-17
Hazardous Materials Sites, by Hazardous Material Category, Segment, Light Rail Alignment Alternative and Design Option

Segment/Alignment	Design Option	Terminus Option	CERCLIS - ECSI		FINDS		RCRIS		LUST		UST
			Displaced	Near [1]	Displaced	Near [1]	Displaced	Near [1]	Displaced or Adjacent [2]	Near [1]	Active Tank Displaced
Clackamas Regional Center											
North of CTC	South of OIT/CCC	105th Ave. Terminus	0	0	0	1	0	8	1	2	16
	North of OIT/CCC	105th Ave. Terminus	0	0	0	1	0	8	1	5	21
	South of OIT/CCC	CTC TC Terminus	0	0	0	0	0	2	0	3	0
	North of OIT/CCC	CTC TC Terminus	0	0	0	0	0	2	0	3	5
South of CTC	South of OIT/CCC	93rd Ave. Terminus	0	0	0	0	0	2	0	0	3
	North of OIT/CCC	93rd Ave. Terminus	0	0	0	0	0	2	0	3	8
	South of OIT/CCC	CTC TC Terminus	0	0	0	0	0	2	0	0	3
	North of OIT/CCC	CTC TC Terminus	0	0	0	0	0	2	0	3	8
East Milwaukie											
Railroad Avenue/Through Traffic [3]			2	5	0	2	0	2	2	2	30
Railroad Avenue/Local Access [3]			2	5	0	2	0	2	2	2	17
Highway 224			1	3	0	1	0	1	1	2	5
Milwaukie Regional Center			0	3	1	5	0	7	0	8	2
McLoughlin Boulevard			0	0	0	0	1	2	1	1	0
South Willamette River Crossing											
Ross Island	East McLoughlin		1	7	1	2	5	6	1	6	25
	West McLoughlin		1	7	2	2	4	7	1	6	11
Caruthers	South Marquam		3	8	2	5	14	7	1	9	12
	Moody St.		3	7	2	5	14	7	1	9	12
Downtown Portland											
Half Transit Mall			0	0	0	10	0	9	0	3	0
Full Transit Mall	Irving St.		0	0	0	13	0	22	4	5	0
	Glisan St.		0	0	0	13	0	22	3	6	0
Eliot											
Wheeler/Russell			0	2	0	2	1	5	0	3	0
East I-5/Kerby			0	2	0	2	2	6	0	3	5
North Portland											
I-5	Retain Alberta Ramps		1	0	0	0	1	0	1	0	61
	Modify Alberta Ramps		1	0	0	0	1	0	1	0	26
Interstate Avenue			1	0	1	2	2	3	4	6	23
Hayden Island/Vancouver			0	0	0	0	3	6	3	1	1

Source: Metro: November 1997.

Note: CERCLIS = Comprehensive Environmental Response, Compensation and Liability Information System; ECSI = Environmental Clean-up Site Inventory; LUST = leaking underground storage tanks; UST = underground storage tanks.

[1] Near is defined as a site within 500 feet of a potential light rail alignment.

[2] Unremediated LUST sites that would be displaced by the project or adjacent to the alignment. Remediated sites would have a lower risk of remaining contamination and are included with the "Near" sites.

[3] Not constructing a Wood Avenue station would displace two fewer USTs with the Through Traffic Alternative and four fewer USTs with the Local Access Alternative.

Table A-18
Summary of Projected Traffic Noise Impacts [1], by Light Rail Alignment Alternative and Design Option

Segment Alignment Alternatives and Options		Impact Criteria	Existing (dBA L_{eq})	Build (dBA L_{eq})	Change (dBA L_{eq})	Structures Impacted [2] Type [2]	w/o Mit.	w/Mit.
Clackamas Regional Center								
South of CTC	South of OIT	No traffic noise impacts are projected.						
	North of OIT	65	61-65	65-67	2-4	SF	7	0
North of CTC	South of OIT	No traffic noise impacts are projected.						
	North of OIT	65	61-65	65-67	2-4	SF	7	0
East Milwaukie								
Highway 224		No traffic noise impacts are projected.						
Railroad Ave./Local Access		No traffic noise impacts are projected.						
Railroad Ave./Through (w/ Wood) [3]		65	62	65	3	SF	7	2
		65	62	65	3	Playground	1	1
Railroad Ave./Through (w/o Wood) [3]		65	62	65	3	SF	11	3
		65	62	65	3	Playground	1	1
Milwaukie Regional Center Main St./ Tillamook Branch Line		No traffic noise impacts are projected.						
McLoughlin Blvd. McLoughlin Boulevard		No traffic noise impacts are projected.						
So. Willamette River Crossing All Alternatives and Design Options		No traffic noise impacts are projected.						
Downtown Portland All Alternatives and Options		No traffic noise impacts are projected.						
Eliot All Alternatives and Design Options		No traffic noise impacts are projected.						
North Portland								
I-5 (Modify Alberta Ramps)		No traffic noise impacts are projected.						
I-5 (Retain Alberta Ramps)		65	62-65	65-67	2-3	SF	5	3
Interstate Avenue		65	62-71	65-72	1-3	SF	90	90
		65	64-69	65-71	1-2	MF	11	11
		65	64-71	65-72	1-2	Hotel	11	11
		65	65-69	68-70	1-3	Playground	2	2
		65	64-68	65-69	1	Church	2	2
		65	70	71	1	Theater	1	1
		65	71	72	1	Park	1	1
Hayden Island/ Vancouver I-5/Washington Street		No traffic noise impacts are projected.						

Source: *Noise and Vibration Impacts Results Report* (Metro: February 1998).
Note: w/o Mit. = without mitigation; w/Mit. = with mitigation; CTC = Clackamas Town Center; OIT = Oregon Institute of Technology
[1] Noise levels are in dBA (L_{eq}). See Section 3.6.2.1 in Chapter 3 of the DEIS for more detail.
[2] Land Use Codes: SF = Single Family; MF = Multi-Family.
[3] "Wood" = Wood Avenue Station.

Table A-19
Summary of Anticipated Wheel Squeal Impacts, by Segment and Light Rail Alignment Alternative

Segment Alignment Alternatives and Options	Impact Criteria (dBA Lmax)[1]	Curve Radius (ft)[2]	Receiver to Curve Distance (ft)	Wheel Squeal (dBA Lmax)[3]	Structure Impacted[4]	
					Type	w/o Mit.
Clackamas Regional Center						
North of CTC, South OIT/CCC	75	214	50-100	82-85	SF	2
North of CTC, North OIT/CCC	75	214	50	82	SF	1
South CTC, All Options	No wheel squeal impacts.					
East Milwaukie	No wheel squeal impacts.					
Milwaukie Regional Center	80	130	110	80	Park	1
McLoughlin Boulevard	No wheel squeal impacts.					
South Willamette River Crossing						
Ross Island, All Options	No wheel squeal impacts.					
Caruthers, Moody Ave. Option	80	300	60	82	MF	1
Caruthers, Marquam Option	No wheel squeal impacts.					
Downtown Portland						
Full Transit Mall, All Options	80	82	50	83	Hotel	1
Half Transit Mall	80	82	50	83	Hotel	1
	85	82	40	85	Comm	2
Eliot[5]						
East I-5, All Options	No wheel squeal impacts.					
Wheeler/Russell, All Options	80	173	40	84	MF	1
North Portland	No wheel squeal impacts.					
Hayden Island/Vancouver						
I-5/Washington St., All Options	80	130-134	110	80	Park	1

Source: *Noise and Vibration Impacts Results Report* (Metro: February 1998).
Note: For parks, impacts exist within the receiver to curve distance inside the park. CTC = Clackamas Town Center; OIT = Oregon Institute of Technology; CCC = Clackamas Town Center.

[1] Wheel squeal impact criteria is provided in Section 3.6.2.7 and in Table 3.6-3 in Chapter 3 of the DEIS.
[2] Curves with a radius of less than 300 feet would produce wheel squeal. A smaller radius would result in a wheel squeal of higher decibels.
[3] dBA Lmax = maximum sound level over a specific time period. Maximum noise of wheel squeal during a LRT vehicle turning on a sharp curve.
[4] SF = single family; MF = multi-family; comm = commercial; w/o Mit. = without mitigation; The number indicates the number of buildings or facilities.
[5] With MOS 2, there would also be a wheel squeal impact at the southwest corner of Holladay Park.

Table A.1-20
Summary of Transit System Revenues [1] Cumulative Total FY 1995 through FY 2015 by No-Build and LRT Length Alternatives [2]

	No-Build	Full-Length	MOS 1 (Bi-State)	MOS 2 (Rose Quarter)	MOS 5 (Lombard)
Passenger Revenues	$1.30	$1.45	$1.38	$1.36	$1.38
Employer/Municipal Payroll Tax	$4.77	$4.77	$4.77	$4.77	$4.77
Self-Employment Tax	$0.21	$0.21	$0.21	$0.21	$0.21
State In-Lieu	$0.05	$0.05	$0.05	$0.05	$0.05
Federal Operating Assistance	$0.01	$0.01	$0.01	$0.01	$0.01
Other [3]	$0.61	$0.60	$0.61	$0.60	$0.60
System Operation Subtotal [4]	$6.95	$7.09	$7.04	$7.00	$7.02
Section 5307 Capital Funds [5]	$0.16	$0.16	$0.16	$0.16	$0.16
Other Federal Capital	$0.10	$0.10	$0.10	$0.10	$0.10
System Capital Subtotal [6]	$0.26	$0.26	$0.26	$0.26	$0.26
Total System Revenues	$7.21	$7.35	$7.30	$7.26	$7.28

Source: Tri-Met: December 1997.

1 In billions and in year-of-expenditure dollars.

2 The operating cost for each length alternative is based on a common set of alignment alternatives and design options (see Section 2.3.2.1.1 in Chapter 2 of the DEIS).

3 Includes sources such as tax revenue on the sale of cigarettes, interest and interest from the sale of advertising.

4 System operations revenues not needed for operating costs are available for system capital costs.

5 Not including South/North capital plan revenues.

6 To avoid double-counting revenues, this sub-total does not include system operations revenues available for system capital costs.

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