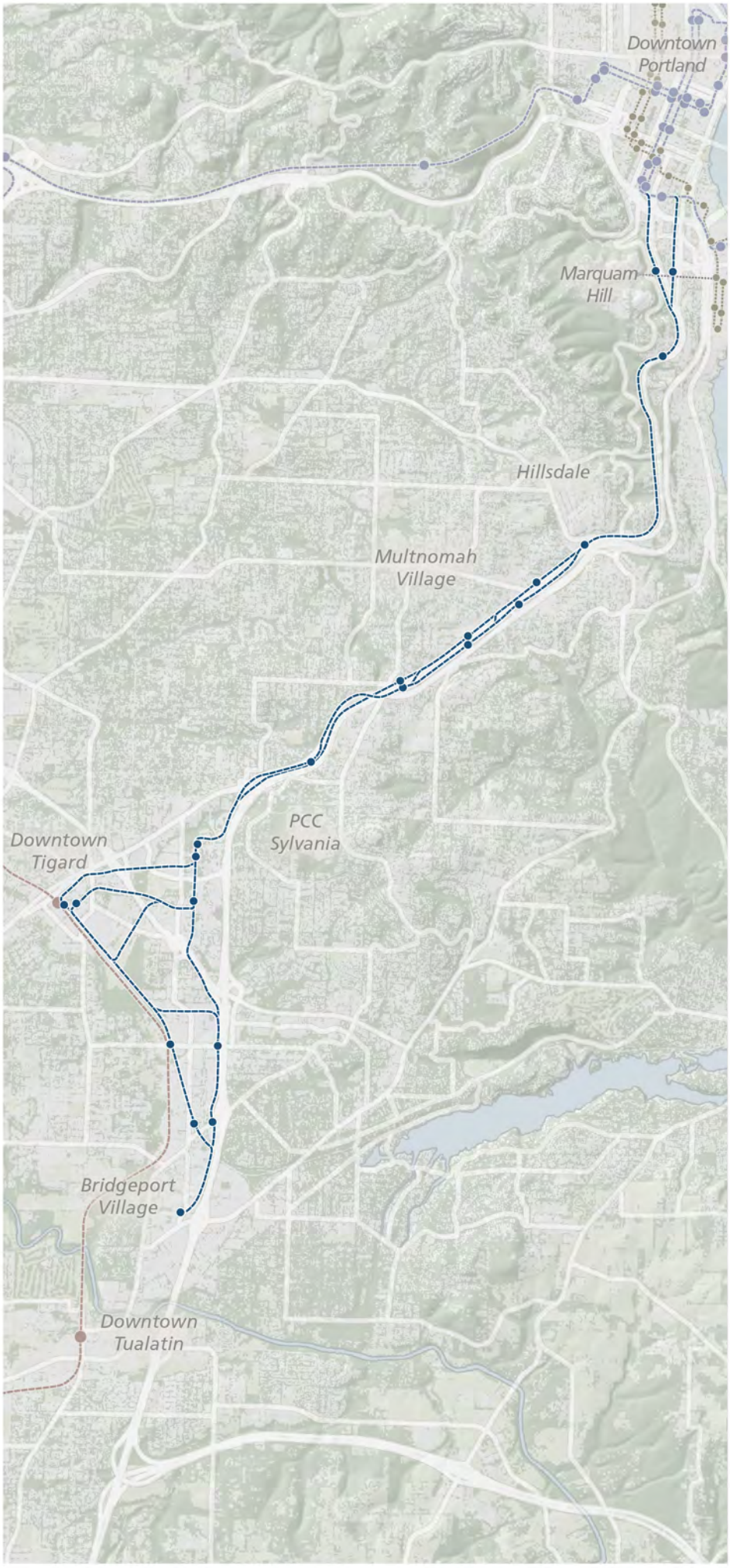

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SW Corridor
Light Rail Project

Southwest Corridor Light Rail Project

Draft Environmental Impact Statement

June 2018

Metro

TRIMET

U.S. Department
of Transportation
Federal Transit Administration

SOUTHWEST CORRIDOR LIGHT RAIL PROJECT

MULTNOMAH AND WASHINGTON COUNTIES, OREGON

DRAFT ENVIRONMENTAL IMPACT STATEMENT

Prepared pursuant to the National Environmental Policy Act

42 U.S.C. 4321 to 4370e

By the

FEDERAL TRANSIT ADMINISTRATION

METRO

TRI-COUNTY METROPOLITAN TRANSPORTATION DISTRICT OF OREGON (TRIMET)

In cooperation with the

FEDERAL HIGHWAY ADMINISTRATION

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Metro, the regional government and municipal planning organization for the Portland, Oregon region, and TriMet, the area's mass transit provider, are the project sponsors of the Southwest Corridor Light Rail Project (LRT Project), a proposed MAX light rail line serving SW Portland, Tigard, Tualatin and the surrounding communities. The project proposal is to construct and operate 12 miles of light rail transit and related facilities between downtown Portland, Oregon in Multnomah County to the cities of Tigard and Tualatin in Washington County. The Draft Environmental Impact Statement (EIS) examines a No-Build Alternative, which is compared to light rail alternatives and related facilities and options. In addition to the light rail alignment alternatives with up to 13 stations, the proposed project facilities include a new operations and maintenance base, a shared transitway, up to seven park-and-rides, bicycle and pedestrian facilities, a transit shuttle, and a new pedestrian connection to the Oregon Health Sciences University on Marquam Hill. The Draft EIS also identifies an Initial Route Proposal, based on the alternatives under consideration in the Draft EIS. The Draft EIS describes the impact analysis and potential mitigation to address long-term, short-term, indirect and cumulative effects on transit service, ridership, accessibility, traffic, regional and local roadways, freight movements, acquisitions and displacements, land use, economics, neighborhoods, visual and aesthetic resources, ecosystems, water quality and hydrology, geology and seismology, air quality, hazardous materials, noise and vibration, energy, hazardous materials, parklands, safety and security, utilities, historic and cultural resources, and public services. After the publication of the DEIS, a 45-day public review and comment period will follow. The Metro Council will then identify a Preferred Alternative for the Final EIS. Following the publication of a Final EIS, the Federal Transit Administration (FTA) will issue a Record of Decision.

Reviewers should provide their comments to Metro during the comment period of the Draft EIS. During that period, Metro and TriMet will hold a public hearing to provide the opportunity for comment on this document; see the project website at www.swcorridorplan.org for the time and location of the public hearings. Metro will analyze and respond to comments and will use the information acquired in the preparation of the Final EIS. Comments on the Draft EIS should be specific and should address the adequacy of the statement and the merits of the alternatives discussed.

TABLE OF CONTENTS

S. Summary S-1
S.1 Southwest Corridor Light Rail Project S-1
S.2 Purpose and Need for the Project S-2
S.3 Alternatives Considered S-4
S.4 Background on Southwest Corridor Planning S-19
S.5 Transportation and Environmental Effects S-19
S.6 Effects of a Full-Corridor Alternative and Minimum Operable Segments (MOS) S-21
S.7 Other Environmental Factors S-22
S.8 Evaluation of Alternatives S-23
S.9 Next Steps and the Project Timeline S-24

1. Project Introduction 1-1
1.1 Southwest Corridor Light Rail Project 1-1
1.2 Purpose of the Project 1-5
1.3 Need for the Project 1-6
1.4 Applying the Purpose and Need to the Project 1-10
1.5 Next Steps 1-10

2. Alternatives Considered 2-1
2.1 Alternatives Development 2-2
2.2 No-Build Alternative 2-6
2.3 Light Rail Alternatives 2-6
2.4 Minimum Operable Segment (MOS) 2-28
2.5 Potential Design Refinements and Options 2-29
2.6 Initial Route Proposal 2-30

3. Transportation Impacts and Mitigation 3-1
3.1 Affected Environment 3-1
3.1.1. Regional and Corridor Travel 3-1
3.1.2. Public Transportation 3-2
3.1.3. Active Transportation 3-3
3.1.4. Motor Vehicle Operations 3-4
3.1.5. On-Street Parking 3-8
3.1.6. Freight Facilities 3-8
3.1.7. Safety 3-9
3.2 Transportation Impacts 3-9
3.2.1. Roadway System Impacts 3-10
3.2.2. Public Transportation Impacts 3-11
3.2.3. Station Usage 3-15
3.2.4. Active Transportation Impacts 3-16
3.2.5. Motor Vehicle Operations Impacts 3-17
3.2.6. Impacts to On-Street Parking 3-22

3.2.7. Freight Facility Impacts 3-23
3.2.8. Safety Impacts 3-24
3.2.9. Short-Term Impacts 3-25
3.3 Potential Mitigation Measures 3-25
3.3.1. Motor Vehicle Mitigation 3-25
3.3.2. Active Transportation Mitigation 3-25
3.3.3. Freight Access Mitigation 3-28
3.3.4. Safety Mitigation 3-28

4. Environmental Impacts and Mitigation 4-1

4.1 Acquisitions, Displacements and Relocations 4-2
4.1.1. Affected Environment 4-2
4.1.2. Long-Term Impacts 4-2
4.1.3. Short-Term Impacts 4-8
4.1.4. Potential Mitigation Measures 4-8
4.2 Land Use 4-9
4.2.1. Affected Environment 4-9
4.2.2. Long-Term Impacts 4-14
4.2.3. Short-Term Impacts 4-20
4.2.4. Potential Mitigation Measures 4-20
4.3 Economics 4-21
4.3.1. Affected Environment 4-21
4.3.2. Long-Term Impacts 4-22
4.3.3. Short-Term Impacts 4-24
4.3.4. Potential Mitigation Measures 4-25
4.4 Communities 4-26
4.4.1. Affected Environment 4-26
4.4.2. Introduction to Impacts Analysis 4-29
4.4.3. Long-Term Impacts to Neighborhoods and Community Facilities 4-30
4.4.4. Long-Term Impacts to Transit-Dependent Populations 4-38
4.4.5. Short-Term Impacts 4-39
4.4.6. Potential Mitigation Measures 4-39
4.5 Visual Quality 4-40
4.5.1. Affected Environment 4-40
4.5.2. No-Build Alternative Impacts 4-41
4.5.3. Long-Term Impacts of the Light Rail Alternatives 4-41
4.5.4. Short-Term Impacts 4-54
4.5.5. Potential Mitigation Measures 4-54
4.6 Historic and Archaeological Resources 4-55
4.6.1. Affected Environment 4-56
4.6.2. Long-Term Impacts – Historic Resources 4-60
4.6.3. Long-Term Impacts – Archaeological Resources 4-63
4.6.4. Short-Term Impacts 4-65

4.6.5. Potential Mitigation Measures 4-66
4.7 Parks and Recreation Resources 4-66
4.7.1. Affected Environment 4-67
4.7.2. Long-Term Impacts 4-74
4.7.3. Short-Term Impacts 4-80
4.7.4. Potential Mitigation Measures 4-81
4.8 Geology, Soils and Hydrogeology 4-81
4.8.1. Affected Environment 4-81
4.8.2. Long-Term Impacts 4-83
4.8.3. Short-Term Impacts 4-83
4.8.4. Potential Mitigation Measures 4-84
4.9 Ecosystems 4-85
4.9.1. Affected Environment 4-85
4.9.2. Long-Term Impacts 4-92
4.9.3. Short-Term Impacts 4-95
4.9.4. Potential Mitigation Measures 4-95
4.10 Water Resources 4-96
4.10.1. Affected Environment 4-96
4.10.2. Long-Term Impacts 4-102
4.10.3. Short-Term Impacts 4-108
4.10.4. Potential Mitigation Measures 4-108
4.11 Noise and Vibration 4-110
4.11.1. Introduction to Noise and Vibration 4-110
4.11.2. Affected Environment 4-112
4.11.3. Long-Term Impacts – Noise 4-113
4.11.4. Long-Term Impacts – Vibration 4-121
4.11.5. Short-Term Impacts – Noise and Vibration 4-122
4.11.6. Potential Mitigation Measures 4-124
4.12 Air Quality and Greenhouse Gases 4-126
4.12.1. Affected Environment 4-126
4.12.2. Long-Term Impacts 4-126
4.12.3. Short-Term Impacts 4-127
4.12.4. Mitigation 4-128
4.13 Energy 4-128
4.13.1. Affected Environment 4-128
4.13.2. Long-Term Impacts 4-128
4.13.3. Short-Term Impacts 4-130
4.13.4. Potential Mitigation Measures 4-130
4.14 Hazardous Materials 4-130
4.14.1. Affected Environment 4-130
4.14.2. Long-Term Impacts 4-132
4.14.3. Short-Term Impacts 4-134

4.14.4. Potential Mitigation Measures 4-135
4.15 Utilities 4-135
4.15.1. Affected Environment 4-136
4.15.2. Long-Term Impacts 4-136
4.15.3. Short-Term Impacts 4-137
4.15.4. Potential Mitigation Measures 4-139
4.16 Public Services 4-139
4.16.1. Affected Environment 4-140
4.16.2. Long-Term Impacts 4-142
4.16.3. Short-Term Impacts 4-143
4.16.4. Potential Mitigation Measures 4-144
4.17 Safety and Security 4-145
4.17.1. Affected Environment 4-145
4.17.2. Long-Term Impacts 4-146
4.17.3. Short-Term Impacts 4-151
4.17.4. Potential Mitigation Measures 4-152
4.18 Indirect and Cumulative Impacts 4-152
4.18.1. Analysis of Indirect Impacts 4-153
4.18.2. Analysis of Cumulative Impacts 4-153
4.18.3. Summary of Indirect and Cumulative Impacts 4-154

5. Evaluation of Alternatives 5-1
5.1 Ability to Meet Purpose and Need 5-1
5.2 Initial Route Proposal 5-9
5.3 Finance Plan 5-12

6. Public Involvement and Agency Coordination 6-1
6.1 Project Outreach History 6-1
6.1.1. Public Engagement Objectives 6-1
6.1.2. Public Engagement Desired Outcomes 6-1
6.1.3. Early Public Involvement Efforts 6-2
6.2 Community Participation During NEPA 6-4
6.3 Agency Coordination 6-5

Appendices

A Detailed Maps and Descriptions of Light Rail Alternatives
B Supporting Materials for Draft EIS Analysis
C Environmental Justice Compliance
D Draft Section 4(f) Evaluation
E Potential Design Refinement Concepts and Options
F Properties Affected by Acquisitions
G List of Preparers
H References
I Project Background and Alternatives Considered

Attachments *(available electronically)*

A Transit Impacts and Travel Demand Forecasting Results Report
B Transportation Impacts Results Report
C Cultural Resource Survey for the Southwest Corridor Light Rail Project, Multnomah and Washington Counties, Oregon
D Ecosystems Results Report
E Noise and Vibration Technical Results Report

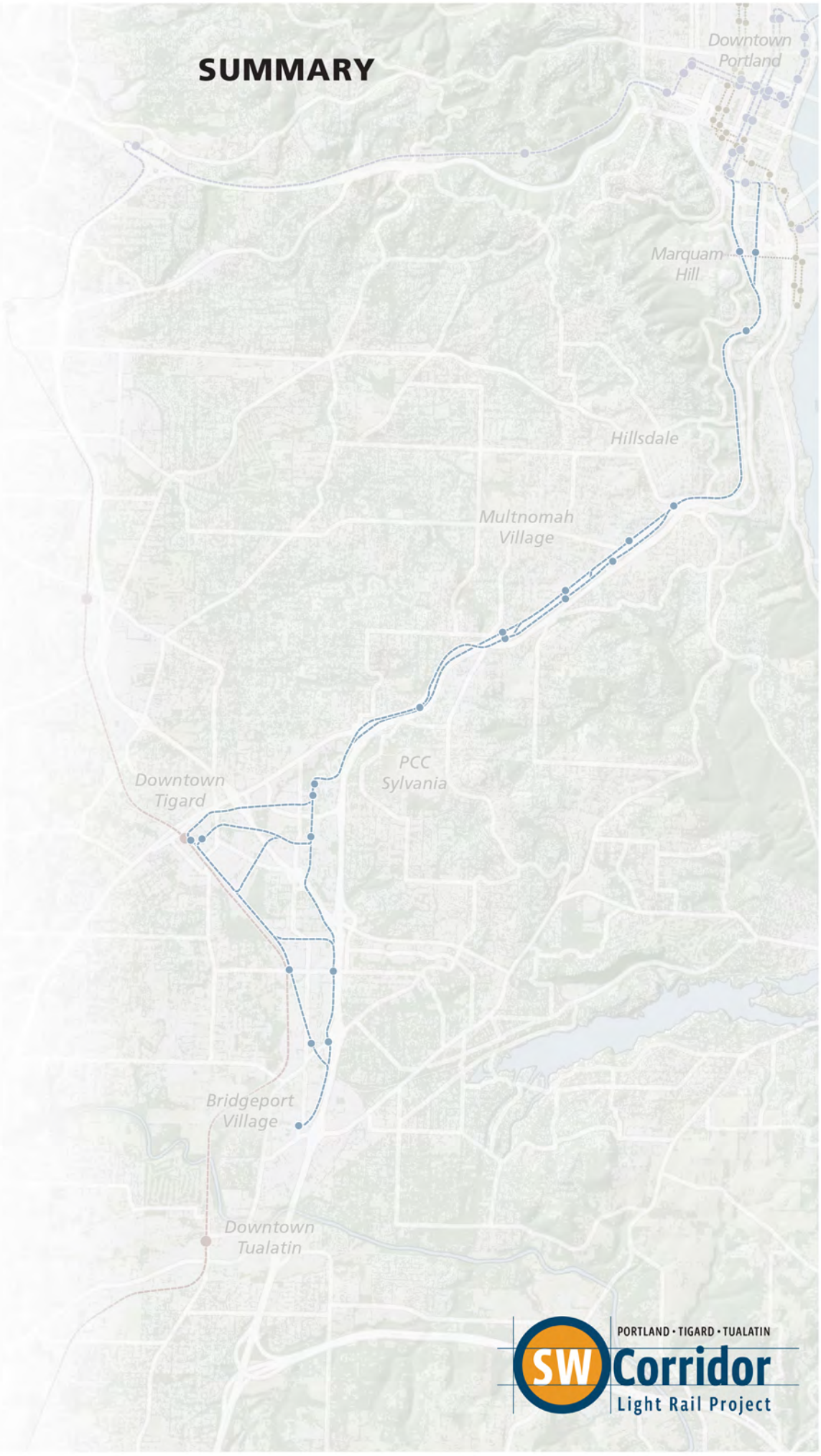
ACRONYMS AND ABBREVIATIONS

99W	Pacific Highway
ACHP	Advisory Council on Historic Preservation
APE	area of potential effects
BMPs	best management practices
Btu	British thermal unit
CAP	Climate Action Plan
CBD	central business district
CFR	Code of Federal Regulations
CIG	Capital Investment Grant
CO	carbon monoxide
COMPASS	Centralized Oregon Mapping Products and Analysis Support System
CORRACTS	Corrective Action Sites
CPTED	crime prevention through environmental design
CSO	combined sewer outfall
dB	decibel
dBA	A-weighted decibel
DMV	(Oregon) Driver and Vehicle Motor Vehicle Services
DOE	Determination of Eligibility
Draft EIS	Draft Environmental Impact Statement
ECSI	Environmental Cleanup Site Information
EDR	Environmental Data Resources
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ERNS	Emergency Response Notification System
ESA	Endangered Species Act
ESA	Environmental Site Assessment
E-zone	environmental overlay zone
FAST	Fixing America's Surface Transportation (Act)
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
Final EIS	Final Environmental Impact Statement

FOE	Finding of Effects
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GHGs	greenhouse gases
GIS	Geographic Information Systems
HCT	high capacity transit
HPA	high probability area
I-5	Interstate 5
I-405	Interstate 405
IPaC	Information, Planning and Consultation System
Ldn	level of day-night sound
Leq	level of equivalent sound
Lmax	level of maximum noise
LEV	low emission vehicle
LOS	level of service
LPA	Locally Preferred Alternative
LRT	light rail transit
LUST	leaking underground storage tank
LWCF	Land and Water Conservation Fund Act of 1965
MAX	Metropolitan Area Express
MFR	multifamily residential
MOS	minimum operable segment
MPO	Metropolitan Planning Organization
MSA	Metropolitan Statistical Area
MUP	multiuse path
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NFA	No Further Action
NHPA	National Historic Preservation Act
NHS	National Highway System
NMFS	National Marine Fisheries Service
NPL	National Priority List
NRHP	National Register of Historic Places
NOx	nitrogen oxide
O&M	operations and maintenance
OAR	Oregon Administrative Rule
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OHSU	Oregon Health & Science University
ORBIC	Oregon Biodiversity Information Center
ORS	Oregon Revised Statutes
OWRD	Oregon Water Resources Division

P&W	Portland and Western
PAHs	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCC	Portland Community College
PGE	Portland General Electric
PM	particulate matter
PM_{10}	particulate matter less than 10 micrometers in diameter
$PM_{2.5}$	particulate matter less than 2.5 micrometers in diameter
PPR	(City of Portland) Parks and Recreation
PPS	Portland Public Schools
PSU	Portland State University
RGA	Recovered Government Archive
RTP	Regional Transportation Plan
SAAQS	State Ambient Air Quality Standards
SEMS	Superfund Enterprise Management System
SFR	single-family residential
SHPO	State Historic Preservation Office
SLOPES	Standard Local Operating Procedures for Endangered Species
TAZ	transportation analysis zone
TC	Transit Center
TCE	Temporary Construction Easement
TCE	trichloroethene
TCPs	Traditional Cultural Properties
TMDL	Total Maximum Daily Load
THPO	Tribal Historic Preservation Officer
TPR	Transportation Planning Rule
TriMet	Tri-County Metropolitan Transportation District of Oregon
UGB	urban growth boundary
USC	United States Code
USDOT	U.S. Department of Transportation
USFWS	U.S. Fish and Wildlife Service
UST	underground storage tank
VA	Veterans Affairs
V/C	volume-to-capacity
VCP	Voluntary Cleanup Program
VdB	vibration decibels
VOC	volatile organic compound
VMT	vehicle miles traveled
WES	Westside Express Service
ZEV	zero emission vehicle

SUMMARY



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SW Corridor
Light Rail Project

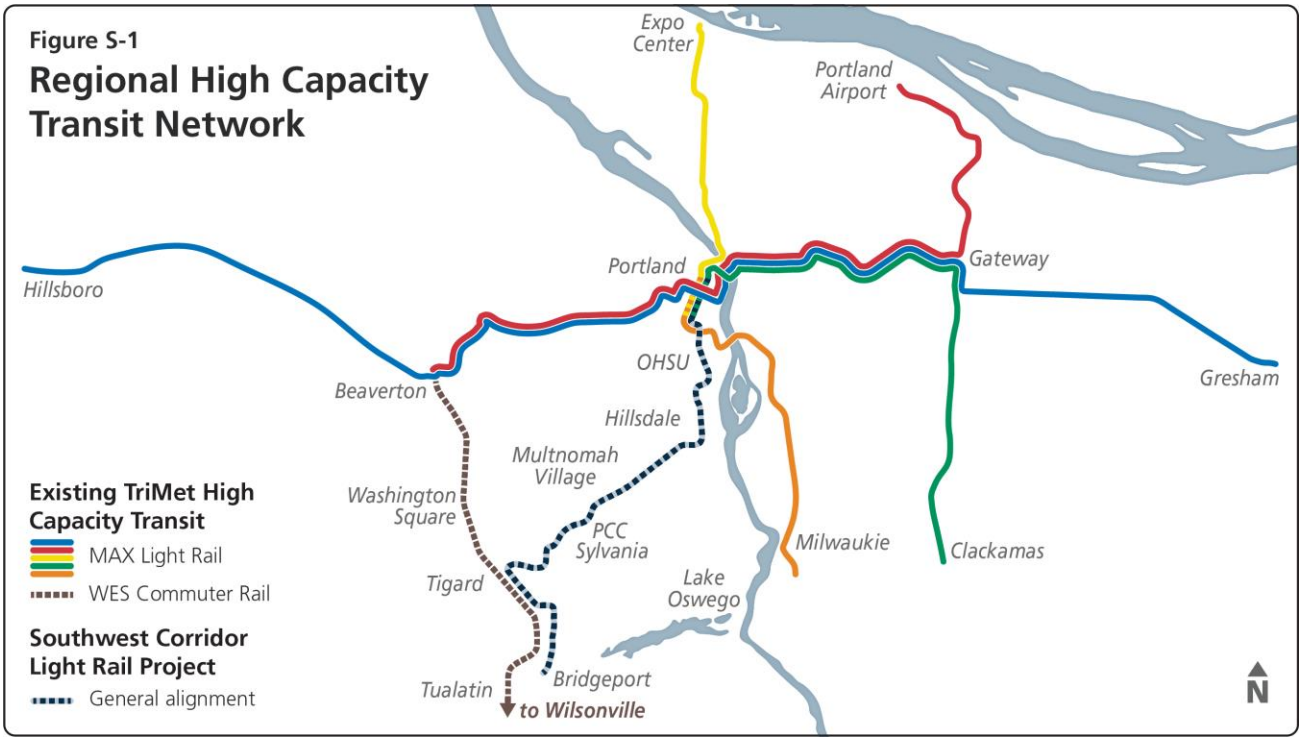
S. SUMMARY

S.1 Southwest Corridor Light Rail Project

Section		Page
S.1	Southwest Corridor Light Rail Project	S-1
S.2	Purpose and Need for the Project	S-2
S.3	Alternatives Considered	S-4
S.4	Background on Southwest Corridor Planning	S-19
S.5	Transportation and Environmental Effects	S-19
S.6	Effects of a Full-Corridor Alternative and Minimum Operable Segments (MOS)	S-21
S.7	Other Environmental Factors	S-22
S.8	Evaluation of Alternatives	S-23
S.9	Next Steps and the Project Timeline	S-24

The Southwest Corridor Light Rail Project is a proposed new 12-mile Metropolitan Area Express (MAX) line from downtown Portland through Tigard, terminating near Bridgeport Village in Tualatin. The new line would be a major new spoke in the Regional High Capacity Transit Network (see Figure S-1). It would extend the existing MAX Green Line, continuing south from the Green Line's current terminus at Portland State University (PSU) and the Downtown Portland Transit Mall. The project would serve a broader north/south travel corridor generally along Interstate 5 (I-5) and Pacific Highway (99W)/SW Barbur Boulevard from southwest Portland to Sherwood, as well as communities to the east and west.

Figure S-1
Regional High Capacity Transit Network



The proposed project would feature:

- **Light rail trackway:** a 12-mile light rail line between downtown Portland and Tualatin via Tigard, which would primarily run at grade but may include up to 2.6 miles of elevated trackway or bridges and up to four cut-and-cover undercrossings
- **Stations and park and rides:** up to 13 light rail stations with platforms up to 200 feet long, including up to seven park and rides with up to 4,200 spaces total, and with two relocated or reconfigured transit centers and tail tracks or third tracks at terminus stations

- **Light rail vehicles:** up to 32 light rail vehicles added to the Tri-County Metropolitan Transportation District of Oregon (TriMet) fleet that would operate in two-car train sets (16 sets)
- **Light rail service:** service frequencies ranging from 7 to 15 minutes in 2035, depending on location along alignment and time of day
- **Bus routing changes:** elimination or modification of bus routes to improve coverage and service levels and avoid duplicating light rail service (service hours reallocated throughout the corridor)
- **Marquam Hill connection:** structures making a new pedestrian connection between SW Barbur Boulevard and Oregon Health & Science University (OHSU) on Marquam Hill
- **Shared transitway:** up to 2 miles of paved light rail transitway in South Portland to allow express use by buses to and from downtown
- **PCC-Sylvania shuttle:** shuttle route connecting the Portland Community College (PCC) Sylvania campus with up to two nearby light rail stations, including either five additional 40-foot buses or three van-sized shuttle buses
- **Operations and maintenance facility:** new light rail operations and maintenance (O&M) facility in Tigard with the capacity for up to 42 light rail vehicles (one facility option would have space to add more storage tracks later for up to 60 vehicles total)
- **Roadway modifications:** modifications to roadways along or intersecting the light rail alignment, such as SW Barbur Boulevard, including addition or reconstruction of bicycle lanes and sidewalks along modified roadways
- **Station access improvements:** new walking and bicycling infrastructure, such as sidewalks, bicycle lanes and paths, to improve access to stations
- **Bridgehead Reconfiguration:** modifications to the roads and ramps accessing the west end of the Ross Island Bridge and addition of signalized intersections along SW Naito Parkway (included with a certain alignment alternative)

S.2 Purpose and Need for the Project

Federal environmental regulations for an Environmental Impact Statement (EIS) require a statement of the problems a proposed project is intended to address, along with reasons why the project is needed. The Purpose and Need is used to define the EIS alternatives to be considered, and it guides the Federal Transit Administration (FTA), Metro, TriMet and their local agency partners in other decisions about the project.

The purpose of the Southwest Corridor Light Rail Project is to directly connect Tualatin, downtown Tigard, southwest Portland, and the region's central city with light rail, high quality transit and appropriate community investments in a congested corridor to improve mobility and create the conditions that will allow communities in the corridor to achieve their land use vision. Specifically, the project aims to, within the Southwest Corridor:

- provide light rail transit service that is cost-effective to build and operate with limited local resources
- serve existing transit demand and significant projected growth in ridership resulting from increases in population and employment in the corridor

- improve transit service reliability, frequency and travel times, and provide connections to existing and future transit networks including Westside Express Service (WES) Commuter Rail
- support adopted regional and local plans including the *2040 Growth Concept*, the *Barbur Concept Plan,* the *Tigard Triangle Strategic Plan* and the *Tigard Downtown Vision* to accommodate projected significant growth in population and employment
- complete and enhance multimodal transportation networks to provide safe, convenient and secure access to transit and adjacent land uses
- advance transportation projects that increase active transportation and encourage physical activity
- provide travel options that reduce overall transportation costs
- improve multimodal access to existing jobs, housing and educational opportunities, and foster opportunities for commercial development and a range of housing types adjacent to transit
- ensure benefits and impacts that promote community equity
- advance transportation projects that are sensitive to the environment, improve water and air quality, and help achieve the sustainability goals and measures in applicable state, regional and local plans

A light rail transit project in the Southwest Corridor is needed for the following reasons:

- Transit service to important destinations in the corridor is limited, and unmet demand for transit is increasing due to growth.
- Limited street connectivity and gaps in pedestrian and bicycle facilities create barriers and unsafe conditions for transit access and active transportation.
- Travel is slow and unreliable on congested roadways.
- There are both a limited supply and a limited range of housing options in the Southwest Corridor that have good access to multimodal transportation networks. In addition, jobs and services are not located near residences.
- Regional and local plans call for high capacity transit in the corridor to meet local and regional land use goals.
- State, regional and local environmental and sustainability goals require transportation investments to reduce greenhouse gas emissions.

Project Partners

Planning for the project is being led by Metro and TriMet, in partnership with the Oregon Department of Transportation (ODOT), Washington County, and the Cities of Portland, Tigard, Tualatin, Beaverton, Durham, King City and Sherwood. A leadership group of agency officials from the partners (known as the Southwest Corridor Steering Committee) has guided the study of the transit options for the Southwest Corridor since 2011.

This Draft EIS is required by the federal government under the National Environmental Policy Act of 1970 (NEPA). It discloses to decision makers and the public the substantive adverse and beneficial effects of the project and proposes ways to avoid, minimize or mitigate negative impacts. FTA is the lead federal agency for the EIS.

S.3 Alternatives Considered

This Southwest Corridor Light Rail Project Draft EIS considers a No-Build Alternative and several light rail alternatives. The No-Build Alternative represents future conditions without the proposed project. The light rail alternatives represent different ways to complete a 12-mile extension of light rail connecting downtown Portland, Oregon, to southwest Portland, downtown Tigard and Tualatin. The EIS also considers two options for a minimum operable segment (MOS), which is a shorter version of the project that could be constructed as a standalone first phase with logical termini. Exhibit S-1 describes how the light rail alternatives relate to other elements of the Southwest Corridor Plan.

No-Build Alternative

The No-Build Alternative is the baseline for evaluating the benefits and impacts of the light rail alternatives. The No-Build Alternative represents transportation and environmental conditions without light rail to connect Portland, Tigard and Tualatin, and without the accompanying roadway, bicycle and pedestrian access improvements. It assumes regionally adopted forecasts for future population and employment growth through the year 2035, as well as adopted land use plans and other transportation investments in the region.

Light Rail Alternatives

Figure S-2 shows a map of the light rail alternatives for the full corridor from Portland to Tualatin. The alignment alternatives serving southwest Portland, Tigard and Tualatin would generally be within existing or new streets, or adjacent to I-5 or railroads. They comprise a total of up to 13 new stations, several with park and rides, as described below by segment. There are also options for a new light rail vehicle O&M facility, transit shuttles, interchange and circulation modifications, and new structures for pedestrians to reach Marquam Hill.

For analysis and comparison purposes, the alternatives are in three geographic segments with multiple alignment alternatives within each segment:

- Segment A: Inner Portland
- Segment B: Outer Portland
- Segment C: Tigard and Tualatin

Exhibit S-1

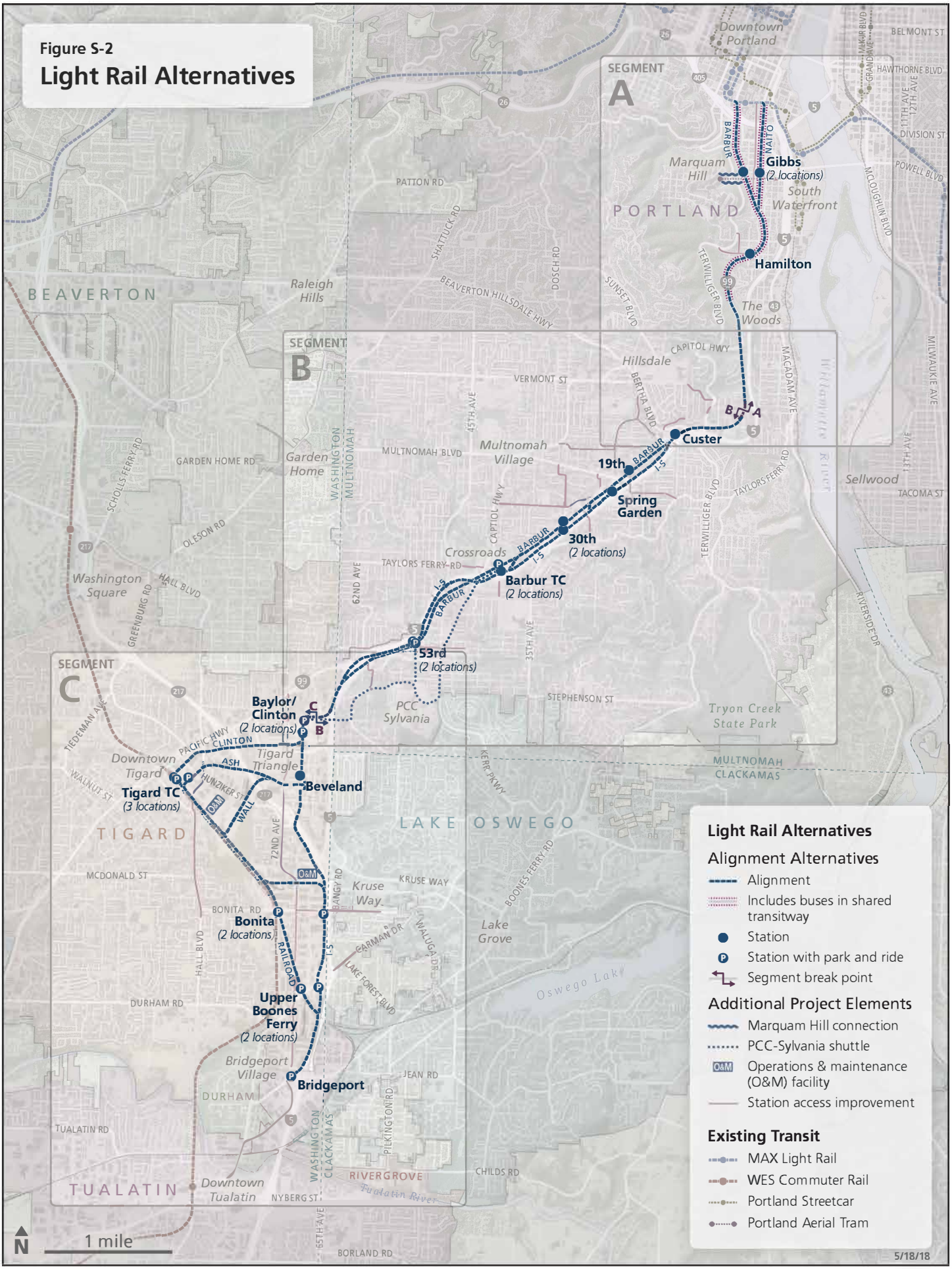
How does the Southwest Corridor Light Rail Project relate to other Southwest Corridor Plan efforts?

The project is a major component of a broader regional effort known as the Southwest Corridor Plan, which calls for strategic investments in this fast-growing part of the Portland region. The Southwest Corridor Plan includes complementary actions to support a successful light rail project. Those initiatives are not evaluated in this Draft EIS, since they are separate projects.

The Southwest Corridor regional partners are working together to support housing, business and workforce needs by making local bus service enhancements, investing in pedestrian and bicycle facilities and regional roadways, and pursuing desired development outcomes. One example is the Ross Island Bridgehead Reconfiguration, which addresses the need to improve multimodal access in the area between Interstate 405, U.S. 26 and the Ross Island Bridge, including changes to SW Naito Parkway; that project is incorporated in one of the segment A alternatives, but could be done separately with another. The Southwest Corridor Equitable Development Strategy (supported by a Corridor-Based Transit-Oriented Development Grant from FTA) is an additional plan component, which will define actions to ensure that individuals and families can continue to live, work and thrive in the Southwest Corridor and are able to take advantage of the increased opportunities that come with the light rail project. See www.swcorridorplan.org for more details.

Figure S-2

Light Rail Alternatives



Summary Details of the Light Rail Project

As shown in Table S-1, a complete, full-corridor project would be made up of one **alignment alternative** for each segment, and it would have a new O&M facility.

Each segment includes **options** that are analyzed separately from the alignment alternatives in order to aid comparisons based on the impacts of different options. These options also would work with any of the alternatives in a given segment.

The alignment alternatives also would have options for other facilities or **station access improvements** that could be added to increase the mobility benefits of the project. Unless noted otherwise below, these options could be paired with all of the alignment alternatives in a given segment.

Table S-2 lists the key characteristics of the stations that are associated with the light rail alignment alternatives. Further details on the stations and related facilities are in Chapter 2 – Alternatives Considered.

Table S-1. Light Rail Alternatives by Segment

Alignment Alternatives	Additional Project Elements *(pair with all alignment alternatives unless otherwise noted)*
Segment A: Inner Portland	
· Alternative A1: Barbur · Alternative A2-BH: Naito with Bridgehead Reconfiguration · Alternative A2-LA: Naito with Limited Access	***Marquam Hill Connection*** · Connection 1A: Elevator/Bridge and Path · Connection 1B: Elevator/Bridge and Recessed Path · Connection 1C: Elevator/Bridge and Tunnel · Connection 2: Full Tunnel ***Station Access Improvements*** · SA01 through SA03 (see Appendix A for detailed information)
Segment B: Outer Portland	
· Alternative B1: Barbur · Alternative B2: I-5 Barbur TC to 60th · Alternative B3: I-5 26th to 60th · Alternative B4: I-5 Custer to 60th	***PCC-Sylvania Shuttle*** · Barbur TC and Baylor Shuttle · 53rd Shuttle ***Station Access Improvements*** · SA04 through SA23 (see Appendix A for detailed information)
Segment C: Tigard and Tualatin	
Through Route · Alternative C1: Ash to I-5 · Alternative C2: Ash to Railroad · Alternative C3: Clinton to I-5 · Alternative C4: Clinton to Railroad ***Branched Route*** · Alternative C5: Ash and I-5 Branched · Alternative C6: Wall and I-5 Branched	***Operations and Maintenance Facility*** · Hunziker Facility · Through 72nd Facility (pairs with Alternatives C1 and C3) · Branched 72nd Facility (pairs with Alternatives C5 and C6) ***Station Access Improvements*** · SA24 through SA29 (see Appendix A for detailed information)

Note: PCC = Portland Community College; TC = Transit Center.

Table S-2. Station Characteristics

Station Name General Location	Alignment Alternatives	Park and Ride[1]		Other Notable Characteristics
		Spaces	Levels	
Lair Hill				
Gibbs Barbur Station	A1	N/A	N/A	Center platform in roadway median
Gibbs Naito Station	A2-BH, A2-LA	N/A	N/A	Center platform in roadway median
Hamilton				
Hamilton Station	All Segment A	N/A	N/A	Center platform in roadway median
Burlingame				
Custer Station	All Segment B	N/A	N/A	Center platform in roadway median
Capitol Hill				
19th Station	B1, B2, B3	N/A	N/A	Side platforms in roadway median
Spring Garden Station	B4	N/A	N/A	Center platform away from roadway
26th/30th				
30th Barbur Station	B1, B2	N/A	N/A	Staggered side platform (far-side)
30th I-5 Station	B3, B4	N/A	N/A	Center platform away from roadway
Barbur TC				
Barbur TC Barbur Station	B1	825	3	Side platforms away from roadway TC reconfigured
Barbur TC I-5 Station	B2, B3, B4	725	3	Side platforms in roadway median TC reconfigured Pedestrian bridge over I-5 replaced
53rd				
53rd Barbur Station	B1	950	3	Center platform in roadway median Pedestrian bridge over SW Barbur Blvd. added
53rd I-5 Station	B2, B3, B4	950	3	Side platforms next to roadway Pedestrian bridge over SW Barbur Blvd. added
Northern Tigard Triangle (the Tigard Triangle is bounded by I-5, Highway 217 and Pacific Highway)				
Baylor Station	C1, C2, C5, C6	425	3	Center platform in side-running configuration
Clinton Station	C3, C4	425	3	Center platform in side-running configuration
Southern Tigard Triangle[2]				
Beveland Station	C1, C2, C5, C6	N/A	N/A	Center platform in side-running configuration
Tigard TC				
Tigard TC Ash Station	C1, C2, C5	300	3	Side platforms in side-running configuration TC moved to SW Ash Ave. For Alt. C5: tail track to Hunziker O&M facility
Tigard TC Clinton Station	C3, C4	275	3	Center platform away from roadway TC moved south on SW Commercial St.
Tigard TC Wall Station	C6	275	3	Platforms at three tracks away from roadway TC moved south on SW Commercial St.
Bonita				
Bonita I-5 Station	C1, C3, C5, C6	150	surface	Side platforms away from roadway 10- to 20-foot walls north and east of platforms
Bonita Railroad Station	C2, C4	100	surface	Center platform on elevated trackway
Upper Boones Ferry				
Upper Boones Ferry I-5 Station	C1, C3, C5, C6	600	3	Side platforms away from roadway 10- to 20-foot walls north and east of platforms
Upper Boones Ferry Railroad Station	C2, C4	50	surface	Center platform away from roadway
Bridgeport Village				
Bridgeport Station	All Segment C	950	4	Platforms at three tracks away from roadway Pedestrian bridge to P&R over SW LBF Rd.

Note: LBF = Lower Boones Ferry; N/A = not applicable; P&R = park and ride; TC = Transit Center.

[1] Based on the maximum proposed size for each park and ride. Subject to refinement during the Final EIS process.

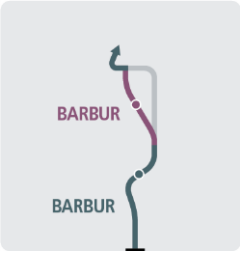
[2] Alternatives C3 and C4 would not include a southern Tigard Triangle station.

Segment A: Inner Portland

Segment A begins at the southern edge of downtown Portland (see Figure S-3) at the south end of the Downtown Portland Transit Mall, with three alignment alternatives that would extend light rail service from SW 5th Avenue and SW Jackson Street, near PSU, to SW Barbur Boulevard just north of SW Brier Place in southwest Portland. The alignments are either continuously along SW Barbur Boulevard, or along SW Naito Parkway and then along SW Barbur Boulevard. All of the alternatives include a 2-mile shared transitway for buses and light rail, starting at SW Barbur Boulevard near SW Capitol Highway, and extending to SW Lincoln Street.

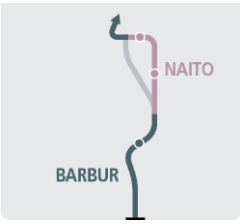
All of the alignment alternatives carry options to build structures providing a new pedestrian connection from SW Barbur Boulevard up to the OHSU Marquam Hill complex. There are three station access improvement options in this segment that involve sidewalks and bicycle lanes.

Alternative A1: Barbur



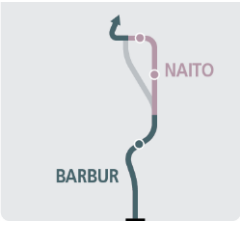
Alternative A1 would run on SW Barbur Boulevard for most of Segment A, primarily operating at grade in the center of the roadway. The light rail alignment for Alternative A1 differs from the other Segment A alignment alternatives between the Transit Mall and the junction of SW Barbur Boulevard and SW Naito Parkway. Stations would be located near SW Gibbs Street and SW Hamilton Street. Both stations would use at-grade center platforms.

Alternative A2-BH: Naito with Bridgehead Reconfiguration



Alternative A2-BH would operate in the center of a widened SW Naito Parkway instead of on SW Barbur Boulevard until about SW Lane Street, where SW Naito Parkway connects to SW Barbur Boulevard. Alternative A2-BH would include stations on SW Naito Parkway at SW Gibbs Street, with an alternate location at SW Hooker Street, and on SW Barbur Boulevard at SW Hamilton Street.

Alternative A2-LA: Naito with Limited Access



Alternative A2-LA would follow the same alignment as Alternative A2-BH, and have the same station locations. As with Alternative A2-BH, it would rebuild SW Naito Parkway to accommodate center-running light rail, but it would not include the Bridgehead Reconfiguration. Instead, Alternative A2-LA would largely maintain SW Naito Parkway's current roadway access restrictions.

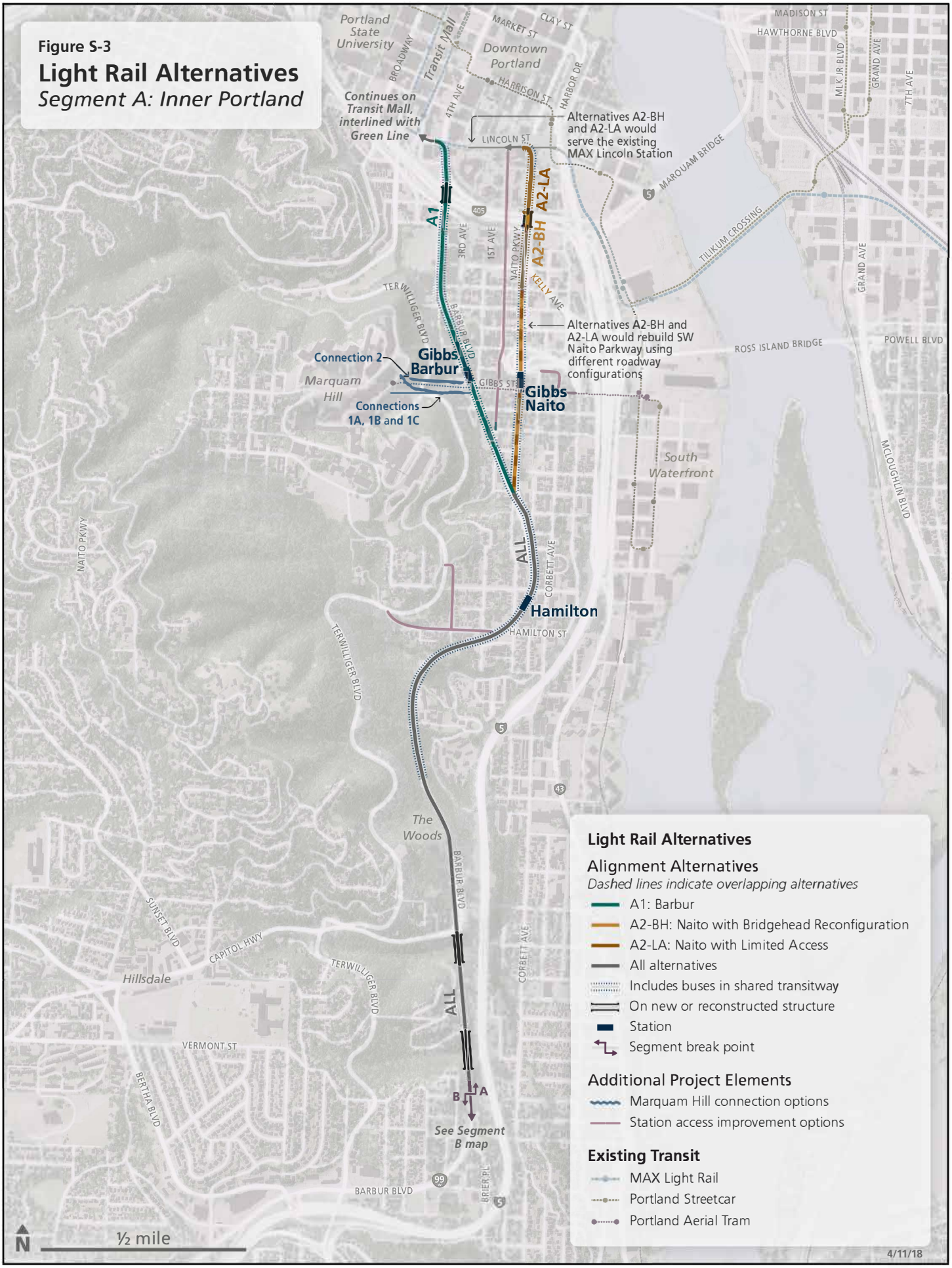
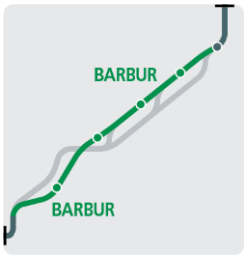


Figure S-3
Light Rail Alternatives
Segment A: Inner Portland
Portland State University
BROADWAY
Transit Mall
MARKET ST
CLAY ST
Downtown Portland
HARRISON ST
HARBOR DR
4TH AVE
Continues on Transit Mall, interlined with Green Line
Alternatives A2-BH and A2-LA would serve the existing MAX Lincoln Station
LINCOLN ST
MADISON ST
HAWTHORNE BLVD
MLK JR BLVD
GRAND AVE
7TH AVE
MARQUAM BRIDGE
A1
A2-BH
A2-LA
405
3RD AVE
1ST AVE
NAITO PKWY
KELLY AVE
TILIKUM CROSSING
GRAND AVE
TERWILLIGER BLVD
BARBUR BLVD
Alternatives A2-BH and A2-LA would rebuild SW Naito Parkway using different roadway configurations
ROSS ISLAND BRIDGE
POWELL BLVD
Connection 2
Gibbs
Barbur
Marquam Hill
GIBBS ST
Gibbs
Naito
Connections 1A, 1B and 1C
South Waterfront
MCLOUGHLIN BLVD
NAITO PKWY
ALL
CORBETT AVE
Hamilton
HAMILTON ST
TERWILLIGER BLVD
5
43
The Woods
BARBUR BLVD
SUNSET BLVD
CAPITOL HWY
Hillsdale
TERWILLIGER BLVD
CORBETT AVE
ALL
VERMONT ST
BERTHA BLVD
B
A
See Segment B map
99W
BARBUR BLVD
BRIER PL
5
N
½ mile
Light Rail Alternatives
Alignment Alternatives
Dashed lines indicate overlapping alternatives
A1: Barbur
A2-BH: Naito with Bridgehead Reconfiguration
A2-LA: Naito with Limited Access
All alternatives
Includes buses in shared transitway
On new or reconstructed structure
Station
Segment break point
Additional Project Elements
Marquam Hill connection options
Station access improvement options
Existing Transit
MAX Light Rail
Portland Streetcar
Portland Aerial Tram
4/11/18

Segment B: Outer Portland

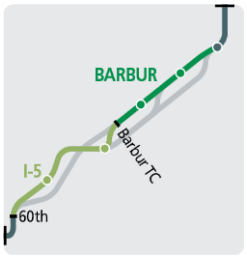
Segment B extends from SW Barbur Boulevard at SW Brier Place to the intersection of SW 68th Parkway and SW Atlanta Street, just west of the Portland/Tigard city boundary (see Figure S-4). The light rail alternatives all have five stations and two park and rides. They all would widen SW Barbur Boulevard to accommodate light rail in the center, but they vary in how long they would stay on SW Barbur Boulevard. One of the alternatives would follow SW Barbur Boulevard through the entire segment, while three would have sections that transition to be adjacent to I-5. Segment B also has two options for a shuttle connection to the PCC-Sylvania campus, as well as 20 options for station access improvements involving sidewalks, bicycle lanes, missing street connections and pedestrian bridges.

Alternative B1: Barbur



Alternative B1 would run in the center of SW Barbur Boulevard until SW 60th Avenue. West of SW 60th Avenue, the alignment would cross back over I-5 between SW Barbur Boulevard and Tigard on a new light rail structure. Stations would be located at grade in the center of SW Barbur Boulevard at SW Custer Street, SW 19th Avenue, SW 30th Avenue, the Barbur Transit Center and SW 53rd Avenue. Three-level park and ride structures would be included at the Barbur Transit Center and 53rd Stations.

Alternative B2: I-5 Barbur Transit Center to 60th

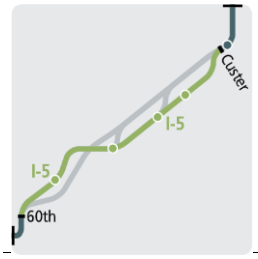


Alternative B2 would be identical to Alternative B1 from SW Brier Place to just north of the Barbur Transit Center, where light rail would transition away from the center of SW Barbur Boulevard to run adjacent to I-5. South of the Barbur Transit Center, the alignment would cross over I-5, SW Capitol Highway and SW Barbur Boulevard on a new light rail structure, and then continue adjacent to I-5 until SW 60th Avenue. West of SW 60th Avenue, the alignment would cross over I-5 and SW Barbur Boulevard on a new bridge. The stations would be the same as Alternative B1 except that the Barbur Transit Center and 53rd Stations would be located next to I-5.

Alternative B3: I-5 26th to 60th

Alternative B3 would be the same as Alternatives B1 and B2 from SW Brier Place to SW 26th Way, where it would shift to run adjacent to I-5. The alignment would depart from SW Barbur Boulevard just north of SW 26th Way and continue south along I-5 to the Barbur Transit Center. The stations would be the same as Alternative B2 except that the 30th Avenue Station would be at grade adjacent to I-5.

Alternative B4: I-5 Custer to 60th

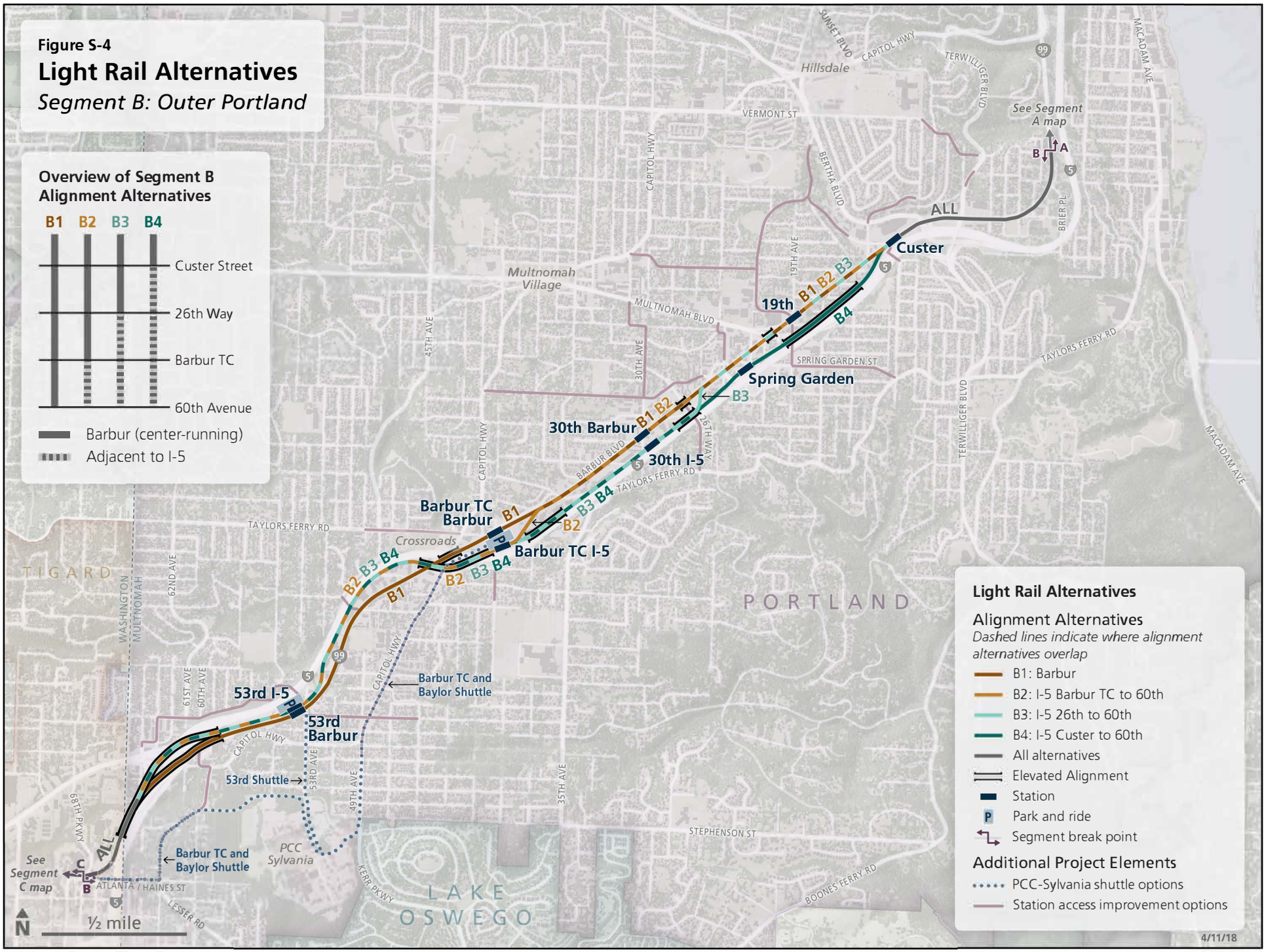


Alternative B4 runs the longest distance adjacent to I-5, starting near SW Barbur Boulevard at SW Custer Street. South of SW 26th Way, Alternative B4 would be identical to Alternative B3. The Custer Station would be the same as in Alternative B1. The 30th, Barbur Transit Center and 53rd Stations would be the same as Alternative B3. The Spring Garden Station would be at grade adjacent to I-5.

Figure S-4

Light Rail Alternatives

Segment B: Outer Portland



Segment C: Tigard and Tualatin

This segment extends from the intersection of SW 68th Parkway and SW Atlanta Street, just west of the Portland/Tigard city boundary, to near Bridgeport Village in Tualatin, which would be the southern terminus of the light rail alignment (see Figures S-5 and S-6). It includes six alternatives with up to six stations, and the alternatives are also grouped by how they would operate. Light rail could run on a continuous "Through Route" serving Tualatin via downtown Tigard, or a "Branched Route," with one branch going to downtown Tigard and the other branch to Tualatin. Segment C has three options for an O&M facility to support light rail operations, and six options for station access improvements for sidewalks, bicycle lanes, missing street connections and pedestrian bridges.

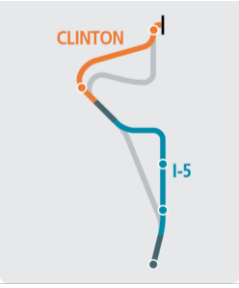
Alternative C1: Ash to I-5

This Through-Routed alignment alternative would be along new and existing streets between the Tigard Triangle (the area bounded by I-5, Highway 217 and Pacific Highway) and downtown Tigard, and then would follow the freight rail and WES tracks before turning east to run along I-5 to Bridgeport Village. It would feature several new bridges, including a crossing over Highway 217 to reach downtown Tigard. There would be two stations in the Tigard Triangle, one with a park and ride; a station in downtown Tigard near a relocated transit center and park and ride; and stations and park and rides along I-5 at SW Bonita Road, SW Upper Boones Ferry Road and Bridgeport Village.

Alternative C2: Ash to Railroad

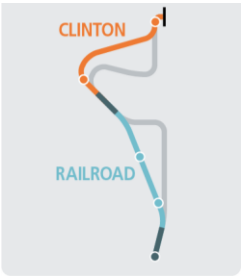
This Through-Routed alignment alternative would be identical to Alternative C1 between the Tigard Triangle and downtown Tigard, including the station locations and park and rides. It then would follow the WES Commuter Rail and freight rail tracks before transitioning to I-5 near SW Upper Boones Ferry Road and continuing to Bridgeport Village. The southern stations and park and rides would be along the freight rail tracks at SW Bonita Road and SW Upper Boones Ferry Road, and along I-5 at Bridgeport Village.

Alternative C3: Clinton to I-5



This Through-Routed alignment alternative would also be mostly along new or existing streets between the Tigard Triangle and downtown Tigard, but the alignment would be to the north of Alternatives C1 and C2 in the Tigard Triangle. Alternative C3 would have one station in the Tigard Triangle and one station in downtown Tigard, both with new park and ride structures. South of downtown Tigard, Alternative C3 would be identical to Alternative C1.

Alternative C4: Clinton to Railroad

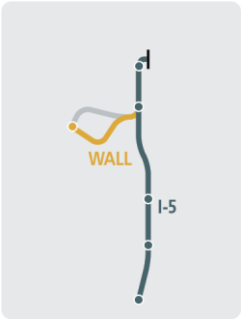


This Through-Routed alignment alternative would use the Alternative C3 alignment between the Tigard Triangle and downtown Tigard, and the Railroad alignment between downtown Tigard and Bridgeport Village. The alignment, station locations and park and rides for this alternative would be identical to Alternative C3 north of and into downtown Tigard and identical to Alternative C2 south of downtown Tigard.

Alternative C5: Ash and I-5 Branched

This Branched alignment alternative would use the Ash alignment for a Tigard branch, and would have a Bridgeport branch that would continue south through the Tigard Triangle to cross Highway 217 and run adjacent to I-5 to reach Bridgeport Village. North of the branch split point, which would be at the Beveland Station, the alternative would be identical to Alternative C1. The Tigard branch alignment to downtown Tigard would be similar to the alignment used for Alternative C1, and the Bridgeport branch alignment would be the same as Alternative C1 south of SW Bonita Road.

Alternative C6: Wall and I-5 Branched



This Branched alignment alternative would be similar to Alternative C5 except that it would connect to SW Wall Street west of Highway 217. At the end of SW Wall Street, the alignment would turn northwest and run parallel to the WES/freight rail tracks to terminate near a reconfigured Tigard Transit Center. The Bridgeport branch would be identical to that of Alternative C5. With the exception of the Tigard Transit Center Station, Alternative C6 would include the same station and park and ride locations as Alternative C1. The Tigard Transit Center Station would be at grade adjacent to the WES station and a reconfigured transit center.

Operations and Maintenance Facility Options

Two locations are being considered for a new light rail O&M facility to serve the corridor. Both are in Segment C. The "Hunziker Facility" option for an O&M facility would be at SW Hunziker Street, adjacent to the WES Commuter Rail tracks. The second location, known as the "Through 72nd Facility," would be southeast of the Tigard Triangle between SW 72nd Avenue and I-5.

Minimum Operable Segments

A minimum operable segment (MOS) is a shorter version of the project that would be suitable to build as a first phase. An MOS must have the ability to function as a standalone project with logical termini if no other phases are built. This Draft EIS considers MOS options that terminate either at the Tigard Transit Center (for either a Through Route or a Branched Route) or at Bridgeport Village (for a Branched Route only).

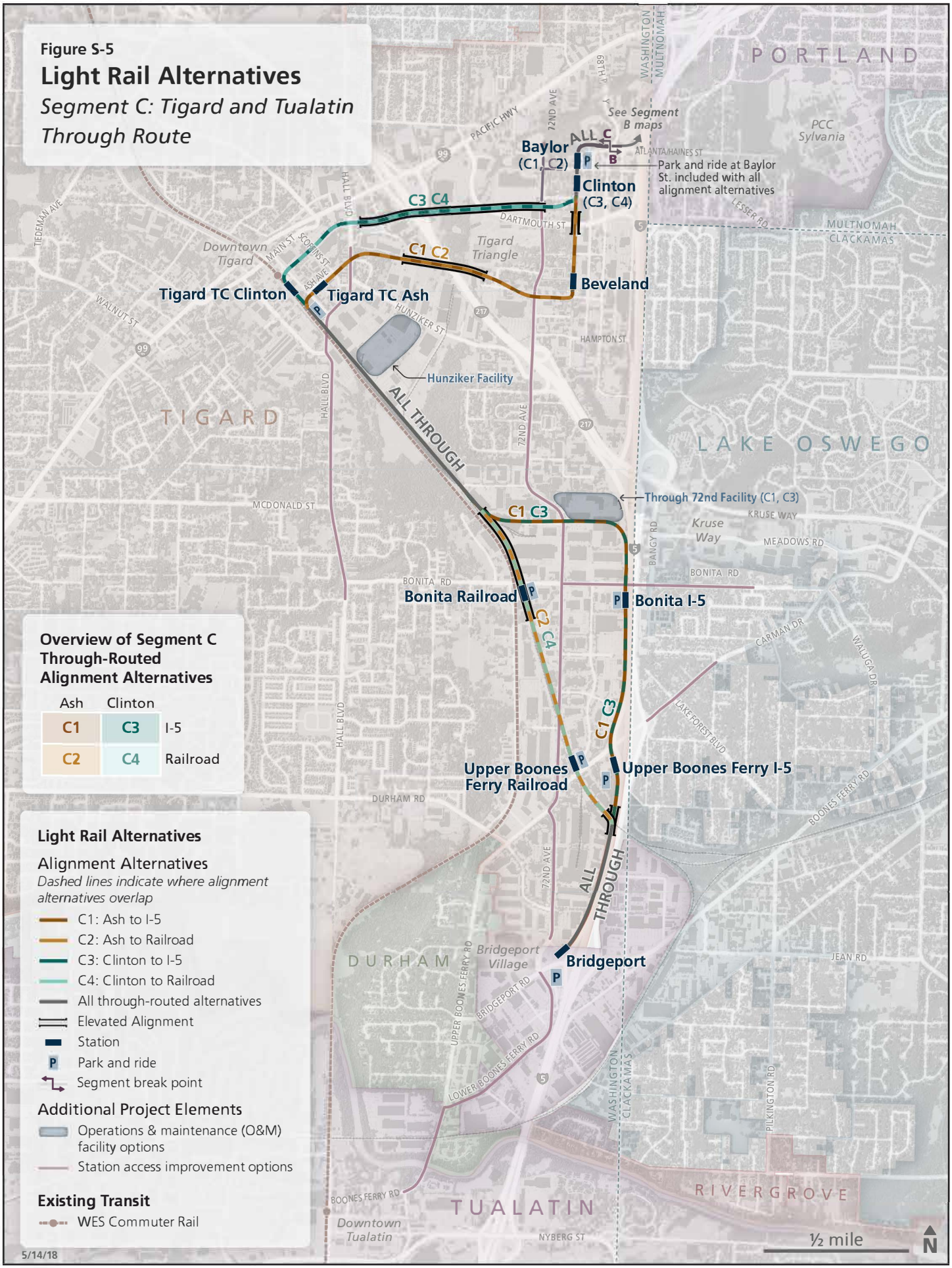


Figure S-5
Light Rail Alternatives
Segment C: Tigard and Tualatin Through Route
PORTLAND
See Segment B maps
PCC Sylvania
Baylor (C1, C2)
ALL C
B
Park and ride at Baylor St. included with all alignment alternatives
Clinton (C3, C4)
C3 C4
C1 C2
Tigard Triangle
Beveland
Downtown Tigard
Tigard TC Clinton
Tigard TC Ash
Hunziker Facility
TIGARD
ALL THROUGH
LAKE OSWEGO
Through 72nd Facility (C1, C3)
C1 C3
Kruse Way
Bonita Railroad
Bonita I-5
C2 C4
Upper Boones Ferry Railroad
Upper Boones Ferry I-5
Bridgeport
DURHAM
Bridgeport Village
TUALATIN
Downtown Tualatin
RIVERGROVE
½ mile
N
Overview of Segment C Through-Routed Alignment Alternatives
Ash
Clinton
C1
C3
I-5
C2
C4
Railroad
Light Rail Alternatives
Alignment Alternatives
Dashed lines indicate where alignment alternatives overlap
C1: Ash to I-5
C2: Ash to Railroad
C3: Clinton to I-5
C4: Clinton to Railroad
All through-routed alternatives
Elevated Alignment
Station
Park and ride
Segment break point
Additional Project Elements
Operations & maintenance (O&M) facility options
Station access improvement options
Existing Transit
WES Commuter Rail
5/14/18

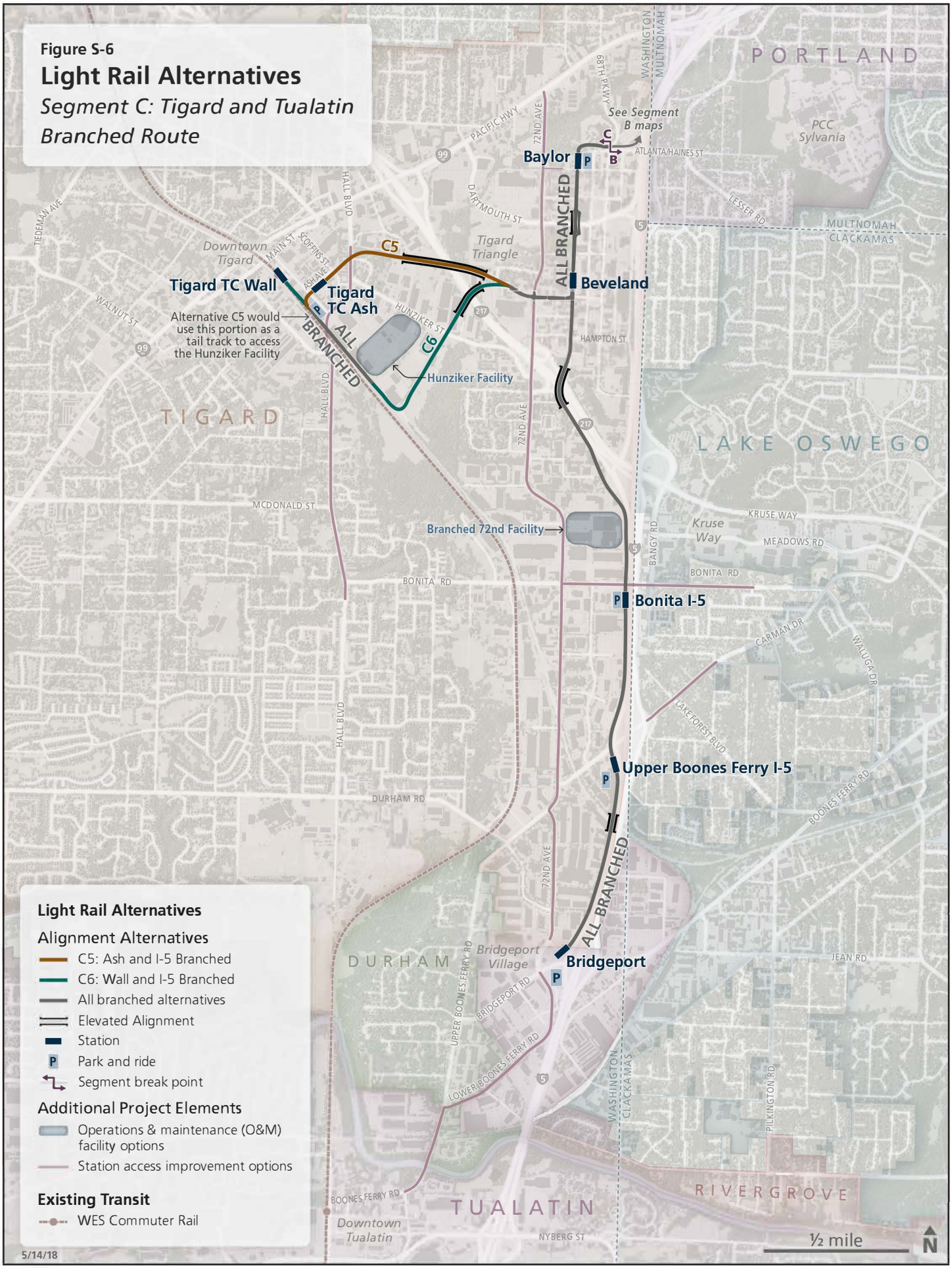


Figure S-6
Light Rail Alternatives
Segment C: Tigard and Tualatin
Branched Route
PORTLAND
TIGARD
LAKE OSWEGO
TUALATIN
DURHAM
RIVERGROVE
Baylor
Beveland
Tigard TC Wall
Tigard TC Ash
Alternative C5 would use this portion as a tail track to access the Hunziker Facility
C5
C6
ALL BRANCHED
Hunziker Facility
Branched 72nd Facility
Bonita I-5
Upper Boones Ferry I-5
Bridgeport
See Segment B maps
Downtown Tigard
Tigard Triangle
Kruse Way
Bridgeport Village
Downtown Tualatin
PCC Sylvania
MULTNOMAH CLACKAMAS
WASHINGTON MULTNOMAH
WASHINGTON CLACKAMAS
PACIFIC HWY
72ND AVE
HALL BLVD
DARTMOUTH ST
HUNZIKER ST
HAMPTON ST
MCDONALD ST
BONITA RD
KRUSE WAY
MEADOWS RD
BANGY RD
CARMAN DR
WALUGA DR
LAKE FOREST BLVD
BOONES FERRY RD
UPPER BOONES FERRY RD
LOWER BOONES FERRY RD
BRIDGEPORT RD
JEAN RD
PILKINGTON RD
NYBERG ST
ATLANTA/HAINES ST
LESSER RD
TIEDEMAN AVE
MAIN ST
SCOFFINS ST
ASH AVE
WALNUT ST
Light Rail Alternatives
Alignment Alternatives
C5: Ash and I-5 Branched
C6: Wall and I-5 Branched
All branched alternatives
Elevated Alignment
Station
Park and ride
Segment break point
Additional Project Elements
Operations & maintenance (O&M) facility options
Station access improvement options
Existing Transit
WES Commuter Rail
5/14/18
½ mile
N

Initial Route Proposal

This Draft EIS identifies a draft Preferred Alternative, known as the initial route proposal, to give the public and federal, state and local agencies, and tribal governments an opportunity to comment on a full-length light rail alternative. The initial route proposal was developed by project partner staff based on information from the Draft EIS analysis and on public outreach.

The initial route proposal is a 12-mile through-routed light rail line with 13 stations, a Marquam Hill connection, a PCC-Sylvania shuttle and an O&M facility (Figure S-7 and Table S-3). The initial route proposal is based on Alternatives A1 (Barbur), B2 (I-5 Barbur Transit Center to 60th), and C2 (Ash to Railroad), with design refinements in selected areas where impacts could be reduced or benefits improved by modifying the design. If there is insufficient funding to construct the entire light rail line, the MOS for the initial route proposal would terminate at the Tigard Transit Center.

The Southwest Corridor Light Rail Project will include a set of station access improvements that will be selected prior to the Final EIS. If Alternative A1 is included in the Preferred Alternative, the Portland region will seek to fund and construct the Bridgehead Reconfiguration as a companion project.

Potential Design Refinements

Based on the impact analysis conducted for this Draft EIS, TriMet, Metro and their partners developed design refinements that could be used to help avoid or reduce impacts by making design modifications, and would result in an overall improvement in project impacts, benefits and costs. These refinements are discussed in Chapter 2 – Alternatives Considered, and more detail is in Appendix E.

Construction Activities

The construction of the Southwest Corridor Light Rail Project would be a major undertaking, similar in scale, duration and complexity to other major public works projects that have been built in the region, such as the Orange Line extending light rail from downtown Portland to Milwaukie. Construction activities could begin by 2022, with major construction lasting approximately four years, followed by system testing. The phases of construction include clearing and demolition, utility relocation, development of major structures, civil and track construction, systems installation and installation of station amenities. The final phases involve testing and finish work, leading up to the opening of the line to passenger service. In addition to the areas where the project would be constructed, other areas would be needed for project staging, including for equipment and materials storage, laydown or preconstruction of some elements; field administration offices; and construction vehicle parking. The project area's major roadways, as well as I-5, would be construction haul routes.

Table S-3. Initial Route Proposal Overview

Alignment Alternatives with Design Refinements[1]	Additional Project Elements
Alternative A1: Barbur	
· *Includes a design refinement for "The Woods" area along SW Barbur Blvd. that shifts the alignment to reduce historic property impacts and construction-period impacts* · Shorter pedestrian connection to Marquam Hill · Faster travel time for light rail and buses in the shared transitway · Fewer displacements of residential units, businesses, employees and potentially eligible historic resources	· Marquam Hill connection[2]
Alternative B2: I-5 Barbur Transit Center to 60th	
· *Includes design refinements for a Taylors Ferry I-5 overcrossing and a modified SW Barbur Blvd. crossing and related alignment to reduce property impacts and other impacts* · More accessible station locations and greater safety improvements for all travel modes compared to Alternatives B3 and B4 · Fewer residential displacements than Alternative B4 · Avoidance of complex reconstruction of the SW Barbur Blvd./I-5 bridge at Crossroads required under Alternative B1	· PCC Sylvania- shuttle[2]
Alternative C2: Ash to Railroad	
· *Includes refinements to the Tigard Transit Center Station with a revised alignment in the Tigard Triangle to downtown Tigard, in order to reduce property impacts and other impacts* · Better support for land use development plans with two stations serving the Tigard Triangle (compared to Alternatives C3 and C4) · Avoidance of critical traffic impact at SW Hall Blvd. associated with Alternatives C3 and C4 · Fewer business and employee displacements along I-5 in southern Tigard compared to Alternatives C1, C3, C5 and C6 · More frequent service in downtown Tigard and better transit connectivity between downtown Tigard and areas to the south compared to the Branched Route (Alternatives C5 and C6)	· Hunziker O&M facility

Note: O&M = operations and maintenance; PCC = Portland Community College; TC = Transit Center.

[1] The design refinements have not been analyzed at the same level of detail as the alignment alternatives in this Draft EIS. Design refinements would be incorporated into the Preferred Alternative in the Final EIS.

[2] The specific options for the Marquam Hill connection and the PCC-Sylvania shuttle route will be identified after the Draft EIS and before the Final EIS through a public process that will involve the institutions, neighborhoods and appropriate resource agencies.

Figure S-7

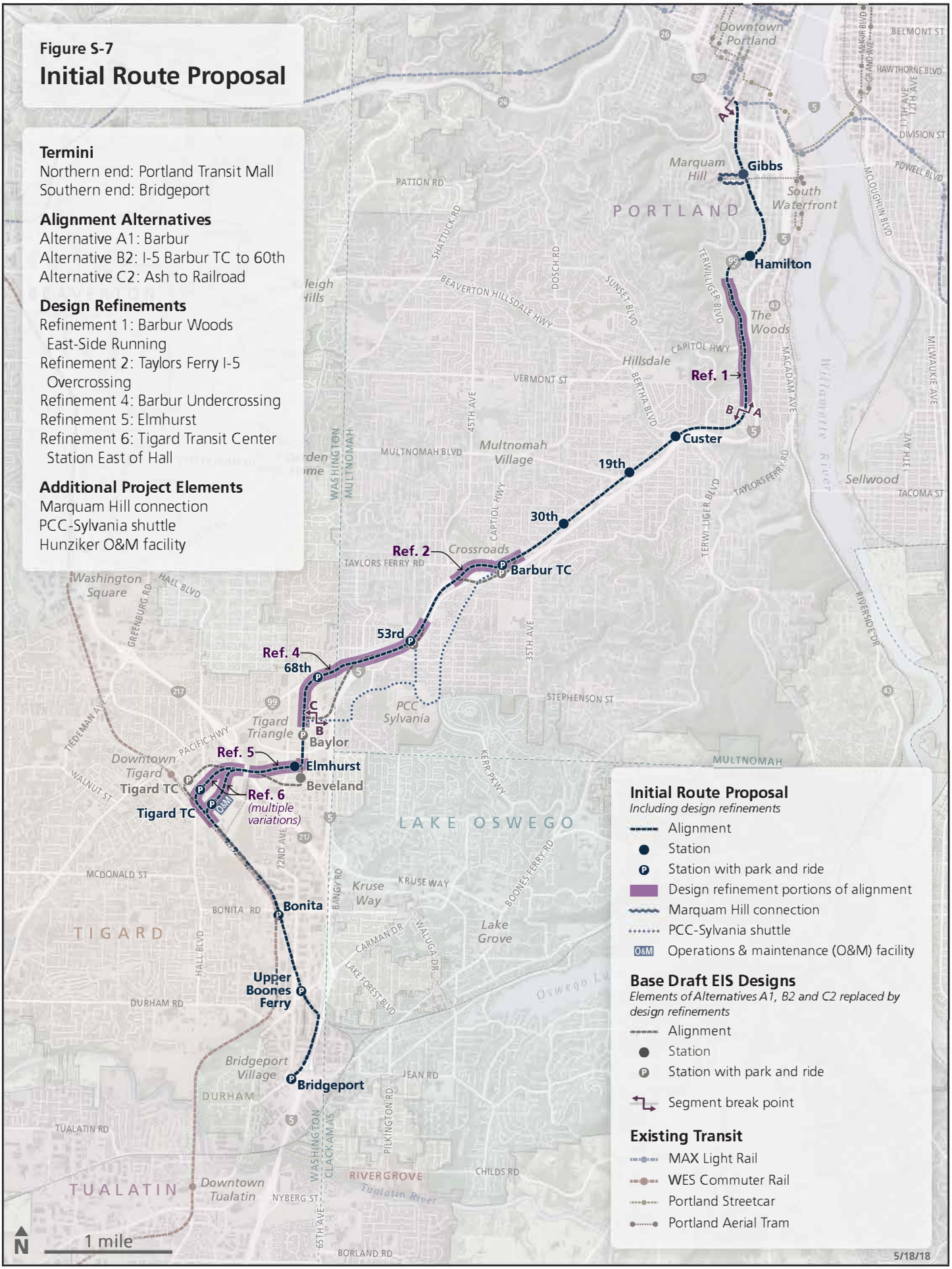
Initial Route Proposal

Termini
Northern end: Portland Transit Mall
Southern end: Bridgeport

Alignment Alternatives
Alternative A1: Barbur
Alternative B2: I-5 Barbur TC to 60th
Alternative C2: Ash to Railroad

Design Refinements
Refinement 1: Barbur Woods East-Side Running
Refinement 2: Taylors Ferry I-5 Overcrossing
Refinement 4: Barbur Undercrossing
Refinement 5: Elmhurst
Refinement 6: Tigard Transit Center Station East of Hall

Additional Project Elements
Marquam Hill connection
PCC-Sylvania shuttle
Hunziker O&M facility



S.4 Background on Southwest Corridor Planning

Public scoping for the Southwest Corridor Light Rail Project EIS began September 2, 2016, and included a comment period that ended October 3, 2016. Public scoping was intended to encourage public and agency comments on the project's Purpose and Need, the range of alternatives being studied and the focus of the environmental analysis. During the public comment period, there were:

- two public online surveys
- five neighborhood association meetings
- an agency and tribal scoping meeting on September 20, 2016
- a public scoping meeting on September 22, 2016

The start of the EIS process for the project follows years of regional planning. In 2009, Metro adopted the 30-year *High Capacity Transit System Plan*, also known as the HCT Plan, to guide investments in light rail, commuter rail, bus rapid transit and rapid streetcar in the Portland region. The HCT Plan identified the Southwest Corridor, the area between downtown Portland and Sherwood including Tigard and Tualatin, as a priority. Between 2011 and 2016, Metro and its local agency partners[1] developed the Southwest Corridor Plan to identify a high capacity transit project and other investment strategies to help improve safety and quality of life, and to support regional and local land use plans and economic development. This plan and its accompanying alternatives analysis and public engagement created the framework for the Purpose and Need (Chapter 1) and the alternatives now being considered in this Draft EIS. Chapter 6 – Public Involvement and Agency Coordination has more information on public engagement efforts to date.

S.5 Transportation and Environmental Effects

Table S-4 reviews the range of environmental effects identified in this Draft EIS, highlighting where the light rail alternatives have different effects compared to the No-Build Alternative or each other. Where the differences in impacts between the individual alternatives and their need for mitigation are notable, the table shows more detail. Otherwise, it shows the general effects for all light rail alternatives. Environmental topics for which there are no clear differences and no effects requiring mitigation are not detailed in the table (Land Use, Air Quality, Energy, Utilities and Public Services).

Table S-4. Summary of Transportation and Environmental Effects *(multi-page table)*

Environmental Discipline	Impacts and Benefits
Transportation • Transit • Streets • Bicycle and Pedestrian • Parking • Freight • Safety	• Compared to the No-Build Alternative, the light rail alternatives would notably improve transit reliability and frequency • Light rail offers up to 9-minute faster in-vehicle transit travel times on full-corridor transit trips than the No-Build Alternative • Light rail would carry up to 41,600 daily light rail riders by year 2035, and the full-corridor project covers up to 8 percent more total transit riders (on bus and rail) than the No-Build Alternative • There would be increased vehicular, bicycle and pedestrian activity around transit stations and park and rides

[1] In addition to Metro, the local agency partners are the Tri-County Metropolitan Transportation District of Oregon (TriMet); Oregon Department of Transportation (ODOT); the cities of Beaverton, Durham, King City, Portland, Sherwood, Tigard and Tualatin; and Washington County.

Table S-4. Summary of Transportation and Environmental Effects *(multi-page table)*

Environmental Discipline	Impacts and Benefits
	• Local and arterial intersections with congestion or queues below standards would have mitigation available to return to No-Build Alternative conditions or better • Impacts to local freight access to individual properties could create out-of-direction travel and increase travel times • Construction could temporarily reduce highway and local roadway capacity, increase truck traffic, involve sidewalk and road closures or detours, and affect access and travel times for transit
Residential Acquisitions and Displacements	• A full-corridor project would acquire and displace 78 to 293 residential units • Segment A alternatives would affect 41 to 125 residential units, with A2-LA having the highest impacts and A1 the least • Segment B alternatives would affect 32 to 78 residential units, with B4 having the highest impacts and B1 the least • Segment C alternatives would affect 5 to 85 residential units, with C1/C2 and C5 having the highest impacts and C3/C4 and C6 the least
Economics (Business Displacements)	• A full-corridor project would have acquisitions affecting 106 to 156 businesses or institutions and 961 to 1,990 employees • Segment A alternatives would have acquisitions affecting 15 to 23 businesses and 108 to 371 employees, with A2-BH and A2-LA having the highest impacts and A1 the least • Segment B alternatives would affect 54 to 66 businesses and 469 to 565 employees, with B1 affecting the fewest businesses, B2 affecting the fewest employees, and the other alignment alternatives at the higher end of the impact range • Segment C alternatives would affect 31 to 55 businesses and 323 to 839 employees; C5 would affect the most businesses, and C3 the most employees • Temporary construction impacts would involve increased traffic congestion and reroutes, noise, vibration, dust, and changes to business access and visibility
Communities	• In all segments, clusters of residential and business displacements could disrupt individual social ties and indirectly cause property values to increase through redevelopment around stations, which could affect low-income populations • In Segment A, all alternatives would affect parking for a church, but replacement parking could be provided as mitigation • In Segment C, Alternatives C1, C2 and C5 would displace a community lodge and businesses providing counseling and a medical clinic • Alternatives C3 and C4 would displace the Tigard U.S. Post Office • Alternatives C3 and C6 would displace a medical clinic • Alternatives C1, C2 and C5 (SW Ash Ave. alignments) would displace a cluster of multifamily residential buildings in the Downtown Tigard neighborhood along SW Hall Blvd. and SW Ash Ave.; the relocation of several blocks of residents would alter the current character and social interactions in this neighborhood. Improved transportation infrastructure and services for all modes could benefit area residents, businesses and patrons
Visual Quality	• Segment A alternatives would have moderate visual impacts overall, but there would be areas with higher impacts due to building and vegetation removal, such as near Marquam Hill, along SW Barbur Blvd. in The Woods, and in areas with historic properties • Segment B alternatives would have moderate visual impacts overall • Segment C alternatives would have high impacts in the Tigard Triangle and downtown Tigard due to prominent new structures, vegetation removal and removal of buildings in areas with nearby residences; Alternatives C1, C2 and C5 would have the highest visual impacts
Historic and Archaeological Resources	• A full-corridor project would have a presumed adverse effect due to full parcel acquisitions of 7 to 21 historic properties • Segment A alternatives would involve full parcel acquisitions on 5 to 15 historic properties, with A2-LA having the highest • All Segment A alternatives would impact two historic trestle bridges on SW Barbur Blvd. • Segment B alternatives would involve 2 to 5 historic properties, with B1 having the most • All of the alignment alternatives could encounter potential archaeological sites

Table S-4. Summary of Transportation and Environmental Effects *(multi-page table)*

Environmental Discipline	Impacts and Benefits
Parks and Recreation Resources	• A1 would remove vegetation bordering Duniway Park and Lair Hill Park • A2-BH and A2-LA would affect strips of land bordering Water and Gibbs Community Garden and Front and Curry Community Garden • All Segment A alternatives would remove vegetation and trees along the Terwilliger Parkway/open space along SW Barbur Blvd. and for the Marquam Hill connection, and in George Himes Natural Area Park • All Segment B alternatives would remove vegetation and trees bordering Fulton Park between the community garden and the street
Geology, Soils and Hydrogeology	• All alternatives are in a seismically active region that requires engineering measures to address the risk of damage from earthquakes • All alternatives cross areas that require measures to reduce slope instability risks
Ecosystems Resources	• A full-corridor project would involve between 1.3 and 1.6 acres of permanent wetland impacts • Tree removal in Segments A and B would affect some protected areas such as stream crossings; there would be less than 0.1 acre of permanent wetland impacts in each segment • Several stream and wetland crossings by alignment alternatives in Segment C; permanent wetland impacts would range from 0.4 acre to 1.6 acres, with C3 and C4 (Clinton) having the most
Water Resources	• There would be increased pollution-generating and non-pollution-generating impervious surfaces for all alternatives • There would be floodplain impacts for all alternatives in Segment C except C6
Noise and Vibration	• There are noise and vibration-sensitive properties, including residences, that would be impacted in all three segments • More frequent trains are needed for the Branched Route, thus creating higher noise and vibration impacts • Segment A would have up to 353 moderate noise impacts, up to 8 severe noise impacts and up to 76 vibration impacts • Segment B would have up to 147 moderate noise impacts, 1 severe noise impact and up to 29 vibration impacts • Segment C would have up to 72 moderate noise impacts, up to 15 severe noise impacts and up to 21 vibration impacts • TriMet would mitigate impacts to be below federal severe impact thresholds for all alternatives
Hazardous Materials	• A full-corridor project would acquire 5 to 8 parcels with higher risk for remaining hazardous materials for the alignment, and an O&M facility could involve 2 additional parcels; resulting cleanup would be an environmental benefit • All Segment B alternatives would acquire up to 3 parcels with higher risk for remaining hazardous materials • Segment C alternatives would acquire 2 to 5 parcels with higher risk for remaining hazardous materials, with C5 having the least
Safety and Security	• Car prowls could occur with new or expanded park and rides • Some station locations in Segment C would be in areas that currently experience property and nuisance crimes, particularly in downtown Tigard
Land Use, Air Quality, Energy, Utilities, Public Services	• No adverse long-term impacts

S.6 Effects of a Full-Corridor Alternative and Minimum Operable Segments (MOS)

A full-corridor alternative adds the effects by segment, including for the O&M facility, for an overall total for the project. Transportation effects, particularly the effects that span the full corridor or are regional in nature, such as increased transit ridership and reduced vehicle trips and miles traveled, are greatest for a full-length alternative. These regional transportation effects are generally positive.

The totals for impacts related to the conversion of land ("project footprint impacts" corresponding to property-related impacts and impacts to natural resources) are at their maximum levels with a full-corridor alternative, as shown in Table S-4.

The MOS options could either avoid or defer the impacts of converting some of the existing land uses for use by the transportation project. However, the MOS options would also have less frequent trains than a full-length alternative, which would reduce noise and vibration impacts.

A shorter project involving lower train frequencies and fewer stations would still bring transportation benefits, but these benefits would be reduced (about 9,200 fewer daily trips than a full-length alternative). Other benefits, such as improvements in air quality, would be lower, and a shorter project would have reduced consistency with regional plans for land use and the transportation system.

S.7 Other Environmental Factors

Environmental Justice

FTA has preliminarily concluded that the Southwest Corridor Light Rail Project would not result in disproportionately high and adverse effects on minority and low-income populations, after mitigation and offsetting benefits have been considered. The primary source of impacts would result from residential and business acquisitions and related displacements and relocations. For all alternatives, these impacts would be mitigated through TriMet's real property acquisition policy, including its compensation and relocation assistance program. The number of people affected could be lowered by choosing alternatives with lower impacts, by applying design refinements that avoid or minimize impacts to properties where low-income or minority individuals are present, or by applying other mitigation or benefits to offset the impacts. After the Draft EIS public comment period concludes, FTA, Metro and TriMet will continue to identify and evaluate measures to minimize the impacts to low-income and minority populations, and they will seek additional ways to maximize benefits to help offset remaining impacts. More details are in Appendix C – Environmental Justice Compliance.

Section 4(f) and Section 6(f) of the Land and Water Conservation Fund Act

Section 4(f) is a federal regulation[2] that restricts FTA's ability to approve a project that adversely affects parks and recreation resources. The Land and Water Conservation Fund (LWCF) Act authorized a federal grant program, and Section 6(f) of the Act places-requirements on projects that impacts parks bought through the fund. This Draft EIS analysis has identified potential adverse impacts to historic resources in Segments A and B, as well as impacts to several parks, including the Terwilliger Parkway, which has a parcel acquired through the LWCF. Therefore, in preparing the Final EIS, FTA, Metro and TriMet will need to continue to review avoidance measures and further define mitigation, working closely with other agencies that have jurisdiction over the affected properties. These regulations, as well as the comments of other agencies with jurisdiction over affected resources, could affect the

[2] Section 4(f) refers to a U.S. Department of Transportation (USDOT) statute that restricts FTA's ability to approve a project that adversely affects significant parks, recreation resources, fish and wildlife refuges, and historic properties, unless no other feasible and prudent alternative is available. Section 6(f) of the Land and Water Conservation Act requires that the conversion of lands or facilities acquired with Land and Water Conservation Act funds be coordinated with the Department of Interior. Usually replacement in kind is required.

definition of the project that advances to the Final EIS. Additional details are in Appendix D – Draft Section 4(f) Evaluation and Draft Section 6(f) of the Land and Water Conservation Fund Evaluation.

S.8 Evaluation of Alternatives

Chapter 5 – Evaluation of Alternatives evaluates the ability of the light rail alternatives to meet the project's Purpose and Need statement, comparing the environmental, transportation and cost differences among the alternatives. While all of the light rail alternatives would meet the Purpose and Need, Chapter 5 highlights areas where the initial route proposal and its design refinements would best meet the Purpose and Need, reduce impacts, maximize benefits, and create the most cost-effective project to build and operate. Environmental effects due to property acquisitions and resulting building removals, including historic properties, as well as impacts to businesses and employees are the primary differentiating factors. There are also differences in how various alignment and station configurations affect travel times, multimodal access, constructability and construction impacts.

The chapter also covers capital and operating costs and finances, which are summarized in Table S-5 for the full corridor and MOS for both the Draft EIS alternatives and the initial route proposal with design refinements. Comparative capital costs for the alignment alternatives by segment are shown in Table S-6. Chapter 5 – Evaluation of Alternatives has more details and an illustrative finance plan.

Table S-5. Estimated Project Capital and Operating Costs

	Total Capital Cost Range[1]	Annual O&M Cost[2]
Draft EIS Alternatives		
Through Route	$3,270 to $3,590 million	$22 million
Branched Route	$3,390 to $3,630 million	$30 million
Tigard Transit Center MOS	$2,920 to $3,160 million	$19 million
Bridgeport MOS	$2,970 to $3,170 million	$22 million
Initial Route Proposal (with design refinements)		
Full corridor	$2,640 to $2,860 million	$22 million
MOS	$2,170 to $2,410 million	$19 million

Note: MOS = minimum operable segment; O&M = operating and maintenance.

[1] Capital costs are in year-of-expenditure (2024) dollars and include finance costs.

[2] Operating costs assume 2035 service frequencies.

Table S-6. Capital Cost Differences Between Alignment Alternatives

Alignment Alternative	Capital Cost Difference[1] *Compared to lowest cost*
Segment A: Inner Portland	
A1: Barbur	lowest cost
A2-BH: Naito Bridgehead	+$140 million
A2-LA: Naito Limited Access	+$160 million
Segment B: Outer Portland	
B1: Barbur	+$40 million
B2: I-5 Barbur TC-60th	+$30 million
B3: I-5 26th-60th	lowest cost
B4: I-5 Custer-60th	lowest cost
Segment C: Tigard and Tualatin	
C1: Ash-I-5	+$60 million
C2: Ash-RR	lowest cost
C3: Clinton-I-5	+$120 million
C4: Clinton-RR	+$60 million
C5: Ash-I-5 Branched	+$20 million
C6: Wall-I-5 Branched	+$60 million

[1] Costs are in year of expenditure (2024) dollars and include finance costs.

S.9 Next Steps and the Project Timeline

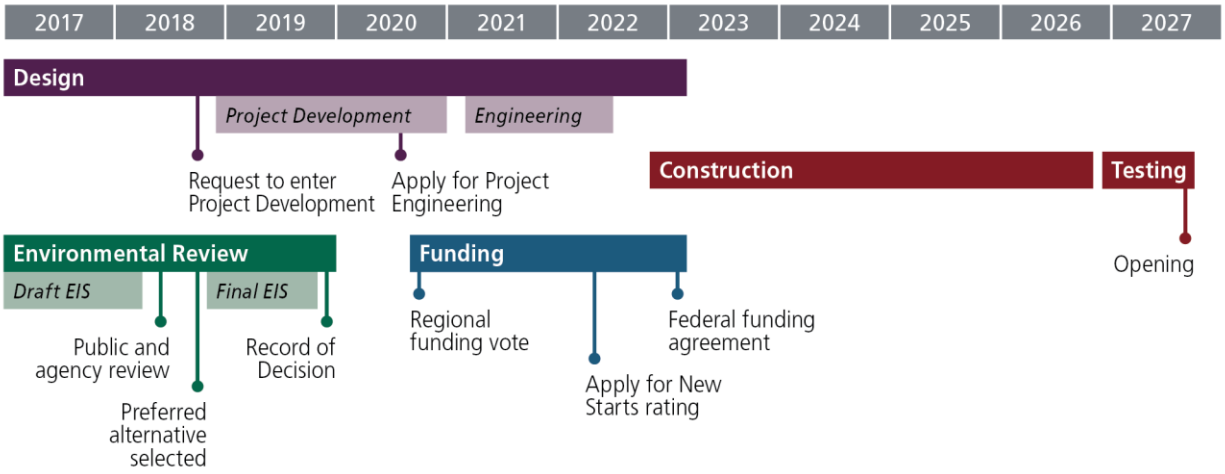
The project schedule, with this Draft EIS being a major milestone, is shown on Figure S-8. A 45-day public review period of the Draft EIS begins once it is published in the Federal Register. After the close of the review period, the Southwest Corridor Steering Committee will recommend a single route—the Preferred Alternative—considering the information from this Draft EIS and comments from the public, staff and the Community Advisory Committee. The Metro Council will also consider the recommendations, the Draft EIS, and comments from the public, agencies and Tribes before adopting the Preferred Alternative.

Certain project components (Marquam Hill connection, PCC-Sylvania shuttle, and station access improvements) may not be defined in the Preferred Alternative, due to the need for further public process, but will be identified prior to development of the Final EIS. FTA, Metro and TriMet will prepare a Final EIS to respond to the substantive comments received on this Draft EIS, and state the complete Southwest Corridor Light Rail Project, environmental findings and mitigation requirements.

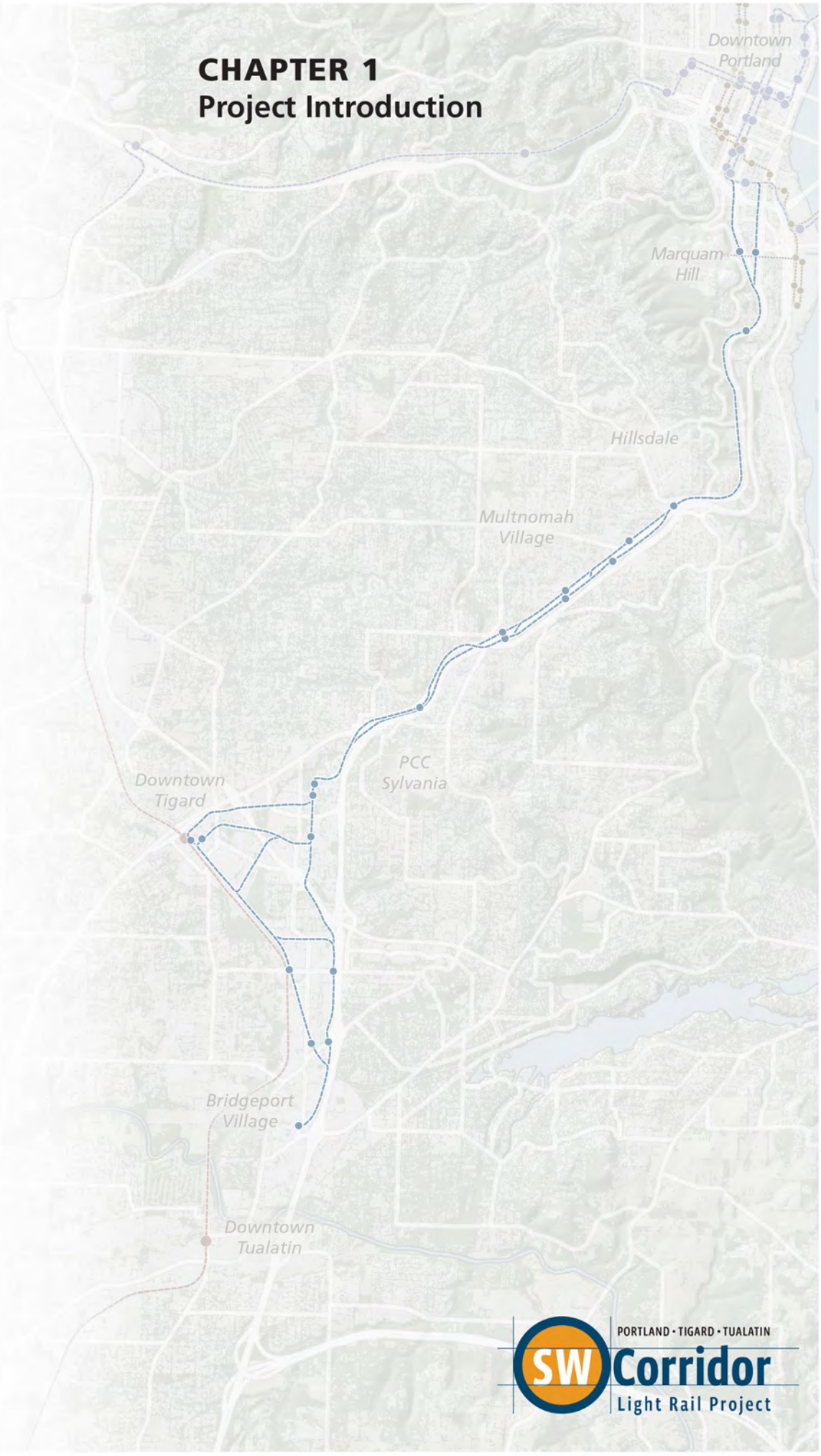
Once the federal environmental review concludes, the Portland region will need to identify and commit local funds to the project and request federal matching funds. Construction would take approximately four years once funding is secured.

Figure S-8

Project Schedule



CHAPTER 1
Project Introduction



PORTLAND • TIGARD • TUALATIN
SW Corridor
Light Rail Project

1. PROJECT INTRODUCTION

See Appendix H for full reference information for plans mentioned and reports cited.

This chapter explains the proposed project, its Purpose and Need, and next steps.

Section		Page
1.1	Southwest Corridor Light Rail Project	1-1
1.2	Purpose of the Project	1-5
1.3	Need for the Project	1-6
1.4	Applying the Purpose and Need to the Project	1-10
1.5	Next Steps	1-10

1.1 Southwest Corridor Light Rail Project

Metro (the designated Metropolitan Planning Organization for the Portland, Oregon, region) and the Tri-County Metropolitan Transportation District of Oregon (TriMet) are proposing a new 12-mile Metropolitan Area Express (MAX) light rail line from downtown Portland to Tigard and Bridgeport Village in Tualatin. Figure 1.1-1 shows the location of the proposed project in the existing regional high capacity transit system.

The project includes various elements to support the new MAX light rail line, including transportation investments such as pedestrian, bicycle, roadway and intersection improvements as well park and ride facilities and an operations and maintenance facility. This Draft Environmental Impact Statement (EIS) analyzes alternatives for these project elements. Metro, TriMet and the Federal Transit Administration (FTA) have prepared this EIS in compliance with the National Environmental Policy Act (NEPA). FTA is the lead federal agency for the NEPA EIS process, because Metro and TriMet anticipate applying for funding from FTA for the project.

The Southwest Corridor Light Rail Project will provide needed mobility options within and through the Southwest Corridor, which increasingly faces congested and unreliable freeways in an area receiving substantial residential and employment growth under the region's adopted *2040 Growth Concept*. It is also needed to improve regional access to existing major employers and medical and educational facilities already located in the Southwest Corridor, and to meet state, regional and local goals for land use and reducing greenhouse gas emissions.

Where is the project located?

The project is located within the cities of Portland in Multnomah County and Tigard and Tualatin in Washington County, as shown in Figure 1.1-2, but it serves a broader north/south travel corridor generally along Interstate 5 (I-5) and Pacific Highway (99W)/SW Barbur Boulevard from downtown Portland to Sherwood, as well as communities to the east and west. The job centers, retail, manufacturing uses, educational institutions and trails in the corridor attract people and generate travel from both within the area and across the Portland metropolitan area.

Figure 1.1-1

Regional High Capacity Transit Network

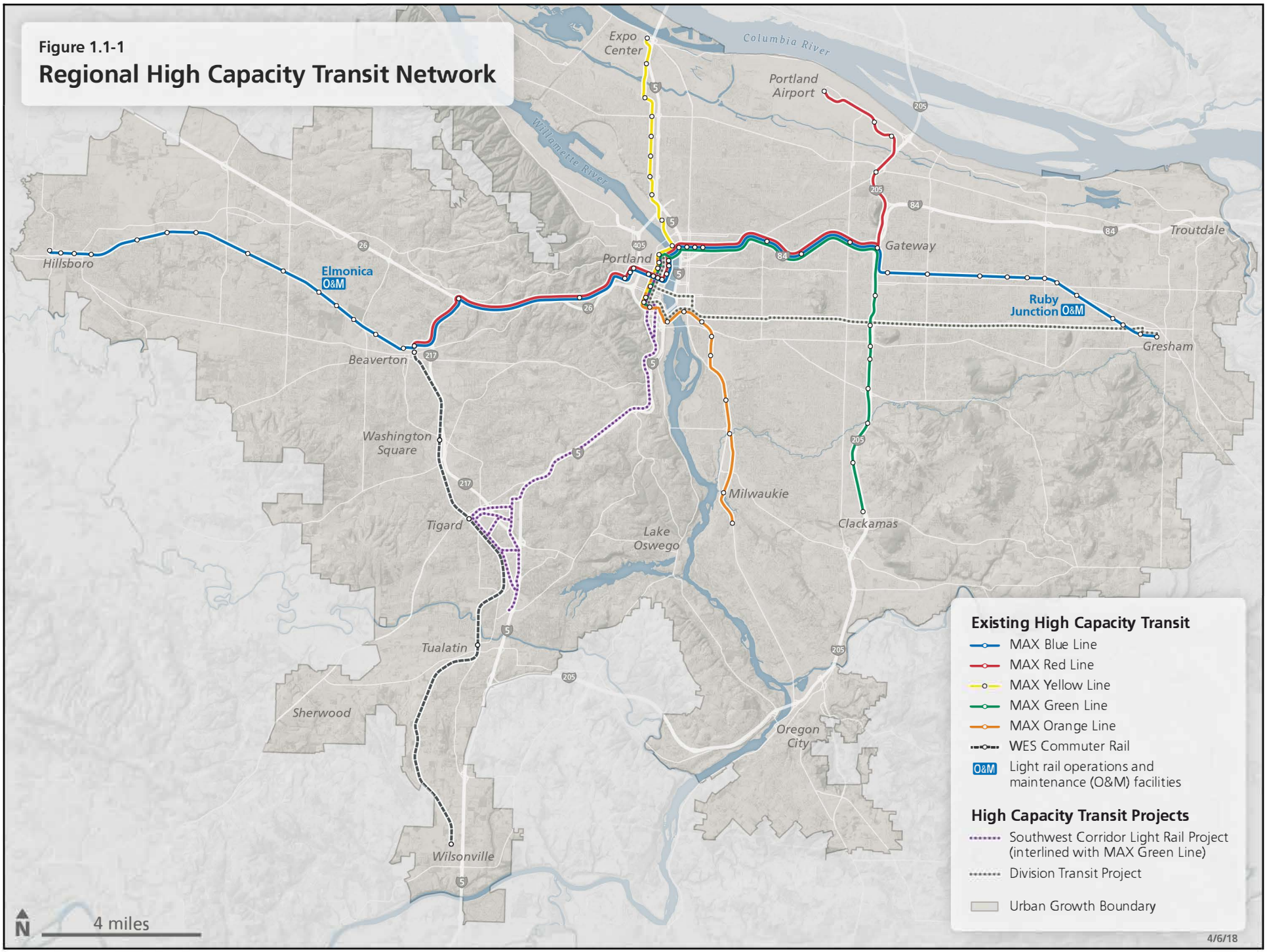
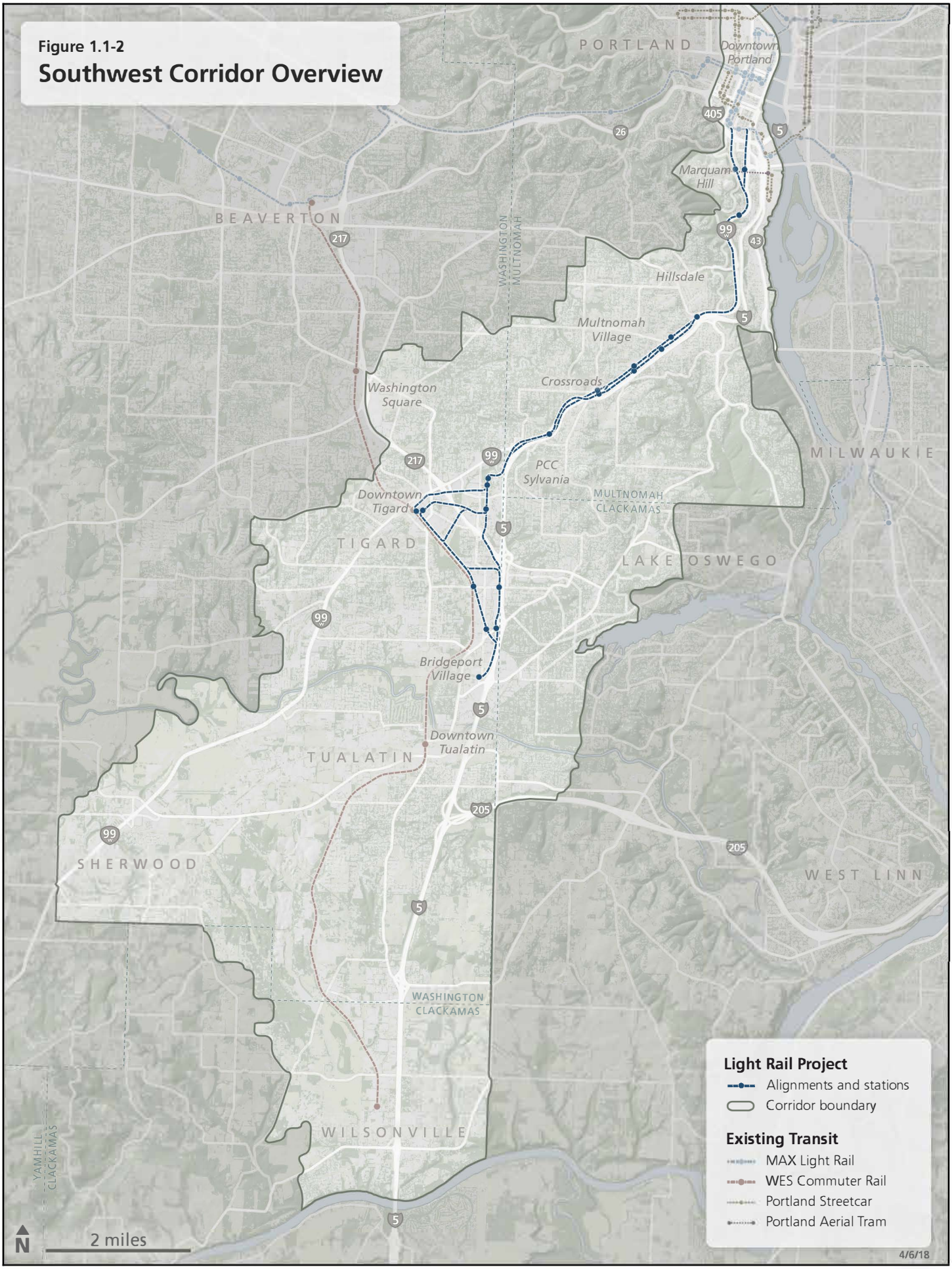


Figure 1.1-2

Southwest Corridor Overview



What is included in the project?

The complete Southwest Corridor Light Rail Project would include a MAX light rail extension of the existing Green Line, continuing south from its current terminus at SW 5th Avenue and SW Jackson Street near Portland State University (PSU), and as many as 13 new stations, up to seven new park and rides, various station access improvements, an operations and maintenance (O&M) facility, a dedicated Portland Community College (PCC) Sylvania campus shuttle, and a connection to Oregon Health & Science University (OHSU) from SW Barbur Boulevard. The complete project could include improvements to circulation at the west end of the Ross Island Bridge, depending on the alternative. Details on all of these components are provided in Chapter 2.

- **MAX Light Rail Line.** For analysis, the light rail extension is considered in three geographic segments. The segments are of roughly equal length and end in locations where only one rail alignment alternative exists. Each segment includes three to six potential alignment alternatives. The alternatives within each segment are analyzed and compared to each other and to a future "No-Build" scenario. The complete project will include an alternative from each segment.

- **Marquam Hill Connection.** The connection between the medical complex on Marquam Hill and SW Barbur Boulevard is critical for the project. Approximately 10,000 daily MAX line transit riders are expected with this improved access to the main campus of OHSU and the Veterans Affairs (VA) Portland Health Care System and Shriners hospitals. This connection will be an element of a complete project.

- **PCC-Sylvania Shuttle.** The connection from PCC-Sylvania to the new MAX light rail line is important to increasing transit mode share to the largest campus of the region's largest community college system. The shuttle will provide a fast connection between the MAX line and campus, and will help address grades of up to 13 percent. The shuttle will be an element of a complete project.

- **Station Access Improvements.** Station access improvements include sidewalk and bicycle facilities to make it safer and more convenient for riders to reach MAX stations. Improvements selected for further study in the Final EIS will be refined to work with the Preferred Alternative.

- **Park and Ride Facilities.** Park and ride facilities will help increase MAX line ridership by helping people who are traveling from further distances or from locations with little or no transit service to access the light rail system. Facilities selected for further study in the Final EIS will be refined to work with the Preferred Alternative; this may include size adjustments to account for adverse effects and projected demand.

- **O&M Facility.** This project requires a new O&M facility in Tigard to service the new light rail vehicles that will travel on the line. TriMet's existing O&M facilities do not have adequate capacity for the number of new vehicles, and the distance of those facilities to the line terminus at Bridgeport Village is greater than desired for timely overnight train maintenance. An O&M facility will be an element of a complete project.

- **Ross Island Bridgehead Reconfiguration.** Roadway adjustments to improve access to and from the western end of the Ross Island Bridge (U.S. 26) are included in the light rail alternatives on SW Naito Parkway due to the integrated nature of SW Naito Parkway and the bridgehead. A separate bridgehead project could occur in coordination with the light rail alternative on SW Barbur Boulevard.

Why are there design refinements?

Design refinements are concepts for improving the light rail designs studied in the Draft EIS, which were "frozen" in early 2017 to allow for environmental analysis. These refinements are a result of the design team exploring ways to optimize the project and avoid and minimize impacts found during the analysis. Refinements recommended for further study as part of the Preferred Alternative would be analyzed in the Final EIS.

What is the initial route proposal?

The Southwest Corridor Steering Committee directed staff from the project partners to identify an initial route for public consideration and comment.[1] The initial route proposal fulfills FTA's need for the Draft EIS to identify a draft preferred alternative and balances it against the Portland region's long history of public process to adopt a preferred alternative. The initial route proposal provides stakeholders an opportunity to comment on a full-length light rail alternative. It includes an alternative from each segment with associated park and ride facilities and stations, a Marquam Hill connection, a PCC-Sylvania shuttle and an O&M facility, as well as some design refinements that reduce construction impacts, long-term impacts and capital cost. The light rail project will also include a set of station access improvements that will be selected prior to the Final EIS.

1.2 Purpose of the Project

The purpose of the Southwest Corridor Light Rail Project is to directly connect Tualatin, downtown Tigard, southwest Portland, and the region's central city with light rail, high quality transit and appropriate community investments in a congested corridor to improve mobility and create the conditions that will allow communities in the corridor to achieve their land use vision. Specifically, the project aims to, within the Southwest Corridor:

- provide light rail transit service that is cost-effective to build and operate with limited local resources
- serve existing transit demand and significant projected growth in ridership resulting from increases in population and employment in the corridor
- improve transit service reliability, frequency, and travel times, and provide connections to existing and future transit networks including Westside Express Service (WES) Commuter Rail
- support adopted regional and local plans including the *2040 Growth Concept*, the *Barbur Concept Plan,* the *Tigard Triangle Strategic Plan* and the *Tigard Downtown Vision* to accommodate projected significant growth in population and employment

[1] The Steering Committee is made up of elected officials from seven cities (Portland, Tigard, Tualatin, Sherwood, Beaverton, King City and Durham), Washington County, and Metro, and top leaders from TriMet and the Oregon Department of Transportation. The entities also have staff working with Metro and TriMet; they are referred to as "project partners."

- complete and enhance multimodal transportation networks to provide safe, convenient and secure access to transit and adjacent land uses
- advance transportation projects that increase active transportation and encourage physical activity
- provide travel options that reduce overall transportation costs
- improve multimodal access to existing jobs, housing and educational opportunities, and foster opportunities for commercial development and a range of housing types adjacent to transit
- ensure benefits and impacts that promote community equity
- advance transportation projects that are sensitive to the environment, improve water and air quality, and help achieve the sustainability goals and measures in applicable state, regional and local plans.

1.3 Need for the Project

A light rail transit project in the Southwest Corridor is needed to address the following issues:

Transit service to important destinations in the corridor is limited, and demand for transit is increasing due to growth.

The economic and educational opportunities and services in the Southwest Corridor need to be connected by improved transit service. The corridor has 11 percent of the region's population and 26 percent of the region's employment. The five colleges and universities in the corridor (OHSU, PSU, National University of Natural Medicine, PCC-Sylvania campus and George Fox University) serve more than 45,000 students. The region's largest shopping destinations (including Bridgeport Village) are located in the corridor. However, transit service in the corridor varies in availability and frequency, and struggles to serve areas due to an incomplete and congested road network. As a result, many of the more heavily traveled areas (such as I-5), major employment centers (such as Kruse Way) and industrial areas (such as the areas south of downtown Tigard) in the corridor do not have frequent transit service. Taking transit between some of the major destinations in the corridor can take four to six times as long as driving, and the corridor generally lacks sidewalk and bicycle connectivity, as discussed below. As a result, driving is the most functional travel option for many people, adding to the traffic congestion in the corridor and leaving many other people with limited options if they cannot drive or choose not to.

The demand for transit service in the corridor is increasing. In 2010, there were 85,100 households in the corridor; Metro's projections show this number growing to 126,000 households in 2035. In Metro's *High Capacity Transit System Plan*, the corridor between Portland city center and Sherwood had the highest projected light rail ridership of any future corridor. The number of transit trips in the corridor is anticipated to increase by 81 percent in the next 25 years. In 2010, there were 121,000 average weekday transit trips in the corridor. The 2035 forecast shows an increase to 219,000 average weekday transit trips. Today 8 bus lines serve the corridor, with up to 26 buses per hour in each direction in peak periods, and buses arriving approximately every 2 minutes on average in some locations. This high frequency currently causes bus bunching and reliability issues. In 2035, with service adjusted to accommodate projected demand, the number of buses would increase to more than 35 per hour. That increase in frequency of buses would exacerbate reliability issues and could strain the capacity of the Downtown Portland Transit Mall. It would also result in less signal priority for buses

because of the high number of requests from buses, further increasing travel times and reducing on-time performance.

Limited street connectivity and gaps in pedestrian and bicycle facilities create barriers and unsafe conditions for transit access and active transportation.

The lack of complete sidewalk networks and crosswalks in the corridor impedes walking to transit and other destinations.[2] The bicycle network also has gaps that hinder connectivity. Roads in much of the corridor are winding and discontinuous, and travel options are also constrained by the geography and development patterns. The area lacks a well-connected street network that would facilitate transit access, make it easier and safer to make short trips on foot or by bicycle, and provide travelers alternative routes. A safe and complete pedestrian network is needed in order to maximize transit use. This project proposes to construct continuous sidewalks along much of the light rail alignment and to station locations.

Travel is slow and unreliable on congested roadways.

A lack of continuous north/south arterials results in regional as well as local traffic funneling onto Pacific Highway/SW Barbur Boulevard and I-5. All vehicles, including transit operating in mixed traffic, are slowed by congestion, especially at key bottlenecks.[3] From PSU in downtown Portland to Tigard Transit Center and to Bridgeport Village, average auto speeds during the weekday PM peak period in the current year are between 24 and 25 miles per hour via I-5, and 19 miles per hour to the Tigard Transit Center via SW Barbur Boulevard.[4] The related travel times are expected to increase by three to four minutes by 2035, with average speeds slowing to 19 to 20 miles per hour on I-5, and 16 to 18 miles per hour on SW Barbur Boulevard. TriMet line 12 bus trips operating in mixed traffic during the PM peak period between PSU and the Tigard Transit Center take about 45 minutes today, and, as with other roadway traffic, these bus trip durations would increase by three to four minutes by 2035.[5]

Sections of Pacific Highway, which is one of the two major north/south transportation facilities in the corridor and the major route for transit, are often slowed by congestion and experiences some of the most unreliable travel times in the corridor. For a 1.7-mile segment in Portland (north of SW Multnomah Boulevard) and a 2.8-mile segment in Tigard, travelers need to budget more than double the average travel time in the PM peak hour to ensure they arrive at destinations on time. Transit travel times are subject to the same lack of reliability and can be expected to vary significantly from the forecast "average condition" because of unreliable roadways. Corridor residents and employees complain of frustrating travel conditions in the area. Focus groups convened in the corridor identified congestion and gridlock as their top concern and a threat to the area's livability, characterizing the roadway network as "congested and dysfunctional."[6] Travel times are likely to vary more in the future than today because of increases in congestion and incidents and greater variation in traffic levels.

[2] SW Corridor Transportation Existing and Future Conditions Technical Report (Metro, 2012). Climate Smart Strategy for the Portland metropolitan region (Metro, 2014).
[3] Ibid.
[4] iPeMS Real Time and Historical Traffic Data for Oregon (iPeMS, 2017).
[5] Metro Research Center travel demand model, 2017. See the Southwest Corridor Project Transit Impacts and Travel Demand Forecasting Results Report attached to this Draft EIS for further information on transit travel times.
[6] Scoping Summary Report (Metro, 2016).

There are both a limited supply and a limited range of housing options in the Southwest Corridor that have good access to multimodal transportation networks. In addition, jobs and services are not located near residences.

The Southwest Corridor is projected to add around 41,000 households from 2010 to 2035, an increase of 48 percent.[7] Currently, the majority of housing in the project area consists of low density, single-family housing. Locally and regionally, the supply of affordable housing is limited.[8] As the region grows, providing a variety of housing options and a larger housing supply in the corridor will be necessary to accommodate the additional residents.

Development around light rail stations can readily serve a broader a range of housing options by permitting greater density and increasing the supply of multiple types of housing. In anticipation of future high capacity transit, jurisdictions in the Southwest Corridor have permitted higher density housing types such as apartments, condos and townhouses, which can be clustered around stations to meet the needs of households that are smaller, have a modest household income or both. These density-enabling land use regulations will allow more homes to be built for the region's growing population, thus expanding the housing supply and meeting the demand for housing that, if not addressed, can cause exceptional appreciation in housing prices.

High capacity transit services also mean that new residential and employment uses can lower the amount of necessary onsite parking—due to easy access to jobs and services via transit, biking or walking—which reduces the cost of new development. Such multimodal access is possible as a result of the region's existing high capacity transit network, into which the new line would connect. Households located near network stations can thereby reduce the costs of owning one or more automobiles, or eliminate those costs entirely. This also makes transit station areas appealing locations for legally binding affordability-restricted housing. Such compact development is not currently possible in portions of Tigard, however, because of State of Oregon Transportation Planning Rules related to capacity on state road facilities.[9]

In addition, the Portland city center, OHSU and many of the other major employment areas reached via the corridor have developed far from the area's housing, requiring many workers to commute over long distances. Driving on congested roadways is often the only choice for people to access their jobs. In addition, the incomplete sidewalk and bicycle networks in the corridor require riders to access transit by car and, as a result, park and ride lots in downtown Tigard and near Bridgeport Village are often full. The limited access of those who reside outside the corridor to its jobs, health services and educational opportunities is also an equity concern for the regional community.

As the region grows, implementation of light rail will be critical to improving transit connections between jobs and residences. Light rail stations that can be accessed by a variety of travel options, including biking, walking or taking local transit, will allow the growing number of people in the corridor and region to have better mobility while limiting impacts to the environment and to quality of life.

[7] Metro Resolution 13-4428, Metro adopted population and employment growth forecast distribution (Metro, 2013).
[8] Opportunities and Strategies for Equitable Housing (Metro, 2016).
[9] Transportation Planning Rule, Oregon Administration Rule 660-012-0000. (Oregon Department of Land Conservation and Development, 2011).

Although providing opportunities for additional housing and jobs near transit is important, that outcome needs to be balanced against impacts on the existing community in the corridor. The region's population growth and economic improvement have elicited concerns about increasing housing costs and displacement of residents and businesses, especially resulting from major public investments. Therefore, the project needs to strive for equitable distribution of benefits and impacts.

Regional and local plans call for high capacity transit in the corridor to meet local and regional land use goals.

To help meet expected levels of growth, Metro's *2040 Growth Concept* for land use in the region calls for "town center" development in downtown Tigard, the Tigard Triangle and west Portland. A town center is intended to provide services to tens of thousands of people within a 2- to 3-mile radius with one- to three-story buildings for employment and housing, and to be well served by transit. This regional land use strategy is supported by Tigard's adopted *High Capacity Transit Land Use Plan*, which identifies preferred station community concepts. The Tigard Triangle, however, is surrounded by congested regional highways and has only basic transit service. Providing light rail transit to this area, which has half the acreage of downtown Portland, would allow for multistory mixed-use development to accommodate a substantial portion of the growth in population and jobs in locations that can be efficiently serviced. This regional strategy is also supported by the City of Portland's *Barbur Concept Plan.* Light rail transit is critical to the fulfillment of that plan, including higher intensity infill development and a continuous and safe bicycle/pedestrian corridor along SW Barbur Boulevard. High capacity transit (also referred to as HCT) service[10] will also support access to jobs in Tualatin, Sherwood and other employment areas in the corridor that are planned for significant job growth.

The *2035 Regional Transportation Plan* identifies the investments in multiple modes of transportation that will help accommodate the location and types of development designated by the *2040 Growth Concept*, noting that "HCT investments help the region concentrate development and growth in its centers and corridors." The *Regional Transportation Plan* designates a high capacity transit system interconnecting the central Tigard and west Portland town centers and Portland's city center as a near-term regional priority.

State, regional and local environmental and sustainability goals require transportation investments to reduce greenhouse gas emissions.

State and regional policies support actions to increase energy efficiency and reduce harmful greenhouse gas emissions, especially from transportation sources. The state has mandated that the Portland metropolitan area develop and implement a strategy to reduce per capita greenhouse gas emissions from cars and small trucks by 2035. In 2014, Metro adopted the *Climate Smart Strategy* to meet that requirement by achieving a 29 percent reduction in per capita greenhouse emissions. A high capacity transit project in the Southwest Corridor, such as the proposed project, would advance Climate Smart by making transit convenient, frequent, accessible and affordable; making biking and walking safe and convenient; and making streets and highways safe, reliable and connected. The high capacity transit project would also need to ensure safe and comfortable access to transit for pedestrians, bicyclists and drivers, and address major gaps in biking and walking routes in the corridor.

The City of Portland's *Climate Action Plan* also addresses greenhouse gas emissions and has objectives such as reducing daily per capita vehicle miles traveled by 30 percent from 2008 levels, improving the

[10] High capacity transit includes light rail, commuter rail, bus rapid transit and rapid streetcar.

efficiency of freight movement within and through the Portland metropolitan area, and ensuring that 80 percent of residents can easily walk or bicycle to meet all basic daily, nonwork needs and have safe pedestrian or bicycle access to transit.

1.4 Applying the Purpose and Need to the Project

The Purpose and Need has been used to identify the EIS alternatives described in Chapter 2 – Alternatives Considered. Chapter 5 – Evaluation of Alternatives describes how Metro, TriMet and FTA have measured the ability of the EIS alternatives to serve the Purpose and Need, along with comparisons of other factors such as environmental impacts, costs and constructability.

1.5 Next Steps

The Draft EIS will be available for a public comment period of 45 calendar days, commencing with the release of a Notice of Availability in the Federal Register. The comment period will include at least one public hearing, at which oral testimony will be recorded. Other opportunities for the public and agencies to comment will include open houses, online engagement and other outreach strategies.

The Southwest Corridor Steering Committee will then consider public, tribal and agency comments received; a recommendation from the Southwest Corridor Light Rail Community Advisory Committee (CAC);[11] and information from the Draft EIS in order to recommend a preferred alternative to the Metro Council.

Before acting on the Preferred Alternative, the Metro Council will take into account the Steering Committee's recommendation as well as input from local agencies and the Joint Policy Advisory Committee on Transportation.[12] Local agencies are expected to include Portland City Council, Tigard City Council, Tualatin City Council, Washington County Board of Commissioners, Oregon Department of Transportation (Region 1) and the TriMet Board.

The Metro Council will then adopt the Preferred Alternative by resolution. The Preferred Alternative is expected to be included in the 2018 update of the Regional Transportation Plan, which includes all of the transportation projects that are eligible for federal transportation funds (anticipated to be considered by the Metro Council in December 2018).

The design for the Marquam Hill connection and the PCC-Sylvania shuttle route will be selected prior to developing the Final EIS through a public process that will involve the institutions, neighborhoods and appropriate resource agencies. Selection of which station access improvements to include in the Final EIS will depend on the Preferred Alternative and further local discussion.

In order to complete the environmental review process, a Final EIS will be prepared by FTA, Metro and TriMet. The Final EIS will respond to the substantive comments received on this Draft EIS, and state the Preferred Alternative, environmental findings and mitigation requirements. There will be a waiting period of at least 30 days following publication of the Final EIS, after which FTA will issue a Record of

[11] The Community Advisory Committee is a group of community stakeholders that provide feedback and recommendations to staff and the Southwest Corridor Steering Committee during production of the Draft EIS (https://www.oregonmetro.gov/public-projects/southwest-corridor-plan/project-committees).

[12] Composed of transportation representatives from across the region, JPACT recommends priorities and develops plans for the region to Metro Council.

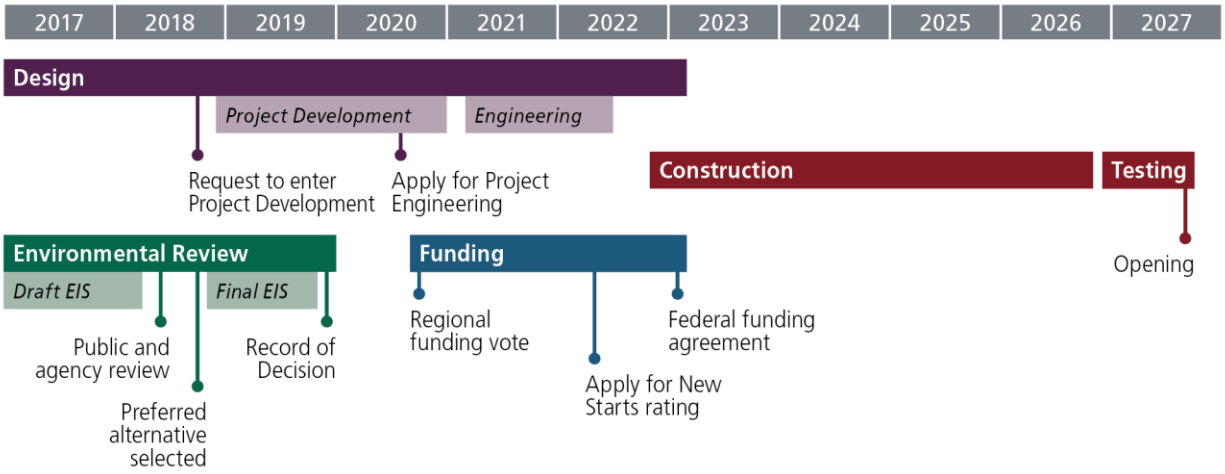
Decision (ROD) stating its determination of the project's compliance with NEPA requirements and the basis for that decision.

Once the federal environmental review concludes, the Portland region will need to identify and commit local funds to the project and will request federal matching funds. Construction activities could begin by 2022, after federal matching funds are secured, and the major construction phase will take approximately four years.

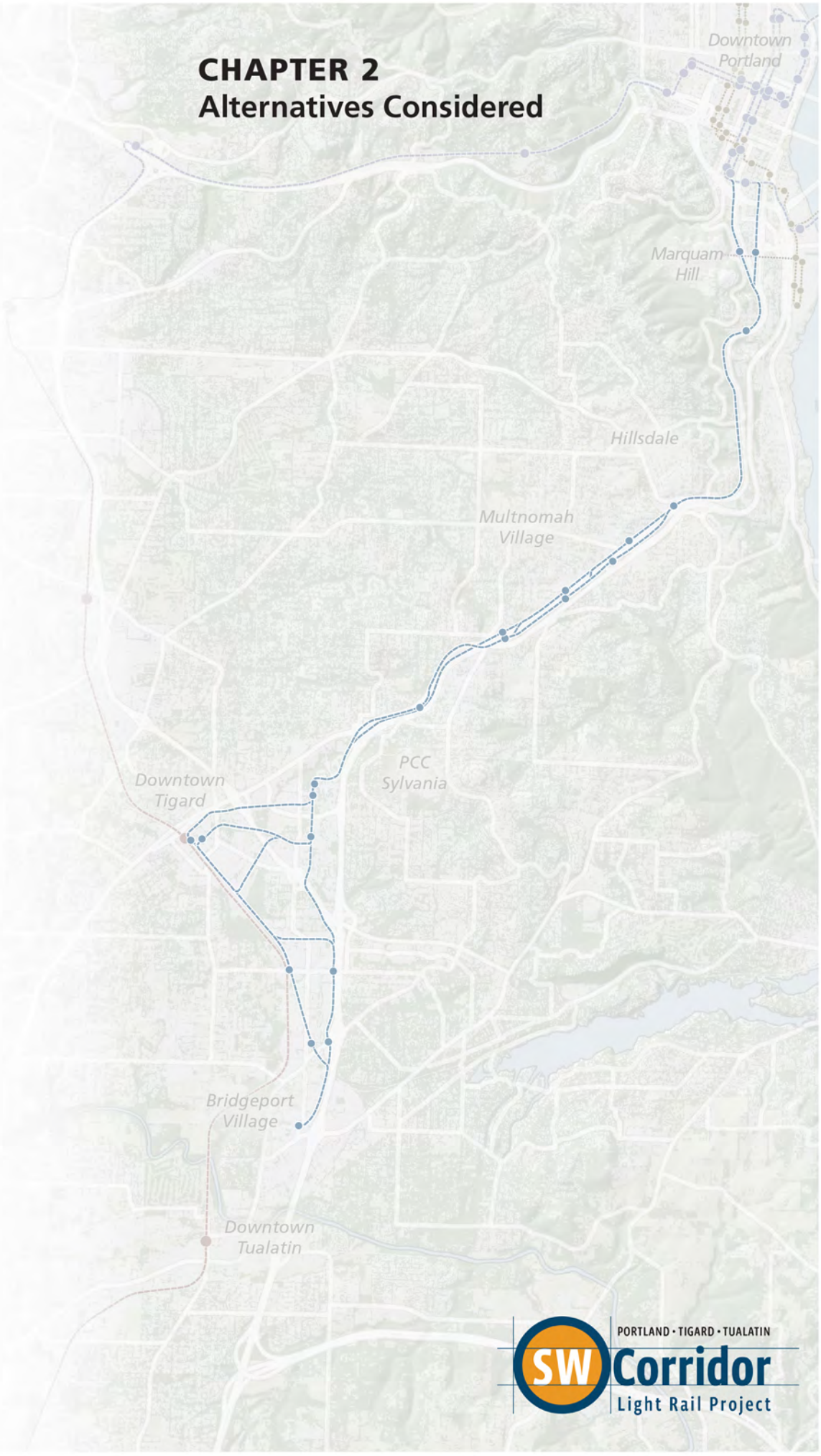
Figure 1.5-1 illustrates the general schedule for the Southwest Corridor Light Rail Project from the EIS through construction.

Figure 1.5-1

Project Schedule



CHAPTER 2
Alternatives Considered



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SW Corridor
Light Rail Project

2. ALTERNATIVES CONSIDERED

The Southwest Corridor Light Rail Project Draft Environmental Impact Statement (EIS) considers the following alternatives:

Section		Page
2.1	Alternatives Development	2-2
2.2	No-Build Alternative	2-6
2.3	Light Rail Alternatives	2-6
2.4	Minimum Operable Segment (MOS)	2-28
2.5	Potential Design Refinements and Options	2-29
2.6	Initial Route Proposal	2-30

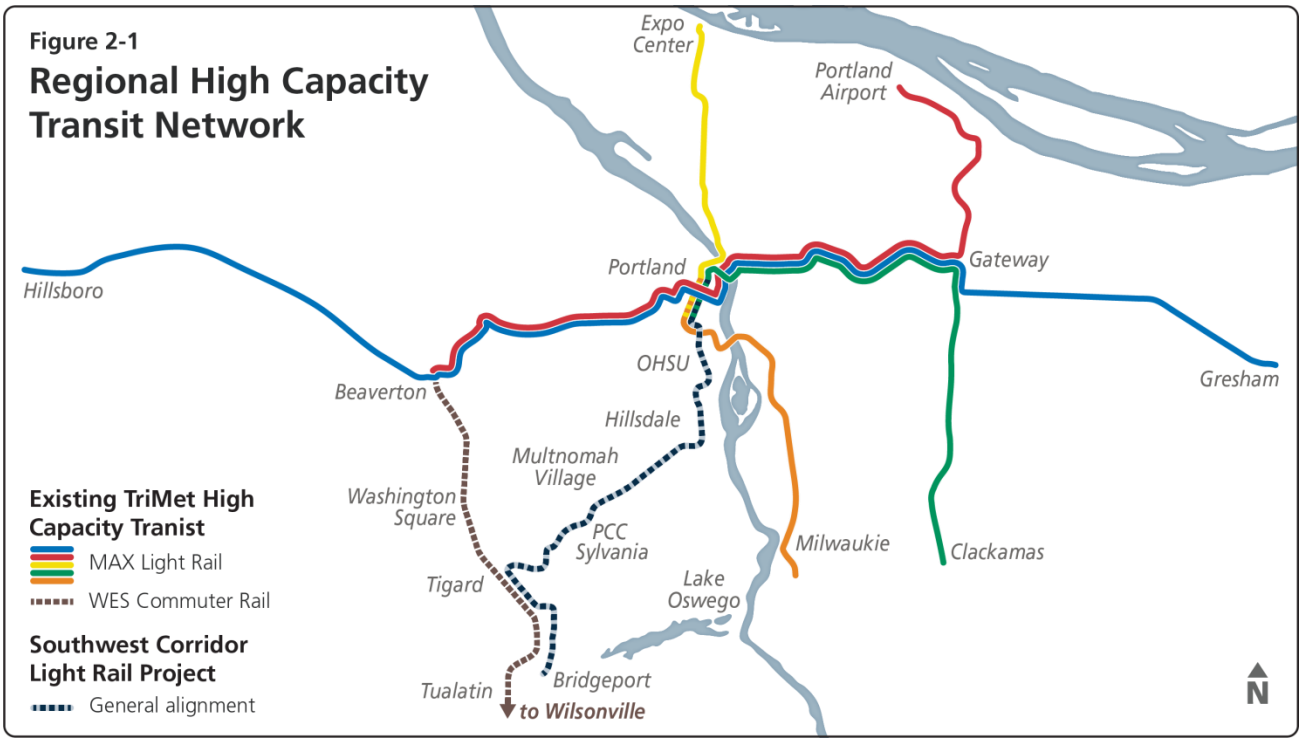
- The **No-Build Alternative** represents future conditions without the proposed light rail project.
- The **light rail alternatives** represent the Southwest Corridor Light Rail Project, which is a proposed extension of light rail connecting downtown Portland, Oregon, to southwest Portland, downtown Tigard and Tualatin.

Table 2-1 provides an overview of the elements of the light rail project. Figure 2-1 illustrates how the light rail line would relate to the existing regional high capacity transit network.

Table 2-1. Light Rail Project Overview

Light Rail Project Elements
· **Light rail trackway**: a 12-mile light rail line between downtown Portland and Tualatin via Tigard, which would primarily run at grade, but may include up to 2.6 miles of elevated trackway or bridges and up to four cut-and-cover undercrossings
· **Stations and park and rides**: up to 13 light rail stations with platforms up to 200 feet long, including up to 7 park and rides with up to 4,200 spaces total, two reconfigured transit centers and tail tracks or third tracks at terminus stations
· **Light rail vehicles**: up to 32 light rail vehicles added to the TriMet fleet that would operate in two-car trains sets (16 sets)
· **Light rail service**: service frequencies ranging from 7 to 15 minutes in 2035, depending on location along alignment and time of day
· **Bus routing changes**: elimination or modification of bus routes to improve coverage and service levels and avoid duplicating light rail service (service hours reallocated to other bus routes in the corridor)
· **Marquam Hill connection**: structures making a new pedestrian connection between SW Barbur Blvd. and OHSU on Marquam Hill
· **Shared transitway**: up to 2 miles of paved light rail transitway in South Portland to allow express use by buses to and from downtown
· **PCC-Sylvania shuttle**: shuttle route connecting the PCC-Sylvania campus with up to two nearby light rail stations, including either five additional 40-foot buses or three van-sized shuttle buses
· **O&M facility**: new light rail O&M facility in Tigard to accommodate up to 42 light rail vehicles (The Hunziker option would have space to add more storage tracks later for up to 60 vehicles total)
· **Roadway modifications**: modifications to roadways along or intersecting the light rail alignment, such as SW Barbur Blvd., including addition or reconstruction of bicycle lanes and sidewalks along modified roadways
· **Station access improvements**: new walking and bicycling infrastructure, such as sidewalks, bicycle lanes and paths, to improve access to stations
· **Bridgehead Reconfiguration**: modifications to the roads and ramps accessing the west end of the Ross Island Bridge and addition of signalized intersections along SW Naito Pkwy. (included with a certain alignment alternative)

Note: O&M = operations and maintenance; OHSU = Oregon Health & Science University; PCC = Portland Community College; TriMet = Tri-County Metropolitan Transportation District of Oregon.



This chapter describes the alternatives considered in this Draft EIS and summarizes the planning process that led to these alternatives. This chapter also describes options for constructing a standalone first phase of the light rail project, known as a minimum operable segment (MOS), several design refinements that have been developed to avoid or minimize the impacts of the alternatives studied, and an initial route proposal for the light rail line.

2.1. Alternatives Development

In 2009, Metro adopted the 30-year *High Capacity Transit System Plan* (Metro, 2009), also known as the HCT Plan, to guide investments in light rail, commuter rail, bus rapid transit and rapid streetcar in the Portland region. The HCT Plan identified the Southwest Corridor, the area between downtown Portland and Sherwood including Tigard and Tualatin, as a high priority.

Between 2011 and 2016, Metro and its local agency partners[1] developed the Southwest Corridor Plan to identify a high capacity transit project and other investment strategies to help improve safety and quality of life, and to support regional and local land use plans and economic development. This plan provided the framework for the Purpose and Need (Chapter 1) and the alternatives now being considered in this Draft EIS.

Alternatives and Concepts Previously Considered

In September 2011, the Federal Transit Administration (FTA) and Metro issued an early scoping notice, which is an optional step prior to starting a project's National Environmental Policy Act (NEPA) review process. The notice advised agencies, tribal governments and the public that Metro and its partners

[1] Tri-County Metropolitan Transportation District of Oregon (TriMet); Oregon Department of Transportation (ODOT); the cities of Beaverton, Durham, King City, Portland, Sherwood, Tigard and Tualatin; and Washington County.

were exploring alternatives for improving transit service between downtown Portland and Sherwood. There were six public meetings to receive comments and suggestions, followed by several years of open public study conducted under the supervision of the Southwest Corridor Steering Committee, which is made up of officials from the jurisdictions in the corridor.[2]

Appendix I – Project Background and Alternatives Considered has more information on the various planning, public involvement and environmental processes that occurred between 2009 and 2016. The report describes the modes and alignments evaluated, explains why they were carried forward or eliminated, and has links to the more detailed documents and information the steering committee reviewed before deciding to advance or remove a given alternative. The primary alternatives that were considered, along with the reasons for their removal if they did not advance, are summarized below.

Transit Modes Considered

The following modes were considered during the development of the Southwest Corridor Plan before the steering committee selected light rail as the preferred mode:

- **Streetcar** was eliminated because it had a limited ability to serve the Southwest Corridor's projected travel demand compared to light rail or bus rapid transit, and it would be slower and less efficient than the other two modes.

- **Interstate 5 (I-5) express lanes**, which dedicated a freeway lane for high occupancy vehicles, tolled vehicles and bus rapid transit, were eliminated because they did not meet the land use goals of the corridor, and they would have poor access to the community centers to be served.

- **Commuter rail**, which involved improvements to the Westside Express Service (WES) Commuter Rail, was eliminated because it did not directly serve the full Southwest Corridor and did not support the land use goals of the corridor, as called for in the project's Purpose and Need.

- **Bus rapid transit alternatives**, which included several types of system concepts such as exclusive lanes, mixed traffic and multi-line systems feeding to a hub, were eliminated in several stages. Initially, mixed traffic and multi-line systems were eliminated because they were less efficient and less reliable than bus rapid transit or light rail operating mostly in dedicated transitways. Bus rapid transit as a mode was ultimately eliminated in 2016, before the start of this Draft EIS, because it lacked the long-term capacity to meet the corridor's projected demand, it had higher long-term operating costs than light rail, and it created regional transit impacts because of the volume of buses it would introduce into downtown Portland. It also had lower agency and public support than light rail.

[2] The Steering Committee is made up of elected officials from seven cities (Portland, Tigard, Tualatin, Sherwood, Beaverton, King City and Durham), Washington County, and Metro, and top leaders from TriMet and ODOT.

Alignments and Destinations Considered

Before the project partners and the steering committee arrived at the range of alternatives now being considered in this Draft EIS, a wide array of alignments and terminus concepts for light rail were considered (see Figure 2.1-1). Alignments that were considered and removed include:

- tunnel alignments to the medical and educational facilities on Marquam Hill, including Oregon Health & Science University (OHSU)
- tunnel alignments to the neighborhoods of Hillsdale and Multnomah Village
- tunnel alignments to the Portland Community College (PCC) Sylvania campus
- light rail extending to downtown Tualatin and Sherwood
- light rail on Pacific Highway (99W) in Tigard

These concepts were removed because they increased travel times, they had higher costs but did not gain ridership compared to the other alternatives available, they had higher engineering or technical risks, or they carried higher environmental or transportation impacts.

Although light rail tunnels with underground stations serving the educational institutions were removed from consideration, the project partners found other solutions that could improve access to OHSU and PCC-Sylvania. The light rail alternatives in this Draft EIS feature several options that connect these destinations to light rail at a lower cost and with fewer impacts.

Initiating the EIS

A scoping comment period for the Southwest Corridor Light Rail Project was held from September 2, 2016, to October 3, 2016, as part of the project's NEPA review process. During the scoping comment period, the project partners and FTA invited broad participation from agencies and the public to review the proposed project. A variety of outreach efforts was used to engage stakeholders and to encourage the involvement of residents and businesses in the Southwest Corridor:

- two public online surveys available September 2 to October 3, 2016
- five neighborhood association meetings on September 7, 8, 12, 19 and 28, 2016
- agency and tribal scoping meeting on September 20, 2016
- public scoping meeting on September 22, 2016

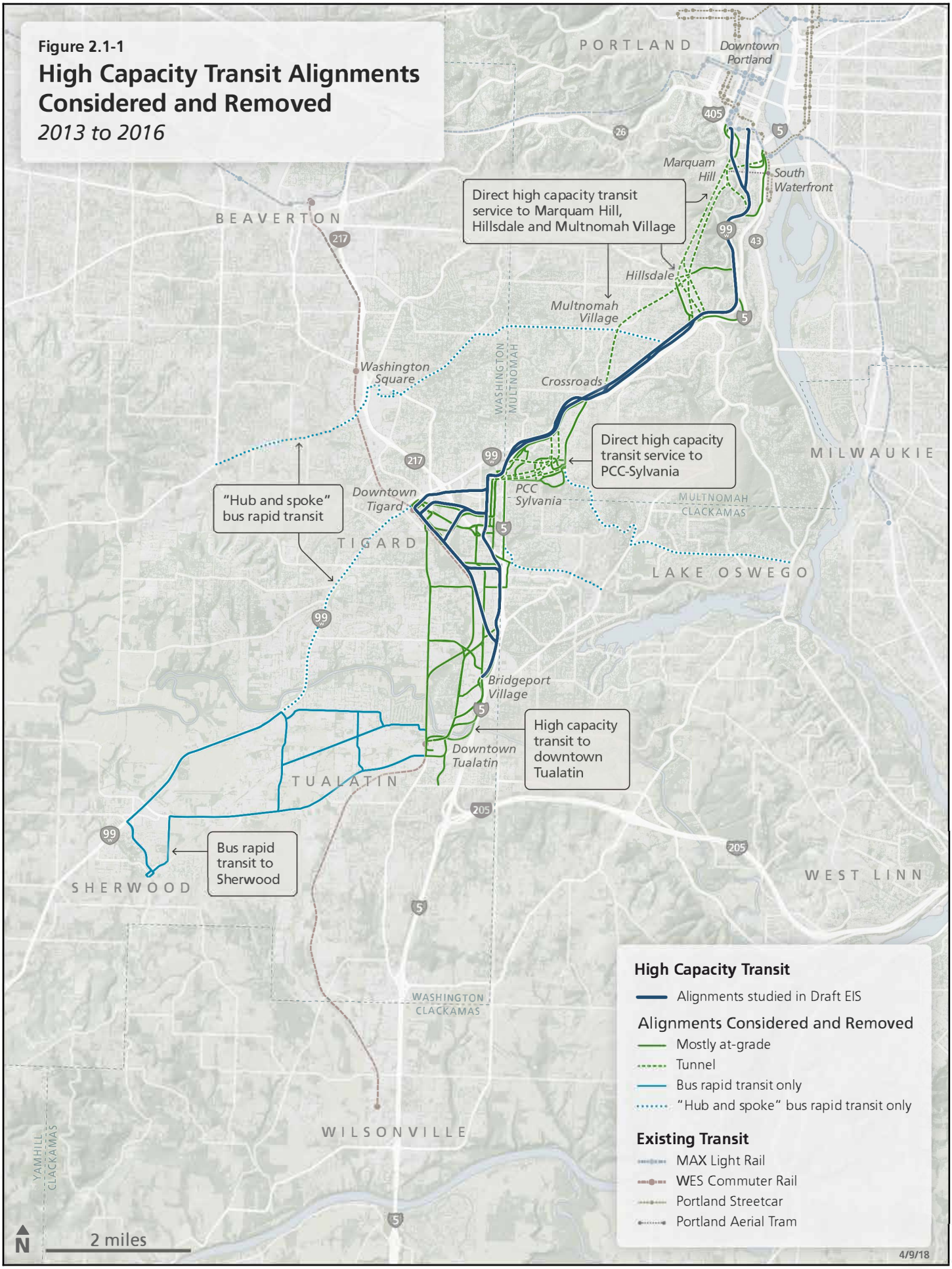
During the scoping comment period, the project received 1,620 comments, including surveys and emails from the general public and letters from agencies and organizations. A majority of comments from the public indicated support for the project as proposed. More than 70 percent of the comments received supported the draft Purpose and Need, the proposed alignments, and the stations, park and rides, and operations and maintenance (O&M) facility locations that are part of the project. Some comments expressed opposition to the project, and some suggested expanding the alternatives or options to be studied. Many of those suggestions had been studied in previous phases of the project, and others were incorporated into the light rail alternatives that are evaluated in this Draft EIS.

Metro's *Southwest Corridor Scoping Summary Report* describes the process and outcomes of the scoping comment period in more detail.

Figure 2.1-1

High Capacity Transit Alignments Considered and Removed

2013 to 2016



2.2. No-Build Alternative

The No-Build Alternative is the baseline for evaluating the benefits and impacts of the light rail alternatives. The No-Build Alternative represents transportation and environmental conditions without light rail connecting Portland, Tigard and Tualatin, and without the roadway, bicycle and pedestrian improvements associated with the proposed light rail line. It assumes the regionally adopted forecast for population and employment growth through the year 2035 (Metro Council Resolution 13-4428; see Appendix 1.3 of the *Regional Transportation Plan* [Metro, 2014]).

The No-Build Alternative includes planned projects that are identified in the financially constrained project list of the *Regional Transportation Plan*, the currently adopted transportation system plan for the greater Portland region. The anticipated regional transit network for 2035, consistent with the *Regional Transportation Plan* and the *Southwest Service Enhancement Plan* (TriMet, 2015), is described in Appendix A – Detailed Maps and Descriptions of Light Rail Alternatives.

2.3. Light Rail Alternatives

The project would extend the existing Metropolitan Area Express (MAX) light rail network with a new 12-mile light rail line serving southwest Portland, Tigard and Tualatin (see Figure 2-1). The alignment would generally be either center-running within existing or new streets, or adjacent to roadways or railroads, and would serve up to 13 new stations with up to 4,200 park and ride spaces. The project would construct a new light rail O&M facility in Tigard. To address topographical challenges, connectivity barriers, and limited existing walking and biking infrastructure, the project also considers accompanying investments to improve access along and to the light rail line.

The light rail alternatives assume the same regionally adopted forecast for future population and employment growth as the No-Build Alternative. They also have the same planned projects from the financially constrained project list of the *Regional Transportation Plan*. The 2035 transit network used for transportation forecast models for the light rail alternatives is similar to what is used for modeling the No-Build Alternative, with select modifications to bus service in the corridor to complement the added light rail service. The bus network changes are described in more detail in Appendix A.

Project Terminology

The project area is divided geographically into three **segments**:

- Segment A: Inner Portland
- Segment B: Outer Portland
- Segment C: Tigard and Tualatin

Each segment includes several **alignment alternatives**, which represent different locations for the light rail trackway, stations and possibly park and rides. The alignment alternatives also include some associated infrastructure changes, such as building missing sidewalks and bicycle lanes where the alignment is center-running in a roadway. The full-corridor project would include one alignment alternative from each segment.

In Segment C, the alignment alternatives use one of two different **route configurations**, which represent the choice between building a single light rail line, known as the Through Route, or two lines

that overlap for most of the route but diverge to terminate at different locations, known as the Branched Route.

Each segment includes additional project elements that are analyzed separately from the alignment alternatives in order to isolate their impacts, although they would also be integral to a complete light rail project. Segment A includes the **Marquam Hill connection**; Segment B includes the **PCC-Sylvania shuttle**; Segment C includes an **O&M facility;** and all three segments include **station access improvements**.

Table 2.3-1 lists the alignment alternatives and additional project elements by segment. Figure 2.3-1 shows a map of the light rail alternatives. Figure 2.3-2 provides a diagram of the alignment alternatives by geographic segment.

Table 2.3-1. Light Rail Alternatives by Segment

Alignment Alternatives	Additional Project Elements *(pair with all alignment alternatives unless otherwise noted)*
Segment A: Inner Portland	
· Alternative A1: Barbur · Alternative A2-BH: Naito with Bridgehead Reconfiguration · Alternative A2-LA: Naito with Limited Access	***Marquam Hill Connection*** · Connection 1A: Elevator/Bridge and Path · Connection 1B: Elevator/Bridge and Recessed Path · Connection 1C: Elevator/Bridge and Tunnel · Connection 2: Full Tunnel ***Station Access Improvements*** · SA01 through SA03 (see Appendix A for detailed information)
Segment B: Outer Portland	
· Alternative B1: Barbur · Alternative B2: I-5 Barbur TC to 60th · Alternative B3: I-5 26th to 60th · Alternative B4: I-5 Custer to 60th	***PCC-Sylvania Shuttle*** · Barbur TC and Baylor Shuttle · 53rd Shuttle ***Station Access Improvements*** · SA04 through SA23 (see Appendix A for detailed information)
Segment C: Tigard and Tualatin	
Through Route · Alternative C1: Ash to I-5 · Alternative C2: Ash to Railroad · Alternative C3: Clinton to I-5 · Alternative C4: Clinton to Railroad ***Branched Route*** · Alternative C5: Ash and I-5 Branched · Alternative C6: Wall and I-5 Branched	***Operations and Maintenance Facility*** · Hunziker Facility · Through 72nd Facility (pairs with Alternatives C1 and C3) · Branched 72nd Facility (pairs with Alternatives C5 and C6) ***Station Access Improvements*** · SA24 through SA29 (see Appendix A for detailed information)

Note: PCC = Portland Community College; TC = Transit Center.

Figure 2.3-1

Light Rail Alternatives

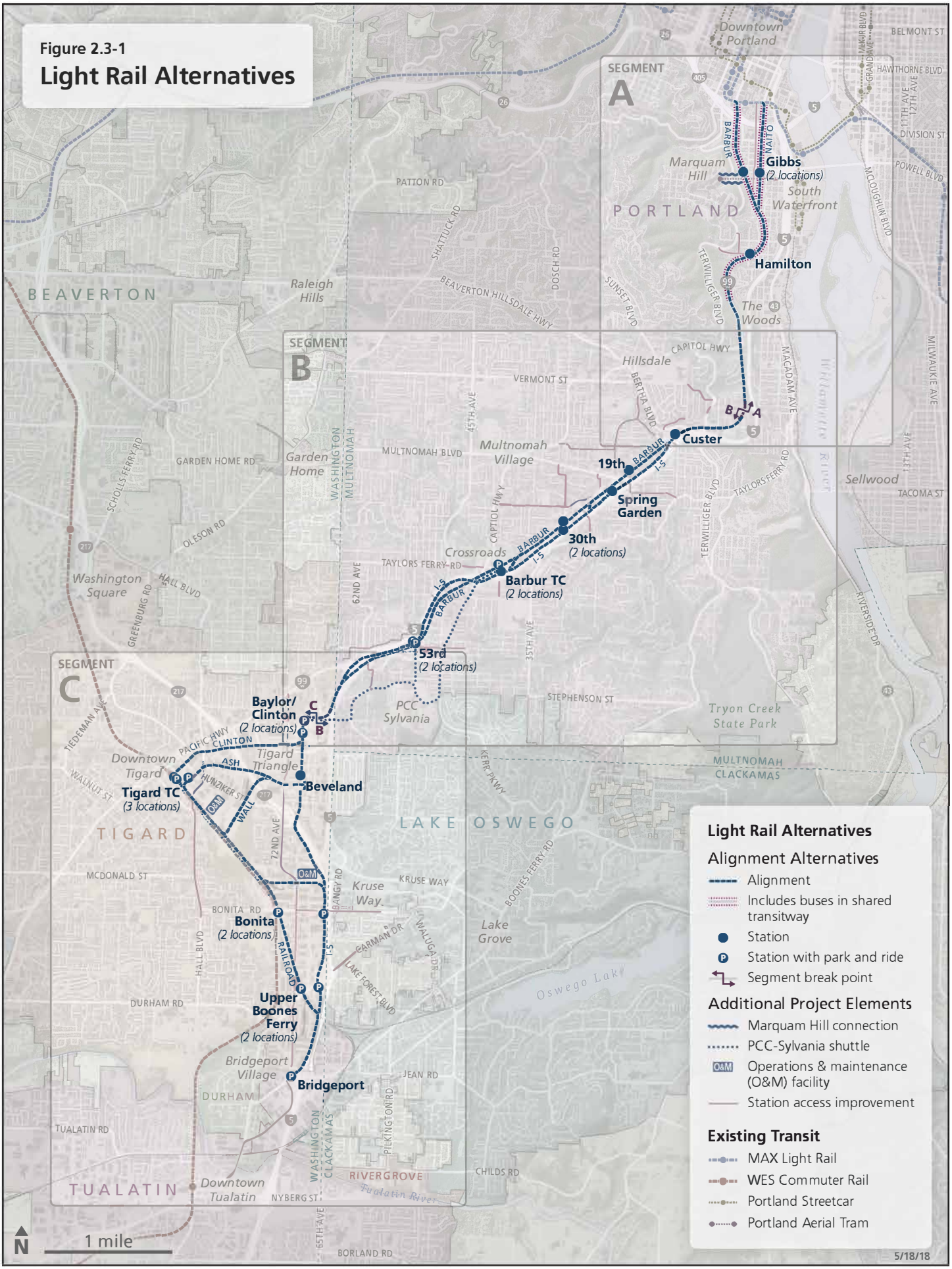
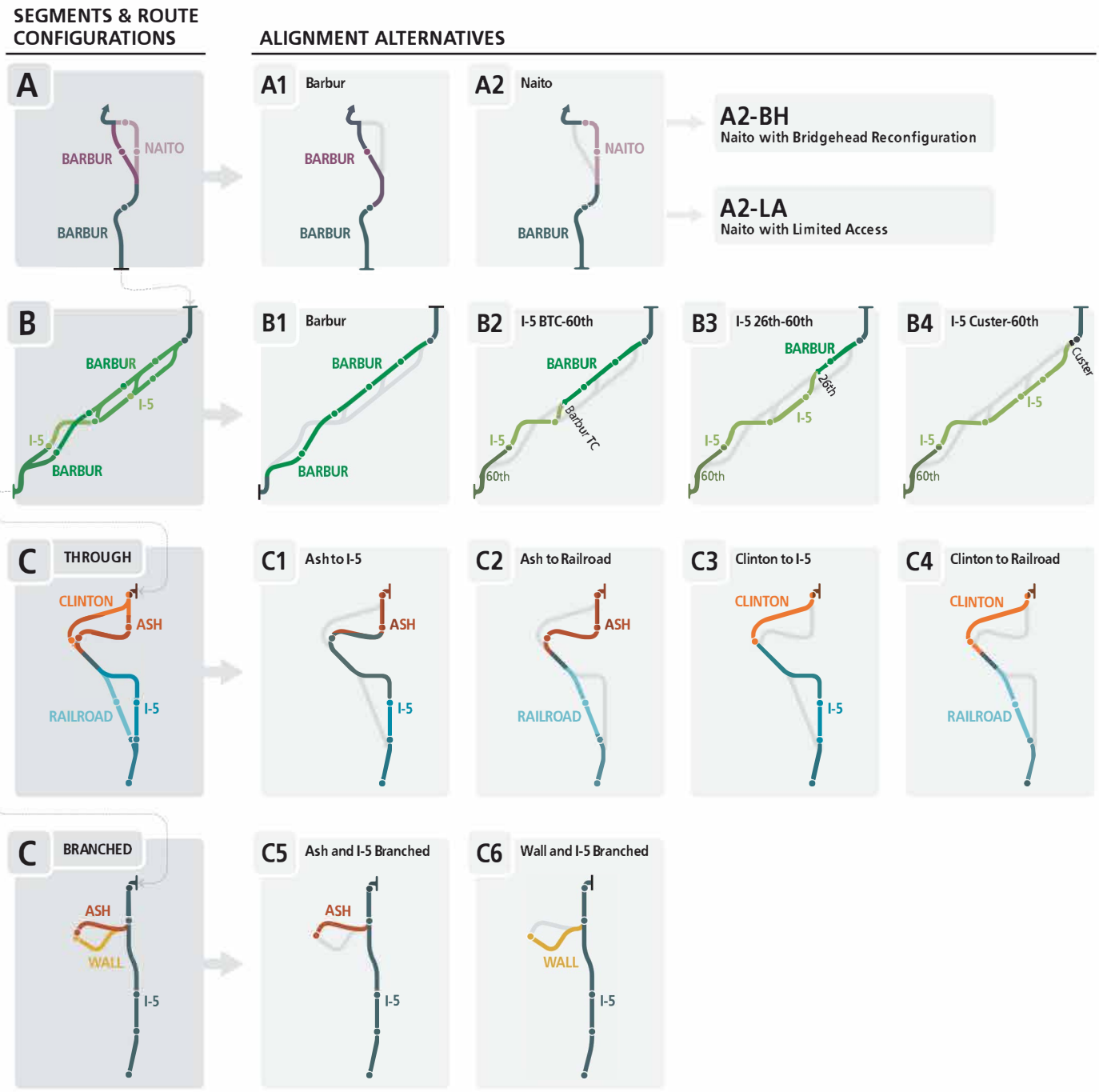


Figure 2.3-2

Alignment Alternatives by Segment



NOTE

Alternatives A1, B2, C1 and C5 are assumed as a baseline when necessary for comparison.

4/10/18

Overview of Light Rail Project Infrastructure

Table 2.3-2 summarizes the physical features that may be included in the light rail project. Table 2.3-3 describes features that would be included with specific station locations. Appendix A includes maps of the alignment alternatives, park and rides, Marquam Hill connection options, O&M facility options and station access improvement options, as well as examples of typical light rail station designs.

Table 2.3-2. Overview of Light Rail Project Infrastructure

Project Element	Potentially Included Infrastructure
Alignment[1]	· light rail trackway, which may be at grade in exclusive right of way, on an aerial structure, on built-up fill, in a cut-and-cover undercrossing, or in retained cut or fill · tracks, which may be embedded, on ballast or directly fixed, and may include switches or turnouts · overhead wires and support poles · electrification stations and substations · train controls and signals, including signal management structures · traffic signals and crossing protection · new or rebuilt roadways and bridges, which may include widening of the roadway or modification of existing through lanes, turn lanes or parking · utilities and utility relocation · streetscape elements, which may include sidewalks, bicycle lanes, landscape buffers, bioswales, benches, lighting and signage
Stations[1]	· platforms up to 200 feet long, which may be located between the tracks in the roadway median, on both sides of the tracks in the roadway median, curbside or elevated · tail tracks or third tracks at terminus stations for operational flexibility · station amenities, including shelters, seating, lighting, signage, telephones, refuse cans and fare collection equipment · at-grade pedestrian crossings accessing one or both ends of each platform · surface or structured parking · bicycle parking · pedestrian bridges
Marquam Hill connection	· elevators, stairs and ramps · pedestrian bridges and pathways · cut-and-cover or bored tunnels/underpasses
PCC-Sylvania shuttle	· bus bays and related passenger facilities on PCC-Sylvania campus · shuttle equipment and storage · shuttle ramp accessing campus
O&M facility	· maintenance and wash bays · storage tracks · wheel truing equipment · vehicle wash · unit repair facility (for vehicle parts) · parts storage · surface parking for employees and fleet vehicles · administrative space · on-site stormwater management
Station access improvements	· sidewalks · shared in-street bikeways · bicycle lanes · protected crossings · pedestrian bridges

Note: O&M = operations and maintenance; PCC = Portland Community College.

[1] The features of the alignment and stations are defined by each "alignment alternative."

Table 2.3-3. Station Characteristics

Station Name by General Location	Alignment Alternatives	Park and Ride[1]		Other Notable Characteristics
		Spaces	Levels	
Lair Hill				
Gibbs Barbur Station	A1	N/A	N/A	Center platform in roadway median
Gibbs Naito Station	A2-BH, A2-LA	N/A	N/A	Center platform in roadway median
Hamilton				
Hamilton Station	All Segment A	N/A	N/A	Center platform in roadway median
Burlingame				
Custer Station	All Segment B	N/A	N/A	Center platform in roadway median
Capitol Hill				
19th Station	B1, B2, B3	N/A	N/A	Side platforms in roadway median
Spring Garden Station	B4	N/A	N/A	Center platform away from roadway
26th/30th				
30th Barbur Station	B1, B2	N/A	N/A	Staggered side platform (far-side)
30th I-5 Station	B3, B4	N/A	N/A	Center platform away from roadway
Barbur TC				
Barbur TC Barbur Station	B1	825	3	Side platforms away from roadway TC reconfigured
Barbur TC I-5 Station	B2, B3, B4	725	3	Side platforms in roadway median TC reconfigured Pedestrian bridge over I-5 replaced
53rd				
53rd Barbur Station	B1	950	3	Center platform in roadway median Pedestrian bridge over SW Barbur Blvd. added
53rd I-5 Station	B2, B3, B4	950	3	Side platforms next to roadway Pedestrian bridge over SW Barbur Blvd. added
Northern Tigard Triangle				
Baylor Station	C1, C2, C5, C6	425	3	Center platform in side-running configuration
Clinton Station	C3, C4	425	3	Center platform in side-running configuration
Southern Tigard Triangle[2]				
Beveland Station	C1, C2, C5, C6	N/A	N/A	Center platform in side-running configuration
Tigard TC				
Tigard TC Ash Station	C1, C2, C5	300	3	Side platforms in side-running configuration TC moved to SW Ash Ave. For Alt. C5: tail track to Hunziker O&M facility
Tigard TC Clinton Station	C3, C4	275	3	Center platform away from roadway TC moved south on SW Commercial St.
Tigard TC Wall Station	C6	275	3	Platforms with three tracks away from roadway TC moved south on SW Commercial St.
Bonita				
Bonita I-5 Station	C1, C3, C5, C6	150	surface	Side platforms away from roadway 10- to 20-foot walls north and east of platforms
Bonita Railroad Station	C2, C4	100	surface	Center platform on elevated trackway
Upper Boones Ferry				
Upper Boones Ferry I-5 Station	C1, C3, C5, C6	600	3	Side platforms away from roadway 10- to 20-foot walls north and east of platforms
Upper Boones Ferry Railroad Station	C2, C4	50	surface	Center platform away from roadway
Bridgeport Village				
Bridgeport Station	All Segment C	950	4	Platforms with three tracks away from roadway Pedestrian bridge to P&R over SW LBF Rd.

Note: LBF = Lower Boones Ferry; N/A = not applicable; P&R = park and ride; TC = Transit Center.

[1] Based on the maximum proposed size for each park and ride. Subject to refinement during the Final EIS process.

[2] Alternatives C3 and C4 would not include a southern Tigard Triangle station.

Segment A: Inner Portland

Segment A encompasses the area from the southern edge of downtown Portland to just north of the intersection of SW Barbur Boulevard and SW Brier Place (see Figure 2.3-1). All three alignment alternatives in Segment A would tie in to the Downtown Portland Transit Mall, which runs along SW 5th and 6th Avenues. The Transit Mall currently supports MAX Green, Yellow and Orange lines. The Southwest Corridor Light Rail Project would extend MAX Green Line service from its terminus at SW 5th Avenue and SW Jackson Street near Portland State University.

As described in the following sections, the alignment alternatives in Segment A include different approaches for the configuration of SW Naito Parkway and the roads and ramps that access the west end of the Ross Island Bridge. Alternative A2-LA would reconstruct SW Naito Parkway and the adjacent streets to generally maintain the existing limited-access roadway configuration. Alternative A2-BH would instead include changes to SW Naito Parkway and the bridge access, known collectively as the Bridgehead Reconfiguration (see Exhibit 2.3-1). The Bridgehead Reconfiguration is also an optional addition to Alternative A1 (see Section 2.5, Potential Design Refinements and Options).

Exhibit 2.3-1

What is the Bridgehead Reconfiguration?

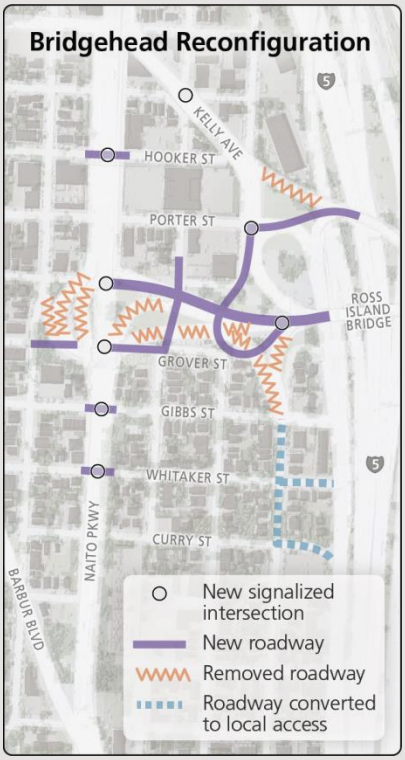
The "Bridgehead" refers to the area at the west end of the Ross Island Bridge in the South Portland neighborhood (see Figure 2.3-3 for context).

This area has been shaped and reshaped by infrastructure projects since the early 1900s. As the automobile became more popular and streets replaced streetcar lines, high-volume roadways such as SW Barbur Boulevard, I-5, SW Harbor Drive, SW Front Avenue (now SW Naito Parkway), freeway interchanges and Ross Island Bridge ramps displaced homes and businesses, and placed barriers to access in the remaining neighborhood.

Congested traffic conditions continue today with queues regularly spilling into the neighborhoods, impacting quality of life, and constraining walking and biking access. The Bridgehead Reconfiguration derives from nearly 40 years of plans for the area, and is intended to accomplish a range of land use and transportation goals of both the City of Portland and ODOT.

The Bridgehead Reconfiguration would redirect traffic from downtown Portland to Interstate 405, including eastbound U.S. 26 traffic, along SW Kelly Avenue to a new ramp on the Ross Island Bridge, and convert SW Naito Parkway to a surface boulevard with at-grade intersections. It would change other ramp accesses to the bridge, add bicycle lanes and open up nearly 3 acres of land for development.

The Bridgehead Reconfiguration is an integral part of Alternative A2-BH.



Segment A includes options for a Marquam Hill connection, which would connect the light rail station at SW Gibbs Street to the OHSU Marquam Hill complex. Segment A contains three station access improvement options. The Marquam Hill connection options and station access improvement options are described after the alignment alternatives in the following sections.

Figure 2.3-3 illustrates the alignment alternatives, Marquam Hill connection options and station access improvement options in Segment A. See Appendix A for more detailed maps.

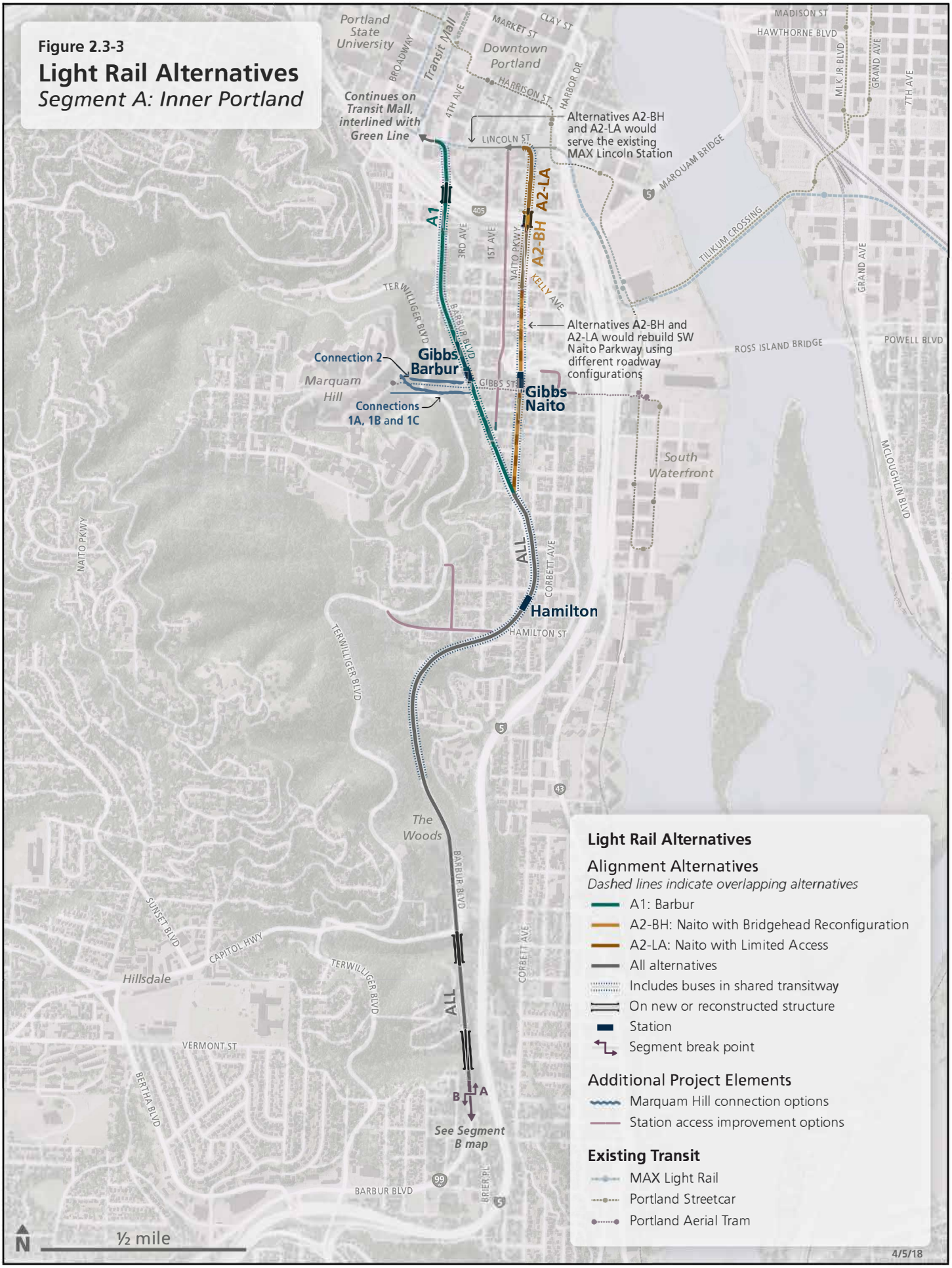
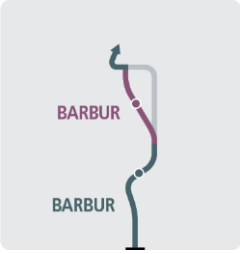


Figure 2.3-3
Light Rail Alternatives
Segment A: Inner Portland
Portland State University
Broadway
Transit Mall
Market St
Clay St
Downtown Portland
Harrison St
Harbor Dr
4th Ave
Continues on Transit Mall, interlined with Green Line
Alternatives A2-BH and A2-LA would serve the existing MAX Lincoln Station
Lincoln St
A1
A2-BH
A2-LA
3rd Ave
1st Ave
Naito Pkwy
Kelly Ave
Marquam Bridge
Tilikum Crossing
Madison St
Hawthorne Blvd
MLK Jr Blvd
Grand Ave
7th Ave
Terwilliger Blvd
Barbur Blvd
Alternatives A2-BH and A2-LA would rebuild SW Naito Parkway using different roadway configurations
Ross Island Bridge
Powell Blvd
Connection 2
Gibbs Barbur
Marquam Hill
Gibbs St
Gibbs Naito
Connections 1A, 1B and 1C
South Waterfront
McLoughlin Blvd
ALL
Corbett Ave
Hamilton
Hamilton St
The Woods
Sunset Blvd
Capitol Hwy
Hillsdale
Vermont St
Bertha Blvd
B
A
See Segment B map
Barbur Blvd
Brier Pl
Light Rail Alternatives
Alignment Alternatives
Dashed lines indicate overlapping alternatives
A1: Barbur
A2-BH: Naito with Bridgehead Reconfiguration
A2-LA: Naito with Limited Access
All alternatives
Includes buses in shared transitway
On new or reconstructed structure
Station
Segment break point
Additional Project Elements
Marquam Hill connection options
Station access improvement options
Existing Transit
MAX Light Rail
Portland Streetcar
Portland Aerial Tram
N
½ mile
4/5/18

Alternative A1: Barbur



Alternative A1 would run on SW Barbur Boulevard for most of Segment A, primarily operating at grade in the center of the roadway. The light rail alignment for Alternative A1 differs from the other Segment A alignment alternatives between the Transit Mall and the junction of SW Barbur Boulevard and SW Naito Parkway.

Alternative A1 would diverge from the existing MAX tracks just west of the current Lincoln Station, at SW Fourth Avenue and SW Lincoln Street. It would cross Interstate 405 (I-405) on a new structure east of and parallel to SW Fourth Avenue. The alignment would run along the east side of SW Barbur Boulevard for several blocks, then transition into the center of SW Barbur Boulevard at SW Hooker Street. The alignment would continue running in the center of SW Barbur Boulevard until the segment break point near SW Brier Place.

Stations would be located near SW Gibbs Street and SW Hamilton Street. Both stations would use at-grade center platforms. The alternative would add a signalized pedestrian crossing of SW Naito Parkway at SW Gibbs Street to provide access across SW Naito Parkway and onto the pedestrian bridge over I-5 at SW Gibbs Street. The Marquam Hill connection options, described in a separate section below, would provide access between the Gibbs Barbur Station and the Marquam Hill complex.

South of SW Hooker Street, SW Barbur Boulevard would be widened and largely rebuilt to accommodate light rail and to add sidewalks and bike lanes. To address the elevation difference between the west and east sides of SW Barbur Boulevard, parts of Alternative A1 would have retaining walls and changes to the grade of connecting side streets.

The alternative would modify intersections and other vehicle access along SW Barbur Boulevard, and would remove the center two-way turn lane that is in some existing roadway sections. The junction of SW Barbur Boulevard and SW Naito Parkway would be modified from a merge to a signalized intersection. Alternative A1 would modify traffic lanes in other sections, maintaining two lanes in each direction south of the junction of SW Barbur Boulevard and SW Naito Parkway. It would restrict some side-street access from SW Barbur Boulevard to right-in and right-out turns. In the section from SW Hamilton Street to SW Brier Place, Alternative A1 would replace several major bridges, including the Newbury and Vermont trestle bridges and the SW Capitol Highway overpass.

Two miles of the light rail alignment for Alternative A1 would be paved to provide a shared transitway that would allow buses as well as light rail (see Exhibit 2.3-2). Located between SW Lincoln Street and The Woods section of SW Barbur Boulevard, the shared transitway would allow buses to avoid traffic congestion in order to improve travel times and reliability. Buses would exit and re-enter the shared transitway to serve a bus stop at SW Gibbs Street.

Exhibit 2.3-2

What is the shared transitway?

A shared transitway is a paved portion of light rail trackway that allows access for buses to improve bus travel time and reliability. The existing MAX Orange Line includes a 1.3-mile shared transitway, which provides access for the bus lines 17 and 9 and the Portland Streetcar approaching and on the Tilikum Crossing bridge.

In Segment A, all of the alignment alternatives would include a 2-mile shared transitway between SW Lincoln Street and The Woods section of SW Barbur Boulevard to allow buses to bypass traffic congestion in South Portland. The buses would serve a stop near SW Gibbs Street to provide access to Marquam Hill.

The final decision on bus network changes in support of the Southwest Corridor Light Rail Project, including which buses would use the shared transitway, would be made much closer to opening day. For the purpose of this Draft EIS analysis, TriMet's bus line 54 is assumed to use the shared transitway, while line 44 would continue to provide local service between Hillsdale and downtown Portland.

Alternative A2-BH: Naito with Bridgehead Reconfiguration

Alternative A2-BH differs from Alternative A1 between the Transit Mall and the junction of SW Barbur Boulevard and SW Naito Parkway, where Alternative A2-BH would operate on SW Naito Parkway instead of on SW Barbur Boulevard.

The alignment would serve the existing Lincoln Station located at SW Lincoln Street and SW 3rd Avenue, and would run for a short distance along the MAX Orange Line tracks before turning south onto a largely rebuilt SW Naito Parkway. It would operate at grade in the center of SW Naito Parkway, and would include the Bridgehead Reconfiguration changes along SW Naito Parkway and surrounding streets (see Exhibit 2.3-1 for background information). The alignment would connect to SW Barbur Boulevard using an underpass for light rail between SW Curry Street and SW Bancroft Street. South of SW Bancroft Street, the alternative would be identical to Alternative A1.

Alternative A2-BH would include stations on SW Naito Parkway at SW Gibbs Street, with an alternate location at SW Hooker Street, and on SW Barbur Boulevard at SW Hamilton Street. Both stations would use at-grade center platforms. The alternative would reconstruct the existing stair connection between SW Barbur Boulevard and SW Gibbs Street to add a ramp, and would add a signalized pedestrian crossing of SW Barbur Boulevard. The Marquam Hill connection options, described in a separate section below, would provide access between the OHSU Marquam Hill complex and SW Barbur Boulevard bus stops and the Gibbs Naito Station.

To rebuild SW Naito Parkway to accommodate light rail, the alternative would replace several of the bridge structures along SW Naito Parkway, including the overcrossings of I-405 and SW Kelly Avenue. The Bridgehead Reconfiguration would create several new at-grade signalized intersections along SW Naito Parkway, including at the Gibbs Naito Station. These new roadway connections would provide additional neighborhood access for autos, bicycles and pedestrians where it is currently restricted. The alternative would largely reconfigure the connection of SW Naito Parkway and SW Barbur Boulevard, creating a new at-grade signalized intersection with crosswalks.

As with the other Segment A alignment alternatives, Alternative A2-BH would include the shared transitway between SW Lincoln Street and The Woods section of SW Barbur Boulevard (see Exhibit 2.3-2).

Alternative A2-LA: Naito with Limited Access

Alternative A2-LA would follow the same alignment as Alternative A2-BH and have the same station locations and the same pedestrian connection at SW Barbur Boulevard and SW Gibbs Street. As with Alternative A2-BH, it would rebuild SW Naito Parkway to accommodate center-running light rail but would not include the Bridgehead Reconfiguration. Instead, Alternative A2-LA would largely maintain SW Naito Parkway's current roadway access restrictions.

The alternative would widen the roadway for light rail and reconstruct the existing ramps to the bridge to accommodate the added width. The alternative would add one new at-grade intersection at SW Naito Parkway and SW Gibbs Street. It would reconstruct the existing pedestrian bridge over SW Naito Parkway at SW Hooker Street. Unlike Alternatives A1 and A2-BH, Alternative A2-LA would retain the current merge pattern at the junction of SW Barbur Boulevard and SW Naito Parkway. Between this junction and SW Hamilton Street, the alternative would retain three traffic lanes in each direction in addition to the center-running light rail.

As with the other Segment A alignment alternatives, Alternative A2-LA would include the shared transitway between SW Lincoln Street and The Woods section of SW Barbur Boulevard (see Exhibit 2.3-2). For Alternative A2-LA, buses would serve a stop at SW Gibbs Street within the shared transitway, because the limited-access configuration would not include signals allowing buses to exit and re-enter the transitway. The added bus stop within the shared transitway would result in a larger footprint of impact at the Gibbs Naito Station than Alternative A2-BH.

Marquam Hill Connection Options

The Marquam Hill connection options would link SW Barbur Boulevard near SW Gibbs Street to the OHSU Kohler Pavilion on Marquam Hill to provide access between the proposed station near SW Gibbs Street and the jobs and services at the medical facilities located at the top of the hill, including OHSU, the Veterans Affairs (VA) Portland Health Care System and the Portland Shriners Hospital for Children.

There are four connection options, which include combinations of tunnels, elevators and bridges. All four of the connection options are compatible with all of the Segment A alignment alternatives. Figure 2.3-3 shows the general location of the connection options, and Table 2.3-4 summarizes the differences between them. Appendix A provides maps, elevation profiles and detailed descriptions of the connection options (see Figures A-24 through A-27).

Station Access Improvement Options

In addition to the walking and biking improvements along SW Barbur Boulevard and SW Naito Parkway included in the alignment alternatives, this Draft EIS studies three station access improvement options in Segment A that could pair with any of the alignment alternatives (see Figure A-30 in Appendix A). These investments would improve walking and biking access to the proposed light rail stations. Within Segment A, station access improvements include adding bikeways, sidewalks and enhanced pedestrian crossings.

Table 2.3-4. Comparison of Marquam Hill Connection Options

Connection Segment	Marquam Hill Connection Option			
	1A: Elevator/Bridge and Path	1B: Elevator/Bridge and Recessed Path	1C: Elevator/Bridge and Tunnel	2: Full Tunnel
SW Barbur Blvd. to SW Terwilliger Blvd.	· At-grade path · Elevator and stairs · Bridge	· At-grade path · Elevator and stairs · Bridge	· At-grade path · Elevator and stairs · Bridge	· At-grade path · Tunnel
Crossing SW Terwilliger Blvd.	· At-grade crossing	· Underpass	· Underpass	· Tunnel (continued)
SW Terwilliger Blvd. to SW Campus Dr.	· Stairs and ramps · Elevator and stairs · Bridge	· Stairs and ramps · Recessed path · Elevator and stairs	· Stairs and ramps · Tunnel · Elevator and stairs	· Tunnel (continued) · Elevator and stairs
Crossing SW Campus Dr.	· At-grade crossing	· Bridge	· Bridge	· Bridge
Access to Kohler Pavilion	· 3rd floor	· 7th floor	· 7th floor	· 7th floor

Segment B: Outer Portland

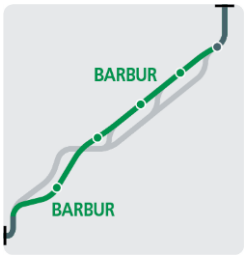
Segment B extends from SW Barbur Boulevard at SW Brier Place to the intersection of SW 68th Parkway and SW Atlanta Street, just west of the Portland/Tigard city boundary (see Figure 2.3-1). In this segment, the alignment alternatives all have sections that would widen the roadway to accommodate light rail in the center of SW Barbur Boulevard while maintaining existing travel lanes. Three of the four alternatives would also transition to run adjacent to I-5, offset from SW Barbur Boulevard.

All of the Segment B alignment alternatives would include park and ride structures at the Barbur Transit Center and 53rd Stations, though the placement of these garage structures relative to the stations and the estimated vehicle capacities vary slightly by alternative.

Figure 2.3-4 illustrates the alignment alternatives, PCC-Sylvania shuttle options and station access improvement options in Segment B. See Appendix A for more detailed maps.

Segment B also contains two options for a shuttle connection to PCC-Sylvania and 20 station access improvement options. These options are described after the alignment alternatives in the following sections.

Alternative B1: Barbur



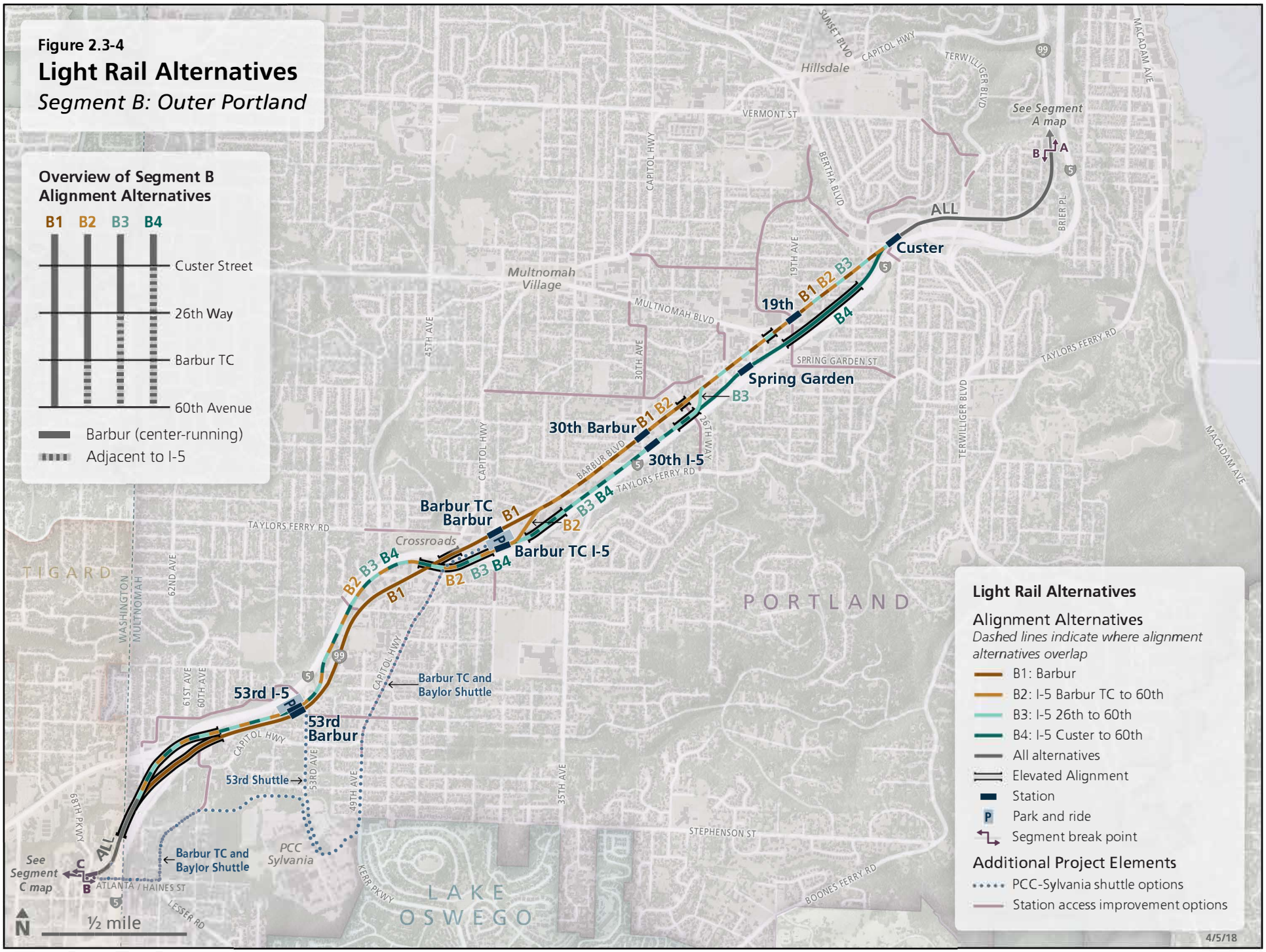
Alternative B1 would run in the center of SW Barbur Boulevard until SW 60th Avenue. The portion of the alignment on SW Barbur Boulevard south of the Barbur Transit Center is unique to Alternative B1.

The alternative would widen SW Barbur Boulevard throughout the segment north of SW 60th Avenue to accommodate light rail tracks, bicycle lanes and sidewalks. Part of the widening would be accomplished by removing two-way center turn lanes and on-street parking where they exist. The alternative would reconstruct several bridges along SW Barbur Boulevard, including the bridge over I-5 at the intersection of SW Barbur Boulevard and SW Capitol Highway. The alternative would construct additional signalized intersections on SW Barbur Boulevard to accommodate left turns and U-turns. Other side-street and driveway access along SW Barbur Boulevard would be limited to right-in and right-out only.

Figure 2.3-4

Light Rail Alternatives

Segment B: Outer Portland



West of SW 60th Avenue, the alignment would cross over I-5 between SW Barbur Boulevard and the Tigard Triangle on a new light rail structure (see Exhibit 2.3-3 for more information on the Tigard Triangle). The alignment would continue south on the structure along the west side of I-5, then turn west and drop below the ground level to an underpass below SW 68th Parkway.

Stations would be located at grade in the center of SW Barbur Boulevard at SW Custer Street, SW 19th Avenue, SW 30th Avenue (or an alternate location near SW 26th Way), the Barbur Transit Center and SW 53rd Avenue. Three-level park and ride structures would be included at the Barbur Transit Center and 53rd Stations, with up to 825 and 950 spaces, respectively (see Figures A-17 and A-18 in Appendix A for detailed maps). All Segment B alignment alternatives would rebuild SW 53rd Avenue with new pavement, sidewalks, stormwater controls and lighting to improve the walking and biking access between the light rail station and PCC-Sylvania.

Exhibit 2.3-3

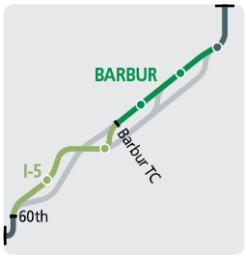
What is the Tigard Triangle?

The "Tigard Triangle" usually refers to the triangle-shaped area bounded by I-5, Highway 217 and Pacific Highway. (In Section 3.4, Communities, the Tigard Triangle neighborhood extends farther southwest beyond Highway 217 to SW Hall Boulevard, the WES/freight railroad tracks and SW Bonita Road.)

The east half of the Tigard Triangle has a gridded street network with a mix of housing and office buildings, while the west half of the Tigard Triangle contains larger retail businesses with some pockets of smaller businesses and housing. A lack of access and missing sewer and stormwater infrastructure have limited development of the Tigard Triangle, and large expanses of vacant land remain.

Local planning has explored ways to overcome these constraints and focus new growth in the Tigard Triangle. The *Tigard Triangle Strategic Plan* (City of Tigard, 2015) outlines a vision of an area with a diverse mix of uses in an enjoyable walking environment with improved connectivity for all travel modes. The city's *High Capacity Transit Land Use Plan* (City of Tigard, 2012) identified the Tigard Triangle as a potential high capacity transit station area community in advance of Southwest Corridor planning.

Alternative B2: I-5 Barbur Transit Center to 60th

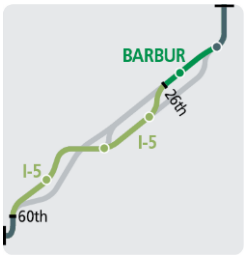


Alternative B2 would be identical to Alternative B1 from SW Brier Place to just north of the Barbur Transit Center, where light rail would transition away from the center of SW Barbur Boulevard to run adjacent to I-5. South of the Barbur Transit Center, the alignment would cross over I-5, SW Capitol Highway and SW Barbur Boulevard on a new light rail structure, and then continue adjacent to I-5 until SW 60th Avenue. West of SW 60th Avenue, the alignment would cross over I-5 and SW Barbur Boulevard on a new light rail structure, continue south on the structure along the west side of I-5, then turn west and drop below the ground level to an underpass below SW 68th Parkway.

North of the Barbur Transit Center, the station locations would be the same as for Alternative B1. The Barbur Transit Center and 53rd Stations would be adjacent to I-5 instead of in the center of SW Barbur Boulevard, but they would still be at grade and include three-level park and ride structures. The Barbur Transit Center Park and Ride would have up to 725 spaces (100 fewer spaces than for Alternative B1) and the 53rd Park and Ride would have up to 950 spaces (same number of spaces as for Alternative B1). See Figures A-17 and A-18 in Appendix A for detailed maps of the park and rides.

Alternative B2 would include the same walking and biking improvements on SW 53rd Avenue as Alternative B1.

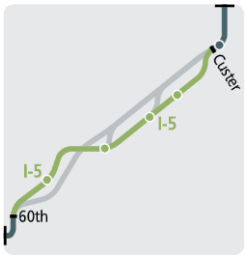
Alternative B3: I-5 26th to 60th



Alternative B3 would be identical to Alternatives B1 and B2 from SW Brier Place to SW 26th Way, where it would transition to run adjacent to I-5. The alignment would depart from SW Barbur Boulevard at a new signalized and gated intersection just north of SW 26th Way. It would cross SW 26th Way on a new light rail structure adjacent to I-5. It would continue south, running along the west side of I-5, primarily at grade but with an 850-foot-long structure approaching the Barbur Transit Center. South of the Barbur Transit Center, the alternative would be identical to Alternative B2.

Station locations and park and rides would be identical to those of Alternative B2, except that the 30th Station would be at grade adjacent to I-5. Alternative B3 would include the same walking and biking improvements to SW 53rd Avenue as Alternative B1.

Alternative B4: I-5 Custer to 60th



Of the Segment B alignment alternatives, Alternative B4 would run for the longest distance adjacent to I-5. The alignment would transition from SW Barbur Boulevard to I-5 at SW Custer Street. North of SW Custer Street, Alternative B4 would be identical to the other Segment B alignment alternatives. The alignment would depart SW Barbur Boulevard at a new signalized and gated intersection at SW Custer Street and would generally run along the portion of SW Multnomah Boulevard alongside I-5 north of SW 19th Avenue. As a result, SW Multnomah Boulevard would be closed between SW Barbur Boulevard and SW 17th Avenue. The alignment along I-5 would alternate between at-grade and elevated sections, depending on the grades and the location of I-5 crossings and ramps. South of SW 26th Way, Alternative B4 would be identical to Alternative B3.

The Custer Station would be identical to that of Alternative B1, and the 30th, Barbur Transit Center and 53rd Stations would be identical to those of Alternative B3. Instead of the 19th Station included in Alternatives B1, B2 and B3, Alternative B4 would include the Spring Garden Station, which would be at grade adjacent to I-5. Park and rides would be identical to those of Alternatives B2 and B3. Alternative B4 would include the same walking and biking improvements on SW 53rd Avenue as Alternative B1.

PCC-Sylvania Shuttle Options

Because it would require about a 0.5-mile walk to access the PCC-Sylvania campus from the nearest proposed light rail station, the project includes two options for a shuttle to connect to PCC-Sylvania. The shuttle would supplement the pedestrian and bicycle improvements on SW 53rd Avenue that are included with all Segment B alignment alternatives. The shuttle would operate at the same service frequency as light rail, ranging from every 7 to 15 minutes in 2035 (see Chapter 3 – Transportation Impacts and Mitigation). The two PCC-Sylvania shuttle options are illustrated in Figure 2.3-4 and described below.

- **Barbur Transit Center and Baylor Shuttle** would operate in mixed traffic on a 2.7-mile route with stops at the Barbur Transit Center, the PCC-Sylvania campus, and the Baylor Station or Clinton

Station in the Tigard Triangle, depending on the alignment alternative. Intermediate stops on SW Capitol Highway and SW Lesser Road could be possible. The shuttle would use about five standard 40-foot TriMet buses to operate.

- **53rd Shuttle** would operate in mixed traffic on an up to 0.5-mile route along SW 53rd Avenue between the PCC-Sylvania campus and the 53rd Station. Currently, a portion of SW 53rd Avenue is undeveloped, and the street dead ends at G Street on the edge of the campus. All Segment B alignment alternatives would rebuild the street with new pavement, sidewalks, stormwater controls and lighting to improve walking and biking access to the campus. The 53rd Shuttle would use this same improved roadway, with the addition of an exclusive ramp for the shuttle to connect to the campus. This shuttle option would use about three small van-sized shuttle buses to operate.

Both shuttle options would include bus bays and related passenger facilities on the PCC-Sylvania campus. These specific elements will be defined after the selection of a shuttle route and will be included in the Final EIS.

Station Access Improvement Options

In addition to the walking and biking investments along SW Barbur Boulevard, there are 20 station access improvements in Segment B, including bikeways, sidewalks, enhanced pedestrian crossings and pedestrian bridges over I-5 (see Figure A-31 in Appendix A).

Segment C: Tigard and Tualatin

This segment extends from the intersection of SW 68th Place and SW Atlanta Street, just west of the Portland/Tigard city boundary, to Bridgeport Village in Tualatin, which would be the southern terminus of the light rail alignment (see Figure 2.3-1).

The segment includes six light rail alternatives, each using one of two *route configurations*:

- **Through Route** to Bridgeport Village via downtown Tigard (see Figure 2.3-5)
- **Branched Route** with a split in the Tigard Triangle, where some trains would continue south to Bridgeport Village while others would turn west to serve downtown Tigard (see Figure 2.3-6)

Segment C contains four alignment alternatives for a Through Route (Alternatives C1 through C4) and two for a Branched Route (Alternatives C5 and C6). The four through-routed alignment alternatives are based on two alignments north of downtown Tigard (Clinton and Ash) and two alignments south of downtown Tigard (Railroad and I-5). The two branched alignment alternatives are based on two alignments between the Tigard Triangle and downtown Tigard (Ash and Wall).

Figures 2.3-5 and 2.3-6 illustrate the Segment C alignment alternatives, O&M facility options and station access improvement options for the Through Route (Alternatives C1, C2, C3 and C4) and Branched Route (Alternatives C5 and C6), respectively. See Appendix A for more detailed maps.

Segment C also includes three options for an O&M facility to support light rail operations and six station access improvement options. These options are described after the alignment alternatives in the following sections.

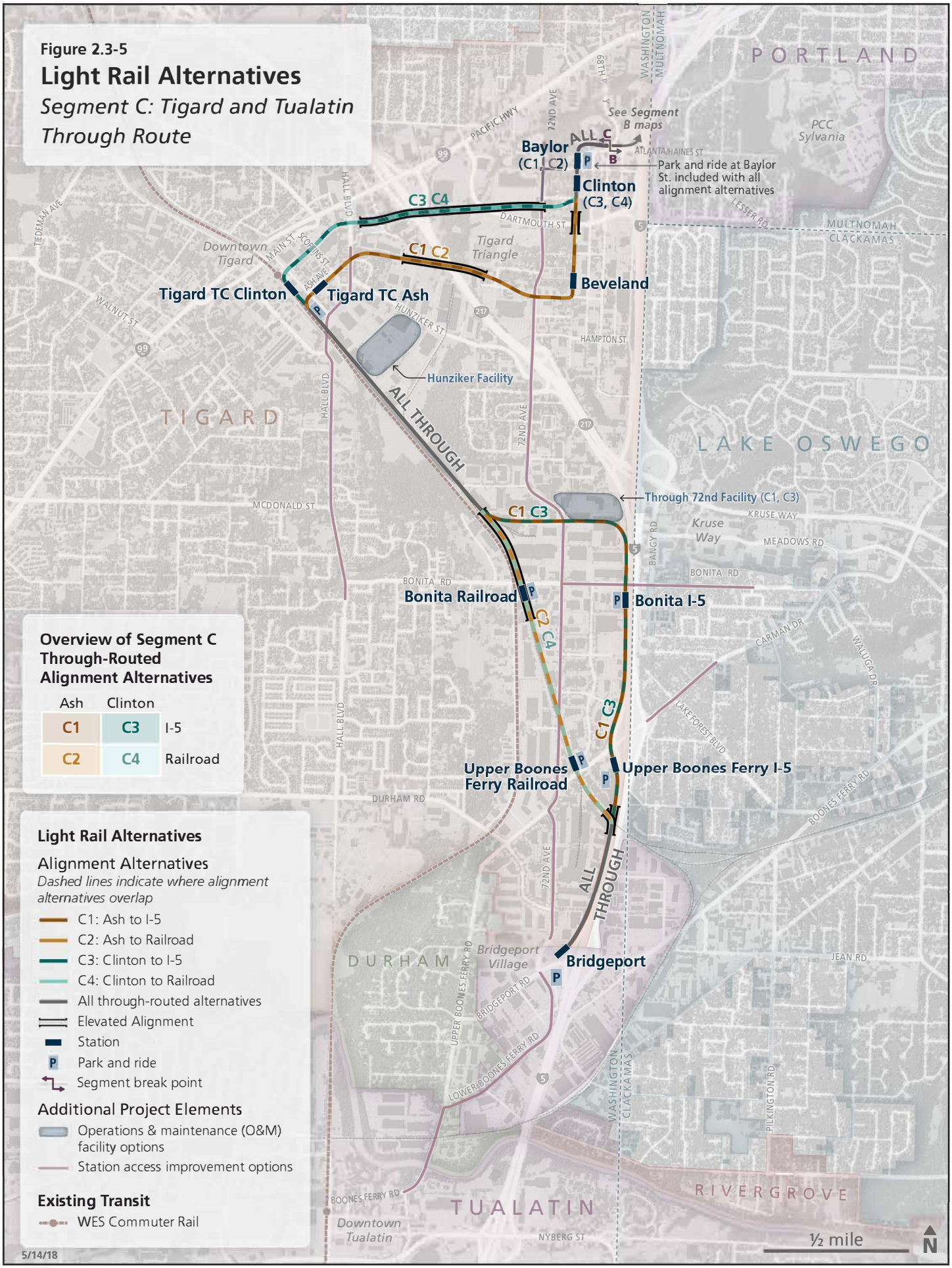


Figure 2.3-5
Light Rail Alternatives
Segment C: Tigard and Tualatin Through Route
PORTLAND
See Segment B maps
PCC Sylvania
Baylor (C1, C2)
ALL C
B
Park and ride at Baylor St. included with all alignment alternatives
Clinton (C3, C4)
C3 C4
C1 C2
Tigard Triangle
Beveland
Tigard TC Clinton
Tigard TC Ash
Downtown Tigard
Hunziker Facility
TIGARD
ALL THROUGH
LAKE OSWEGO
Through 72nd Facility (C1, C3)
C1 C3
Kruse Way
Bonita Railroad
Bonita I-5
C2 C4
Upper Boones Ferry Railroad
Upper Boones Ferry I-5
DURHAM
Bridgeport Village
Bridgeport
TUALATIN
Downtown Tualatin
RIVERGROVE
Overview of Segment C Through-Routed Alignment Alternatives
Ash
Clinton
C1
C3
I-5
C2
C4
Railroad
Light Rail Alternatives
Alignment Alternatives
Dashed lines indicate where alignment alternatives overlap
C1: Ash to I-5
C2: Ash to Railroad
C3: Clinton to I-5
C4: Clinton to Railroad
All through-routed alternatives
Elevated Alignment
Station
Park and ride
Segment break point
Additional Project Elements
Operations & maintenance (O&M) facility options
Station access improvement options
Existing Transit
WES Commuter Rail
5/14/18
½ mile
N

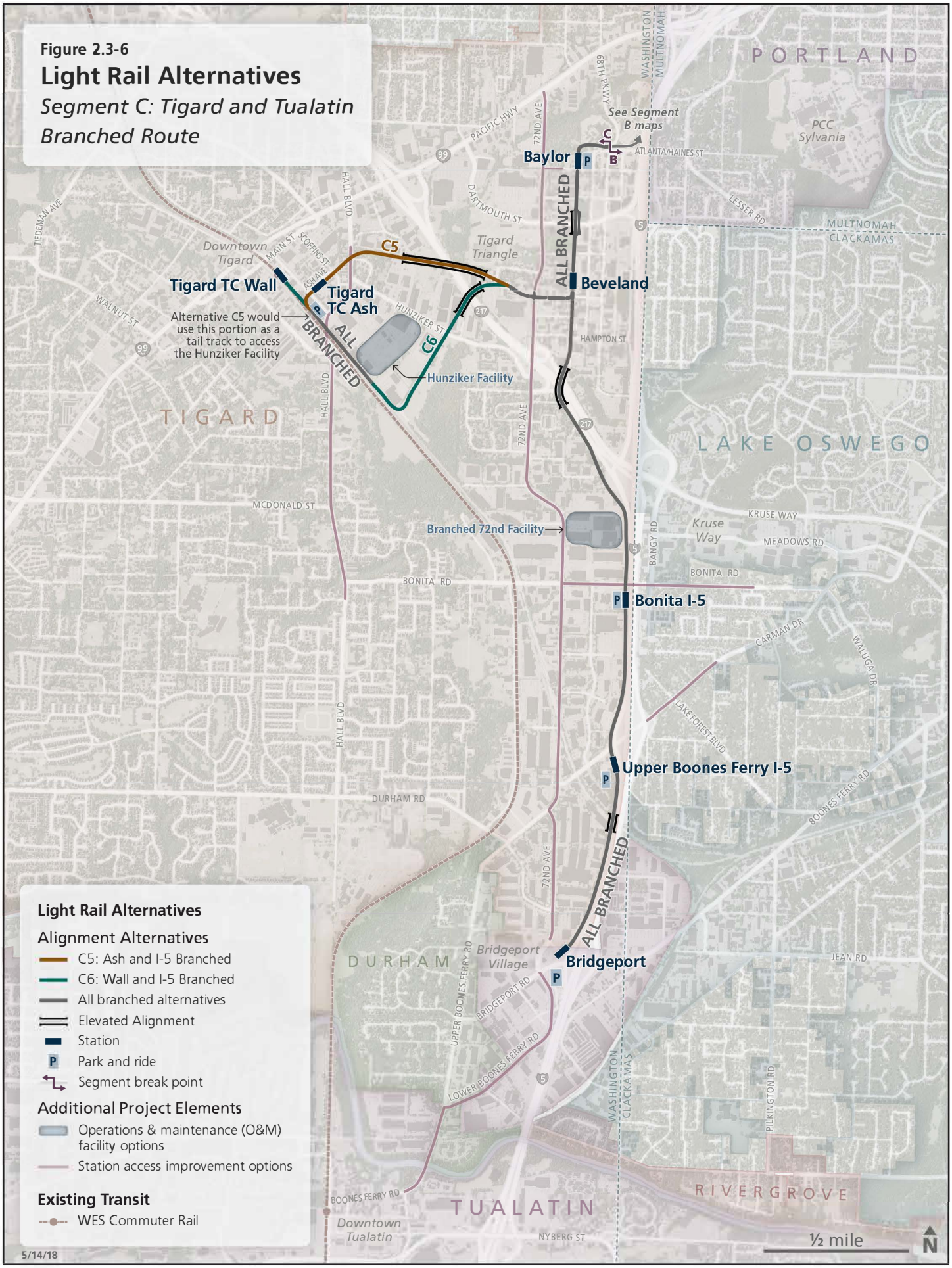


Figure 2.3-6
Light Rail Alternatives
Segment C: Tigard and Tualatin
Branched Route
PORTLAND
See Segment B maps
Baylor
ALL BRANCHED
Beveland
C5
Tigard TC Wall
Tigard TC Ash
Alternative C5 would use this portion as a tail track to access the Hunziker Facility
ALL BRANCHED
C6
Hunziker Facility
Tigard Triangle
Downtown Tigard
TIGARD
LAKE OSWEGO
Branched 72nd Facility
Kruse Way
Bonita I-5
Upper Boones Ferry I-5
ALL BRANCHED
Bridgeport
DURHAM
Bridgeport Village
TUALATIN
Downtown Tualatin
RIVERGROVE
PCC Sylvania
MULTNOMAH CLACKAMAS
Light Rail Alternatives
Alignment Alternatives
C5: Ash and I-5 Branched
C6: Wall and I-5 Branched
All branched alternatives
Elevated Alignment
Station
Park and ride
Segment break point
Additional Project Elements
Operations & maintenance (O&M) facility options
Station access improvement options
Existing Transit
WES Commuter Rail
5/14/18
½ mile
N

Alternative C1: Ash to I-5

This through-routed alternative would use the Ash alignment between the Tigard Triangle and downtown Tigard, and the I-5 alignment between downtown Tigard and Bridgeport Village (see Exhibit 2.3-3 for more information on the Tigard Triangle). In the Tigard Triangle, the alignment would be side-running along the east side of SW 70th Avenue. Between SW Atlanta Street and SW Beveland Street, Alternative C1 would construct missing portions of the SW 70th Avenue roadway. At the intersection of SW 70th Avenue with SW Dartmouth Street, light rail would cross over SW Dartmouth Street on a new structure, while the auto lanes would remain at grade. The route would turn west on SW Beveland Street and then cross over Highway 217 on a new light rail bridge with a multi-use path to reach downtown Tigard. The alignment would cross SW Hall Boulevard just north of SW Knoll Drive, then run on SW Ash Avenue between SW Scoffins Street and SW Commercial Street.

Alternative C1 would include two stations in the Tigard Triangle and one in downtown Tigard. The northern Tigard Triangle station would be at grade on SW 70th Avenue near SW Baylor Street, and would include a three-level park and ride structure with 425 spaces. The southern Tigard Triangle station would be on SW 70th Avenue near SW Beveland Street. The downtown Tigard station would be at grade on SW Ash Avenue, and would be paired with a reconfigured and relocated Tigard Transit Center and a three-level park and ride structure with 300 spaces. See Figures A-19 and A-20 for maps of the park and rides at the Baylor and Tigard Transit Center Stations. The alternative includes a new auto, walking and biking crossing of the railroad at SW Ash Avenue, connecting SW Commercial Street and SW Burnham Street.

South of downtown Tigard, the alignment would travel southeast along the freight rail and WES Commuter Rail tracks before turning east near SW Landmark Lane until reaching I-5. At I-5, the alignment would continue south adjacent to the freeway, passing under SW Bonita Road and SW Upper Boones Ferry Road, until SW Lower Boones Ferry Road near Bridgeport Village, where the line would terminate. Alternative C1 would include stations and park and rides at SW Bonita Road, SW Upper Boones Ferry Road and Bridgeport Village. The Bonita and Upper Boones Ferry Stations would be at grade with adjacent properties but 10 to 20 feet below the level of the adjacent roadway. The Bonita park and ride would include 150 spaces on a surface lot. The Upper Boones Ferry and Bridgeport park and rides would both be structured with three levels, and would have 600 and 950 spaces, respectively. See Figures A-21, A-22 and A-23 in Appendix A for maps of the park and rides.

Alternative C2: Ash to Railroad

This through-routed alternative would be identical to Alternative C1 between the Tigard Triangle and downtown Tigard, including station locations and park and rides.

It would use the Railroad alignment between downtown Tigard and Bridgeport Village. South of downtown Tigard, the alignment would continue along the freight rail tracks instead of turning east toward I-5. The alignment would be elevated between just south of SW Tech Center Drive and just south of SW Bonita Road to avoid a freight rail spur track, including an elevated crossing over SW Bonita Road. The alignment would continue adjacent to the railroad at grade and cross SW 72nd Avenue and

SW Upper Boones Ferry Road with at-grade gated intersections. The route would reach I-5 about 0.25 mile south of SW Upper Boones Ferry Road before turning south to the terminus at SW Lower Boones Ferry Road near Bridgeport Village.

Stations and park and rides would be included at SW Bonita Road, SW Upper Boones Ferry Road and Bridgeport Village. The Bonita Station would be elevated, and the Upper Boones Ferry Station would be at grade. The Bonita and Upper Boones Ferry Stations would include surface park and ride lots with 100 and 50 spaces, respectively. The Bridgeport Station and Park and Ride would be identical to those included with Alternative C1.

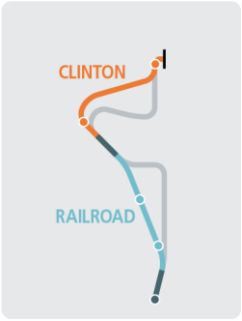
Alternative C3: Clinton to I-5

This through-routed alignment alternative would use the Clinton alignment between the Tigard Triangle and downtown Tigard, and the I-5 alignment between downtown Tigard and Bridgeport Village. Similar to Alternatives C1 and C2, the Alternative C3 alignment would be side-running on SW 70th Avenue south of SW Atlanta Street, but instead of continuing south on SW 70th Avenue to serve the southern portion of the Tigard Triangle, the alignment would turn west on SW Clinton Street to cross over SW Dartmouth Street and Highway 217 on a new light rail bridge with a multi-use path. The alignment would cross SW Hall Boulevard at grade south of Pacific Highway to approach downtown Tigard, and then would travel along a new street parallel to SW Main Street until the WES Commuter Rail tracks. The alignment would then turn south to run parallel to the WES tracks.

Alternative C3 would include one station in the Tigard Triangle, near SW 70th Avenue and SW Clinton Street, and one station near a reconfigured Tigard Transit Center. The Clinton and Tigard Transit Center Stations would both be at grade, and would both include three-level park and ride structures, which would have 425 and 275 spaces, respectively.

South of downtown Tigard, Alternative C3 would be identical to Alternative C1, including station locations and park and rides.

Alternative C4: Clinton to Railroad



This through-routed alternative would use the Clinton alignment between the Tigard Triangle and downtown Tigard, and the Railroad alignment between downtown Tigard and Bridgeport Village. The alignment, station locations, and park and rides for this alternative would be identical to Alternative C3 for those north of downtown Tigard and identical to Alternative C2 for those south of downtown Tigard.

Alternative C5: Ash and I-5 Branched

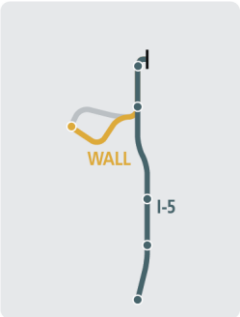
This branched alternative would use the Ash alignment for the Tigard branch and the I-5 alignment for the Bridgeport branch. North of the branch split point at the Beveland Station, this alternative would be identical to Alternative C1.

Routing and station locations for the Tigard branch of this alternative would be similar to those for Alternatives C1 and C2 between the Beveland and Tigard Transit Center Stations. Alternative C5 would include a 0.3-mile double-tracked tail track adjacent to the WES and freight rail tracks for operational flexibility and to access the Hunziker O&M Facility location.

The Bridgeport branch would extend south from the Beveland Station along the SW 70th Avenue right of way and cross over Highway 217 on a new light rail structure with a multi-use path. The alignment would continue south adjacent to Highway 217 and I-5 to the terminus at Bridgeport Village.

Alternative C5 would include the same station and park and ride locations as Alternative C1, and the same new auto, walking and biking crossing of the railroad at SW Ash Avenue.

Alternative C6: Wall and I-5 Branched



This branched alternative would use the Wall alignment for the Tigard branch and the I-5 alignment for the Bridgeport branch. In this alternative, the Tigard branch would extend west on SW Beveland Street and would cross over Highway 217 to connect to SW Wall Street at SW Hunziker Street. At the end of SW Wall Street, the alignment would turn northwest and run parallel to the WES/freight rail tracks to terminate near a reconfigured Tigard Transit Center, including an at-grade crossing of SW Hall Boulevard. The Bridgeport branch in this alternative would be identical to that of Alternative C5.

With the exception of the Tigard Transit Center Station, Alternative C6 would include the same station and park and ride locations as Alternative C1. The Tigard Transit Center Station would be at grade adjacent to the WES station and a reconfigured transit center with three tracks for operational flexibility. The station would include a three-level park and ride structure with 275 spaces.

Operations and Maintenance (O&M) Facility Options

The project would construct a new light rail O&M facility to accommodate the added 32 light rail vehicles in the TriMet system. There are two locations being considered for a light rail O&M facility in Tigard, one of which includes variations to pair with each route configuration. The Segment C alignment maps show the locations of these three O&M facility options (see Figures 2.3-5 and 2.3-6). See Figures A-29 and A-30 in Appendix A for more detailed maps of the O&M facility options.

The first location, the **Hunziker Facility**, would encompass about 20 acres near downtown Tigard adjacent to the freight rail tracks and SW Hunziker Street, and could serve any of the Segment C alignment alternatives. The facility layout would be designed to provide 9,000 feet of storage track for approximately 42 light rail vehicles (storage for 10 more vehicles than needed for the project to allow for system growth and operations flexibility) and accommodate most maintenance functions necessary to operate the light rail system, including 10 maintenance bays, a space for wheel truing, vehicle wash

area, a unit repair facility (for vehicle parts) and parts storage (both indoor and outdoor). The Hunziker Facility could accommodate additional storage tracks for up to 60 vehicles total to support additional system growth in the future. The Hunziker Facility would also include a surface parking lot for employees and fleet vehicles, administrative space to support the on-site operations, and on-site stormwater management. Up to 85 percent of the site would be improved with impervious surfaces, consistent with local zoning regulations for industrial development. Light rail vehicles would access this facility via switches on the main light rail alignment parallel to the WES and freight railroad tracks.

The second location, referred to as the 72nd Facility, would encompass about 17 acres southeast of the Tigard Triangle between SW 72nd Avenue and I-5. This location would provide the same facilities as the Hunziker Facility, but with slightly reduced storage and maintenance capacity. There are two options for the specific location and layout of this facility, depending on the light rail alignment:

- The **Through 72nd Facility** would be across from SW Landmark Lane and could serve the through-routed alternatives that would operate adjacent to I-5 south of Tigard (Alternatives C1 and C3). Light rail vehicles would access this facility via switches on the adjacent exclusive trackway to the south of the site (between SW 72nd Avenue and I-5).

- The **Branched 72nd Facility** would shift the facility slightly to the north to serve the branched alternatives (Alternatives C5 and C6). Light rail vehicles would access this facility via switches on the trackway adjacent to I-5.

Both 72nd Facility options would provide 7,500 feet of storage track for approximately 36 light rail vehicles, vehicle wash, parts storage (both indoor and outdoor), surface parking for employees and fleet vehicles, administrative space to support on-site operations and on-site stormwater management. Both options would improve up to 85 percent of the site with impervious surfaces, consistent with local zoning regulations for industrial development.

Station Access Improvement Options

There are six station access improvement options in Segment C that could be paired with any of the alignment alternatives (see Figure A-32 in Appendix A). These investments include adding bikeways, sidewalks and enhanced pedestrian crossings to improve walking and biking access to the proposed light rail stations.

Construction Activities

The anticipated construction activities associated with the light rail alternatives are summarized below and described in more detail in Appendix A. This information is based on conceptual design and typical construction practices. Construction practices will continue to be refined during the preliminary and final design stages.

Construction could begin as early as 2021 following a Record of Decision, final design and funding agreements. Although construction activities would occur over the length of the project during this time, the impact would not be continuous along the corridor for the full duration, because the project would likely be divided into various segments or line sections for construction.

Construction would include activities such as demolitions, utility relocations, construction of the light rail project elements, and stormwater treatments and landscaping. In addition, construction typically

requires staging areas for activities such as stockpiling materials, assembling project elements and locating construction field administration offices. Specific staging area locations will be identified when the project is in final design.

Where possible, construction activities would be coordinated with other capital improvement projects, including projects carried out by the local jurisdictions, to help minimize construction impacts. In addition, TriMet will actively engage with local jurisdictions as the project nears construction to develop a Conduct of Construction plan that would guide coordination throughout construction.

2.4. Minimum Operable Segment (MOS)

An MOS could be constructed as the first phase of the full-length light rail project, and would have the ability to function as a standalone project with logical termini until further extensions can be developed. This Draft EIS considers two MOS options: Tigard Transit Center and Bridgeport (see Figure 2.4-1). Both MOS options could use any of the alignment alternatives in Segments A and B. In Segment C, only the Branched Route (Alternatives C5 and C6) would be compatible with the Bridgeport MOS. These options were chosen because either would serve a majority of the corridor and provide benefits on a regional scale. Either MOS would substantially reduce costs, and could ultimately be extended to create a full-length alignment described in this Draft EIS.

Tigard Transit Center MOS

With the Tigard Transit Center MOS, the first phase of the light rail project would extend from downtown Portland to terminate at the Tigard Transit Center Station. This MOS would be compatible with either route configuration, though the applicable alignment alternatives would vary:

- **A Through Route** would use the Clinton or Ash alignment to reach the station at the Tigard Transit Center. The second phase would extend south between the station at the Tigard Transit Center and the Bridgeport Station, via either the Railroad or I-5 alignment.
- **A Branched Route** would use either the Ash or the Wall alignment to reach the Tigard Transit Center station. The second phase would extend south from the Tigard Triangle using the I-5 alignment for the Bridgeport branch to reach the Bridgeport Station.

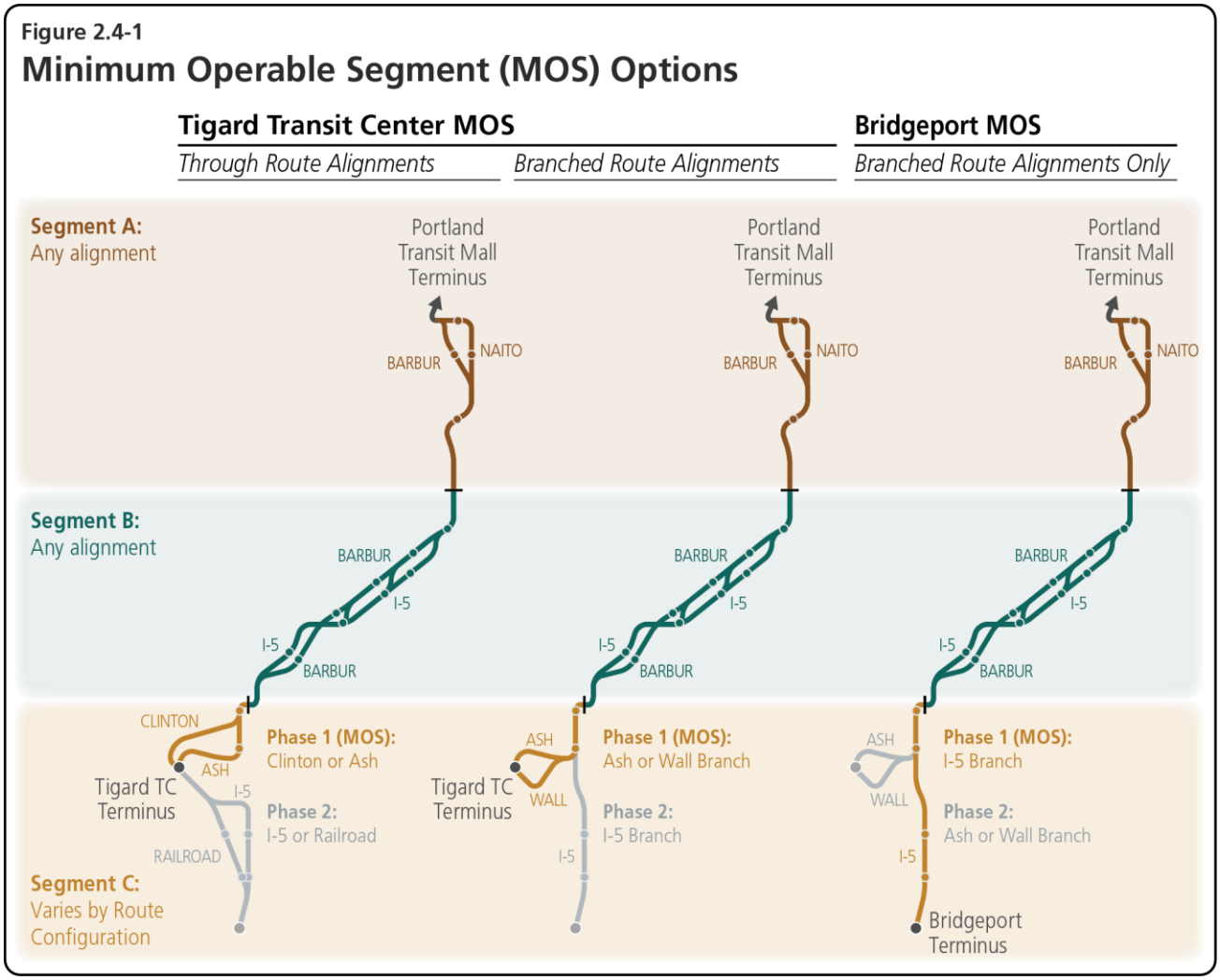
The Tigard Transit Center MOS would use the Hunziker Facility for the O&M facility. For the Clinton or Ash alignment, light rail tracks would extend beyond the station at the Tigard Transit Center to access the O&M facility. This MOS would include all park and rides in Segment B and those at the Baylor and Tigard Transit Center Stations in Segment C.

Bridgeport MOS

The Bridgeport MOS would extend light rail from downtown Portland to terminate at Bridgeport Village via the I-5 alignment for the Bridgeport branch in Segment C, which would connect the Beveland Station in the Tigard Triangle to the Bridgeport Station. The second phase would be the downtown Tigard branch between the Beveland Station and the Tigard Transit Center Station, via either the Ash or the Wall alignment.

Figure 2.4-1

Minimum Operable Segment (MOS) Options



The Bridgeport MOS would include the Branched 72nd Facility for the O&M facility. It would include all park and rides in Segment B and all in Segment C, except for the structure at the Tigard Transit Center, which would be constructed in the second phase.

2.5. Potential Design Refinements and Options

This section describes potential modifications to the light rail alternatives, including design refinements and other options. Figure 2.5-1 shows the general location of the design refinements and options. For more information, including more detailed maps, see Appendix E – Potential Design Refinement Concepts and Options.

Design Refinements

Based on the impact analysis conducted for this Draft EIS, TriMet, Metro and their partners developed six design refinements that would modify alignment alternatives to avoid or minimize impacts:

- Refinement 1: Barbur Woods East-Side Running
- Refinement 2: Taylors Ferry I-5 Overcrossing
- Refinement 3: I-5 Undercrossing

- Refinement 4: Barbur Undercrossing
- Refinement 5: Elmhurst
- Refinement 6: Tigard Transit Center Station East of Hall

Appendix E describes these refinements in more detail and provides a map of each refinement. Appendix E also discusses, at a general level, how these refinements could change the impacts of the alignment alternatives studied in this Draft EIS. Some of these design refinements would result in different property acquisition impacts, which are shown in Appendix F – Properties Affected by Acquisitions. If these refinements are included in the Preferred Alternative, the associated impacts will be analyzed in more detail in the Final EIS.

Bridgehead Reconfiguration Option

The Bridgehead Reconfiguration roadway changes along SW Naito Parkway and SW Kelly Avenue could be added to Alternative A1 as an option. Appendix E describes how the Bridgehead Reconfiguration would change the impacts of Alternative A1.

Alternative Station Location Options

Some different station location options could be considered to reduce impacts compared to the stations that are part of the alignment alternatives. These include:

- shifting the Naito Gibbs Station (Alternatives A2-BH and A2-LA) four blocks north to SW Hooker Street
- shifting the 30th Barbur Station (Alternatives B1 and B2) or 30th I-5 Station (Alternatives B3 and B4) four blocks north to SW 26th Way
- shifting the Beveland Station (Alternatives C1 and C2) around a corner to be on SW Beveland Street between SW 70th Avenue and SW 72nd Avenue

2.6. Initial Route Proposal

This Draft EIS identifies a draft Preferred Alternative, known as the initial route proposal, to give the public and federal, state and local agencies, and tribal governments an opportunity to comment on a full-length light rail alternative. After the close of public comments on the Draft EIS, input on the initial route proposal will inform the selection of the Preferred Alternative to study in the Final EIS (see Section 1.5, Next Steps, for more information).

The initial route proposal was developed by project partner staff based on information from the Draft EIS analysis and on public outreach. Chapter 5 – Evaluation of Alternatives provides more information on the impacts of the initial route proposal and the reasoning behind its selection.

Figure 2.5-1

Design Refinements and Alternate Station Locations

Design Refinements

1. Barbur Woods East-Side Running
2. Taylors Ferry At-Grade Crossing
3. I-5 Undercrossing
4. Barbur Undercrossing
5. Elmhurst
6. Hunziker

Alternate Station Locations

- **A** Hooker Station
- **B** 26th Station (Barbur or I-5)
- **C** Beveland Ash Through Station

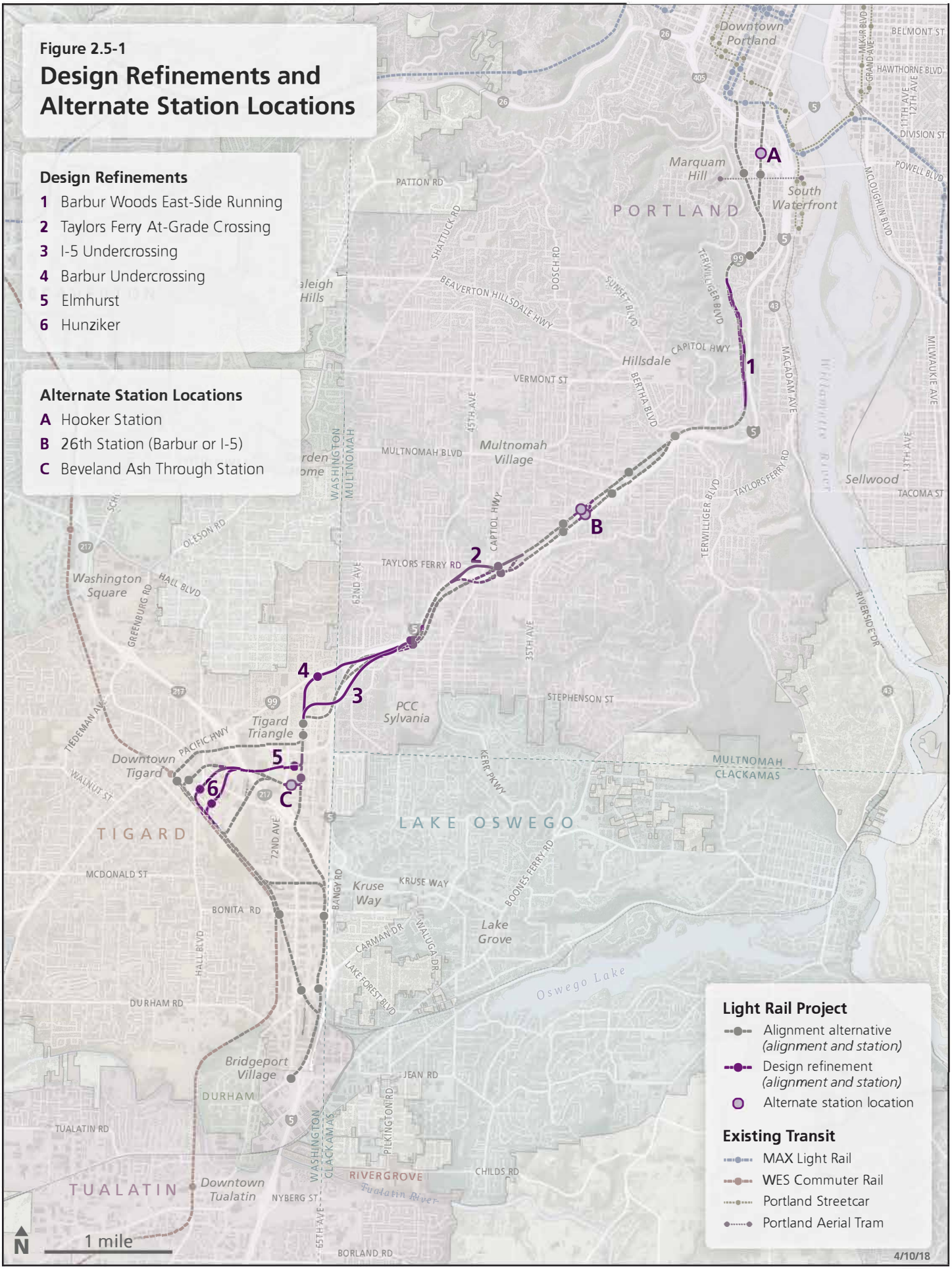


Table 2.6-1 and Figure 2.6-1 show the alignment alternatives, design refinements and additional project elements that are included in the initial route proposal. The initial route proposal is a 12-mile through-routed light rail line with 13 stations, a Marquam Hill connection, a PCC-Sylvania shuttle and an O&M facility. The initial route proposal includes up to seven park and rides with a likely range of 2,000 to 3,650 spaces. The initial route proposal would use 32 light rail vehicles operating as two-car train sets (16 sets) at headways of 7 to 15 minutes in 2035, depending on location and time of day. If there is insufficient funding to construct the entire light rail line, the MOS for the initial route proposal would terminate at the Tigard Transit Center.

Table 2.6-1. Initial Route Proposal Overview

Segment	Alignment Alternatives and Design Refinements[1]	Additional Project Elements
Segment A	Alternative A1: Barbur Refinement 1: Barbur Woods East-Side Running	Marquam Hill connection[2]
Segment B	Alternative B2: I-5 Barbur TC to 60th Refinement 2: Taylors Ferry I-5 Overcrossing Refinement 4: Barbur Undercrossing	PCC-Sylvania shuttle[2]
Segment C	Alternative C2: Ash to Railroad Refinement 5: Elmhurst Refinement 6: Tigard Transit Center Station East of Hall	Hunziker O&M facility

Note: O&M = operations and maintenance; PCC = Portland Community College; TC = Transit Center.

[1] The design refinements have not been analyzed at the same level of detail as the alignment alternatives in this Draft EIS. Design refinements would be incorporated into the Preferred Alternative in the Final EIS. Refinement 3, I-5 Undercrossing, was not selected because it was less promising than Refinement, 4 Barbur Undercrossing, which covers the same area.

[2] The design for the Marquam Hill connection and the PCC-Sylvania shuttle route will be selected before the Final EIS through a public process that will involve the institutions, neighborhoods and appropriate resource agencies.

The Southwest Corridor Light Rail Project will include a set of station access improvements that will be selected before the Final EIS is developed. If Alternative A1 is included in the Preferred Alternative, the Portland region will seek to fund and construct the Bridgehead Reconfiguration as a companion project.

Figure 2.6-1

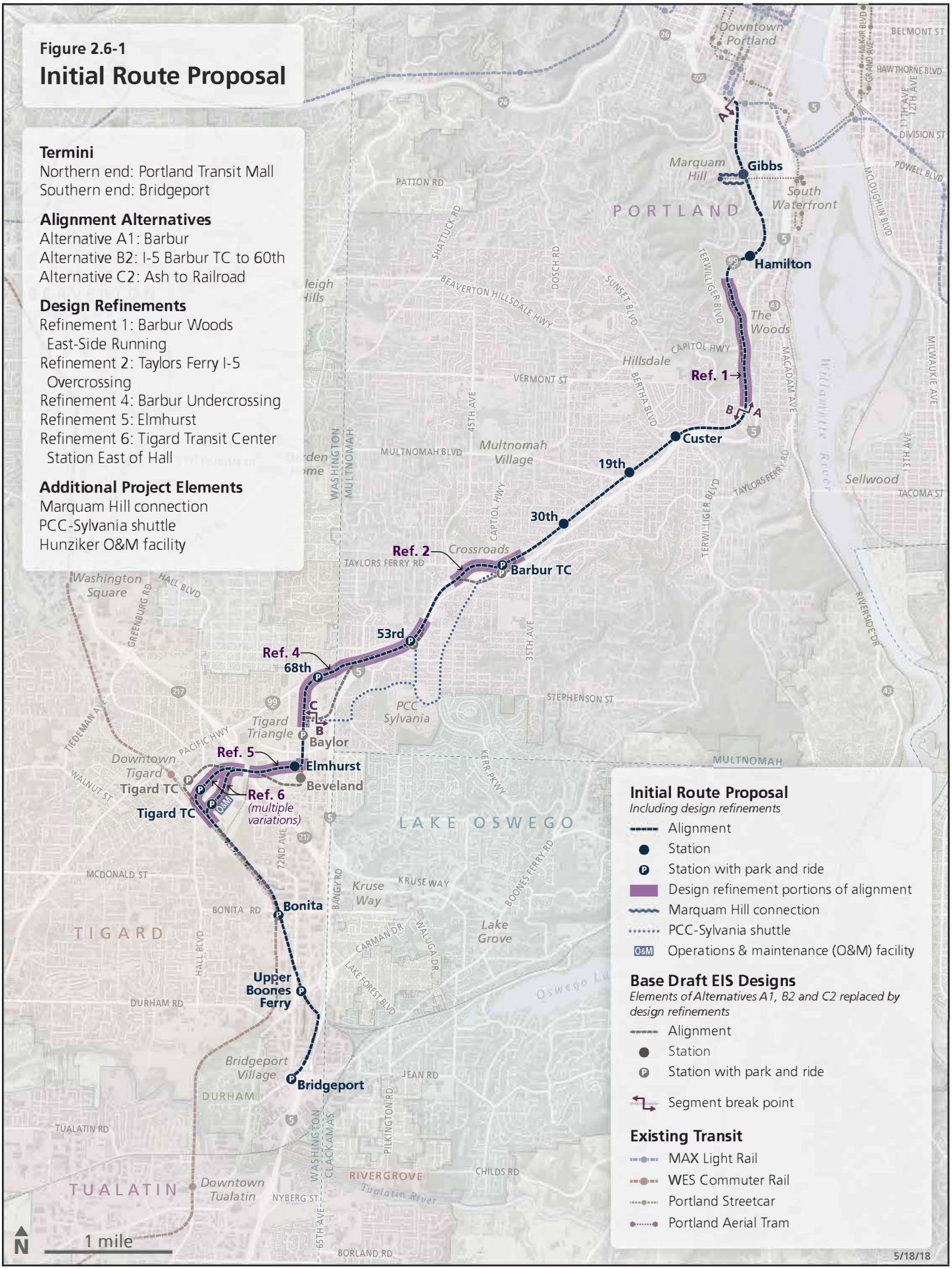
Initial Route Proposal

Termini
Northern end: Portland Transit Mall
Southern end: Bridgeport

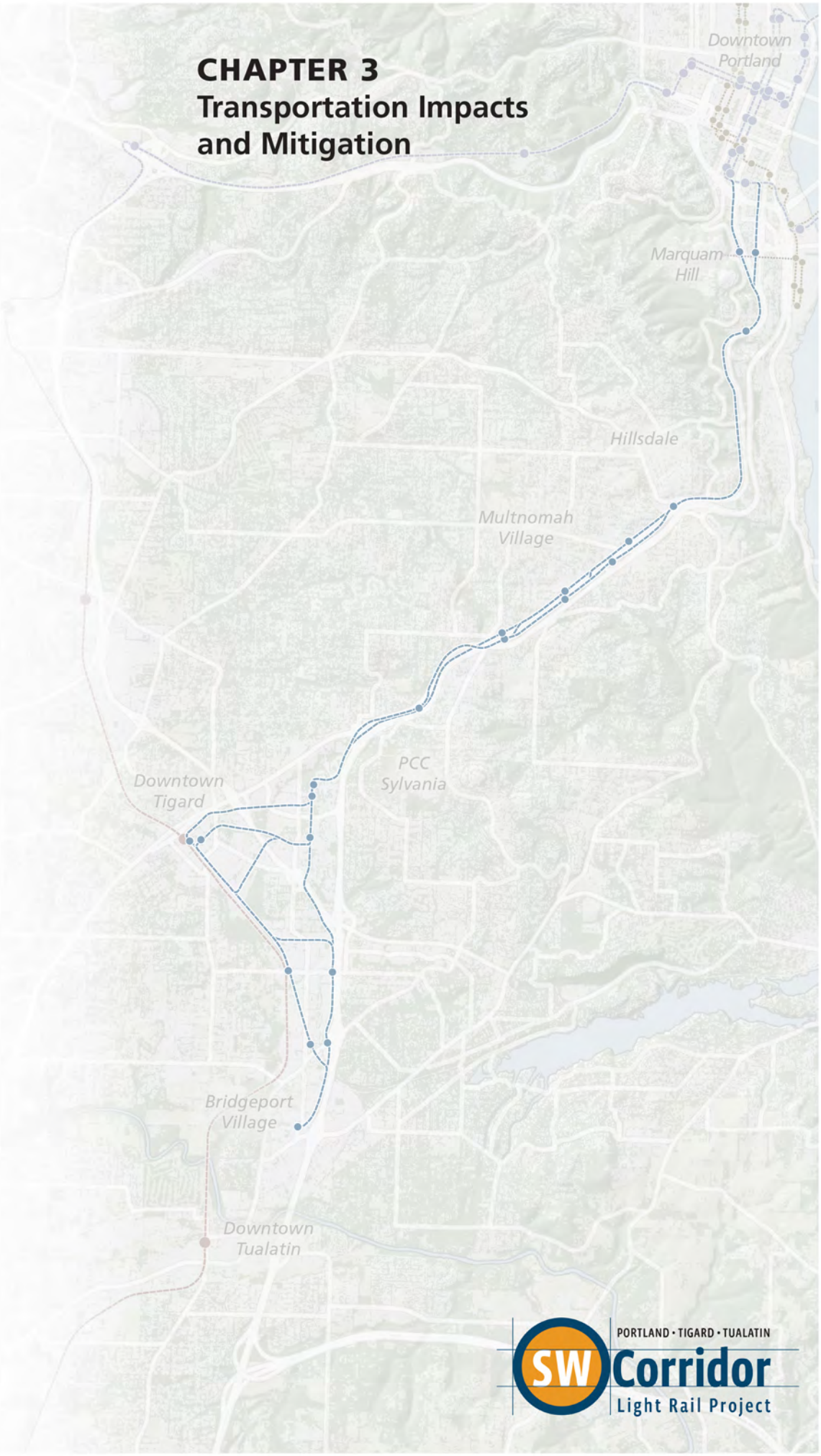
Alignment Alternatives
Alternative A1: Barbur
Alternative B2: I-5 Barbur TC to 60th
Alternative C2: Ash to Railroad

Design Refinements
Refinement 1: Barbur Woods East-Side Running
Refinement 2: Taylors Ferry I-5 Overcrossing
Refinement 4: Barbur Undercrossing
Refinement 5: Elmhurst
Refinement 6: Tigard Transit Center Station East of Hall

Additional Project Elements
Marquam Hill connection
PCC-Sylvania shuttle
Hunziker O&M facility



CHAPTER 3
Transportation Impacts and Mitigation



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Light Rail Project

3. TRANSPORTATION IMPACTS AND MITIGATION

Section		Page
3.1	Affected Environment	3-1
3.2	Transportation Impacts	3-9
3.3	Potential Mitigation Measures	3-25

This chapter summarizes the roles and functions of the various modes of transportation in the Southwest Corridor and describes the potential impacts and mitigation that could result from the project. The transportation analysis was based on a study area that includes the locations within the corridor where the project would have impacts to transit, walking, bicycling or traffic operations. The transportation study area was determined using traffic and travel demand models that identify locations where changes in transit ridership and traffic operations would be evident and that encompass walksheds to the proposed light rail stations. In addition to locations adjacent to the potential light rail alignments, the study area includes streets in the southern portion of downtown Portland and the interchange areas along Interstate 5 (I-5) between Interstate 405 (I-405) and SW Lower Boones Ferry Road. Mainline freeway operations on I-5 and I-405 would not be impacted by the project and were not included in the analysis.

The analysis of the transportation system considers:

- regional travel
- public transportation
- active transportation (pedestrians and bicyclists)
- motor vehicle operations
- on-street parking
- freight
- safety

More detail on existing conditions and transportation impacts is available in the *Transit Impacts and Travel Demand Forecasting Results Report* (Attachment A), and the *Transportation Impacts Results Report* (Attachment B). Detailed discussion of project impacts to emergency services can be found in Section 3.16, Public Services.

3.1. Affected Environment

This section summarizes the characteristics and performance of the existing transportation system in the corridor and in the region.

3.1.1. Regional and Corridor Travel

I-5 is the primary north/south route in the federal Interstate Highway System on the West Coast, serving travel between and within California, Oregon and Washington. In the Portland metropolitan area, I-5 is the major route serving vehicle trips between central Portland and the suburban communities of Tigard, Tualatin, Lake Oswego and Wilsonville, and points north and south. In 2015, the base year for the analysis in this chapter, daily bidirectional traffic volumes on I-5 in the corridor ranged from 120,000 to 165,000. Before the construction of I-5 in the 1960s, the major north/south highway route was Pacific Highway (99W), which includes parts of SW Barbur Boulevard. SW Barbur

Boulevard can serve as an alternate route when there are collisions or other traffic incidents on I-5. I-405 is a major north-south route within the corridor serving regional and local travel through downtown Portland, and connecting I-5 with US Highway 26 (U.S. 26). U.S. 26 is a major east-west route within the corridor connecting Washington County to southeast Portland and Gresham via the Ross Island Bridge.

3.1.2. Public Transportation

Transit service in the corridor is primarily provided by fixed-route, fixed-schedule buses operating in mixed traffic, and Westside Express Service (WES) Commuter Rail operating during peak hours between Beaverton and Wilsonville. The major frequent-service bus route (operating every 15 minutes or better all day) is the 12 Barbur line. The 94 Pacific Highway/Sherwood bus operates on weekdays between Sherwood and downtown Portland, and the 96 Tualatin/I-5 bus runs peak-hour, express service between Tualatin and downtown Portland. The 93 Tigard/Sherwood bus operates daily service connecting Sherwood to the Tigard Transit Center and the 97 Tualatin-Sherwood Road bus operates weekday service connecting Sherwood to the Tualatin WES station. Ride Connection, a private, nonprofit paratransit provider, operates two deviated fixed routes in Tualatin.

The Portland Aerial Tram connects the South Waterfront and Oregon Health & Science University (OHSU); the Portland Streetcar A and B Loops and N-S Line connect South Waterfront with central Portland; and the Metropolitan Area Express (MAX) Orange Line connects South Waterfront with downtown Portland, southeast Portland and Milwaukie.

Transit Lines, Operations and Facilities

The Tri-County Metropolitan Transportation District of Oregon (TriMet) has a current fleet of 683 buses that serve 81 bus lines and seasonal shuttles with 6,591 bus stops and 980 bus shelters. There are 180 miles of frequent-service bus lines on 13 routes that provide 15-minute or better service 7 days a week. The 60-mile-long MAX light rail system has 97 stations and also operates at least every 15 minutes. In addition to fixed-route bus and MAX service, TriMet operates 268 LIFT vehicles, which provide door-to-door service for people with special needs. TriMet operates three bus operations and maintenance (O&M) facilities and two rail O&M facilities.

Table 3.1-1 summarizes TriMet's fixed-route service. Overall, 90 percent of people within the TriMet district live within one-half mile of TriMet service.

Table 3.1-1. 2016 TriMet Fixed-Route Service Summary

	Streetcar	MAX LRT	Commuter Rail	Frequent Bus	Standard Bus
Routes	2	5	1	13	68
Length (miles)	16	60	15	180	784

Note: LRT = light rail transit.

Current Ridership

In Fiscal Year 2017, the TriMet system averaged 186,800 bus boardings, 123,200 light rail boardings and 1,800 WES Commuter Rail boardings. Additionally, LIFT service, which provides rides for elderly or disabled peopled, averaged 3,500 weekday boardings; streetcar service, operated by Portland

Streetcar Inc., averaged more than 15,000 weekday boardings; and the Portland Aerial Tram, operated by OHSU, averaged more than 8,500 weekday boardings.

3.1.3. Active Transportation

Active transportation refers to people traveling by walking or riding a bicycle. While the neighborhoods in Segment A were developed earlier than those in the other two segments and tend to feature sidewalks, many of the neighborhoods in the vicinity of Segment B and the Tigard Triangle portions of Segment C were developed in the 1950s and 1960s, and were not designed with sidewalks. Many sections of sidewalk throughout the corridor do not meet current local design guidelines.

In Segment A, north of SW Hamilton Street, SW Barbur Boulevard includes areas with substandard and discontinuous sidewalks, and SW Naito Parkway is a limited-access facility that includes sections with frontage roads and discontinuous sidewalks, and limited pedestrian crossing opportunities. South of SW Hamilton Street, on the east side of SW Barbur Boulevard, there are substandard and discontinuous sidewalks, and there are no sidewalks on the west side of the street except on structures. SW Barbur Boulevard has unprotected bicycle lanes adjacent to relatively high-speed traffic, and there are no bicycle lanes on the Newbury (SW Iowa Street) and Vermont trestle bridges. SW Naito Parkway has no bicycle lanes south of SW Lincoln Street. SW Barbur Boulevard and SW Naito Parkway do not meet the city's guidance for marked pedestrian crossing frequency.

In Segment B, SW Barbur Boulevard again has discontinuous and often substandard sidewalks. SW Multnomah Boulevard, southeast of SW Barbur Boulevard, does not have sidewalks but has some gravel shoulders. Although all public street intersections are considered to be legal pedestrian crossings, SW Barbur Boulevard has a limited number of marked or signalized crossings in Segment B. SW Barbur Boulevard has either a designated bicycle lane or paved shoulder generally available for bicycles except at a short section southbound just east of SW 19th Avenue and at the SW Multnomah Boulevard overcrossing. SW Barbur Boulevard does not meet the City of Portland's guidance for marked pedestrian crossing frequency.

In Segment C, the streets have varied sidewalk facilities within the study area. Many streets are low-volume, local facilities that do not have bicycle lanes. These streets are categorized in Table 3.1-2.

Table 3.1-2. Segment C Description of Existing Sidewalks and Streets with Bicycle Lanes

Streets with Full Sidewalks	Streets with Partial Sidewalks	Streets with No Sidewalks	Streets with Bicycle Lanes
SW Commercial St. SW Bonita Rd. SW Lower Boones Ferry Rd. SW Beveland St. (west of SW 72nd Ave.)	SW Atlanta St. SW Beveland St. (east of SW 72nd Ave.) SW Scoffins St. SW Landmark Ln. SW Hall Blvd. SW 70th Ave. SW 72nd Ave. SW Dartmouth St. SW Hunziker St. SW Hermoso St. SW Upper Boones Ferry Rd.	SW Baylor St. SW 69th Ave. SW Clinton St. SW Knoll Dr. SW Ash Ave.	SW Bonita Rd. SW Dartmouth St. (partial) SW Hall Blvd. SW Lower Boones Ferry Rd.

Figure 3.1-1 shows where there are gaps in pedestrian facilities in the corridor, and Figure 3.1-2 shows the gaps in the bicycle network in the corridor. The *Transportation Impacts Results Report* contains maps and details on marked pedestrian crossing spacing.

3.1.4. Motor Vehicle Operations

Intersection Operations

Project impacts to motor vehicle operations are identified based on two measures, volume-to-capacity (V/C)[1] ratio at intersections and queuing at intersections. The V/C ratio compares the number of vehicles making various movements at an intersection (e.g., through, right-turn and left-turn movements) with the capacity of the intersection to accommodate those movements. Local jurisdictions and transportation agencies typically have established targets that seek to achieve a V/C ratio of less than 1.0, which indicates that the intersection volume is equal to its capacity. However, in heavily congested areas such as downtown Portland and designated town centers, V/C ratios of up to 1.1 are acceptable during the peak hour provided they meet the second-hour target.

Queuing refers to vehicles lining up and potentially blocking adjacent intersections or stacking up on freeway off-ramps. Local jurisdictions and Oregon Department of Transportation (ODOT) have adopted targets for acceptable V/C ratios at intersections, whereas queuing is identified as a problem when intersections are blocked or queues spill onto the freeway mainline. The models used to evaluate V/C ratios at intersections do not account for traffic queuing back through intersections. To understand how the light rail alignment alternatives would impact queuing, Vissim and SimTraffic microsimulation models were developed to supplement the V/C analysis. Vissim was used to evaluate two particularly complex locations: Segment A and the Segment B intersections of SW Terwilliger Boulevard, SW Barbur Boulevard, SW Bertha Boulevard and the I-5 ramps. SimTraffic simulation models were used to evaluate queuing in the Crossroads area (the intersection of SW Capitol Highway, SW Barbur Boulevard, SW Taylors Ferry Road, and the I-5 ramps) and at I-5 interchanges in Segment C. Field observations were made on weekdays in the Spring of 2017 and they indicated traffic is variable in many locations in the corridor. The analysis presented in this chapter reflects the conditions for 2017 peak-hour traffic volumes based on the days observed. Most of the intersections within one-half mile of the alignment alternatives currently meet jurisdiction or agency targets in the AM and PM peak hours, except for:

In Segment A:

- SW Naito Parkway/on-ramp to the Hawthorne Bridge (PM – stop-controlled intersection)
- Ross Island Bridge on-ramps from SW Naito Parkway and SW Kelly Street (AM and PM – stop-controlled intersections)
- SW Corbett Avenue/SW Bancroft Street (PM – stop-controlled intersection)
- SW Corbett Avenue/SW Hamilton Street (AM and PM – stop-controlled intersection)

[1] The applicable measure of motor vehicle performance in the State of Oregon is volume to capacity (V/C) ratio. All jurisdictions in the corridor study area use V/C ratio except for the City Lake Oswego, which uses level of service (LOS). Consequently, LOS is reported for the one study intersection in Lake Oswego, and V/C ratio is reported for all other study intersections.

Figure 3.1-1

Existing Sidewalk Gaps

There are **more than 50 miles of missing sidewalks** on arterial and collector streets within a half mile of the light rail project alignments.

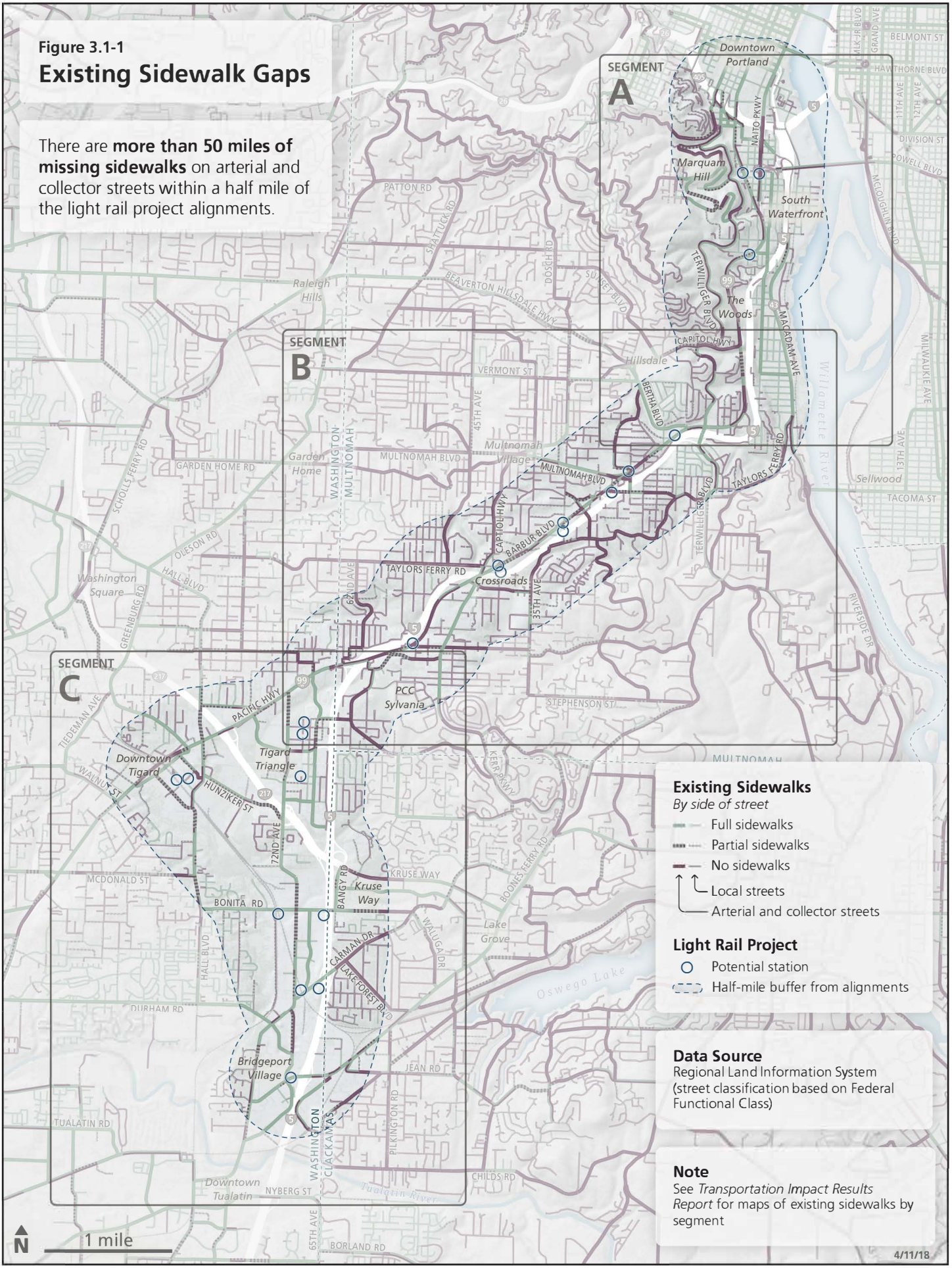
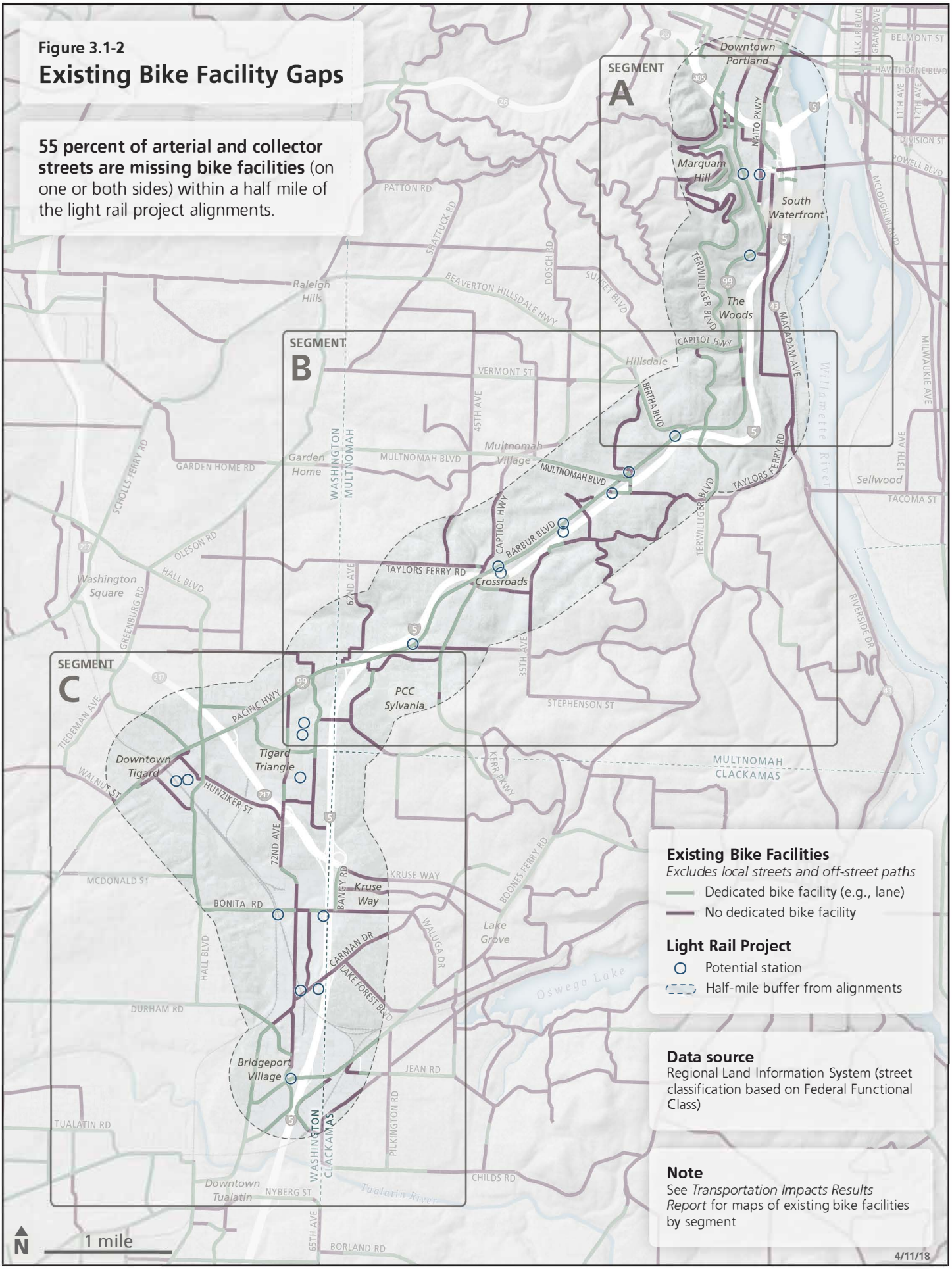


Figure 3.1-2

Existing Bike Facility Gaps

55 percent of arterial and collector streets are missing bike facilities (on one or both sides) within a half mile of the light rail project alignments.



In Segment B:

- SW Barbur Boulevard/SW 3rd Avenue (AM – signalized intersection)
- SW Barbur Boulevard/SW Terwilliger Boulevard (AM – signalized intersection)
- SW Barbur Boulevard/SW Bertha Boulevard/I-5 ramps (AM – signalized intersection)
- SW Terwilliger Boulevard/I-5 northbound off-ramp (PM – signalized intersection)
- SW Barbur Boulevard/SW 22nd Avenue (AM – stop-controlled intersection)
- SW Barbur Boulevard/SW 24th Avenue/I-5 southbound off-ramp (AM – signalized intersection)
- SW Barbur Boulevard/SW Barbur Court (north) (AM – stop-controlled intersection)
- SW Barbur Boulevard/SW Taylors Ferry Road/SW Baird Street (AM – stop-controlled intersection)
- SW Barbur Boulevard/SW Taylors Ferry Road/Barbur Transit Center (PM – signalized intersection)
- SW Taylors Ferry Road/I-5 southbound off-ramp (PM – stop-controlled intersection)
- SW Taylors Ferry Road/SW Capitol Highway (AM and PM – stop-controlled intersection)
- SW Barbur Boulevard/SW 64th Avenue/I-5 southbound off-ramp (PM – signalized intersection)

In Segment C:

- SW 65th Avenue/SW Haines Street/I-5 northbound off-ramp (PM – stop-controlled intersection)

Queuing

While traffic queuing at traffic signals and stop signs is often evident, in some instances the queues become so long that they inhibit the operation of motor vehicles, pedestrians and bicyclists. Locations identified with noticeable existing AM and PM peak hour queuing problems include:

In Segment A:

- access to the eastbound Ross Island Bridge from SW Naito Parkway and SW Kelly Street
- SW Hamilton Street at SW Barbur Boulevard
- SW Corbett Avenue at SW Hamilton Street

In Segment B:

- SW Barbur Boulevard at SW Terwilliger Boulevard
- SW Barbur Boulevard at SW Bertha Boulevard
- northbound I-5 off-ramp at SW Terwilliger Boulevard

In Segment C:

- SW Hall Boulevard at WES Commuter Rail crossing
- SW Carman Drive at northbound I-5 ramps
- SW Lower Boones Ferry Road at SW 72nd Avenue

3.1.5. On-Street Parking

In all three segments, there is limited on-street parking along the streets where light rail could run; street parking spaces are much more prevalent on side streets or in off-street lots. Table 3.1-3 shows the existing on-street parking locations and supply by segment and alignment alternative.

Table 3.1-3. Existing On-Street Parking Supply

Parking Location	Relevant Alignment Alternatives	On-Street Parking Supply	Parking Restrictions
Segment A: Inner Portland			
SW Barbur Blvd. south of SW Sheridan St.	A1	16	2-hour limit
SW Naito Pkwy. between SW Gibbs St. and SW Pennoyer St.	A2-LA, A2-BH	21	2-hour visitor parking 7 a.m.–6 p.m., Mon.–Fri.: Except by zone F permit
Segment B: Outer Portland			
SW Multnomah Blvd. southeast of SW Barbur Blvd.	B4	12	Assumed no legal parking adjacent to existing guardrail
SW Barbur Blvd. from SW 13th Ave. to SW Taylors Ferry Rd.	B1, B2	36	5 spaces near Original House of Pancakes are 2-hour limit
SW Barbur Blvd. from SW 13th Ave. to SW 26th Ave.	B3	27	5 spaces near Original House of Pancakes are 2-hour limit
SW Barbur Blvd. in the vicinity of SW 53rd Ave.	B1	25	2-hour parking for 5 spaces near SW 55th Ave.
Segment C: Tigard and Tualatin			
SW Dartmouth St. and SW 70th Ave.	C1, C2, C5, C6	29	None identified
SW Beveland St. west of SW 69th Ave.	C1, C2, C5, C6	63	Signed No Parking near the intersection of SW Beveland St. and SW 72nd Ave.
SW Ash Ave. from SW Scoffins St. to SW Commercial St.	C1, C2, C5	18	3 spaces near SW Scoffins St. signed No Parking 8:00 a.m.– 4:30 p.m.

3.1.6. Freight Facilities

Roadway Freight

Federal, state and local jurisdictions have the following freight route designation systems in the study area:

- The National Highway System (NHS) is a network of highways serving strategic economic, defense and transportation facilities such as ports, terminals and railway stations.
- The Oregon Highway Plan freight system list includes roadway design and mobility standards to accommodate trucks.
- Oregon Revised Statute (ORS) 366.215 specifies routes designated for oversized freight trucks, with planning, project development and maintenance requirements to ensure oversize freight movement is not restricted.
- Regional freight routes, which are designated by Metro, prioritize areas for investment in freight mobility.

- Portland and Tigard designate city freight routes. Portland's designation indicates that all truck types should be accommodated on those streets, where practicable. Tigard designates the most desirable routes for trucks, with supporting design standards for those streets.

In Segment A, SW Barbur Boulevard south of SW Naito Parkway, SW Naito Parkway and the Ross Island Bridge ramps are all part of the NHS, and they carry state and local freight designations as well. The NHS designation is consistent with transit access in that these routes are a national priority for being maintained in a state of good repair. The Ross Island Bridge and its ramps are designated by ORS 366.215 to accommodate oversize freight. In Segment B, SW Barbur Boulevard is part of the NHS and is a City of Portland freight route. In Segment C, none of the light rail alternatives are on designated freight routes, but they do cross freight routes.

Railroad Freight

There are no existing freight railroads within Segments A and B. Within Segment C, Portland and Western (P&W) Railroad is a short-line operator that provides freight rail service on tracks owned by Union Pacific Railroad to customers in Tigard and Tualatin with connections to Clatsop, Columbia and Washington counties; to the Union Pacific Railroad tracks at Willsburg Junction; and to points south within the Willamette Valley. All of the alignment alternatives in Segment C would be located adjacent to the Union Pacific tracks for at least a portion of their alignment.

3.1.7. Safety

Between 2011 and 2015, there were 41 serious injury collisions and 10 fatal collisions in the study area. This includes roadways within approximately one-quarter mile of potential light rail alignments. Three particular collision problem areas are: the Ross Island Bridge (8 of the serious injuries), SW Barbur Boulevard curves (4 of the fatal collisions) and Pacific Highway in Tigard between I-5 and Highway 217 (12 of the serious injuries). The alignment alternatives could modify operations at the Ross Island Bridge and the SW Barbur Boulevard curves near Fulton Park, while Pacific Highway in Tigard would not be modified.

3.2. Transportation Impacts

This section discusses how the No-Build Alternative and the light rail alternatives will affect travel patterns, public transportation, motor vehicle operations, active transportation (bicycle and pedestrian), and freight (roadway and rail).

The technical analysis described here uses traffic and other travel data generated for a 2035 forecast year using Metro's regional travel demand model. The travel forecast is consistent with the adopted regional growth forecast and Metro's *2014 Regional Transportation Plan*. In addition to the 2035 forecast, the Federal Highway Administration (FHWA) and ODOT requested that locations where the project could impact freeway ramp terminal operations be analyzed using forecasted traffic volumes that represent 20 years from the day of project opening. For those locations, a 2045 traffic forecast year was used to meet their standards.

3.2.1. Roadway System Impacts

The system-wide analysis reviews motor vehicle travel patterns, including changes to circulation patterns as well as the potential for traffic to divert to other streets. The analysis considers existing conditions for comparison, but it reflects future travel conditions with and without the project (No-Build Alternative compared to the light rail alternatives). Future traffic levels would be higher than today in all segments for the No-Build Alternative as well as for the light rail alternatives. However, future traffic levels would generally be lower with the light rail alternatives than with the No-Build Alternative.

Segment A: Inner Portland

There are three streets in Segment A where light rail would substantially increase traffic compared to the No-Build Alternative:

- **SW Corbett Avenue**. All of the alignment alternatives except Alternative A2-LA would increase traffic on SW Corbett Avenue between SW Bancroft Street and SW Hamilton Street by up to 70 percent, because all of the alignment alternatives except Alternative A2-LA would relocate the southbound left turn on SW Barbur Boulevard from SW Hamilton Street to SW Bancroft Street, and those trips turning left from SW Barbur Boulevard traveling south on SW Corbett Avenue would add traffic for this one-block segment. This increase would be accompanied by a corresponding reduction on SW Barbur Boulevard of up to 15 percent.

- **SW 1st Avenue**. Alternative A2-BH would increase traffic by up to 86 percent on SW 1st Avenue north of SW Arthur Street due to the rerouting of trips from SW Naito Parkway with the Ross Island Bridgehead Reconfiguration option. Alternative A1 with the Bridgehead Reconfiguration option would be similar.

- **SW Kelly Avenue**. Alternative A2-BH would increase traffic by up to 33 percent on SW Kelly Avenue east of SW 1st Avenue due to the rerouting of trips from SW Naito Parkway with the Ross Island Bridgehead Reconfiguration option. Alternative A1 with the Bridgehead Reconfiguration option would be similar.

With Alternative A2-BH (or Alternative A1 with the Bridgehead Reconfiguration option), traffic on SW 1st Avenue and SW Kelly Avenue would increase, while traffic would be reduced on SW Naito Parkway by up to 59 percent, compared to the No-Build Alternative. This traffic redistribution would result from the changes in access to the Ross Island Bridge included in this alternative.

Segment B: Outer Portland

North/south traffic volumes on streets crossing a SW Vermont Street/SW Sunset Boulevard screenline and a SW Taylors Ferry Road screenline would be about 1 percent less with the light rail alternatives than with the No-Build Alternative. Two streets would have up to 9 percent lower traffic than the No-Build Alternative: SW Capitol Highway (AM peak hour) and SW Taylors Ferry Road (PM peak hour).

Segment C: Tigard and Tualatin

Most streets in Segment C would see no significant difference in traffic volumes between the No-Build Alternative and the light rail alternatives. For all of the Segment C alignment alternatives, there would

be slightly more traffic on SW Boones Ferry Road at the Tualatin River because of trips to the park and rides at the Bridgeport Station and Upper Boones Ferry (I-5 or Railroad) Station.

Alternative C6 would create a new motor vehicle overcrossing of Highway 217 at SW Beveland Street, which would increase traffic on several streets. Traffic would increase by up to 25 percent on SW 72nd Avenue and on SW Hunziker Street, both north of SW Beveland Street. South of SW Beveland Street, those same two streets would see traffic drop by up to 13 percent on SW 72nd Avenue and up to 57 percent on SW Hunziker Street compared to the No-Build Alternative. Traffic would increase by nearly 20 percent on SW Dartmouth Street between SW 72nd Avenue and SW 68th Avenue with the new overcrossing.

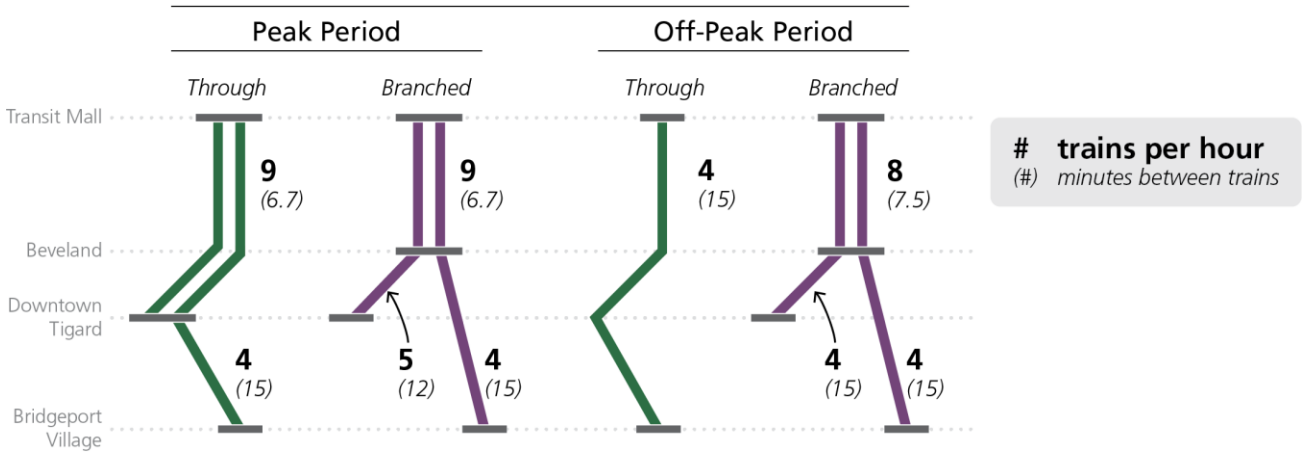
3.2.2. Public Transportation Impacts

The impacts analysis for public transportation focuses on transit operations and performance, looking at the full length of the corridor. There are two route configurations for the full corridor: light rail trains would operate either continuously through Tigard to the Bridgeport Station terminus (the Through Route), or they would branch off into two lines in the Tigard Triangle, with some trains terminating at the Tigard Transit Center and others continuing on to the Bridgeport Station (the Branched Route). See Chapter 2 – Alternatives Considered for descriptions of the individual alignment alternatives that comprise each configuration, and see the *Transit Impacts and Travel Demand Forecasting Results Report* (Metro, 2018) for details on the supporting bus networks.

Service Levels

Figure 3.2-1 illustrates the service frequencies for each route configuration. With the Through Route, nine trains per hour would travel to downtown Tigard during peak periods in 2035, with four of those trains continuing to Bridgeport Village. In off-peak periods, all trains (four per hour) would travel to Bridgeport Village. With the Branched Route, each branch would be required to meet TriMet's 15-minute frequency policy (four trains per hour); where the branches overlap north of downtown Tigard, this would result in twice as many trains operating during the off-peak period as with the Through Route.

Figure 3.2-1. 2035 Through Route and Branched Route Service Frequency



Travel Time

Compared to the No-Build Alternative, in 2035 light rail would reduce the PM peak-hour in-vehicle transit travel time from Portland State University to Bridgeport Village from 38 minutes (via TriMet bus line 96 Tualatin Express) to 29 minutes with the Branched Route or 33 minutes with the Through Route. The difference in light rail frequencies between the Through Route and the Branched Route would affect the wait times and result in differences in total travel time.

In peak periods, the Branched Route would have less frequent service in downtown Tigard than the Through Route. All Through Route trains would stop in downtown Tigard, resulting in nine trains per hour during the peak period in 2035. With the Branched Route, four of those trains would serve the Bridgeport branch, leaving five trains per hour serving downtown Tigard. The result would be longer waiting times for riders using the Tigard Transit Center Station with the Branched Route.

Reliability

Light rail lines in the TriMet system use reserved or exclusive right of way and exhibit greater percentages of on-time arrivals than do buses operating in mixed traffic. Table 3.2-1 summarizes three measures of transit reliability in the corridor: miles of exclusive or reserved right of way (light rail), the number of passenger miles that would occur in that right of way, and the percentage of passenger miles that would occur in that right of way. The light rail alignment on SW Barbur Boulevard between downtown Portland and the SW Capitol Highway ramps would be paved to accommodate buses as well as light rail. Use of this shared transitway would allow buses to avoid congestion and improve travel times and reliability. TriMet bus line 54 is assumed to operate on the shared transitway, and its riders are included in the table's calculations.

Table 3.2-1. Transit Reliability - Transit Passenger Miles in Exclusive Right of Way[1] – Year 2035

Measure	No-Build	Through Light Rail	Branched Light Rail
Miles of light rail	0	13	12
Average weekday passenger miles in exclusive right of way	0	255,400	243,400
Percentage of total corridor transit passenger miles in exclusive right of way	0%	55%	54%

Source: Metro, 2018

[1] Excludes downtown Portland.

Southwest Corridor Light Rail Project and Light Rail System Ridership

The light rail ridership presented in Table 3.2-2 below shows 2035 forecast average weekday boardings for the light rail lines in the TriMet system, including the Southwest Corridor Light Rail Project. The Through Route is forecast to have 41,600 daily light rail riders, with an additional 8,900 bus riders utilizing the shared transitway. The Branched Route is forecast to have 43,200 daily light rail riders, with an additional 8,800 bus riders on the shared transitway. The higher ridership on the Branched Route is chiefly because of the more frequent off-peak service along much of the alignment (see Figure 3.2-1).

Most existing light rail lines would experience changes in ridership with the introduction of the project. Ridership on the MAX Green Line, however, is projected to increase by more than 10 percent,

demonstrating the effect of interlining the Green Line with the Southwest Corridor line and allowing riders to access the corridor without transferring.

Table 3.2-2. Average Weekday Light Rail Ridership – Year 2035

Measure	No-Build	Through Light Rail	Branched Light Rail
Southwest Corridor Light Rail Project	N/A	41,600	43,200
Portland-Milwaukie MAX (Orange Line)	23,000	23,000	23,000
East-West MAX (Blue Line) Eastside	57,800	59,500	59,700
East-West MAX (Blue Line) Westside	62,300	61,600	61,700
Airport MAX (Red Line) Eastside	26,700	27,600	27,700
Airport MAX (Red Line) Westside	25,200	24,500	24,600
I-205 MAX (Green Line)	52,900	58,700	58,700
Interstate MAX (Yellow Line)	41,100	41,400	41,500

Note: I-205 = Interstate 205, N/A = Not Applicable.

Corridor and Total System-Wide Ridership

With the light rail alternatives, total transit ridership in the corridor, including riders on light rail, buses and commuter rail in the corridor, would be 8 percent greater than with the No-Build Alternative (see Table 3.2-3). Total system-wide transit ridership would increase over the No-Build Alternative by 17,800 to 18,600 average weekday trips.

Table 3.2-3. Average Weekday Total System-wide and Southwest Corridor Transit Trips – Year 2035

Measure	Existing (2015)	No-Build	Through Light Rail	Branched Light Rail
Total corridor transit trips (originating rides)	132,500	227,800	244,900	245,600
Change from existing Percentage change from existing	N/A	95,300 72%	112,400 85%	113,100 85%
Change from No-Build Percentage change from No-Build	N/A	N/A	17,100 8%	17,800 8%
Total system-wide transit trips	311,700	563,900	581,700	582,500

Source: Metro, 2018

Note: N/A = Not Applicable.

Transit Trip Productions

Figure 3.2-2 shows the change in the number of transit trips produced by location with introduction of light rail in the corridor (based on the Through Route compared to the No-Build Alternative). The map shows where the volume of transit trips produced would increase with the project, and conversely, where the number of transit trips would decrease.

The ridership forecasts were prepared using Metro's regional travel demand model, which divides the region into more than 2,000 geographic units known as transportation analysis zones (TAZs). Of the 180 TAZs in the corridor, 114 zones would see an increase of more than 20 average weekday transit trips compared to the No-Build Alternative, for a total of 11,150 additional transit trips with the project. Two zones in the corridor would see a reduction of more than 20 transit trips, for a total of 62 fewer transit trips. In addition, 66 zones outside of the corridor would gain more than 20 transit trips, for a total of 2,480 new transit trips. In general, the increase in transit trips would be a result of improvements in travel times and accessibility with the proposed light rail line.

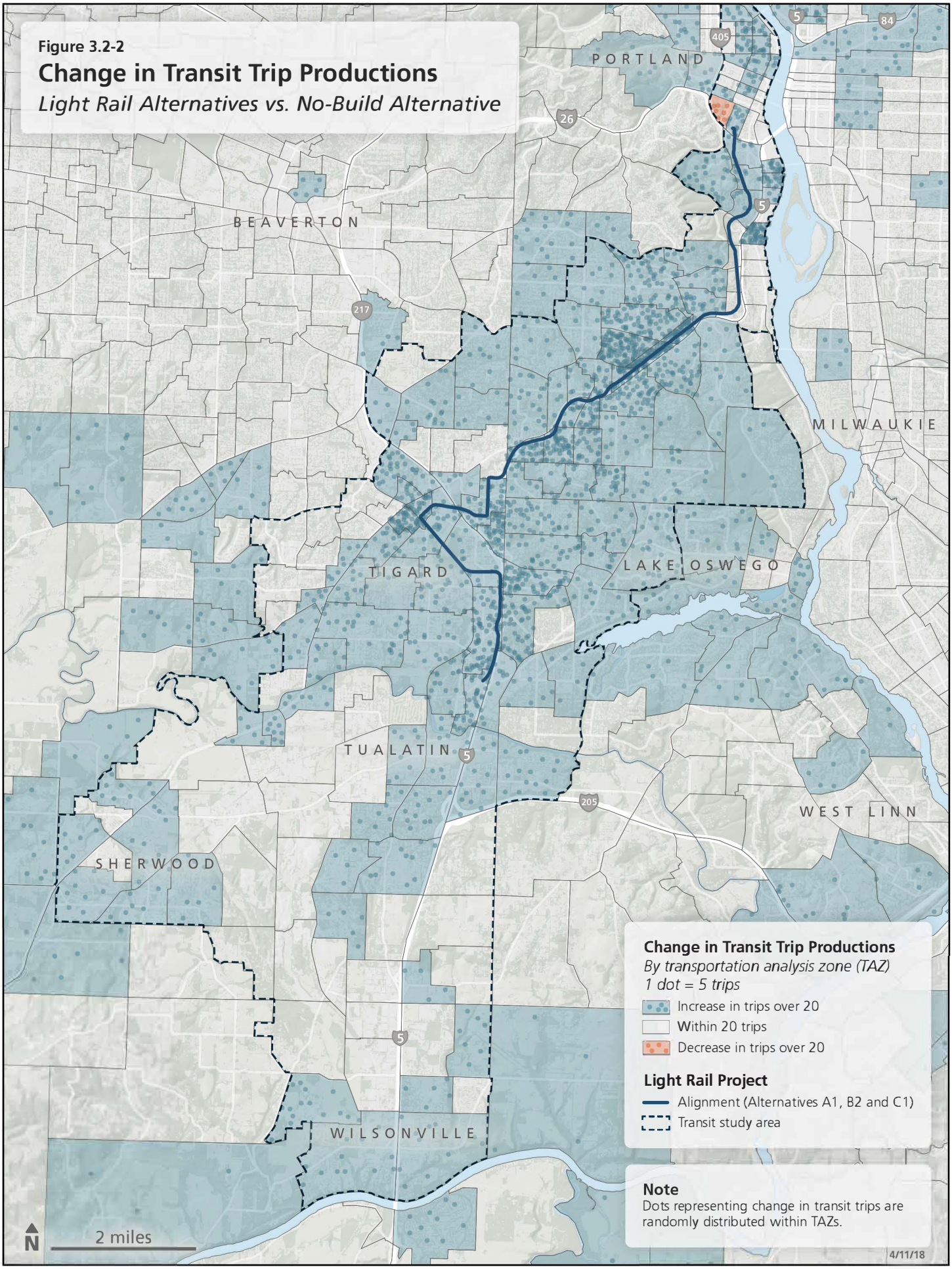


Figure 3.2-2
Change in Transit Trip Productions
Light Rail Alternatives vs. No-Build Alternative
PORTLAND
BEAVERTON
TIGARD
LAKE OSWEGO
MILWAUKIE
TUALATIN
SHERWOOD
WEST LINN
WILSONVILLE
5
26
217
405
84
205
Change in Transit Trip Productions
By transportation analysis zone (TAZ)
1 dot = 5 trips
Increase in trips over 20
Within 20 trips
Decrease in trips over 20
Light Rail Project
Alignment (Alternatives A1, B2 and C1)
Transit study area
Note
Dots representing change in transit trips are randomly distributed within TAZs.
N
2 miles
4/11/18

The reduction in transit trips for certain TAZs would be the result of modifications that are assumed to occur to local bus service with the project (bus routing changes are described in the *Transit Impacts and Travel Demand Forecasting Results Report* (Metro, 2018). TriMet will make final bus service decisions before implementation of light rail in the corridor.

Work and Non-Work Transit Trips and Mode Share

Table 3.2-4 shows corridor transit trips and transit mode share (percentage of trips choosing to ride transit for a given trip) for trips produced in the Southwest Corridor that would be destined to the Portland central business district (CBD) for work and non-work purposes. The CBD is projected to have nearly 90,000 jobs in 2035, accounting for 28 percent of the jobs in the corridor. Full-corridor light rail combining alignment alternatives in Segments A, B and C would have a higher transit mode share for both home-based work and non-work trips destined to the CBD than the No-Build Alternative.

Table 3.2-4. Average Weekday Work and Non-Work Corridor Transit Trips and Transit Mode Share to Portland CBD – Year 2035

Measure	Existing (2015)	No-Build	Through Light Rail	Branched Light Rail
Home-Based Work[1]				
Transit Trips	5,470	9,750	11,330	11,320
Total Person Trips	16,000	21,970	21,970	21,970
Mode Share	34%	44%	52%	52%
Non-work[2]				
Transit Trips	4,810	10,400	11,440	11,710
Total Person Trips	48,530	67,180	67,180	67,180
Mode Share	10%	15%	17%	17%
Total				
Transit Trips	10,280	20,150	22,770	23,030
Total Person Trips	64,530	89,150	89,150	89,150
Mode Share	16%	23%	26%	26%

Source: Metro, 2018.

[1] Home-based work trips are defined as trips taken directly between one's home and one's place of work.

[2] Non-work trips are defined as all trips that are not home-based work trips.

3.2.3. Station Usage

The most frequently used station with the Through Route would be the Tigard Transit Center Station, which would have 20 percent of the total corridor light rail on-and-off activity. With the Branched Route, where one branch would terminate at the Tigard Transit Center and would not connect directly to the Bridgeport Station, the Tigard Transit Center Station would have 11 percent of the total corridor light rail on-and-off activity. Between 53 and 61 percent of the riders at the Tigard Transit Center Station would transfer to or from light rail via bus. The Gibbs Barbur Station (or Gibbs Naito Station) in Portland, where riders could access the Marquam Hill connection, is forecast to have 15 to 16 percent of the total corridor light rail on-and-off activity, making it the busiest station with the Branched Route and the second busiest with the Through Route. Station-level on-and-off activity, and the related access mode, are included in Table 3.4-4 in the *Transit Impacts and Travel Demand Forecasting Results Report* (Metro, 2018).

3.2.4. Active Transportation Impacts

With the No-Build Alternative, pedestrian and bicycle activity would increase with the forecast residential and employment growth in the corridor. While the No-Build Alternative would include some localized bicycle and pedestrian facility improvements, no major corridor-wide investments to improve facilities would be included.

The light rail alternatives would include new or improved pedestrian and bicycle facilities in all three segments from Inner Portland to Tualatin. All of the in-street segments of the light rail alignments would feature sidewalks, bicycle lanes or adjacent trails and marked crossings; there would be improved crossings of I-5 in several locations; and there would be a new crossing of Highway 217. These new and improved facilities would fill in existing gaps in the pedestrian and bicycle facilities in the corridor, and would attract increased pedestrian and bicycle activity on the streets and structures. Areas near light rail transit stations would see increased pedestrian activity from transit riders accessing the stations.

In Segment B, because Alternative B1 would travel in SW Barbur Boulevard from SW Brier Place to SW 60th Avenue, it would provide the most marked pedestrian crossings. Alternatives B2 and B3 would spend less time in the median of SW Barbur Boulevard and would provide somewhat fewer marked crossings. Alternative B4, which would leave SW Barbur Boulevard at SW 13th Avenue, would provide the fewest marked crossings of the Segment B alignment alternatives.

Compared to the No-Build Alternative, in all segments, the project would substantially increase the number of marked crossings, add ramps that are compliant with the Americans with Disabilities Act, and improve safety and reduce the risk of unsafe crossings that result from the current long distance between marked crosswalks. Many locations also would feature improved intersections and signals. In addition, the light rail alternatives would improve bicycle facilities throughout the corridor and eliminate existing gaps in the bicycle facilities. Locations where bicycles would cross the light rail tracks would be designed to minimize the risk of bicycle tires getting caught in the trackway.

Marquam Hill Connection Options

OHSU and other facilities on Marquam Hill are a major concentration of employment and medical services for the Portland metropolitan area. Four connection options were analyzed for improving the connection between the OHSU Kohler Pavilion and the proposed SW Gibbs Street light rail station at SW Barbur Boulevard (for Alternative A1: Barbur) and at SW Naito Parkway (for Alternatives A2-BH: Naito with Bridgehead and A2-LA: Naito with Limited Access). All four connection options would improve pedestrian and bicycle accessibility between the OHSU campus, SW Barbur Boulevard, SW Naito Parkway, the Darlene Hooley pedestrian bridge over I-5 and the surrounding neighborhoods. The Marquam Hill connection options are described in detail in Appendix A – Detailed Maps and Descriptions of Light Rail Alternatives.

PCC-Sylvania Shuttle Options

The light rail alternatives would improve SW 53rd Avenue to provide a safe pedestrian and bicycle connection between the 53rd Avenue light rail station and the Portland Community College (PCC) Sylvania campus. Improvements would include pavement, sidewalks and lighting. The PCC-Sylvania shuttle options are described in detail in Chapter 2 – Alternatives Considered.

Station Access Improvement Options

In all three segments, the project would include additional station access improvements featuring a mix of bicycle lanes, sidewalks, marked pedestrian crossings and shared-use bicycle routes. Segment B also has options for a bicycle/pedestrian bridge over I-5. The station access improvements would increase pedestrian and bicycle trips from neighborhoods to the light rail stations. They would all be designed to meet current standards, including Americans with Disabilities Act requirements. They would connect to the pedestrian and bicycle facilities along the alignment alternatives as well, making walking and bicycling easier and safer along the Southwest Corridor. The station access improvement options are described in detail in Appendix A – Detailed Maps and Descriptions of Light Rail Alternatives.

3.2.5. Motor Vehicle Operations Impacts

The analysis of motor vehicle operations focuses on intersections. It combines regional travel forecasts and traffic analysis and simulation models to predict future conditions in the year 2035 (and 2045 for freeway ramps) for the No-Build Alternative and for the light rail alternatives. The *Transportation Impacts Results Report* (Metro, 2018) provides more detail on the types of models that were used and the technical results. Mobility targets are determined by the operating jurisdiction or agency, and typically use V/C measures.

Segment A Intersection Analysis

The No-Build Alternative would have five locations where intersections would not meet operating targets in 2035. In some cases, the light rail alternatives would improve the intersection operations, and in others the intersection operations would be similar or slightly worse than with the No-Build Alternative (see Table 3.2-5). When intersections are operating below targets, delays increase as cars wait through several signal cycles to pass through an intersection.

In some cases, Segment A alignment alternatives would change specific travel patterns but would not increase the total volume of travel in the segment. Alternatives A1 and A2-BH would have a new traffic signal with a southbound left-turn lane from southbound SW Barbur Boulevard to SW Bancroft Street, closing the southbound left turn at SW Hamilton Street, while Alternative A2-LA would maintain the existing southbound left turn at SW Hamilton Street. Modifications to street classifications in the City of Portland *Transportation System Plan* may be required for SW Corbett Avenue and SW Bancroft Street.

Alternative A2-BH (and Alternative A1 with the Bridgehead Reconfiguration option) would establish new access routes to and from the Ross Island Bridge, increasing volumes along SW 1st Avenue and SW Kelly Street, while reducing volumes on SW Naito Parkway and several neighborhood streets. Alternative A2-BH (and Alternative A1 with the Bridgehead Reconfiguration option) would also improve operations compared to the No-Build Alternative at the eastbound Ross Island Bridge access from SW Naito Parkway.

Table 3.2-5. Segment A Intersections Not Meeting V/C Mobility Targets for Forecast Year 2035

Intersection	Operating Target (V/C)	No-Build	A1: Barbur*	A2-BH: Naito Bridgehead	A2-LA: Naito Limited Access
Ross Island Bridge access at SW Naito Pkwy.	0.99	1.56 (AM)[S] >2 (PM)[S]	1.56 (AM)[S] >2 (PM)[S]	0.87 (AM) 0.89 (PM)	1.56 (AM)[S] >2 (PM)[S]
Ross Island Bridge access at SW Kelly Ave. Ramps	0.99	1.18 (AM)[S] >2 (PM)[S]	1.18 (AM)[S] >2 (PM)[S]	0.66 (AM) 0.99 (PM)	1.18 (AM)[S] >2 (PM)[S]
SW Naito Pkwy. and SW Harrison St.	0.99	0.74 (AM) 0.91 (PM)	0.78 (AM) 0.87 (PM)	0.78 (PM)[3]	1.01 (PM)[3]
SW Naito Pkwy. and SW Gibbs St.	0.99	0.04 (AM)[S] 0.54 (PM)[S]	0.65 (PM)[S 1]	0.74 (AM) 0.90 (PM)	1.00 (PM)[3]
SW Barbur Blvd. and SW Bancroft St.	0.99	1.00 (AM)[S] 0.18 (PM)[S]	1.10 (AM) 0.90 (PM)	1.10 (AM) 0.84 (PM)	0.50 (PM)[S 1]
SW Barbur Blvd. and SW Hamilton St.	0.99	0.99 (AM) 0.99 (PM)	1.09 (AM) 0.97 (PM)	1.09 (AM) 0.97 (PM)	0.99 (AM) 1.00 (PM)
SW Corbett St. and SW Bancroft St.	0.99	0.29 (AM)[S] 1.34 (PM)[S]	0.69 (PM)[2†]	0.48 (AM)† 0.42 (PM)†	1.39 (PM)[S 1]
SW Corbett St. and SW Hamilton St.	0.99	1.52 (AM)[S] 1.39 (PM)[S]	0.75 (PM)[2†]	0.89 (AM)† 0.63 (PM)†	0.64 (PM)[3†]

Note: Shading indicates intersections where mitigation would be considered.

* Alternative A1 with the Bridgehead Reconfiguration option was analyzed separately. Its performance is comparable to that of Alternative A2-BH and is documented in the *Transportation Impacts Results Report*.

[S] Stop-controlled intersection; V/C ratio for the worst approach is reported.

† Analysis assumes the traffic signal that is required as mitigation.

[1] PM only analyzed for this intersection. AM operations would be similar to No-Build Alternative.

[2] PM only analyzed for this intersection. AM operations would be similar to Alternative A2-BH.

[3] PM only analyzed for this intersection.

Segment A Queuing

Several locations in Segment A were identified where there would be queuing impacts with the light rail alternatives compared to the No-Build Alternative:

- Southbound left-turn PM peak-hour queues on SW Barbur Boulevard at SW Bancroft Street would overflow the 500-foot left-turn storage included in the project plan sheets (Alternatives A1 and A2-BH)
- Southbound through PM peak-hour queues on SW Naito Parkway at SW Lincoln Street that extend through upstream intersections (Alternative A2-BH and Alternative A1 with the Bridgehead Reconfiguration option)
- Queues on the one-lane ramp from northbound SW Macadam Avenue to the intersection of SW Kelly Avenue and SW Porter Street would limit the operations of the downstream traffic signal (Alternative A2-BH and Alternative A1 with the Bridgehead Reconfiguration option)
- The westbound and southbound queues approaching the intersection of SW Naito Parkway and the Ross Island Bridge (SW Woods Street) would overflow the two-lane approaches, limiting operations at the traffic signal (Alternative A2-BH and Alternative A1 with the Bridgehead Reconfiguration option)

Locations where the analysis identified improved queuing with the light rail alternatives compared to the No-Build Alternative are:

- At the intersection of SW Hamilton Street and SW Corbett Avenue in the PM peak hour, overall traffic input would improve due to the change from a four-way stop to a full traffic signal (all light rail alignment alternatives)
- At the intersection of SW Hamilton Street and SW Barbur Boulevard in the PM peak hour, northbound queues would be reduced due to relocating the southbound left-turn signal from SW Hamilton Street to SW Bancroft Street (Alternatives A1 and A2-BH)
- Northbound and southbound queues approaching the Ross Island Bridge via SW Naito Parkway would be reduced in the PM peak hour with the Bridgehead reconfiguration (Alternative A2-BH and Alternative A1 with the Bridgehead Reconfiguration option)
- With removal of the eastbound Ross Island Bridge access from northbound SW Kelly Avenue, queuing along local streets in the vicinity of SW Kelly Avenue, SW Gibbs Street and SW Whitaker Street would be eliminated (Alternative A2-BH and Alternative A1 with the Bridgehead Reconfiguration option).

The intersections at the I-405 ramp terminals at SW 4th Avenue and SW 6th Avenue were analyzed with a 2045 forecast year to be consistent with FHWA and ODOT requirements to analyze 20 years from the date of project opening. The 2045 ramp terminal analysis showed no significant differences between the No-Build Alternative and the light rail alternatives.

Segment B Intersection Analysis

The No-Build Alternative would have 10 locations not meeting operating targets in 2035 (see Table 3.2-6). With the light rail alternatives, the V/C ratio at some of those intersections would improve compared to the No-Build Alternative due in part to providing new signals at several intersections.

There are four intersections where the No-Build Alternative would meet operating targets and the light rail alternatives would not meet operating targets, or where the No-Build Alternative would not meet operating targets and where the light rail alternatives would worsen the operations (see Table 3.2-6):

- SW Barbur Boulevard and SW 24th Avenue/I-5 southbound ramp (AM)
- SW Barbur Boulevard and SW Taylors Ferry Road/Barbur Transit Center Park and Ride access (PM)
- SW Taylors Ferry Road and I-5 southbound off-ramp (PM)
- SW Barbur Boulevard and SW 53rd Avenue/53rd Park and Ride access (AM and PM)

The impact at SW Barbur Boulevard and SW 24th Avenue would be a result of modifying the signal phasing to include a protected left-turn phase. The impacts at the SW Barbur Boulevard intersections with SW Taylors Ferry Road and SW 53rd Avenue and at SW Taylors Ferry Road and the I-5 southbound off-ramp would be due to traffic accessing and leaving the park and ride lots.

Segment B Queuing

Intersections where freeway ramps intersect with the local street system were analyzed using 2045 traffic volumes to be consistent with FHWA and ODOT analysis requirements. This analysis helps to identify whether the additional 10 years of growth would identify additional freeway interchange area locations where project impacts might require mitigation.

Table 3.2-6. Segment B Intersections Not Meeting V/C Mobility Targets for Forecast Year 2035

Intersection	Operating Target (V/C)	No-Build	B1: Barbur	B2: I-5 BTC-60th	B3: I-5 26th-60th	B4: I-5 Custer-60th
SW Barbur Blvd. and SW 3rd Ave.	0.99	1.05 (AM) 0.82 (PM)	0.71 (AM) 0.59 (PM)	0.71 (AM) 0.59 (PM)	0.71 (AM) 0.59 (PM)	0.71 (AM) 0.59 (PM)
SW Barbur Blvd. and SW Terwilliger Blvd.	0.99	1.09 (AM) 1.08 (PM)	1.05 (AM) 1.10 (PM)	1.05 (AM) 1.10 (PM)	1.05 (AM) 1.10 (PM)	1.05 (AM) 1.10 (PM)
SW Barbur Blvd. and SW Bertha Blvd./I-5 ramps	0.85	0.91 (AM) 0.83 (PM)	0.94 (AM) 0.80 (PM)	0.94 (AM) 0.80 (PM)	0.94 (AM) 0.80 (PM)	0.94 (AM) 0.80 (PM)
SW Terwilliger Blvd. and I-5 northbound off-ramp	0.85	0.67 (AM) 0.89 (PM)	0.66 (AM) 0.89 (PM)	0.66 (AM) 0.89 (PM)	0.66 (AM) 0.89 (PM)	0.66 (AM) 0.89 (PM)
SW Barbur Blvd. and SW 22nd Ave.	0.99	>2 (AM)[S] 0.14 (PM)[S]	0.70 (AM) 0.80 (PM)	0.70 (AM) 0.80 (PM)	0.70 (AM) 0.80 (PM)	>2 (AM)[S] 0.14 (PM)[S]
SW Barbur Blvd. and SW 24th Ave./I-5 southbound off-ramp	0.85	0.85 (AM) 0.67 (PM)	0.91 (AM) 0.76 (PM)	0.91 (AM) 0.76 (PM)	0.91 (AM) 0.76 (PM)	0.85 (AM) 0.67 (PM)
SW Barbur Blvd. and SW Barbur Ct.	0.99	1.06 (AM)[S] 0.77 (PM)[S]	1.06 (AM)[S] 0.77 (PM)[S]	1.06 (AM)[S] 0.77 (PM)[S]	0.68 (AM) 0.55 (PM)	1.06 (AM)[S] 0.77 (PM)[S]
SW Barbur Blvd. and SW Alice St.	0.99	0.88 (AM)[S] 1.21 (PM)[S]	0.62 (AM) 0.57 (PM)	0.62 (AM) 0.57 (PM)	0.88 (AM)[S] 1.21 (PM)[S]	0.88 (AM)[S] 1.21 (PM)[S]
SW Barbur Blvd. and SW Taylors Ferry Rd./SW Baird St.	0.99	>2 (AM)[S] >2 (PM)[S]	0.58 (AM) 0.56 (PM)	0.58 (AM) 0.56 (PM)	>2 (AM)[S] >2 (PM)[S]	>2 (AM)[S] >2 (PM)[S]
BTC access road at SW Barbur Blvd./SW Taylors Ferry Rd.	0.99	0.71 (AM) 0.91 (PM)	0.95 (AM) 1.14 (PM)	0.95 (AM) 1.14 (PM)	0.71 (AM) 0.91 (PM)	0.71 (AM) 0.91 (PM)
SW Taylors Ferry Rd. and I-5 southbound off-ramp	0.85	0.33 (AM)[S] 1.34 (PM)[S]	0.52 (AM)[S] 1.57 (PM)[S]	0.52 (AM)[S] 1.57 (PM)[S]	0.52 (AM)[S] 1.57 (PM)[S]	0.52 (AM)[S] 1.57 (PM)[S]
SW Barbur Blvd. and SW 53rd Ave.	0.99	0.86 (AM) 0.72 (PM)	1.24 (AM) 1.17 (PM)	1.24 (AM) 1.17 (PM)	1.24 (AM) 1.17 (PM)	1.24 (AM) 1.17 (PM)
SW Barbur Blvd. and SW 64th Ave. and I-5 southbound off-ramp	0.85	0.77 (AM) 0.89 (PM)	0.75 (AM) 0.91 (PM)	0.75 (AM) 0.91 (PM)	0.75 (AM) 0.91 (PM)	0.75 (AM) 0.91 (PM)

Note: Shading indicates intersections where mitigation would be considered. BTC = Barbur Transit Center.

[S] Stop-controlled intersection; V/C ratio for the worst approach is reported.

The assessment of queuing in Segment B focused on the freeway ramps in the vicinity of SW Barbur Boulevard and SW Terwilliger Boulevard and the freeway ramps in the vicinity of SW Barbur Boulevard and SW Capitol Highway (the Crossroads area). No other queuing impacts in Segment B were identified. At the southbound off-ramp from I-5 at the Terwilliger exit, all of the alignment alternatives include removing the northbound auxiliary lane on SW Barbur Boulevard between SW Bertha Boulevard and SW Terwilliger Boulevard. As a result, vehicles exiting the freeway that are bound for southbound SW Terwilliger Boulevard would no longer have a free right turn onto SW Barbur Boulevard and would have to make a 90-degree turn at the intersection. The loss of this free right turn would result in longer queues than with the No-Build Alternative on the I-5 southbound off-ramp, which would occasionally extend off-ramp queues back toward the freeway travel lanes.

Queuing was also measured in the Crossroads area (vicinity of SW Barbur Boulevard and SW Capitol Highway and the I-5 ramps). This analysis found a high level of queuing and delay in 2045 on the I-5 southbound off-ramp to SW Taylors Ferry Road with the No-Build Alternative. Queuing with the light rail alternatives would be similar to or slightly worse than queuing with the No-Build Alternative.

Segment C Intersection Analysis

The No-Build Alternative would have four locations not meeting operating targets in 2035 (see Table 3.2-7).

Table 3.2-7. Segment C Intersections Not Meeting V/C Mobility Targets for Forecast Year 2035

Intersection	Mobility Target (V/C)	No-Build	C1: Ash-I-5	C2: Ash-Railroad	C3: Clinton-I-5	C4: Clinton-Railroad	C5: Ash-I-5 Branched	C6: Wall-I-5 Branched
SW 65th Ave. and SW Haines St./I-5 northbound ramps	0.85	1.08 (PM)[S]	1.11 (PM)[S]	1.11 (PM)[S]	1.11 (PM)[S]	1.11 (PM)[S]	1.11 (PM)[S]	1.11 (PM)[S]
SW 68th Ave. and SW Atlanta St.	1.00	0.77 (PM)[S]	1.14 (PM)[S]	1.14 (PM)[S]	1.14 (PM)[S]	1.14 (PM)[S]	1.14 (PM)[S]	1.12 (PM)[S]
SW Commercial St. and SW Main St.	1.00	0.61 (PM)[S]	1.06 (PM)[S]	1.06 (PM)[S]	1.06 (PM)[S]	1.06 (PM)[S]	1.06 (PM)[S]	1.14 (PM)[S]
SW Hall Blvd. and SW Commercial St.	0.99	0.96 (PM)[S]	1.19 (PM)[S]	1.19 (PM)[S]	1.19 (PM)[S]	1.19 (PM)[S]	1.19 (PM)[S]	1.49 (PM)[S]
SW Carman Dr. and I-5 northbound ramps	0.85	0.83 (AM) 0.89 (PM)	1.05 (AM) 0.93 (PM)	0.88 (AM) 0.88 (PM)	1.05 (AM) 0.93 (PM)	0.88 (AM) 0.88 (PM)	1.05 (AM) 0.93 (PM)	1.05 (AM) 0.93 (PM)
SW Upper Boones Ferry Rd. and I-5 southbound ramps	0.85	0.84 (AM) 0.69 (PM)	1.06 (AM) 0.74 (PM)	0.88 (AM) 0.68 (PM)	1.06 (AM) 0.74 (PM)	0.88 (AM) 0.68 (PM)	1.06 (AM) 0.74 (PM)	1.06 (AM) 0.74 (PM)
SW Lower Boones Ferry Rd. and I-5 northbound ramps	0.85	0.90 (PM)	0.91 (PM)	0.91 (PM)	0.91 (PM)	0.91 (PM)	0.91 (PM)	0.91 (PM)
SW Lower Boones Ferry Rd. and park and ride access at Travelers Lane	0.99	1.13 (PM)[S]	>2 (PM)[S]	>2 (PM)[S]	>2 (PM)[S]	>2 (PM)[S]	>2 (PM)[S]	>2 (PM)[S]

Note: Shading indicates intersections where mitigation would be considered.

[S] Stop-controlled intersection; V/C ratio for the worst approach is reported.

With all of the alignment alternatives, additional traffic volumes associated with new park and ride lots would contribute to the following intersections exceeding operating targets and performing worse than the No-Build Alternative:

- SW 65th Avenue and SW Haines Street/I-5 northbound ramp (PM)
- SW 68th Avenue and SW Atlanta Street (PM)
- SW Commercial Street and SW Main Street (PM)
- SW Hall Boulevard and SW Commercial Street (PM)
- SW Carman Drive and I-5 northbound ramps (AM and PM)
- SW Upper Boones Ferry Road and I-5 southbound ramps (AM)
- SW Lower Boones Ferry Road and the Bridgeport Park and Ride access road at Travelers Lane (PM)

Alternative C6 would include motor vehicle access on the light rail structure crossing Highway 217 from SW Beveland Street at SW Hermoso Way to SW Hunziker Street at SW Wall Street. The traffic pattern changes resulting from this new motor vehicle connection, together with the additional park and ride trips, would result in the intersection of SW Hall Boulevard and SW Commercial Street performing worse than with the other alignment alternatives.

Segment C Queuing

Intersections where freeway ramps intersect with the local street system were analyzed using 2045 traffic volumes to be consistent with FHWA and ODOT analysis requirements. This analysis helps to identify whether the additional 10 years of growth would identify additional freeway interchange area locations where project impacts might require mitigation. The 2045 analysis also evaluated queuing and did not identify any additional locations where queuing mitigation would be required.

Compared to the No-Build Alternative, the alignment alternatives would have the following queuing impacts in Segment C:

- Alternatives C3 and C4 (Clinton) would result in southbound queues on SW Hall Boulevard at the light rail crossing extending into the intersection with Pacific Highway.
- All Segment C alignment alternatives would extend northbound and southbound queues at SW 72nd Avenue at SW Beveland Street with the new light rail crossing.
- All Segment C alignment alternatives would see queues similar to those of the No-Build Alternative at the SW Hall Boulevard crossing of the existing WES tracks with a single light rail train crossing. In the event of an extended crossing time due to two trains crossing in opposite directions, all of the alignment alternatives would see a substantial increase in queue length.
- Alternatives C2 and C4 (Railroad) would have queues on SW Upper Boones Ferry Road, starting at the traffic signal at SW Sequoia Parkway and extending across the light rail tracks.
- Alternatives C2 and C4 (Railroad) would have queues at SW Upper Boones Ferry Road at the I-5 southbound ramps.
- Alternatives C1, C3, C5 and C6 (I-5) would have queues on SW Upper Boones Ferry Road at SW Durham Road.
- All of the Segment C alignment alternatives would extend queues on the I-5 northbound ramp at SW Lower Boones Ferry Road.
- All of the Segment C alignment alternatives would have a queue at SW Lower Boones Ferry Road at the park and ride access road at SW Travelers Lane.

3.2.6. Impacts to On-Street Parking

With the No-Build Alternative, there would be no change to the on-street parking supply. However, demand for parking would be expected to increase, particularly if there are no major transit improvements and people remain reliant on the automobile for travel.

In locations where the alignment alternatives would operate within or adjacent to street rights of way, on-street parking would typically be eliminated. Areas that would have reduced parking are summarized below. The *Transportation Impacts Results Report* (Metro, 2018) has more detail on specific locations where existing parking might be eliminated by the project.

In Segment A, Alternative A1 would remove 16 two-hour limited parking spaces near Duniway Park, while Alternatives A2-BH and A2-LA would remove 21 residential zone permit parking spaces along SW Naito Parkway. Eliminating the spaces would increase demand for remaining on-street spaces on nearby streets. However, the combination of improved transit and improved bicycle and pedestrian facilities could help offset the impact.

In Segment B, Alternative B1 would remove 61 on-street parking spaces on SW Barbur Boulevard between SW 13th Avenue and SW 60th Avenue; Alternative B2 would remove 36 on-street parking spaces on SW Barbur Boulevard between SW 13th Avenue and SW 60th Avenue; and Alternative B3 would remove 27 on-street parking spaces on SW Barbur Boulevard between SW 13th Avenue and SW 26th Way. These spaces are lightly used, and most adjacent properties have available off-street parking.

With Alternative B4, 12 on-street spaces on SW Multnomah Boulevard southeast of SW Barbur Boulevard would be eliminated. These unrestricted spaces appear to be primarily used by transit riders, and the impact of lost parking would be offset by added park and ride capacity at the Barbur Transit Center.

In Segment C, Alternatives C1, C2, C5 and C6 would reduce parking supply by eight spaces along SW 70th Avenue. Alternatives C1, C2, C5 and C6 would remove 63 spaces on SW Beveland Street. Alternatives C1, C2 and C5 would remove 18 spaces along SW Ash Avenue. Usage surveys found that most of these spaces have moderate levels of use.

3.2.7. Freight Facility Impacts

Roadway Freight

All of the alignment alternatives would maintain horizontal and vertical clearances large enough to accommodate typical trucks throughout the corridor. Where light rail would operate in the median, most of the impacts would be related to right-in, right-out restrictions from driveways and unsignalized side streets without frequent access by large trucks. In Segment A, there would be no other impacts to freight access, and no designated freight routes would be affected.

In Segment B, the light rail alternatives would alter the streetscape and close and relocate truck accesses. Alternatives B1 and B2 would alter but maintain truck access to two gas stations. All of the alignment alternatives would alter truck access to the Fred Meyer grocery store at SW Barbur Boulevard and SW Bertha Boulevard. Access modifications and changes to internal site circulation or revisions to the light rail design would be required at the Fred Meyer store to accommodate freight deliveries to the existing loading docks.

In Segment C, the alignment alternatives would be predominantly located in exclusive right of way adjacent to local streets, major highways or railroads, with a few local streets featuring median light rail that would limit driveway access to right-in/right-out access. With Alternatives C1, C2, C5 and C6, the light rail alignment would be in the median of SW Beveland Street, which would eliminate left turns at the primary truck access for the Lowe's Home Improvement store. These alternatives would add a traffic signal at a second driveway that trucks could use, but making this change could require revising Lowe's internal site circulation.

With Alternatives C1 and C3, the light rail alignment would eliminate existing truck access to three properties on SW Landmark Lane and impact access to a fourth property. Replacement or modification of the access to these sites would need to be identified.

All of the alignment alternatives would preserve vehicle and freight capacity on I-5 and Pacific Highway, with adjacent and overcrossing structures meeting the current design clearance requirements for height and width.

Railroad Freight

The project would not have impacts to freight railroads within Segments A and B. Within Segment C, all of the alignment alternatives would parallel at least a portion of the Portland and Western (P&W) Railroad right of way. Alternatives C2 and C4 would operate adjacent to the tracks for the longest distance of any of the alternatives, from SW Ash Avenue in Tigard to just south of SW Upper Boones Ferry Road.

In Segment C, there would be no at-grade light rail crossings of the main freight rail lines with any alignment alternative. In locations where the light rail alignment would cross existing spur lines, either the light rail would be grade-separated, or the existing spur line would be acquired and removed.

The alternative alignments in Segment C provide for a minimum 25-foot separation between the light rail tracks and the freight railroad tracks where they would run parallel. This separation would result in wider at-grade, gated railroad crossings. At three locations (SW Hall Boulevard, SW 72nd Avenue and SW Upper Boones Ferry Road) the existing at-grade crossings would be widened to accommodate light rail. The wider crossings would not impact freight rail operations.

3.2.8. Safety Impacts

The light rail alternatives would improve pedestrian and bicycle safety by increasing the number of marked pedestrian crossings of SW Naito Parkway and SW Barbur Boulevard, and providing bicycle lanes along all portions of at-grade light rail. The station access improvements would also improve safety for pedestrians and bicyclists accessing light rail stations from adjacent neighborhoods.

Alternative A2-BH (and Alternative A1 with the Bridgehead Reconfiguration option) could help reduce the current high rate of rear-end collisions by providing signalized intersections at the Ross Island Bridge access points, rather than using the existing stop-controlled intersections. All of the Segment B alignment alternatives would provide a more substantial median barrier that would help reduce the collision risk at the “Barbur curves” trouble spot.

With all of the alignment alternatives, emergency vehicle (police, fire, etc.) operations and access would be similar to the No-Build Alternative, except where light rail would operate in the roadway median and left-turn access would be limited to intersections. Future project design would consider treatments to restrict drivers from turning left across median light rail at intersections where left turns are prohibited.

All alignments would introduce at-grade roadway crossing with light rail, similar to existing at-grade light rail crossing of roadways. Alternatives C1 and C6 would introduce shared crossing of roadways with freight rail at SW Hall and Alternatives C2 and C4 would introduce shared freight crossing at SW 72nd

and SW Upper Boones Ferry road. TriMet currently has designed and constructed shared crossing of roadways with freight rail on the MAX Orange Line consistent with current safety rules and TriMet Design Criteria.

3.2.9. Short-Term Impacts

Construction of the Southwest Corridor Light Rail Project would result in temporary impacts to local and regional transportation operations. These impacts could include temporary lane closures, signals, detours and related impacts to motor vehicle, bus, bicycle and pedestrian operations. The *Transportation Impacts Results Report* (Metro, 2018) includes a table that identifies the estimated type and duration of construction activities that could impact various modes of travel.

Potential outcomes of these construction impacts could result in temporary:

- traffic intrusion on local streets due to congestion detours
- lane closures on SW Barbur Boulevard, SW Naito Parkway, I-405, I-5, Highway 217 and other arterial, collector and local streets
- disruption of access to local businesses
- loss of on-street parking
- increase in truck deliveries and trucks removing construction materials
- temporary detours for bicycles and pedestrians
- transportation operations within the corridor.

3.3. Potential Mitigation Measures

3.3.1. Motor Vehicle Mitigation

Potential mitigation strategies for motor vehicles were prepared for the intersections where the light rail alternatives would cause the operations to exceed the V/C targets or increase queue lengths in locations where the additional queuing would impact intersection or freeway operations compared to the No-Build Alternative. A determination regarding mitigation will take into account all applicable policies and will be made in consultation with the local jurisdiction or operating agency. Table 3.3-1 displays those locations and potential mitigation.

3.3.2. Active Transportation Mitigation

Because the light rail alternatives would improve pedestrian crossing opportunities and close gaps in the bicycle and pedestrian networks, no light-rail-specific active transportation mitigation measures are needed beyond those shown in Table 3.3-1. However, the station access improvement options are an important component to maximize ridership potential, and would provide a safe and inviting active transportation environment in the corridor.

Table 3.3-1. Potential Motor Vehicle Mitigation *(multi-page table)*

Location	Alignment Alternative	Issue	Potential Mitigation	Potential Active Transportation Impact of Mitigation
Segment A: Inner Portland				
SW Naito Pkwy. at SW Harrison St.	A2-LA	V/C exceeds target of 0.99	Add a traffic signal and northbound left-turn lane at SW Naito Pkwy. and SW Sheridan St., and add a traffic signal to SW 1st Ave. and SW Sheridan St.	Adds multiple pedestrian crossings.
SW Macadam Ave. ramp at SW Kelly Ave.	A2-BH	Queuing may block access to I-5 South on-ramp	Modify lane configuration to two lanes westbound.	No impact.
Southbound SW Naito Pkwy. between SW Harrison St. and SW Lincoln St.	A2-BH	Queuing inhibits merge operations	Extend dual-lane section to SW Sheridan St.	Would widen the pedestrian crossing at SW Lincoln St.
Northbound transitway on SW Naito Pkwy. at SW Gibbs St.	A2-BH	Light rail operations impact	Add storage lane for buses.	No impact.
SW Naito Pkwy. at SW Gibbs St.	A2-LA	V/C exceeds target of 0.99	Modify signal to two-stage pedestrian crossing.	Increased delay for some pedestrian crossings of SW Naito Pkwy. at SW Gibbs St.
SW Barbur Blvd. at SW Bancroft St.	A1 and A2-BH	Left-turn demand exceeds storage	Modify signal to two-stage pedestrian crossing. Increase eastbound right-turn radius speed, or grade separate the left turn.	Increased delay for some pedestrian crossings of SW Barbur Blvd. at SW Bancroft St.
SW Bancroft St. at SW Corbett Ave.	A1 and A2-BH	V/C exceeds target of 0.99	Add a traffic signal.	No impact.
SW Hamilton Street at SW Corbett St.	All	V/C exceeds target of 0.99	Add a traffic signal.	No impact.
SW Barbur Blvd. and SW Hamilton St.	All	V/C exceeds target of 0.99 and queuing	Modify signal timing, extend third northbound lane on SW Barbur Blvd. as it approaches SW Hamilton St.	Could increase conflicts with northbound bicyclists on SW Barbur Blvd.
SW 4th Ave. at SW Lincoln St./I-405 northbound off-ramp	A1	Right turn conflicts with bicycle and pedestrian facility	Reconfigure off-ramp to single northbound through lane and right-turn-only lane. Hold right-turn lane during protected bike/ped phase.	Improves bicycle and pedestrian safety.
SW Naito Pkwy. at Ross Island Bridge access (SW Woods St.)	A2-BH	Westbound and southbound queue spillback	Increase westbound right-turn queue length, extend southbound two-lane section and close crossing of SW Woods St. at SW Water Ave.	Minimal impact to intersection of SW Naito Pkwy. at Ross Island Bridge ramp. Closure of SW Water Ave. crossing would require north/south bike and ped trips to use SW Naito Pkwy.
Segment B: Outer Portland				
SW Barbur Blvd. at SW Terwilliger Blvd. and SW Bertha Blvd.	All	Queue spillback on I-5 southbound off-ramp	Provide queue detection to flush the off-ramp signal phase and/or add a northbound auxiliary lane between the off-ramp intersection with SW Barbur Blvd. and SW Terwilliger Blvd. (similar to existing operation).	Queue detection would have little to no impact. Adding the auxiliary lane could limit the ability to provide a pedestrian crossing and sidewalks on the east side of SW Barbur Blvd. and create an additional conflict point for bicyclists.

Table 3.3-1. Potential Motor Vehicle Mitigation *(multi-page table)*

Location	Alignment Alternative	Issue	Potential Mitigation	Potential Active Transportation Impact of Mitigation
SW Barbur Blvd. at SW 24th Ave./I-5 southbound off-ramp	B1, B2, B3	V/C exceeds target of 0.85	Prohibit the left turn from northbound SW Barbur Blvd. during the AM peak hour.	No impact.
Barbur Transit Center access road at SW Barbur Blvd./SW Taylors Ferry Rd.	All (PM)	V/C exceeds target of 0.99	Modify circulation to operate one-way within Barbur TC Park and Ride and/or reduce the size of the park and ride lot. Add a southbound right-turn lane to SW Barbur Blvd.	Added right-turn lane lengthens the pedestrian crossing distance.
SW Taylors Ferry Rd. at I-5 southbound off-ramp	All	V/C exceeds target of 0.85	Add a traffic signal.	Would add a marked pedestrian crossing.
SW 53rd Ave. at SW Barbur Blvd. and park and ride access	All	V/C exceeds target of 0.99	Move park and ride access to a new intersection located west of SW 53rd Ave. Add a second northbound lane to SW 53rd Ave. approaching SW Barbur Blvd.	Would reduce motor vehicle demand at SW 53rd Ave. and add a pedestrian crossing. Added lane on 53rd lengthens the pedestrian crossing distance.
Segment C: Tigard and Tualatin				
SW 65th Ave. at SW Haines St./ I-5 northbound ramp	All	V/C exceeds target of 0.85 and queuing	Signalize or build roundabout.	No impact.
SW 68th Pkwy. at SW Atlanta St.	All	V/C exceeds target of 1.00 and queuing on intersection approaches	Add a traffic signal.	No impact.
SW Commercial St. at SW Main St.	All	V/C exceeds target of 1.00 and queuing	Add a traffic signal.	No impact.
SW Hall Blvd. at SW Clinton St. light rail crossing	C3, C4	Southbound queue spillback	Grade separate light rail at SW Hall Blvd.	Would remove a proposed pedestrian crossing.
SW Hall Blvd. at SW Commercial St.	All	V/C exceeds target of 1.00 and queuing	Add a traffic signal.	No impact.
SW Carman Dr. at I-5 northbound ramps	All	V/C exceeds target of 0.85 and queuing	Add westbound right-turn lane (C2, C4). Add northbound lane to ramp (C1, C3, C5, C6).	Would lengthen the pedestrian crossing distance.
SW Upper Boones Ferry Rd. at I-5 southbound ramps	All	V/C exceeds target of 0.85 and queuing	Modify signal timing (C2, C4). Convert signal to split phasing and convert westbound left-turn lane to left-through and add eastbound right-turn lane or reduce the size of the park and ride lot (C1, C3, C5, C6).	No impact.
SW Upper Boones Ferry Rd. west of SW Sequoia Pkwy.	C2 and C4	Delay and queuing across rail crossing	Manage queue with signal preemption and timing optimization or grade separation of rail crossing.	A grade separation could improve bicycle and pedestrian safety in the vicinity of rail crossing.
SW Lower Boones Ferry Rd. at I-5 northbound ramps	All	V/C exceeds target of 0.85 and queuing	Modify signal timing.	Longer signal cycle length could increase pedestrian and bicycle delay.

Table 3.3-1. Potential Motor Vehicle Mitigation *(multi-page table)*

Location	Alignment Alternative	Issue	Potential Mitigation	Potential Active Transportation Impact of Mitigation
SW Lower Boones Ferry Rd./Travelers Lane at park and ride access	All	V/C exceeds target of 0.99	Add a traffic signal.	Adds a marked pedestrian crossing.

Notes: TC = Transit Center.

Mitigation for Alternative A1 with the Bridgehead Reconfiguration option would include all the mitigation identified for both Alternatives A1 and A2-BH, except for the bus storage lane at SW Naito Parkway and SW Gibbs Street.

3.3.3. Freight Access Mitigation

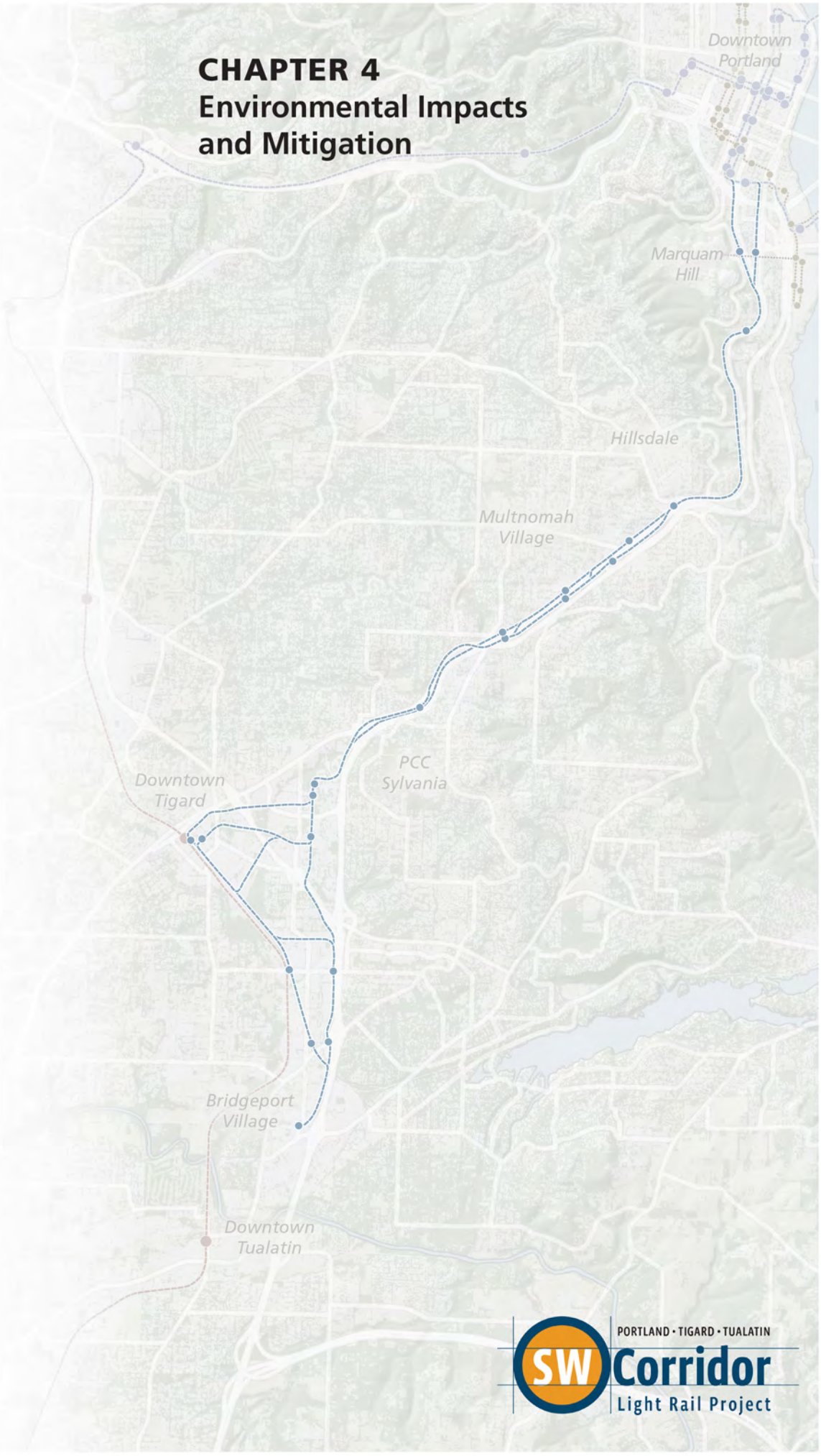
Additional design refinements are needed to ensure adequate freight access at three locations:

- Fred Meyer Store on SW Barbur Boulevard at SW Bertha Boulevard (all Segment B alignment alternatives): Design refinements would be considered to facilitate truck access to the existing loading dock, as well as general site circulation and parking.
- Lowe's Home Improvement on SW Beveland Street at SW 72nd Avenue (Alternatives C1, C2, C5 and C6): Design refinements would be considered to facilitate truck access to the existing loading dock, as well as general site circulation and parking.
- With Alternatives C1 and C3, the light rail alignment would eliminate existing truck access to three properties on SW Landmark Lane and impact access to a fourth property. Light rail design refinements would be considered to facilitate maintenance, replacement or modification of access to these sites.

3.3.4. Safety Mitigation

TriMet will coordinate during design and comply with regulations related to at-grade roadway crossing with the local roadway authorities. TriMet will coordinate during design and comply with regulations related to shared freight rail roadway crossing. This coordination will include the railroad, local roadway authorities, the State Safety Oversight Agent and the Federal Railroad Administration during design and permitting phases. TriMet will follow TriMet's Design Criteria for at-grade crossings.

CHAPTER 4
Environmental Impacts and Mitigation



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4. ENVIRONMENTAL IMPACTS AND MITIGATION

This chapter discusses the affected environment and environmental impacts for the topics listed at the right. Each section describes the resource study area, potential direct positive and negative long-term and short-term (construction) impacts, and potential mitigation measures for negative impacts for each alternative. The National Environmental Policy Act also requires that the Environmental Impact Statement (EIS) disclose indirect and cumulative impacts of a proposed action on the environment. These types of impacts are defined as follows:

Section	Page
4.1 Acquisitions, Displacements and Relocations	4-2
4.2 Land Use	4-9
4.3 Economics	4-21
4.4 Communities	4-26
4.5 Visual Quality	4-40
4.6 Historic and Archaeological Resources	4-55
4.7 Parks and Recreation Resources	4-66
4.8 Geology, Soils and Hydrogeology	4-81
4.9 Ecosystems	4-85
4.10 Water Resources	4-96
4.11 Noise and Vibration	4-110
4.12 Air Quality and Greenhouse Gases	4-126
4.13 Energy	4-128
4.14 Hazardous Materials	4-130
4.15 Utilities	4-135
4.16 Public Services	4-139
4.17 Safety and Security	4-145
4.18 Indirect and Cumulative Impacts	4-152

- **Direct (long-term or short-term) impacts** are caused by the action and occur at the same time and place (40 Code of Federal Regulations [CFR] 1508.8(a)). For example, there will be long-term impacts of stormwater runoff from increased roadway surface (impervious) or short-term air quality impacts from construction equipment.

- **Indirect impacts** are caused by the action and occur later in time or farther removed in distance but still are reasonably foreseeable (40 CFR 1508.8(b)), such as changes in land use patterns around station locations.

- **Cumulative impacts** result from the proposed action's incremental impact when added to those of other past, present and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR 1508.7). Cumulative impacts are considered because the public and government agencies need to evaluate a proposed action and its alternatives in a broad perspective, including how the project might interact with impacts that persist from past actions, with present-day activities, and with other projects that are planned but have not been built yet (reasonably foreseeable future actions). See Appendix B4-18 for the list of projects considered.

The structure and definition of the alternatives considered in this analysis are described in more detail in Chapter 2 – Alternatives Considered. The level of detail in which the impacts of the light rail alternatives are described varies by environmental resource. Discussion of certain project elements is omitted in cases where there would be no associated impacts. In particular, the project options described below are anticipated to have few impacts and are discussed minimally in this chapter:

- **PCC-Sylvania shuttle options.** The PCC-Sylvania shuttle would have some physical impacts outside of the light rail stations. including bus bays and related passenger facilities on the PCC-Sylvania campus. Where relevant, discussion is included.

- **Station access improvement options.** The designs for these options, which range from roadway restriping for bike lanes to a pedestrian bridge over Interstate 5, are preliminary and would be generally be modified to avoid adverse environmental impacts. The impacts of station access improvements will be analyzed in more detail in the Final EIS once a Preferred Alternative has been identified.

The two minimum operable segment (MOS) options and the initial route proposal full-length light rail alternatives are discussed in Chapter 5.

4.1. Acquisitions, Displacements and Relocations

This section addresses the potential for the Southwest Corridor Light Rail Project to acquire property, displace current land uses and relocate the parties or activities currently using the land. The related environmental effects of these potential property conversions are further analyzed in many of the sections that follow in Chapter 4, including in Section 4.2, Land Use; Section 4.3, Economics; Section 4.4, Communities; Section 4.6, Historic and Archaeological Resources; Section 4.7, Parks and Recreation Resources; and Section 4.14, Hazardous Materials, as well as in Chapter 3 – Transportation. Appendix C – Environmental Justice Compliance and Appendix D – Draft Section 4(f) Evaluation are both based on the properties identified for acquisition and displacement.

4.1.1. Affected Environment

The study area for this analysis includes parcels that are within the areas where the light rail alternatives, including the alignments, stations, related facilities, access projects or mitigation, could be developed or where they could affect property access. The study area is heavily developed, and contains transportation, residential, commercial, industrial, public, institutional and vacant property.

4.1.2. Long-Term Impacts

No-Build Alternative

Transportation projects and anticipated regional growth under the No-Build Alternative may result in projects that require some partial or full property acquisitions. However, there are no known property acquisitions within the study area and, for this analysis, it is assumed that no displacements or relocations would occur under the No-Build Alternative.

Light Rail Alternatives

Most of the light rail alternatives would use public streets, highways and railroad rights of way, but additional public and private property would be needed as well. The additional land could be converted to trackway, expanded roadways, sidewalks, bike lanes, stations, traction power substations, noise walls and other project-related facilities, such as operations and maintenance (O&M) facilities, and stormwater facilities. Other street or highway modifications that could be required in order to avoid roadway congestion effects of the project may also need additional property. Property easements could also be needed, but they would typically not convert the affected property to a transportation use.

The Tri-County Metropolitan Transportation District of Oregon (TriMet) has established policies and programs for transportation improvement projects that need to acquire right of way or other property interests, which can involve moving households and businesses. For all affected properties, TriMet will

meet the requirements with the federal Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Uniform Act). The Uniform Act and its amendments direct how federal agencies, or agencies receiving federal funding for a project, will compensate property owners or tenants who must relocate if they are displaced by a project. The project will also comply with TriMet's Acquisition and Relocation Policy, Procedures, and Guidelines, which requires property owners and tenants to be treated uniformly and fairly.

There are two types of permanent property acquisitions that could convert property to a transportation use:

- **A "partial parcel acquisition"** indicates that a portion of a parcel would be acquired, including sliver takes. A partial parcel acquisition generally would not displace all residential or nonresidential uses on the parcel, but the parcel would be impacted by the project.

- **A "full acquisition"** indicates that the full parcel would be impacted by the project and the current use would be displaced. Full acquisitions include parcels that might not be fully needed for the project but would be affected to the extent that current uses would be substantially impaired (e.g., loss of parking or access).

The estimate of the numbers of affected properties reflects land use conditions at the time the analysis was conducted and also applies design information from early planning stages. Because design details and property uses would change as the project develops, the number and/or type of displacements could vary between what is disclosed in the Environmental Impact Statement (EIS) and what would be required. Final determinations about the properties needed for the project will be based on the project's final design after Federal Transit Administration (FTA) completes the EIS process. Section 4.1.6, Potential Mitigation Measures, includes a summary of the process and timing for property acquisition, including notification of property owners.

If there is surplus property (property no longer needed after construction), TriMet could sell or lease the surplus property. TriMet will work with Cities of Tigard and Portland, Washington County, Metro and affordable housing providers to dispose of surplus property, with an emphasis on encouraging affordable housing near stations. Some types of joint development projects are also possible for surplus property for a transit project, per FTA regulations (FTA Circular C 7050.1A), by which TriMet could partner with others to develop a surplus property.

According to 23 Code of Federal Regulations (CFR) 810 Part C, "Making Highway Rights-of-Way Available for Mass Transit Projects," TriMet must submit an application to the Oregon Department of Transportation (ODOT) to use the Interstate 5 (I-5) right of way, and also develop an Intergovernmental Agreement between ODOT and FTA. Ultimately, the Federal Highway Administration (FHWA) must authorize the use of interstate right of way for a transit use. The request to FHWA would be accompanied by evidence that the use of the right of way for light rail would not impair future highway improvements or access or the safety of highway users. FHWA would review the request in accordance with 23 CFR 710 and 810.

In the areas where the light rail alternatives are proposed within the I-5 right of way, TriMet, Metro and ODOT coordinated to define the potential areas where transit could be accommodated. The agencies'

collaborative planning considered current conditions on the corridor, applicable design standards for highways and light rail, and ODOT's ability to make future highway improvements.

Some alternatives could also affect properties by modifying their access. If an alternative is in an area where I-5 ramps or interchanges could be affected, FHWA and ODOT must review any changes. If ODOT and FHWA require more restricted road access to maintain safe and effective interchange operations, a property that completely loses access as a result would need to be acquired.

SW Barbur Boulevard right-of-way is owned by ODOT, and the City of Portland and ODOT are developing a jurisdictional transfer agreement that describes the conditions and terms for the transfer of the roadway and right of way.

Table 4.1-1 presents the estimated number of affected properties and the related acquisitions and displacements for each alignment alternative. Appendix F lists and maps the properties that would be acquired (partial and full) by the light rail alternatives.

Table 4.1-1. Potential Property Acquisitions *(multi-page table)*

Alignment Alternative	Number of Affected Parcels	Residential - Single-Family to Fourplex		Residential - Multifamily		Commercial and Industrial		Public and Institutional		Vacant Land		Total Full Acquisitions	Total Partial Parcel Acquisitions	Total Displacements and Relocations	
		Full	Partial	Full	Partial	Full	Partial	Full	Partial	Full	Partial			Residential Units	Businesses and Institutional
Segment A: Inner Portland															
A1: Barbur	116	6	35	2	6	12	19	0	2	7	27	27	89	41	15
A2-BH: Naito Bridgehead	120	9	30	2	7	13	22	0	0	8	29	32	88	53	22
A2-LA: Naito Limited Access	123	20	28	6	5	12	17	0	0	8	27	46	77	125	23
Segment B: Outer Portland															
B1: Barbur	205	13	28	2	12	58	65	0	1	15	11	88	117	32	54
B2: I-5 Barbur TC-60th	190	15	24	2	8	54	63	0	1	9	14	80	110	32	61
B3: I-5 26th-60th	181	16	24	2	7	44	66	0	1	8	13	70	111	35	66
B4: I-5 Custer-60th	163	18	17	2	6	29	70	0	1	8	12	57	106	78	62
Segment C: Tigard and Tualatin															
C1: Ash-I-5	131	10	4	3	6	23	70	1	7	4	3	41	90	85	41
C2: Ash-Railroad	128	10	4	3	6	15	75	1	7	5	2	34	94	85	37
C3: Clinton-I-5	101	5	2	0	0	20	55	8	5	5	1	38	63	5	35
C4: Clinton-Railroad	97	5	2	0	0	12	59	8	5	6	0	31	66	5	31
C5: Ash-I-5 Branched	143	10	4	3	6	24	80	1	7	5	3	43	100	85	55
C6: Wall-I-5 Branched	128	6	0	0	2	27	78	3	5	4	3	40	88	7	47

Table 4.1-1. Potential Property Acquisitions *(multi-page table)*

Alignment Alternative	Number of Affected Parcels	Residential - Single-Family to Fourplex		Residential - Multifamily		Commercial and Industrial		Public and Institutional		Vacant Land		Total Full Acquisitions	Total Partial Parcel Acquisitions	Total Displacements and Relocations	
		Full	Partial	Full	Partial	Full	Partial	Full	Partial	Full	Partial			Residential Units	Businesses and Institutional
Marquam Hill Connection Options															
1A: Elevator/Bridge and Path	6	2	0	0	0	1	1	0	2	0	0	3	3	5	2
1B: Elevator/Bridge and Recessed Path	6	2	0	0	0	1	1	0	2	0	0	3	3	5	2
1C: Elevator/Bridge and Tunnel	6	2	0	0	0	1	1	0	2	0	0	3	3	5	2
2: Full Tunnel	4	0	0	0	0	1	1	0	2	0	0	1	3	0	1
O&M Facilities Options															
Hunziker	5	0	0	0	0	5	0	0	0	0	0	5	0	0	10
Branched 72nd	3	0	0	0	0	3	0	0	0	0	0	3	0	0	5
Through 72nd	3	0	0	0	0	3	0	0	0	0	0	3	0	0	5

Note: TC = Transit Center

Segment A: Inner Portland

The Segment A alignment alternatives would affect residential, commercial and vacant properties. Nearly half of the properties that would be affected by the Segment A alignment alternatives are residential, which include single-family properties and duplexes, as well as larger multifamily buildings. Alternatives A1 and A2-BH would acquire two apartment complexes, while Alternative A2-LA would acquire six apartment complexes. Alternative A2-LA would have the most residential unit displacements, at 125, considerably more than the other two alternatives. The Segment A alignment alternatives also affect commercial, public/institutional or vacant properties. This effect includes a partial acquisition of a parking area for a church, which is affected by all of the Segment A alignment alternatives.

Marquam Hill Connection Options

Connection Options 1A, 1B and 1C would displace two residential properties (including a fourplex), while Connection 2 would not displace any residential properties. All of the Marquam Hill connection options would require a partial parcel acquisition at Oregon Health & Science University (OHSU) as well as a strip of parkland owned by the City of Portland. They would all acquire a former synagogue that is now used as a congregation business office.

Segment B: Outer Portland

Segment B affects the largest number of parcels of all three segments, largely due to the widening needed along SW Barbur Boulevard to accommodate light rail and bicycle and pedestrian facilities, while maintaining two traffic lanes in each direction within Segment B.

Of the parcels that would be affected by the Segment B alignment alternatives, the majority are commercial. Segment B Alternatives B2, B3 and B4 displace 61 to 66 businesses. Alternative B1 would affect the fewest, displacing 54 businesses.

The Segment B alignment alternatives have a similar number of residential acquisitions (13 to 18 single-family, duplex or fourplex residences, and two multifamily buildings). Alternative B4 affects larger apartment complexes, and would have the most displaced residential units (78).

Segment C: Tigard and Tualatin

Of the properties that would be affected by the Segment C alternatives, most are commercial or industrial, but some residential and public/institutional properties would be acquired.

The Segment C alignment alternatives pass through the Hunziker Industrial Area, Sequoia Parkway Industrial Area, Oregon Business Park, Bridgeport Village and other industrial or commercial districts. Alternative C1 would displace 40 businesses (without institutional); Alternative C2 would displace 36; Alternative C3 would displace 27; Alternative C4 would displace 23; Alternative C5 would displace 54; and Alternative C6 would displace 44. Section 4.3, Economics, has more information on the business properties and related employment impacts.

Alternatives C3, C4 and C6 would require rights to occupy part of the railroad right of way directly behind the Tigard Transit Center facility. Alternatives C3 and C4 would acquire three vacant lots behind the Tualatin Valley Fire & Rescue station as well as the U.S. Postal Service facility and parking lot in downtown Tigard.

Alternatives C1, C2 and C5, which all follow a SW Ash Avenue alignment into downtown Tigard, would have the highest levels of residential impacts, fully displacing three apartment complexes, partially displacing one apartment complex, and fully displacing 10 smaller residential properties, including a duplex, a triplex and a fourplex, affecting 85 housing units. Alternatives C3, C4 and C6 would displace five to six residential properties, affecting five to seven housing units.

O&M Facilities Options

The Hunziker Facility option would acquire five commercial or industrial parcels and displace 10 businesses. Both the Branched 72nd Facility option and the Through 72nd Facility option would acquire three commercial or industrial parcels and displace five businesses, including several larger employers. Sections 4.2, Land Use, and 4.3, Economics, have more information on the business properties and related employment impacts, as well as on issues related to impacts to industrial lands.

4.1.3. Short-Term Impacts

During construction, property will be needed in each segment for staging areas, construction access and temporary construction easements. Much of the construction needs would be accommodated within property required for permanent rights of way, although some other properties would be needed. Many staging and access requirements could be fulfilled through temporary construction easements or leases, but some full acquisitions would still be likely. Contractors could also negotiate use of additional property directly with the property owner.

A temporary construction easement allows for temporary use of a property during construction. When construction is complete, the property is restored to its previous condition for the owner, and the easement is terminated. Such easements would be necessary at various locations along the light rail alignment. The size of the easement would depend on the type of activity expected on the property and the type of land uses in the area; for example, a vacant property would provide an opportunity for a larger easement, whereas easements adjacent to developed property likely would be smaller in order to reduce or avoid impacts.

Off-site staging areas might be needed by the contractor to stockpile excavated materials or to cast and store precast structural elements. These areas would be located close to work sites, when possible, to minimize the impact on local traffic.

The construction staging areas primarily would be adjacent to the proposed alignments. The project might use ODOT right of way for construction staging where feasible and approved by FHWA and ODOT, and could use other available lands on a temporary basis, including parts of city street rights of way.

4.1.4. Potential Mitigation Measures

For property that is permanently or temporarily acquired for the Southwest Corridor Light Rail Project, TriMet will compensate property owners affected by the project, as required by the federal Uniform Act, as amended, and state relocation and property acquisition law and regulations. Benefits would vary by property depending on the level of impact, available relocation options and other factors. The primary mitigation for acquisitions and displacements would be payment of just compensation and relocation assistance.

A public agency must pay just compensation to property owners for land and improvements acquired for public purposes. Just compensation must not be less than the fair market value of the property acquired, including damages or benefits to the remaining property in the case of partial parcel acquisitions.

For temporary construction easements, in addition to just compensation, the property would be restored to its previous condition for the owner and another type of compensation would be employed, or both, as agreed upon during the negotiation process for the easement.

Summary of TriMet Real Property Acquisition and Relocation Policy, Procedures and Guidelines

Before the release of this Draft EIS, Metro and TriMet notified property owners whose property would be directly affected by any of the light rail alternatives. When the Draft EIS is published, affected property owners will also be notified that the document is available for review. Acquisitions of property would typically occur only after the Final EIS and National Environmental Policy Act (NEPA) process was complete, except for early acquisitions to accommodate property owner hardships or protect a given property from imminent development that may be incompatible with the project. TriMet staff are available to answer questions and provide additional information about compensation and relocation assistance services, payments, reimbursement eligibility and the timing of the process.

TriMet will work with residents and businesses to help them plan ahead for relocation, assist in finding new homes or sites and help solve problems that might occur. While the ultimate choice of a relocation site would be decided by the affected resident or business, the agency would help investigate possible locations, including nearby properties. TriMet also uses interpreters to help those with limited English proficiency understand their choices and options.

4.2. Land Use

This section addresses the potential land use impacts of the study alternatives, considering changes to existing land uses as well as compatibility with existing plans, policies and regulations at local, regional and state levels.

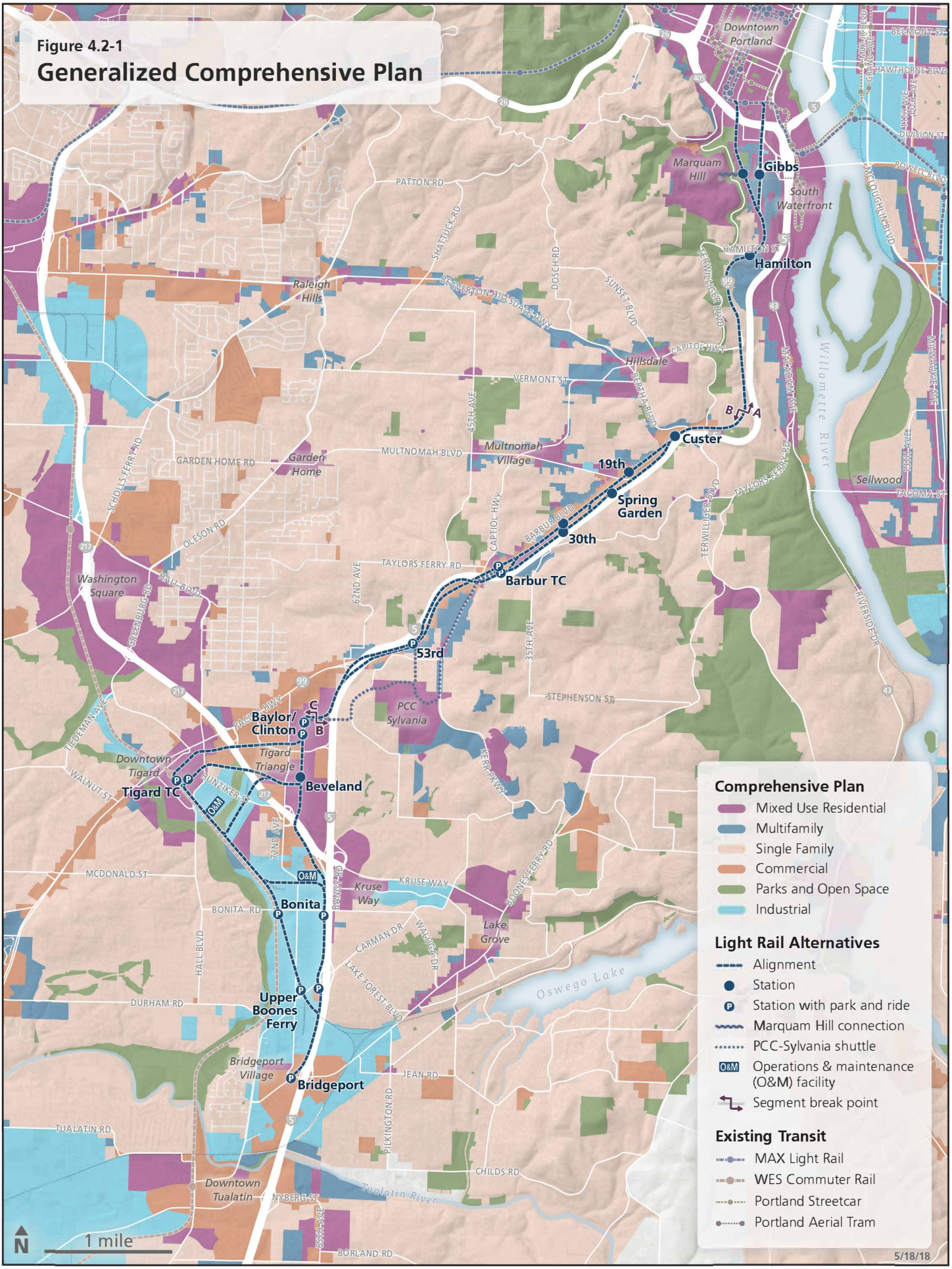
Long-term direct land use impacts can occur when property is converted to a transportation use from another use. This changes a property's land use and can also change land use patterns. Long-term impacts can also occur if the transportation improvements are not consistent with the goals of existing plans and policies. Short-term land use impacts can occur when the effects of construction, such as increases in noise, dust, traffic congestion or access, temporarily affect existing land uses or conflict with adopted plans and policies.

4.2.1. Affected Environment

Figure 4.2-1 shows generalized comprehensive plan designations for the corridor. Appendix B4.2 has figures showing existing land use and generalized zoning. All figures are based on planning documents from the cities of Portland, Tigard, Tualatin, Lake Oswego and Durham. The general study area for land use includes the cities that the alignment intersects or borders, with a more detailed study area covering a half mile circle around stations and one quarter mile along the alignment.

Figure 4.2-1

Generalized Comprehensive Plan



Existing Land Uses

Segment A covers the southern end of downtown Portland, the South Waterfront District, and extends south to the Burlingame and Hillsdale neighborhoods. Segment A land use patterns transition from the larger-scale buildings and multiple uses found in downtown to the older city neighborhoods found along SW Barbur Boulevard and SW Naito Parkway. These areas have a mix of commercial, open space and residential uses, including multifamily housing and commercial and institutional uses, as well as parks, some dating back to the 1800s. South of SW Hamilton Street, the land uses along SW Barbur Boulevard transition to mostly wooded areas, much of which are parklands, with Interstate 5 (I-5) to the east and residential areas to the west. Approaching SW Terwilliger Boulevard, the adjacent uses change to a mix of commercial uses, including auto-oriented services, and largely residential neighborhoods away from the arterials and the transportation corridor defined by I-5 and SW Barbur Boulevard.

Segment B continues generally along SW Barbur Boulevard and I-5 through an area with rolling topography, and a mix of commercial businesses, offices, and some multifamily residential properties. Multnomah Village, Hillsdale, Portland Community College (PCC) Sylvania campus and other neighborhoods connect to SW Barbur Boulevard. Many of these have a variety of land uses, including low-density commercial development surrounded by residential neighborhoods. The most densely populated commercial centers are near major intersections, including I-5 access ramps. Residential neighborhoods built to typical city standards are also adjacent to each side of SW Barbur Boulevard.

Segment C includes all of the City of Tigard, the western half of Lake Oswego and the northern end of Tualatin. Tigard is transected by Pacific Highway (99W), Highway 217 and I-5. Many commercial developments are located along the Pacific Highway and Highway 217. Pacific Highway features auto-oriented commercial developments such as strip malls that are set to attract passing drivers. The office commercial and retail developments along parts of Highway 217 and off of I-5 include office parks in the Tigard Triangle, and the mixed-use retail developments of Bridgeport Village shopping center and Washington Square Mall. A mix of commercial, office and residential uses are located near the mixed-use central business district of downtown Tigard. Industrial uses are located to the east of Highway 217 and adjacent to I-5.

Planning and Policy Framework

In Oregon, land use planning and development is guided by statewide land use goals and objectives that are implemented through local land use plans and codes. This section briefly reviews the major plans and policies that apply to the Southwest Corridor. For further discussion of these and other plans and policies, see Appendix B4.2. The major plans relevant to the Southwest Corridor include:

Oregon Statewide Planning Goals, specifically Goal 5 – Natural Resources, Scenic and Historic Areas, and Open Spaces; Goal 9 – Economic Development, guiding comprehensive planning in urban areas; Goal 10 – Housing; and Goal 12 – Transportation, guiding transportation planning.

Metro's *2040 Growth Concept* (1995, Amended 2014) guides the region's growth into compact urban centers, main streets, and corridors with focused civic activities, public services, and a variety of housing options and commerce well served by high capacity transit.

Climate Smart Strategy (2014) outlines specific strategies for reducing greenhouse gas emissions from cars and small trucks by 2035, whereby improved transit and bicycle and pedestrian facilities are a key component.

Southwest Service Enhancement Plan (2015) is TriMet's vision for transit in the southwest, including Tigard, Tualatin, Sherwood, Lake Oswego, West Linn, Durham, King City and Southwest Portland.

Regional Transportation Plan (2014) is Metro's federally mandated guide for future investments in the region's transportation system.

High Capacity Transit System Expansion Policy (2009–2010) is Metro's regional implementation guide for near-term and long-term regional high capacity transit priority corridors.

City of Portland Comprehensive Plan (2016) states policies guiding development around transit stations, preserving industrial land, guiding infill development, guiding neighborhood-compatible redevelopment, and supporting development along transit corridors.

[Portland] Central City 2035 (Recommended Draft 2017) provides the City of Portland's vision and framing policies for the Central City, and includes key strategies of extending the light rail system and making the area more accessible to the rest of the region and better able to accommodate more growth.

Climate Action Plan (2015) provides Portland's strategies for addressing climate change, which include increasing transit ridership and options and improving bicycle and pedestrian facilities.

City of Tigard Plans (2007 *Tigard Comprehensive Plan*, 2015 *Tigard Triangle Strategic Plan*, 2005 *Downtown Improvement Plan* and 2012 *Tigard High Capacity Transit Plan*) promote multimodal transportation improvements, an intensification of land uses in designated centers and corridors, and a strategy for future light rail.

City of Tualatin Comprehensive Plan gives guidance and goals for addressing future traffic, bicycle, pedestrian and transit demand, as well as improving multimodal access to key destinations.

Barbur Concept Plan (2013) presents the City of Portland's preferred concept for leveraging high capacity transit to advance a more walkable, vibrant SW Barbur Boulevard, with safer and more effective multimodal connections to neighborhood centers and major destinations, including Oregon Health & Science University (OHSU) and PCC-Sylvania.

Land Use in Station Areas

The existing conditions in station areas within Segments A and B and C include all properties that are within one-half mile of potential station sites. The station areas for the full project are shown in Figure 4.2-1, which shows generalized comprehensive plan designations. Appendix B4.2, Figures B4.2-1 to 3 show the station areas in more detail in mappings of existing land uses by segment. Table 4.2-1 breaks down the existing land uses by percentage for each of the station areas, each of which comprise 503 acres of land.

Table 4.2-1. Existing Land Uses by Station Area

Station	Agriculture %	Commercial %	Industrial %	Multi-family %	Single Family %	Public %	Open Space + Undeveloped %	Unknown %	Water %	Right-of-way %
Gibbs Barbur		33.7%		5.1%	9.9%		13.9%	0.4%		37.0%
Gibbs Naito		35.5%		5.9%	7.9%		14.1%	0.4%		36.2%
Hamilton		18.1%		11.2%	11.8%		20.3%	0.4%	8.3%	29.9%
Custer		8.3%		3.1%	47.1%		8.1%			33.4%
19th		10.2%		4.8%	46.7%		5.1%	1.8%		31.6%
Spring Garden		10.7%		6.6%	47.9%		4.1%	1.8%		28.9%
30th Barbur		9.0%		7.1%	50.9%		6.1%	1.0%		25.9%
30th I-5		8.2%		6.9%	52.4%		6.8%	0.8%		25.0%
Barbur TC Barbur		9.1%		5.2%	43.2%		14.9%	0.8%		26.8%
Barbur TC I-5		9.4%		5.7%	43.0%		14.6%	0.8%		26.6%
53rd Barbur		18.4%		6.4%	38.3%		8.5%	0.3%		28.0%
53rd I-5		17.8%		6.3%	39.0%		8.5%	0.3%		28.2%
Baylor		46.3%		1.3%	17.1%	4.5%	3.1%	5.3%		22.4%
Clinton		50.3%		1.1%	14.6%	4.6%	2.5%	4.9%		22.0%
Beveland		49.4%		2.2%	13.7%	1.7%	1.3%	3.9%		27.9%
Beveland Ash Through		52.3%		2.3%	12.2%	1.5%	0.9%	3.8%		27.1%
Tigard TC Ash		39.0%	1.9%	7.5%	11.8%	14.2%	0.9%	7.0%		17.6%
Tigard TC Clinton		34.9%	1.9%	8.3%	16.2%	12.8%	1.0%	9.2%		15.6%
Tigard TC Wall		33.3%	1.9%	8.6%	18.3%	11.8%	1.1%	9.0%		16.1%
Bonita I-5	0.1%	42.6%	5.0%	2.8%	17.4%	3.1%	4.5%	0.6%		23.9%
Bonita RR	3.3%	42.9%	5.3%	2.3%	13.1%	9.0%	3.4%	3.7%		17.1%
Upper Boones I-5		40.2%	3.2%		27.6%	1.6%	3.6%	3.3%		20.5%
Upper Boones RR	0.6%	46.2%	2.3%		21.5%	2.5%	3.9%	2.2%		20.7%
Bridgeport Village		49.5%	10.6%	1.9%	11.5%	1.7%	1.1%	1.8%		21.7%
26th Barbur		12.1%		7.0%	46.8%		5.4%	2.3%		26.4%
26th I-5		11.7%		6.4%	47.1%		6.6%	2.2%		26.1%
Hooker		34.0%		5.7%	6.5%		14.5%	0.4%		38.8%

In Segments A and B, the stations are at or near to locations already identified as station areas in the City of Portland's Barbur Concept Plan. In 2016, the City of Portland updated its Comprehensive Plan to change land uses, zoning and development guidelines citywide, which included changes to reflect the Barbur Concept Plan. As a result, the current land uses and zoning in Segments A and B are intended to encourage dense development in accordance with the general city strategy of intensifying corridors with frequent transit service, whether local bus or high capacity transit. This approach follows Portland's past position on land use around transit, which is to rely on pre-existing districtwide guidelines and to not rezone afterwards nor create specific station area plans.

The above conditions similarly apply to Segment C. The City of Tigard has adopted new land use and development regulations for the Tigard Triangle and downtown Tigard in the last few years in anticipation of the proposed project. These changes encourage transit-oriented developments as well as a greater mix of land use types, including buildings with multiple stories and more square footage. The station locations in Segment C also have already approved upzoning that would allow transit-oriented developments. The southern portion of Segment C is largely industrial or commercial (office parks) and is largely developed. Only modest infill development of the same land use types using existing regulations is anticipated in adopted plans and zoning.

4.2.2. Long-Term Impacts

No-Build Alternative

Land Use Conversion

The No-Build Alternative would not directly alter existing land uses.

Compatibility with Statewide Planning Goals

The No-Build Alternative would not directly conflict with Statewide Planning Goals. However, it is less likely to achieve the goals for focused growth reduction in vehicle miles traveled (VMT) per capita called for in Goal 12.

Compatibility with Regional and Local Plans

The No-Build Alternative would not deliver transportation and mobility improvements needed to support the long-range plans of Metro at the regional level. These improvements are also needed to help implement the plans of Portland, Tigard and Tualatin. All regional and local plans anticipate managing future growth by focusing development in the corridor, supported by a strong multimodal transportation system. Without light rail, areas anticipating higher rates of growth, such as downtown Portland, Hillsdale, Multnomah Village and the Tigard Triangle, would likely have a more difficult time maintaining good mobility. The lack of transit infrastructure investments could slow or discourage growth in these areas. Congestion and limited mobility choices would make the areas less attractive for businesses and residents. Slowed growth in these areas could also create more pressure for growth in less congested locations, typically on the fringes of the urban area, which is contrary to regional planning goals.

The No-Build Alternative does not change any plan designations, so it would not prevent the *2040 Growth Concept* from being achieved, but it could hinder its implementation. The regional multimodal transportation system called for in the *Regional Transportation Plan* would not include service in this corridor, and would not allow the regional system to connect to other Regional Centers and Town Centers to the degree envisioned in the *2040 Growth Concept*.

Light Rail Alternatives

Land Use Conversion

Table 4.2-2 shows the acreage of existing land use that would be converted to a transportation use for all light rail alternatives.

Table 4.2-2. Acres of Land Use Conversion, by Alignment Alternative *(multi-page table)*

Alignment Alternative	Commercial	Industrial	Multi-Family Residential	Single-Family Residential	Vacant	Public	Total
Segment A: Inner Portland							
A1: Barbur	2.94	N/A	0.70	1.30	3.04	N/A	7.98
A2-BH: Naito Bridgehead	3.35	N/A	0.40	1.21	3.19	N/A	8.15
A2-LA: Naito Limited Access	3.68	N/A	1.46	2.28	3.24	N/A	10.66
Segment B: Outer Portland							
B1: Barbur	24.65	N/A	0.90	1.89	2.85	N/A	30.29
B2: I-5 Barbur TC-60th	23.89	N/A	0.73	2.19	2.44	N/A	29.25
B3: I-5 26th-60th	19.18	N/A	0.44	2.19	2.20	N/A	24.01
B4: I-5 Custer-60th	18.27	N/A	1.29	3.13	2.14	N/A	24.83
Segment C: Tigard and Tualatin							
C1: Ash-I-5	28.84	10.37	2.70	1.98	1.21	5.45	50.55
C2: Ash-Railroad	19.02	0.56	2.70	1.98	2.59	5.54	32.39
C3: Clinton-I-5	34.54	10.37	N/A	0.02	1.42	9.67	56.02
C4: Clinton-Railroad	24.67	0.56	N/A	0.02	2.81	9.75	37.81
C5: Ash-I-5 Branched	31.55	0.46	2.70	1.98	1.28	3.48	41.45
C6: Wall-I-5 Branched	40.46	0.46	0.15	N/A	1.03	4.56	46.66

Note: TC = Transit Center.

Compatibility with State Planning Goals

Any combination of light rail alternatives comprising the full Southwest Corridor Light Rail Project would be consistent with the Statewide Planning Goal 12, which strengthens the connection between land use and transportation planning, and supports measures that encourage transit use and pedestrian and bicycle travel.

Compatibility with Regional and Local Planning Goals

The light rail alternatives would be consistent with adopted regional plans and policies, including Washington County and Clackamas County plans, all of which encourage high quality transit serving growth centers, and transportation facility designs that encourage bicycle and pedestrian use. The light rail alternatives would not alter total population or employment region-wide. While transit improvements can shape where new development and redevelopment occurs within a region, which affects where population and employment growth would occur over time, adopted plans already anticipate this focused growth supported by transit. Metro's population growth projections already assume the proposed project and the cities' recently adopted land use regulations. The light rail alternative scenarios may quicken the pace of redevelopment and affect details of individual developments but growth in population and jobs is anticipated even in the No Build scenario through the year 2035.

The compatibility of the light rail alternatives with plans at the city level are discussed by segment below.

Station Access Improvements

Station access improvements in Segments A, B and C involve the addition of walking and biking investments along the alignment alternatives. These improvements stem from locally planned infrastructure projects that support adopted land use plans and would not have a notable impact on existing land uses.

Segment A: Inner Portland

Land Use Conversion

All three Segment A alignment alternatives convert existing land uses to a transportation use, but the level of conversion would not alter the overall patterns of land use (see Table 4.2-1). The affected parcels are dispersed along the alignment and would not alter the overall pattern of land uses in the corridor. Alternative A2-BH would convert nearly eight acres of land to a transportation use, including areas near the Ross Island Bridge. While slightly more land would be affected than with Alternative A1, it would not alter the overall pattern of land uses in the corridor or the city.

Alternative A2-LA would convert more than ten acres to transportation use, the most of all of the Segment A alignment alternatives, but this effect would still not alter overall patterns of land use in the corridor or the city.

Local Plan Compatibility

All of the Segment A alignment alternatives are generally consistent with the overall intent of the *Barbur Concept Plan*, because they would increase accessibility for pedestrians, bicyclists and transit riders heading to or from downtown Portland. However, localized features of some of the alignment alternatives would conflict with elements of the concept plan (see Table 4.2-3.

Table 4.2-3. Segment A: Summary of Local Plan Compatibility

Alignment Alternative	Local Plan Compatibility
A1: Barbur	Barbur Concept Plan – generally consistent · increases accessibility for pedestrians, bicyclists and transit riders · stations on SW Barbur Boulevard support goals to improve transit and pedestrian access in this area · omits elements altering SW Naito Parkway to remove the barrier the roadway presents National University of Natural Medicine Master Plan – consistent · located away from the area covered by this plan
A2-BH: Naito Bridgehead	Barbur Concept Plan – generally consistent · meets the plan's goals for transit improvements on SW Naito Parkway and for stronger east-west connections in the area · reduces neighborhood traffic from Ross Island Bridge National University of Natural Medicine Master Plan – inconsistent · acquisitions needed to reconfigure the Ross Island bridgehead would conflict
A2-LA: Naito Limited Access	Barbur Concept Plan – generally consistent · would not improve pedestrian or bicycle access as much as Alternative A2-BH · less supportive of goals to encourage nodes of mixed-use walkable development near SW Naito Parkway · improves transit and pedestrian access to inner Portland neighborhoods National University of Natural Medicine Master Plan – consistent · partial parcel acquisition does not impact this plan
Marquam Hill Connection Options	Barbur Concept Plan – generally consistent · transit improvements could support OHSU development and growth while helping protect the neighboring Lair Hill and South Portland Historic District · addresses barriers to bicycle and pedestrian access between SW Barbur Boulevard, SW Naito Parkway, the neighborhood of Lair Hill, and the parks and the trails leading west to one of the main entrances of the OHSU Marquam Hill complex OHSU 20-Year Facilities Master Plan – consistent · addresses a barrier to bicycle and pedestrian access between SW Barbur Boulevard, SW Naito Parkway, the neighborhood of Lair Hill, and the parks and the trails leading west to one of the main entrances of the OHSU Marquam Hill complex

Segment B: Outer Portland

Land Use Conversion

All of the alignment alternatives in Segment B would acquire properties distributed along the length of the alignment. These acquisitions (see Table 4.2-1) all would be in the same range, and their effects on land use patterns would be similar.

Local Plan Compatibility

For all Segment B alignment alternatives, light rail stations and improved transit service, along with streetscape and access improvements (bicycle and pedestrian), would be consistent with the local land use goals identified in the *Barbur Concept Plan* (see Table 4.2-4). Alternatives B1 and B2, with alignments mostly along SW Barbur Boulevard, would better support the plan than the alignments that are more adjacent to I-5 (Alternatives B3 and B4). The connections to PCC-Sylvania and its station access improvements would support the PCC's campus master plan goals by improving overall mobility through better transit connections and pedestrian and bicycle access.

Table 4.2-4. Segment B: Summary of Local Plan Compatibility

Alignment Alternative	Local Plan Compatibility
B1: Barbur	Barbur Concept Plan – generally consistent · includes stations in locations identified for medium density mixed-use development, consistent with transit-oriented development · increases access for pedestrians, bicyclists and transit riders · station parking structures could increase auto traffic in the area PCC-Sylvania Campus Master Plan – consistent · improves overall mobility through transit connections and pedestrian and bicycle access · 53rd Barbur Station would support plan goals by converting land that is underdeveloped
B2: I-5 Barbur Transit Center to 60th	Barbur Concept Plan – generally consistent · station access improvements would support goals to increase access for pedestrians, bicyclists and transit riders · improves multimodal access along SW Barbur Boulevard and across I-5 · all stations are proposed in areas targeted for redevelopment in the plan · alignment along I-5 between the Barbur Transit Center and the 53rd I-5 Station is less supportive of walkability and redevelopment · station parking structures could increase auto traffic in the area PCC-Sylvania Campus Master Plan – consistent · improves overall mobility through transit connections and pedestrian and bicycle access
B3: I-5 26th to 60th	Barbur Concept Plan – generally consistent · station access improvements would support goals to increase access for pedestrians, bicyclists and transit riders, however would not improve access as much as Alternatives B1 or B2 · improves multimodal access along SW Barbur Boulevard and across I-5 · less supportive of the plan's goals to encourage redevelopment PCC-Sylvania Campus Master Plan – consistent · improves overall mobility through transit connections and pedestrian and bicycle access
B4: I-5 Custer to 60th	Barbur Concept Plan – generally consistent · increases access for pedestrians, bicyclists and transit riders, however would not improve access as much as Alternatives B1, B2 or B3 PCC-Sylvania Campus Master Plan – consistent · improves overall mobility through transit connections and pedestrian and bicycle access

Segment C: Tigard and Tualatin

Land Use Conversion

All of the alignment alternatives in Segment C would acquire properties in the Tigard Triangle and downtown Tigard, and then along the alignment adjacent to existing transportation facilities to Tualatin. The acquisitions (see Table 4.2-2) would vary in terms of the amounts and types of land uses affected, particularly industrial land uses. In Tualatin, minor conversions of land uses would be needed.

At a more localized level, the Alternative C1's effects on land use patterns in the Tigard Triangle and downtown Tigard could affect several blocks of properties in a number of locations. The Upper Boones Ferry I-5 Station and Park and Ride in Alternatives C1, C3, C5 and C6 would also convert multiple adjacent parcels from commercial use to a transportation use. The alignment of Alternatives C2 and C4 along the railroad would largely avoid impacts to industrial lands. Alternative C3 would affect different properties in the Tigard Triangle and downtown Tigard, and there would be lower levels of residential properties affected than by Alternative C1.

Local Plan Compatibility

All of the Segment C alignment alternatives have stations and other improvements including streets, paths and access elements that support the *Tigard Triangle Strategic Plan* goals to increase multimodal access (see Table 4.2-5). The alignment alternatives that include two light rail stations in the Tigard Triangle (Alternatives C1, C2, C5 and C6) are the most supportive of these goals. They would also construct a longer segment of SW 70th Avenue, and the second station area would likely encourage more redevelopment and higher intensity land uses than a single station would.

The alternatives following SW Ash Avenue (Alternatives C1, C2 and C5) would be most supportive of the City of Tigard's *Downtown Improvement Plan*, because they include a new street alignment extending SW Ash Avenue. All of the Segment C alignment alternatives would support the multimodal goals of the *City of Tualatin Comprehensive Plan*.

Table 4.2-5. Segment C: Summary of Local Plan Compatibility *(multi-page table)*

Alignment Alternative	Local Plan Compatibility
C1: Ash to I-5	Tigard Triangle Strategic Plan and Tigard Downtown Improvement Plan – consistent · alignment, stations and multimodal features include local street extensions, transit center relocation, and other access improvements that are consistent with plans City of Tigard Comprehensive Plan – consistent · supports goals to increase access to high capacity transit and provide an efficient and balanced transportation system · the operations and maintenance facility would preserve industrial uses and generate employment in area designated as industrial land Lake Oswego Comprehensive Plan – consistent · includes station and access improvements for commuters and Kruse Way employment district City of Tualatin Comprehensive Plan – generally consistent · Bridgeport Station, park and ride, and station access improvements would be generally consistent with transportation goals

Table 4.2-5. Segment C: Summary of Local Plan Compatibility *(multi-page table)*

Alignment Alternative	Local Plan Compatibility
C2: Ash to Railroad	Tigard Triangle Strategic Plan and Tigard Downtown Improvement Plan – consistent · alignment, stations and multimodal features include local street extensions, transit center relocation, and other access improvements that are consistent with plans City of Tigard Comprehensive Plan – consistent · Bonita Railroad Station close to transit-supportive land uses, supporting goals to increase access to high capacity transit and provide an efficient and balanced transportation system · Upper Boones Ferry Railroad Station also supports city's transportation goals Lake Oswego Comprehensive Plan – generally consistent · SW Bonita I-5 Station further from Kruse Way employment district City of Tualatin Comprehensive Plan – generally consistent · Bridgeport Station, park and ride, and station access improvements would be generally consistent with transportation goals
C3: Clinton to I-5	Tigard Triangle Strategic Plan and Tigard Downtown Improvement Plan – consistent · SW Clinton alignment and station in Tigard Triangle would provide access improvements that are consistent with plans but would implement fewer elements of Strategic Plan City of Tigard Comprehensive Plan – consistent · increases access to high capacity transit and provides an efficient and balanced transportation system Lake Oswego Comprehensive Plan – consistent · includes station and access improvements for commuters and Kruse Way employment district City of Tualatin Comprehensive Plan – generally consistent · Bridgeport Station, park and ride, and station access improvements would be generally consistent with transportation goals
C4: Clinton to Railroad	Tigard Triangle Strategic Plan and Tigard Downtown Improvement Plan – consistent · SW Clinton alignment and station in Tigard Triangle would provide access improvements that are consistent with plans but would implement fewer elements of Strategic Plan City of Tigard Comprehensive Plan – consistent · increases access to high capacity transit and provides an efficient and balanced transportation system Lake Oswego Comprehensive Plan – consistent · includes station and access improvements for commuters and Kruse Way employment district City of Tualatin Comprehensive Plan – generally consistent · Bridgeport Station, park and ride, and station access improvements would be generally consistent with transportation goals
C5: Ash and I-5 Branched	Tigard Triangle Strategic Plan and Tigard Downtown Improvement Plan – consistent · alignment, stations and multimodal features include local street extensions, transit center relocation, and other access improvements that are consistent with plans · the branch through Tigard Triangle would further increase multimodal access City of Tigard Comprehensive Plan – consistent · increases access to high capacity transit and provides an efficient and balanced transportation system
C6: Wall and I-5 Branched	Tigard Triangle Strategic Plan and Tigard Downtown Improvement Plan – generally consistent · alignment, additional light rail stations and multimodal features include local street extensions, transit center relocation, and other access improvements that are consistent with plans · new multimodal bridge would connect downtown Tigard and the Tigard Triangle, but would be further away from the centers of these two subareas City of Tigard Comprehensive Plan – consistent · increases access to high capacity transit and provides an efficient and balanced transportation system

4.2.3. Short-Term Impacts

Construction of the light rail alternatives would temporarily affect existing land uses due to construction activities (e.g., staging areas, earthmoving and truck traffic). Temporary impacts include increases in noise levels, dust, traffic congestion, visual changes, and increased difficulty accessing residential, commercial, and other uses. Chapter 2 – Alternatives Considered describes the general construction approach for the light rail alternatives. Although some land uses might experience inconveniences or hardships during construction, the level of temporary impacts would not rise to a level that would make a given land use unviable.

For more information on construction impacts, including impacts on the existing uses (i.e., businesses and residences) and measures to avoid, minimize and mitigate for those impacts, see Chapter 3 on transportation construction impacts, and Sections 4.3, Economics; 4.4, Communities; 4.5, Visual Quality; 4.12, Air Quality and Greenhouse Gases; and 4.11, Noise and Vibration.

In areas that may not be permanently acquired, project construction activities would require temporary construction easements, including on public lands owned by Oregon Department of Transportation (ODOT) and local jurisdictions. Any construction staging within I-5 right of way must also be approved by the Federal Highway Administration, considering factors such as safety, the environment and potential impacts to the freeway. Construction easements would be temporary, and the property would be returned to preconstruction conditions upon completion of the construction activities.

Finally, some larger parcels that could be acquired for construction of the project could have remnant portions that may not be immediately redeveloped following the construction of the project. The potential temporary presence of vacant lands along the alignment or near stations would be less consistent with applicable plans that envision a dense, vibrant mix of land uses along the corridor.

4.2.4. Potential Mitigation Measures

No long-term land use impacts requiring mitigation have been identified for any of the light rail alternatives. While some localized areas would experience changes to existing land uses, the compensation and relocation assistance described in Section 4.1, Acquisitions, Displacements and Relocations, would mitigate the effects on affected property owners and tenants.

During construction, potential temporary impacts to existing land uses could be mitigated, as described in other sections of this Draft EIS, including in Chapter 3 and in Chapter 4 sections on air quality, economics, noise and vibration, and visual quality. In addition, TriMet could reduce the potential temporary effect of vacant lands along the alignments by partnering with local jurisdictions to promote the availability of lands that could become available after construction is complete. In some cases, property acquisitions could also be conducted to support the redevelopment plans of existing owners who could retain ownership of unused portions of their property, rather than by requiring full parcel acquisitions.

Chapter 3 – Transportation Impacts and Mitigation identifies measures for mitigating indirect and cumulative land use changes due to increases in traffic congestion or indirect changes in accessibility. For other types of indirect or cumulative impacts, TriMet could partner with ODOT, Metro, local jurisdictions and other agencies to coordinate the development of other projects, and to develop programs and incentives to minimize undesired land use change effects, including changes due to escalating land values and pressure to redevelop existing land uses (particularly existing affordable housing stock).

4.3. Economics

This section addresses potential economic impacts caused by the Southwest Corridor Light Rail Project. The long- and short-term direct impacts include potential changes to jobs and tax revenue, while indirect impacts include potential changes to economic activity, jobs, tax revenue and property values. These impacts can range from affecting individual businesses to those occurring at the municipal or regional level. Therefore, this section discusses impacts along the Southwest Corridor for each of the three cities along the proposed project: Portland, Tualatin and Tigard. It also considers impacts in terms of trends on the broader regional economy, defined as the Portland-Vancouver-Hillsboro Metropolitan Statistical Area (MSA), referred to here as the Portland metropolitan area. Detailed data and supporting information are available in Appendix B4.3 –Economics.

4.3.1. Affected Environment

Demographic and Economic Trends

General descriptions of the economics and employment are described at the regional level. The study area for impact analysis are based on parcels identified for full or partial parcel acquisition in Section 4.1, Acquisitions, Displacements and Relocations.

Population grew nearly 10 percent in the City of Portland between 2010 and 2016, which is one of the fastest growth rates in the nation. While recent population growth in the city of Portland has outpaced its surrounding suburbs, constraints on supply of developable (and redevelopable) land are expected to slow growth in central Portland at least somewhat over the next two decades. Between 2015 and 2035, population in the Portland metropolitan area is projected to grow slightly faster than in the city of Portland (1.1 percent and 1.0 percent annually, respectively). Because households in Portland are smaller on average than in the suburbs, future growth in Portland's household count should continue to outpace regional household growth (1.7 percent and 1.4 percent, respectively). Employment growth is expected to be similarly constrained by land availability in the city of Portland, with 1.0 percent annual projected growth in the city versus nearly 1.5 percent annual employment growth across the region.

As of 2015, the overall Portland metropolitan area was approaching 1.1 million employees, 2.3 million residents and just more than 850,000 households. The city of Portland accounts for approximately 32 percent of the population and 41 percent of the jobs within the region. Within the city of Portland, there are 1.66 jobs per household, a substantially higher ratio than the regional jobs/housing ratio of 1.26. Tigard and Tualatin are smaller municipalities, with populations of 54,170 and 26,887, respectively. While suburban in location, these cities both have considerable employment clusters and in fact have much higher jobs/housing ratios (2.40 for Tigard and 2.68 for Tualatin) than the city of Portland.

Employment

The current distribution of jobs across all major industry groupings varies greatly for the three cities along the proposed project. Portland's larger employment base is broadly diversified, with education and health care services combining for nearly one-quarter of all jobs. Of the three cities, Tigard is most strongly characterized by retail and administrative support services (approximately 16 percent of jobs each). Tualatin's employment base is disproportionately in the industrial sectors, with 35 percent of that city's jobs in either manufacturing or wholesaling.

Property Tax Revenue

Property tax revenue represents between 30 and 40 percent of all government revenues for each affected jurisdiction.

4.3.2. Long-Term Impacts

A new light rail system can cause changes in the local business environment and surrounding neighborhoods. These changes in turn can benefit or adversely affect the success of existing businesses and influence future economic opportunity in the area. Direct economic impacts of each study alternative could include business and employee displacements and property acquisitions that result in potential tax impacts for the municipalities.

No-Build Alternative

The No-Build Alternative would avoid any direct property acquisitions and other construction-related impacts. However, the corridor would continue to be constrained by limited transportation options and redevelopment opportunities.

Light Rail Alternatives

While the ongoing operation of the new light rail line would require in the range of 200 to 300 employees, net employment change in the corridor and region over the long term resulting from the project would likely be negligible. Light rail's higher carrying capacity results in more efficient service and may require fewer bus operators and related jobs in the corridor.

Impacts of Business and Employment Displacements

Table 4.3-1 estimates the number of businesses and employees that the light rail alternatives would displace as a result of property acquisitions for each segment, including for the Marquam Hill connection options and the operations and maintenance (O&M) facilities options. The numbers shown here assume that only *full* acquisitions of a given property displace a business or place of employment. Section 4.1, Acquisitions, Displacements and Relocations, describes how TriMet would provide compensation and relocation assistance to qualified businesses that would be displaced. If some of these businesses relocate in the same city or general area, business-related adverse impacts would be reduced. Employment is listed separately from displacements, because some businesses might choose not to relocate in the same area, which could affect their employees. TriMet's experience with past projects shows that most employers choose to relocate in the same cities. For example, on TriMet's Portland Milwaukie Light Rail Project, there were 67 businesses displaced. Of these, 63 of the 67 businesses and 858 employees relocated, including 40 businesses within the same jurisdiction, 22 businesses within the Portland Metropolitan Area and one business relocating to Ohio. Four businesses chose not to relocate, affecting 28 employees.

Acquisitions could also result in permanent net employment changes for the affected municipalities. However, because dislocated firms are free to relocate within the same cities, the displacement numbers summarized in Table 4.3-1 are likely to overstate actual long-term net job losses to the affected cities. Compared to the existing estimated employment totals in the affected municipalities, there would be relatively moderate differences across alignment alternatives in terms of displaced businesses and employees (see the "Affected Employees as % of Total Jobs by Municipality" column in Table 4.3-1).

Table 4.3-1. Estimated Business and Employment Displacements

Alignment Alternatives and Options	Number of Displaced Businesses or Institutions	Number of Affected Employees	Affected Employees as % of Total Jobs by Municipality	Industries Most Impacted
Segment A: Inner Portland			*(% of Portland jobs)*	
A1: Barbur	15	108	<0.1%	Admin./Support
A2-BH: Naito Bridgehead	22	371	<0.1%	Admin./Support
A2-LA: Naito Limited Access	23	231	<0.1%	Admin./Support
Segment B: Outer Portland			*(% of Portland jobs)*	
B1: Barbur	54	500	0.11%	Food Svc., Financial
B2: I-5 Barbur TC-60th	61	469	0.11%	Food Svc., Financial
B3: I-5 26th-60th	66	565	0.13%	Other Svc., Food Svc.
B4: I-5 Custer-60th	62	496	0.11%	Admin./Support, Food Svc.
Segment C: Tigard and Tualatin			*(% of Tigard + Tualatin jobs)*	
C1: Ash-I-5	41	734	0.99%	Health Care, Food Svc., Prof. Svc.
C2: Ash-Railroad	37	323	0.44%	Health Care, Food Svc., Prof. Svc.
C3: Clinton-I-5	35	839	1.13%	Health Care, Food Svc., Retail
C4: Clinton-Railroad	31	428	0.58%	Health Care, Food Svc., Manufacturing
C5: Ash-I-5 Branched	55	515	0.69%	Health Care, Food Svc., Manufacturing
C6: Wall-I-5 Branched	47	545	0.74%	Health Care, Food Svc., Financial
Marquam Hill Connection Options			*(% of Tigard + Tualatin jobs)*	
1A: Elevator/Bridge and Path	2	4	<0.1%	N/A
1B: Elevator/Bridge and Recessed Path	2	4	<0.1%	N/A
1C: Elevator/Bridge and Tunnel	2	4	<0.1%	N/A
2: Full Tunnel	1	3	<0.1%	N/A
O&M Facilities Options			*(% of Tigard + Tualatin jobs)*	
Hunziker	10	185	0.27%	Retail
Branched 72nd	5	505	0.73%	Manufacturing
Through 72nd	5	58	<0.1%	Manufacturing

Note: TC = Transit Center.

Impacts of Property Acquisitions on Tax Revenue

The project would acquire residential and commercial properties and convert them to public ownership, which would make them exempt from property taxes. Table 4.3-2 estimates the annual property tax loss resulting from property acquisitions on affected cities, based on 2016 revenues. Changes in property tax revenues are based on anticipated full property acquisitions (see Section 4.1, Acquisitions, Displacements and Relocations).

Overall, the property tax revenue impact (loss) (see Table 4.3-2) would be negligible (less than 0.1 percent) to the budget of each local jurisdiction, and there are relatively small differences between

the alignment alternatives in each segment. In the long run, some of the land purchased for the construction of the project might not be needed permanently and could be released for development after the project is built. The potential effects of this project-related action are discussed further below, in Section 4.3.4, Indirect Impacts.

Table 4.3-2. Total Annual Property Tax Loss for Cities, by Alignment Alternative in Each Segment

Alignment Alternatives and Options	City of Portland	City of Tigard	City of Tualatin
Segment A: Inner Portland			
A1: Barbur	$51,141	$0	$0
A2-BH: Naito Bridgehead	$100,514	$0	$0
A2-LA: Naito Limited Access	$63,721	$0	$0
Segment B: Outer Portland			
B1: Barbur	$208,661	$0	$0
B2: I-5 Barbur TC-60th	$182,277	$0	$0
B3: I-5 26th-60th	$107,395	$0	$0
B4: I-5 Custer-60th	$88,427	$0	$0
Segment C: Tigard and Tualatin			
C1: Ash-I-5	$0	$202,498	$19,188
C2: Ash-Railroad	$0	$58,335	$19,188
C3: Clinton-I-5	$0	$189,533	$19,188
C4: Clinton-Railroad	$0	$45,371	$19,188
C5: Ash-I-5 Branched	$0	$98,399	$19,188
C6: Wall-I-5 Branched	$0	$96,323	$19,188
Marquam Hill Connection Options			
1A: Elevator/Bridge and Path	$4,530	$0	$0
1B: Elevator/Bridge and Recessed Path	$4,530	$0	$0
1C: Elevator/Bridge and Tunnel	$4,530	$0	$0
2: Full Tunnel	$4,530	$0	$0
O&M Facilities Options			
Hunziker	$0	$27,019	$0
Branched 72nd	$0	$87,747	$0
Through 72nd	$0	$46,035	$0

Source: Multnomah County and Washington County assessors based on 2016 revenues.
Note: TC = Transit Center.

4.3.3. Short-Term Impacts

Capital expenditures required to construct the light rail alternatives would entail a significant investment in the local economy, creating an influx of new employment, earnings and output for the duration of construction period. Construction increases employment and brings money into the economy from construction worker wages and their purchases of local goods and services. Impacts are considered to represent "net new" economic activity to the extent that project capital funding is sourced from outside the local region (i.e., for that portion of capital expenses paid for with federal and state funding sources). Newly generated economic activity would occur at the regional level (defined here as the Portland MSA) as construction labor, professional/technical services and materials are purchased from metropolitan-area firms. These benefits would be generally the same for all of the light rail alternatives.

Positive Impacts from Construction Capital Expenditures

Of a total potential capital investment of up to $3.3 billion, approximately $1.48 billion will be spent on professional services and general construction and are likely to expand the Portland MSA economy in the short term. Of this total, an estimated 60 percent, or just more than $890 million, is expected to be paid for with state and federal funding sources that are outside of the Portland MSA economy, and thus constitute "new dollars" flowing into the region.

The $890 million of new dollars are multiplied by recirculation in the local economy due to business-to-business local purchasing (indirect effects) and increased worker household spending (induced effects). Based on this multiplier effect, the short-term influx of new money from the project is likely to result in a one-time total impact of approximately:

- $2.13 billion in new economic output (total value of goods and services) for the MSA
- $450 million in new metropolitan area wage earnings
- 7,817 new (person-year) jobs.

Negative Construction Impacts

Construction can also negatively affect businesses by reducing access and visibility of businesses and increasing congestion and travel times by rerouting traffic. Potential customers might choose to avoid businesses due to real or perceived inconvenience caused by construction, including noise, dust and access changes, resulting in adverse short-term impacts.

Temporary impacts are most likely for commercial establishments adjacent to construction for the Segment B alignment alternatives, where SW Barbur Boulevard and I-5 run parallel. In this area, businesses include strip retail and freestanding sites such as gas stations, motels, fast food restaurants, and a grocery store. Signage and adequate detour arrangements will largely offset potential impacts on these businesses; however, some decline in sales during construction might still occur and would likely be very similar across all of the alignment alternatives in Segment B.

The urban context for Segment C is more oriented to business parks with primarily office and light industrial uses. Workers, patrons and visitors of those firms could experience construction-related inconvenience, but the establishments are unlikely to see a decline in business performance as a result. There are, however, a number of restaurant, retail and personal service establishments operating in the business parks that could experience similar nuisance impacts to those expected in Segment B. These short-term impacts could be mitigated by adequate detour arrangements and signage during construction.

Segment A, which has far less retail and dining activity than the other two segments, is least likely to experience significant impacts due to construction-related nuisances.

4.3.4. Potential Mitigation Measures

For businesses that are permanently or temporarily acquired for the Southwest Corridor Light Rail Project, TriMet will compensate property owners affected by the project, as required by the federal Uniform Act, as amended, and state relocation and property acquisition law and regulations. Benefits would vary by property depending on the level of impact, available relocation options and other

factors. The primary mitigation for acquisitions and displacements would be payment of just compensation and relocation assistance.

Construction of the project would be planned to minimize road closures and to avoid complex detours to businesses. Signs to identify the location of these access points and the businesses served by them would be provided during detours or closures. Programs to help businesses affected during construction could include business planning assistance, marketing and retail consulting, business-oriented workshops and promotions to generate patronage.

4.4. Communities

This section describes how the Southwest Corridor Light Rail Project would affect the surrounding communities. The analysis considers impacts to neighborhood cohesion, neighborhood quality of life and community facilities, which are defined as follows:

- **Neighborhood cohesion** is the sense of community within a neighborhood resulting from opportunities for interaction and features of the neighborhood that contribute to a shared neighborhood identity.
- **Neighborhood quality of life** is the satisfaction residents derive from living in the neighborhood from factors such as aesthetics, noise, affordability, and access to jobs and services.
- **Community facilities** include land uses that are important to the social characteristics or function of neighborhoods, such as parks, schools, religious institutions and community centers.

In addition to neighborhoods and community facilities, this analysis considers impacts to transit-dependent populations (see Section 4.4.4). Information on impacts to minority and low-income populations in the context of environmental justice compliance is provided in Appendix C, Environmental Justice Compliance.[1]

4.4.1. Affected Environment

The community impacts analysis focuses on 18 study neighborhoods that are located fully or predominantly within a 0.5-mile buffer of the light rail alignments (see Figure 4.4-1). This section provides an overview of the characteristics of the study neighborhoods and the broader Southwest Corridor related to neighborhood cohesion, neighborhood quality of life and community facilities. The study neighborhoods are also described individually in more detail in Appendix B4.4.

Downtown Portland, at the northern end of the corridor, contains the region's densest concentration of employment. The close-in Homestead and South Portland neighborhoods contain several large medical and educational institutions as well as clusters of single-family homes and multifamily residences as large as 30 stories tall. The South Portland neighborhood includes the South Portland Historic District (see Section 4.6, Historic and Archaeological Resources).

[1] The Draft EIS is addressing environmental justice in compliance with Presidential Executive Order 12898, Federal Actions to Address Environmental Justice to Minority Populations and Low-Income Populations (February 11, 1994); the U.S. Department of Transportation (USDOT) Order 5610.2, Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (April 15, 1997); and the USDOT Order 5610.2(a) (May 2, 2012) updating the USDOT policy to consider environmental justice principles in all programs, policies and activities.

The outer portion of Southwest Portland contains primarily single-family neighborhoods, with commercial and multifamily land uses concentrated along major roadways such as SW Barbur Boulevard and SW Capitol Highway. The Hillsdale and Multnomah neighborhoods feature distinct town centers made up of relatively low-density commercial land uses such as shops and restaurants.

A swath of commercial land surrounds Highway 217 and Interstate 5 (I-5) in the cities of Beaverton, Tigard and Tualatin, including office, retail and manufacturing businesses. Single-family housing surrounds these commercial and industrial areas. Multifamily housing is located primarily along major roadways such as Pacific Highway (99W) and in each city's downtown.

Circulation and Barriers

The street network in much of the corridor is winding and discontinuous as a result of the hilly topography and suburban-style development patterns. Throughout the corridor, major roadways, rivers and rail lines obstruct connectivity and separate neighborhoods. High traffic volumes are funneled onto the streets that do cross these barriers, resulting in congestion for cars, trucks and buses, and less comfortable conditions for biking and walking.

Walking and biking are challenging in many parts of the corridor because of poor street connectivity; unimproved roads; steep terrain; high volumes and speeds of auto traffic; and limited sidewalks, bikeways and safe crossings. Transit service is relatively limited in the corridor. Bus travel times are somewhat slow, because many of the bus lines take circuitous routes along the non-gridded arterial and collector streets in the corridor. The Westside Express Service (WES) Commuter Rail and many bus lines operate either during peak periods only or with limited service frequencies during off-peak periods.

Demographics

In general, the Southwest Corridor has a lower proportion of transit-dependent populations than the region overall. Along the light rail alignments, the highest concentrations of transit-dependent populations are located in downtown Portland and in Tigard, Tualatin and Durham.

With 40 percent of its population identifying as non-white or Hispanic, Downtown Tualatin is the only study neighborhood with a higher proportion of minority residents than the region overall. In the Tigard Triangle, Downtown Tigard and Downtown Portland neighborhoods, about one-quarter of residents identify as members of racial or ethnic minorities. In the remaining study neighborhoods, 80 to 90 percent of the population identifies as white alone and non-Hispanic.

Appendix B4.4, Communities Background, includes more detailed information on where transit-dependent populations reside within the study neighborhoods.

Community Facilities

Figure 4.4-1 shows the location of existing community facilities within the study neighborhoods. See Appendix B4.4 for a list of the community facilities within each study neighborhood.

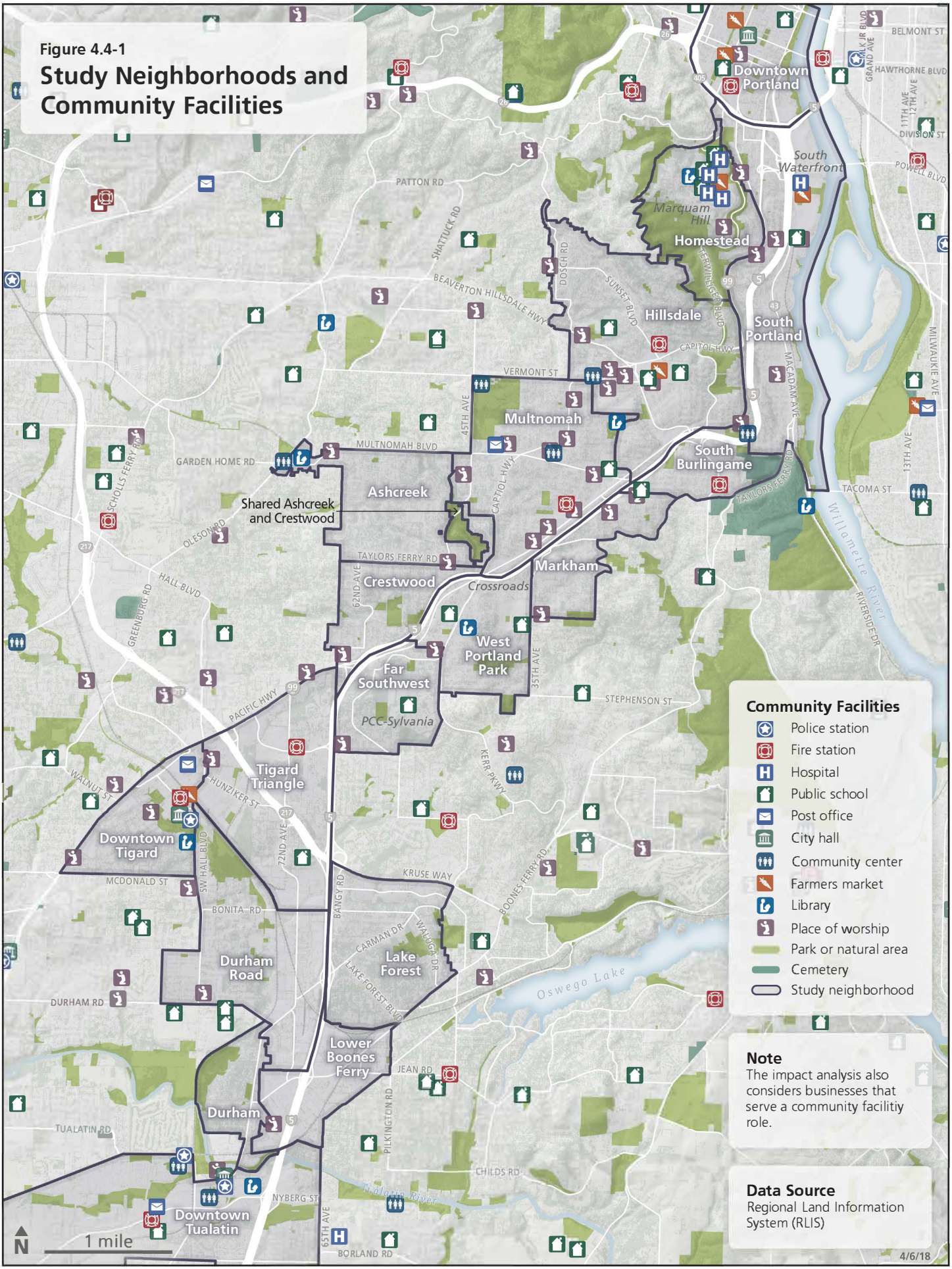


Figure 4.4-1
Study Neighborhoods and Community Facilities
Downtown Portland
South Waterfront
Marquam Hill
Homestead
Hillsdale
South Portland
Multnomah
South Burlingame
Ashcreek
Shared Ashcreek and Crestwood
Crestwood
Crossroads
Markham
West Portland Park
Far Southwest
PCC-Sylvania
Tigard Triangle
Downtown Tigard
Durham Road
Lake Forest
Lower Boones Ferry
Durham
Downtown Tualatin
Oswego Lake
Willamette River
PATTON RD
BEAVERTON HILLSDALE HWY
VERMONT ST
MULTNOMAH BLVD
GARDEN HOME RD
TAYLORS FERRY RD
HALL BLVD
PACIFIC HWY
STEPHENSON ST
KRUSE WAY
MCDONALD ST
BONITA RD
DURHAM RD
TUALATIN RD
NYBERG ST
BORLAND RD
CHILDS RD
JEAN RD
CAPITOL HWY
TACOMA ST
BELMONT ST
HAWTHORNE BLVD
DIVISION ST
POWELL BLVD
Community Facilities
Police station
Fire station
Hospital
Public school
Post office
City hall
Community center
Farmers market
Library
Place of worship
Park or natural area
Cemetery
Study neighborhood
Note
The impact analysis also considers businesses that serve a community facilitiy role.
Data Source
Regional Land Information System (RLIS)
N
1 mile
4/6/18

4.4.2. Introduction to Impacts Analysis

The analysis of impacts to communities is based on the impacts and mitigation identified in other sections within this Draft Environmental Impact Statement (EIS). Table 4.4-1 identifies long-term, short-term and indirect impacts that could result in an impact to neighborhood cohesion, neighborhood quality of life or community facilities. Certain long-term, short-term and indirect impacts could result in a cumulative impact, as explained in Section 4.18 Indirect and Cumulative Impacts. Appendix B4.4 includes a table that identifies these impacts to communities by the relevant environmental discipline within this Draft EIS.

Table 4.4-1. Summary of Community Impacts

Impact Category	Community Impacts		
	Neighborhood Cohesion	**Neighborhood Quality of Life**	**Community Facilities[1]**
Long-Term	· Displacement of residents and businesses · Consistency with adopted local land use plans · Conversion of land to transportation use · Addition, removal or reinforcement of physical or perceived barriers · Impacts to walking and biking · Impacts to features that contribute to neighborhood identity, such as landmarks or historic properties · Impacts to community facilities that provide opportunities for interaction	· Noise, vibration, air quality and visual impacts · Traffic congestion in the neighborhood · Quality of transit access to and from the neighborhood · On-street parking removal	· Displacement of a community facility · Changed access to a community facility · Changed functionality of a community facility, such as from visual or noise impacts
Short-Term	· Temporary addition or reinforcement of physical or perceived barriers as a result of construction activities	· Noise, vibration, air quality and visual impacts during construction · Traffic and parking impacts resulting from construction	· Changed access to a community facility during construction · Changed functionality of a community facility during construction, such as from increased noise
Indirect	· Indirect displacement of residents or businesses resulting from reduced affordability · New facilities providing opportunities for interaction as a result of increased development around stations	· Reduced affordability of market-rate housing resulting from increases in property value and demand to live near new light rail service · Better and faster multimodal connections · Reduced availability of on-street parking resulting from "hide and ride" activity	· N/A

[1] Community facilities may include businesses or residences where the community gathers. Although these facilities are not shown in Figure 4.4-1, those that would be impacted are addressed in Section 4.4.3.

In addition to considering effects to the general population, the analysis considers impacts to the following groups:

- minority (population not identifying as both "white alone" and "non-Hispanic")
- low income (population earning below 200 percent of federal poverty level, or about $48,000 per year for a family of four in 2014)
- limited English proficiency (population speaking English less than "very well")
- older adults (population age 65 and over)
- youth (population age 21 or under)
- limited vehicle access (households with zero vehicles or one vehicle and two or more workers)
- people with disabilities.

4.4.3. Long-Term Impacts to Neighborhoods and Community Facilities

No-Build Alternative

The No-Build Alternative would not acquire any properties, and thus would not directly displace any residents, businesses or community facilities. Overall, cohesion within the study neighborhoods would remain relatively similar to today, with some localized changes over time as residents and businesses relocate for other reasons. While some improvements would be made to sidewalks, bikeways and crosswalks, there would be no major investments that could greatly enhance cohesion within neighborhoods that have incomplete walking and biking infrastructure today.

Quality of life in many of the study neighborhoods could worsen under the No-Build Alternative as a result of reduced mobility. Traffic congestion is anticipated to increase in future years under the No-Build Alternative. Neighborhoods located along major roadways would be most likely to experience increased cut-through traffic. Although TriMet is planning to add new bus routes and improve service frequencies on existing routes, bus travel times and reliability would worsen as a result of the increased congestion.

Light Rail Alternatives

Impacts to communities are discussed below by segment for the light rail alternatives and options. All of the station access improvement options would increase neighborhood cohesion and quality of life by improving walking, biking and transit access. Many of the station access improvements would also improve access to nearby community facilities.

Segment A: Inner Portland

In Segment A, the impacts to communities would vary in terms of the number of residential and business displacements, impacts to community facilities, changes to the existing barrier of SW Naito Parkway through the South Portland neighborhood, changes in traffic congestion and the routing of regional through traffic, and impacts to historic properties that contribute to the identity of South Portland as a historic district. Table 4.4-2 describes community impacts within Segment A by alignment alternative and the Marquam Hill connection options.

Table 4.4-2. Long-Term Community Impacts: Segment A *(multi-page table)*

Alignment Alternative/ Option	Community Impacts		
	Neighborhood Cohesion	**Neighborhood Quality of Life**	**Community Facilities**
Common to all alignment alternatives in Segment A	· Overall cohesion in the adjacent neighborhoods would remain intact, though residential and business displacements could disrupt individual social ties. The number and distribution of displacements would vary by alignment alternative. · No new barriers would be created through intact neighborhoods. Walking and biking access through the South Portland neighborhood would be maintained or improved.	· Overall, the project would improve quality of life in the surrounding neighborhoods. · The project would improve transit access for the South Portland and Homestead neighborhoods, which would be served by the Gibbs and Hamilton stations. Although local bus service would be reduced, light rail would provide faster and more reliable transit service. · The shared transitway would improve bus travel times and reliability between the Downtown Portland and Hillsdale neighborhoods. · The project would introduce a new source of noise and vibration along the alignment.	· The project would improve transit access to the medical and educational facilities in the Homestead and South Portland neighborhoods, including OHSU, VA Portland and NUNM. · All of the light rail alternatives would acquire parcels that are used as parking for the Tabernacle Seventh-Day Adventist Church. · All of the Marquam Hill connection options would acquire the Congregation Ahavath Achim property, which is now primarily used as office space and not for regularly scheduled services. · All of the Marquam Hill connection options would acquire a portion of Terwilliger Parkway near SW Gibbs Street and SW Campus Drive. · All of the alignment alternatives would acquire portions of Terwilliger Parkway and George Himes Park along SW Barbur Boulevard in The Woods.
Alignment Alternatives			
A1: Barbur	· The light rail trackway would not create any new barriers within neighborhoods, because it would run along SW Barbur Boulevard, which generally follows the boundary between the South Portland and Homestead neighborhoods. · Alternative A1 would add an at-grade pedestrian crossing of SW Naito Parkway at SW Gibbs Street, which would slightly reduce the effect of SW Naito Parkway as a barrier dividing the South Portland neighborhood. · Alternative A1 would displace 41 residential units and 15 businesses with an estimated 108 employees. The displacements would be relatively dispersed along the alignment, but with a small cluster of	· Alternative A1 would leave existing traffic patterns in South Portland largely unchanged, including regional through traffic that routes on local residential streets, but would not preclude future changes. · Alternative A1 would shift some traffic from SW Barbur Boulevard to SW Corbett Avenue between SW Bancroft Street and SW Hamilton Street. · Alternative A1 would remove 16 existing on-street parking spaces along SW Barbur Boulevard near Duniway Park.	· The Gibbs Barbur Station would provide the shortest walking distance to the medical and educational facilities on Marquam Hill, but the longest walking distance to those on SW Naito Parkway and in the South Waterfront area. · Alternative A1 would acquire a portion of Lair Hill Park, but would not reduce the functionality of the park.

Table 4.4-2. Long-Term Community Impacts: Segment A *(multi-page table)*

Alignment Alternative/ Option	Community Impacts		
	Neighborhood Cohesion	**Neighborhood Quality of Life**	**Community Facilities**
	14 residential units and 8 businesses displaced near SW Hamilton Street.		
A2-BH: Naito Bridgehead	· Alternative A2-BH would reduce the existing barrier effect of SW Naito Parkway by adding signalized intersections that would reconnect the divided South Portland neighborhood. Walking and biking access on and across SW Naito Parkway would be improved south of SW Lincoln Street. · Alternative A2-BH would displace 53 residential units and 22 businesses with an estimated 371 employees.	· The Ross Island bridgehead reconfiguration would result in visual changes, but would improve quality of life in South Portland overall. Regional through traffic would be rerouted off of SW Whitaker Street and SW Curry Street, which are local residential streets. Land currently used for ramps would become available for future development. · Alternative A2-BH would shift some traffic from SW Naito Parkway to SW First Avenue and SW Kelly Avenue, and from SW Barbur Boulevard to SW Corbett Avenue between SW Bancroft Street and SW Hamilton Street. · Alternative A2-BH would remove 21 on-street parking spaces along SW Naito Parkway.	· The Gibbs Naito Station would provide the shortest walking distance to the medical and educational facilities on SW Naito Parkway and in the South Waterfront area, but the longest walking distance to those on Marquam Hill. · Alternative A2-BH would acquire portions of two community gardens. · Alternative A2-BH would displace the Lair Hill location of the NUNM Health Center, which specializes in naturopathic care, classical Chinese medicine and care for people who identify as transgendered, genderqueer or gender fluid.
A2-LA: Naito Limited Access	· Alternative A2-LA would be the most likely to disrupt social ties within neighborhoods, because it would displace 125 residential units and 23 businesses with an estimated 231 employees. In particular, Alternative A2-LA would displace a cluster of 55 single-family and multifamily residential units near SW Hamilton Street. · Alternative A2-LA would displace six historic properties along SW Naito Parkway, which could detract from the identity of the South Portland neighborhood as a historic district. · Alternative A2-LA would reinforce SW Naito Parkway as a barrier through South Portland and reduce the likelihood of a future project reconnecting the divided neighborhood. However, biking access along SW Naito Parkway would be improved with the addition of bike lanes.	· Alternative A2-LA would leave existing traffic patterns in South Portland largely unchanged, including regional through traffic that routes on local residential streets. · Alternative A2-LA would remove 21 on-street parking spaces along SW Naito Parkway.	· The Gibbs Naito Station would provide the shortest walking distance to the medical and educational facilities on SW Naito Parkway and in the South Waterfront area, but the longest walking distance to those on Marquam Hill. · Alternative A2-LA would acquire portions of two community gardens.

Table 4.4-2. Long-Term Community Impacts: Segment A *(multi-page table)*

Alignment Alternative/ Option	Community Impacts		
	Neighborhood Cohesion	Neighborhood Quality of Life	Community Facilities
Marquam Hill Connection Options			
All options	· The options would displace zero to two residential units. These options would displace one to two business with an estimated three to four employees.	· No additional impacts specific to the options.	· No additional impacts specific to the options.

Note: OHSU = Oregon Health & Science University, NUNM = National University of Natural Medicine and VA Portland = Veterans Affairs (VA) Portland Health Care System.

Segment B: Outer Portland

The community impacts of the Segment B alignment alternatives would vary in terms of the number of residential and business displacements, impacts to community facilities, potential creation of a perceived barrier along SW Barbur Boulevard, walking and biking improvements, and local traffic circulation. Table 4.4-3 describes community impacts within Segment B by alignment alternative and Portland Community College (PCC) Sylvania campus shuttle options (PCC-Sylvania shuttle options).

Table 4.4-3. Long-Term Community Impacts: Segment B *(multi-page table)*

Alignment Alternative/ Option	Community Impacts		
	Neighborhood Cohesion	Neighborhood Quality of Life	Community Facilities
Common to all alignment alternatives in Segment B	· Overall cohesion in the adjacent neighborhoods would remain intact, though residential and business displacements could disrupt individual social ties. The number and distribution of displacements would vary alignment alternative. · No new barriers would be created within neighborhoods, because the alignment would run within or parallel to existing major roadways along the boundaries between neighborhoods. · Light rail might be perceived as reinforcing SW Barbur Boulevard as a barrier, although new and improved sidewalks, bike lanes and protected crosswalks would provide an offsetting benefit. The length of alignment along SW Barbur Boulevard would vary by alignment alternative (see rows below).	· Overall, the project would improve quality of life in the surrounding neighborhoods. · The project would improve transit access for the neighborhoods bordering SW Barbur Boulevard. Although local bus service on SW Barbur Boulevard would be reduced, light rail would provide faster and more reliable service. · The project would introduce a new source of noise and vibration along the alignment. · All of the alignment alternatives would change the character of SW 53rd Avenue to a more urban form with complete sidewalks. · The project would reduce auto volumes on SW Capitol Highway in the West Portland Park neighborhood and on SW Taylors Ferry Road in the Markham neighborhood.	· All of the alignment alternatives would acquire a portion of Fulton Park, which would result in the removal of mature trees along SW Barbur Boulevard and the loss of up to four plots in the community garden. · All of the alignment alternatives would pave and add sidewalks to SW 53rd Avenue adjacent to Sylvania Natural Area Park. No park property would be acquired, but the addition of sidewalks would create a more defined edge to the park. · All of the alignment alternatives would improve transit access to PCC-Sylvania.

Table 4.4-3. Long-Term Community Impacts: Segment B *(multi-page table)*

Alignment Alternative/ Option	Community Impacts		
	Neighborhood Cohesion	**Neighborhood Quality of Life**	**Community Facilities**
Alignment Alternatives			
B1: Barbur	· Alternative B1 would run in the center of SW Barbur Boulevard for 3.7 miles. · Alternative B1 would displace 32 residential units and 54 businesses with an estimated 500 employees.	· Alternative B1 would remove 61 on-street parking spaces on SW Barbur Boulevard, but low usage of these spaces indicates there would be little resulting impact to quality of life.	· Alternative B1 would acquire a portion of the Marquam Elementary School property, but would not displace any uses of the property.
B2: I-5 Barbur TC-60th	· Alternative B2 would run in the center of SW Barbur Boulevard for 2.3 miles. · Alternative B2 would displace 32 residential units and 61 businesses with an estimated 469 employees.	· Alternative B2 would remove 36 on-street parking spaces on SW Barbur Boulevard, but low usage of these spaces indicates there would be little resulting impact to quality of life.	· No additional impacts specific to Alternative B2.
B3: I-5 26th-60th	· Alternative B3 would run in the center of SW Barbur Boulevard for 1.6 miles. · Alternative B3 would displace 35 residential units and 66 businesses with an estimated 565 employees.	· Alternative B3 would remove 27 on-street parking spaces on SW Barbur Boulevard, but low usage of these spaces indicates there would be little resulting impact to quality of life.	· No additional impacts specific to Alternative B3.
B4: I-5 Custer-60th	· Alternative B4 would run in the center of SW Barbur Boulevard for 0.8 mile. · Alternative B4 would displace 78 residential units and 62 businesses with an estimated 496 employees.	· Alternative B4 would remove 12 on-street parking spaces on SW Multnomah Boulevard that appear to be used primarily by transit riders.	· No additional impacts specific to Alternative B4.
PCC-Sylvania Shuttle Options			
Barbur TC-Baylor Shuttle	· The Barbur TC-Baylor Shuttle would not adversely affect cohesion within the surrounding neighborhoods, because it would operate on roadways used by existing TriMet bus routes.	· N/A	· N/A
53rd Shuttle	· The 53rd Shuttle would travel on a local residential street through the Far Southwest neighborhood. The Segment B alignment alternatives would change the character of this street by paving it and adding sidewalks. The shuttle would add small van-sized vehicles to this reconstructed roadway while PCC-Sylvania classes are in session.	· The addition of small van-sized shuttle buses to SW 53rd Avenue could reduce quality of life for adjacent residents, but this impact could be offset by the addition of sidewalks and street lighting.	· The 53rd Shuttle would operate adjacent to Sylvania Natural Area Park.

Note: PCC = Portland Community College. TC = Transit Center.

Segment C: Tigard and Tualatin

The community impacts of the Segment C alignment alternatives would vary in terms of residential and business displacements, impacts to community facilities, walking and biking improvements, local traffic circulation, transit service improvements and changes in the overall character of certain neighborhoods. Table 4.4-4 describes community impacts within Segment C by alignment.

Table 4.4-4. Long-Term Community Impacts: Segment C *(multi-page table)*

Alignment Alternative/ Option	Community Impacts		
	Neighborhood Cohesion	**Neighborhood Quality of Life**	**Community Facilities**
Common to all alignment alternatives in Segment C	· Within the Tigard Triangle and Downtown Tigard neighborhoods, the project would change circulation by creating new street rights of way and improving access across Highway 217. · The project would change the character of SW 70th Avenue by reconstructing or adding portions of the roadway with light rail and sidewalks, displacing existing single-family residences and adding a multistory parking garage. The extent of changes to this area would vary by alignment alternative (see rows below). · South of downtown Tigard, the trackway would mostly run parallel to the existing barriers of the railroad tracks or I-5. · Each alignment alternative would result in clusters of residential and business displacements that could disrupt individual social ties. The number and distribution of displacements would vary by alignment alternative.	· Overall, the project would improve quality of life in the surrounding neighborhoods. · The project would improve transit access for the adjacent neighborhoods. · The project would introduce a new source of noise and vibration along the alignment. · The project would add traffic accessing new park and rides at congested interchange locations along I-5 at SW Upper and Lower Boones Ferry roads.	· Impacts to community facilities vary by light rail alternative.
Alignment Alternatives			
C1: Ash-I-5	· In total, Alternative C1 would displace 85 residential units and 40 businesses with an estimated 734 employees. · Alternative C1 would change the character of 0.5 mile of SW 70th Avenue. · Alternative C1 would displace 15 businesses along SW Beveland Street and remove some on- and off-street parking serving remaining businesses. Owners of businesses along SW Beveland Street have expressed concerns about impacts to cohesion among the affected business owners and employees.	· Alternative C1 would remove 8 existing on-street parking spaces along SW Dartmouth Street and SW 70th Avenue, 63 spaces along SW Beveland Street and 18 spaces along SW Ash Avenue. Usage surveys found that most of these spaces have moderate levels of use.	· Alternative C1 would displace the Fraternal Order of the Eagles Aerie #4. · Alternative C1 would displace two businesses providing psychological and counseling services within a cluster of small health care providers along SW Beveland Street. · Alternative C1 would displace a large medical clinic near SW Sequoia Parkway.

Table 4.4-4. Long-Term Community Impacts: Segment C *(multi-page table)*

Alignment Alternative/ Option	Community Impacts		
	Neighborhood Cohesion	**Neighborhood Quality of Life**	**Community Facilities**
	· Alternative C1 would displace a cluster of 69 residential units in the Downtown Tigard neighborhood along SW Hall Boulevard and SW Ash Avenue, ranging from a duplex to a 26-unit apartment building. The overall character of this portion of the Downtown Tigard neighborhood would become more urban, with the addition of sidewalks, light rail, a reconfigured transit center and a multistory parking garage. · Alternative C1 would improve access across an existing barrier in the Downtown Tigard neighborhood by extending SW Ash Avenue across the freight and commuter rail tracks.		
C2: Ash-Railroad	· In total, Alternative C2 would displace 85 residential units and 36 businesses with an estimated 323 employees. · Other specific impacts would be the same as described for Alternative C1.	· Same as Alternative C1.	· Alternative C2 would displace the Fraternal Order of the Eagles Aerie #4. · Alternative C2 would displace the same two businesses providing psychological and counseling services as Alternative C1.
C3: Clinton-I-5	· In total, Alternative C3 would displace 5 residential units and 27 businesses with an estimated 839 employees. · Alternative C3 would change the character of 0.2 mile of SW 70th Avenue. · Alternative C3 would change the character of the Downtown Tigard neighborhood by adding a new roadway parallel to SW Main Street, including light rail, auto lanes, bike lanes, parking and sidewalks.	· Alternative C3 would add an at-grade light rail crossing of SW Hall Boulevard just south of Pacific Highway, which could lead to added traffic congestion during rail crossing events.	· Alternative C3 would displace the Tigard Post Office. · Alternative C3 would displace the same large medical clinic as Alternative C1.
C4: Clinton-Railroad	· In total, Alternative C4 would displace 5 residential units and 23 businesses with an estimated 428 employees. · Other specific impacts would be the same as described for Alternative C3.	· Same as Alternative C3.	· Alternative C4 would displace the Tigard Post Office.

Table 4.4-4. Long-Term Community Impacts: Segment C *(multi-page table)*

Alignment Alternative/ Option	Community Impacts		
	Neighborhood Cohesion	**Neighborhood Quality of Life**	**Community Facilities**
C5: Ash-I-5 Branched	· In total, Alternative C5 would displace 85 residential units and 54 businesses with an estimated 515 employees. · Other specific impacts would be the same as described for Alternative C1.	· The Branched Configuration of Alternative C5 would result in less frequent light rail service in downtown Tigard and more frequent service in southwest Portland and the Tigard Triangle than the Through Configuration. Downtown Tigard would not have a direct light rail connection to stations in the Durham Road and Lower Boones Ferry neighborhoods. · Alternative C5 would have more noise impacts in southwest Portland neighborhoods and in the Tigard Triangle neighborhood than the Through Configuration alternatives. · Alternative C5 would remove the same on-street parking spaces as Alternative C1.	· Same as Alternative C1.
C6: Wall-I-5 Branched	· In total, Alternative C6 would displace 7 residential units and 44 businesses with an estimated 545 employees. · Alternative C6 would change the character of 0.5 mile of SW 70th Avenue. · Alternative C6 would displace eight businesses along SW Beveland Street and remove some on- and off-street parking serving remaining businesses. Owners of businesses along SW Beveland Street have expressed concerns about impacts to cohesion among the affected business owners and employees.	· The Branched Configuration of Alternative C6 would result in less frequent light rail service in the Downtown Tigard neighborhood and more frequent service in southwest Portland and the Tigard Triangle than the Through Configuration. Downtown Tigard would not have a direct light rail connection to stations in the Durham Road and Lower Boones Ferry neighborhoods. · Alternative C6 would have more noise impacts in southwest Portland neighborhoods and in the Tigard Triangle neighborhood than the Through Configuration alignment alternatives. · Alternative C6 would remove 8 on-street parking spaces along SW Dartmouth Street and SW 70th Avenue, and 63 spaces along SW Beveland Street.	· Alternative C6 would modify access to Potso Dog Park but would not reduce the functionality of the park. · Alternative C6 would displace the same two businesses providing psychological and counseling services and the same large medical clinic as Alternative C1.

O&M Facility Options

Operations and maintenance facility options would vary in terms of business displacements, as described in Table 4.4-5.

Table 4.4-5. Long-Term Community Impacts for O&M Facilities Options

O&M Facility Option	Community Impacts		
	Neighborhood Cohesion	Neighborhood Quality of Life	Community Facilities
Hunziker	· The Hunziker Facility would displace 10 businesses with an estimated 185 employees.	· No additional impacts specific to the Hunziker Facility.	· No additional impacts specific to the Hunziker Facility.
Through 72nd	· The Through 72nd Facility would displace 5 businesses with an estimated 58 employees.	· No additional impacts specific to the Through 72nd Facility.	· No additional impacts specific to the Through 72nd Facility.
Branched 72nd	· The Branched 72nd Facility would displace 5 businesses with an estimated 505 employees.	· No additional impacts specific to the Branched 72nd Facility.	· No additional impacts specific to the Branched 72nd Facility.

4.4.4. Long-Term Impacts to Transit-Dependent Populations

Overall, the improved transit, walking and biking access provided by the project would be particularly beneficial for transit-dependent populations. Light rail would provide faster and more reliable travel times than existing and future bus service (see Appendix A, Detailed Maps and Descriptions of Light Rail Alternatives). Stations would have more amenities than most existing bus stops, including real-time arrival information, benches and platforms that allow for level boarding.

Along SW Barbur Boulevard, it is currently assumed that light rail would replace the existing TriMet line 12 bus service between the Barbur Transit Center and the Downtown Portland Transit Mall (see Chapter 3 – Transportation Impacts and Mitigation). Though the light rail stations would include more amenities, they would be spaced farther apart than the existing bus stops. The increased spacing could have the greatest impact on people with difficulty walking, which may include older adults and people with disabilities. However, the project would provide offsetting benefits to improve transit access for people with difficulty walking. All of the Segment B alignment alternatives would fill in the existing sidewalk gaps on SW Barbur Boulevard and add additional protected pedestrian crossings. The station access improvement options would fill additional sidewalk gaps on adjacent streets that provide access to the light rail stations.

The Through Route (Alternatives C1, C2, C3 and C4) would better serve transit-dependent populations in downtown Tigard than the Branched Route (Alternative C5 and C6). The Through Route would provide more frequent light rail service and direct access to more stations for downtown Tigard, which has relatively high proportions of transit-dependent populations, including minority, low-income, limited English proficiency and limited vehicle access populations, and people with disabilities. However, both the Through and Branched Routes would provide improved transit service in downtown Tigard compared to the No-Build Alternative.

Some transit-dependent populations would be affected by residential displacements (see Section 4.1, Acquisitions, Displacements and Relocations). TriMet would help locate new residences for displaced

households, which could include identifying housing with transit access. TriMet would use interpreters to help people with limited English proficiency navigate the relocation and compensation process.

4.4.5. Short-Term Impacts

Neighborhood Cohesion

Certain neighborhoods could temporarily experience reduced cohesion if the construction activities create a perceived barrier along the alignment. In Segments A and B, construction activities could reinforce the feeling of SW Barbur Boulevard or SW Naito Parkway acting as a barrier to east/west neighborhood connectivity within or between neighborhoods. In Segment C, the Tigard Triangle and Downtown Tigard neighborhoods could experience temporarily reduced cohesion during construction, because the light rail alignment would not follow existing boundaries between neighborhoods.

Adjacent businesses could experience a temporary reduction in customer activity due to a real or perceived inconvenience caused by construction activities (see Section 4.3, Economics). Among the businesses adjacent to the construction, commercial establishments such as restaurants and shops would be most likely to be affected.

Neighborhood Quality of Life

Neighborhood quality of life would be diminished in the area directly adjacent to the alignment during the construction period as a result of noise, dust, detours, loss of on-street parking, increased congestion and increased truck traffic (see Section 4.11, Noise and Vibration; Section 4.12, Air Quality and Greenhouse Gases; and Chapter 3 – Transportation Impacts and Mitigation). Detours and congestion during construction could result in slower and less reliable bus service, and could increase traffic volumes on other streets near the directly affected roadways.

Community Facilities

The function of community facilities located near the light rail alignment could be temporarily diminished during construction. Construction could impede access to community facility parking lots or buildings in the areas directly adjacent to active construction sites (see Chapter 3 – Transportation Impacts and Mitigation). Efforts would be made to maintain access to community facilities by establishing detours and alternative methods for entrance and egress to businesses and facilities that remain open during construction. Visual impacts, light, glare, dust and noise could affect users of parks and other community facilities with outdoor functions located near the light rail alignment (see Section 4.5, Visual Quality, and Section 4.12, Air Quality and Greenhouse Gases).

4.4.6. Potential Mitigation Measures

No mitigation related to impacts to neighborhood cohesion, neighborhood quality of life or community facilities would be required during construction or operation of the project beyond the mitigation strategies identified in other sections of this Draft EIS. The following sections of this Draft EIS describe mitigation measures related to community impacts:

- **Section 4.1, Acquisitions, Displacements and Relocations** describes TriMet's policy, procedures and guidelines for property acquisition and relocation. TriMet would help investigate nearby properties for relocation in an effort to avoid disrupting social ties within neighborhoods.

- **Section 4.3, Economics,** describes measures to reduce impacts to businesses during construction.
- **Section 4.5, Visual Quality,** describes measures to reduce visual impacts, such as considering aesthetic treatments for the design of structures to improve compatibility with surrounding areas.
- **Section 4.6, Historic and Archaeological Resources,** describes mitigation measures that would help retain the historic identity of the South Portland neighborhood.
- **Section 4.7, Parks and Recreation Resources,** describes that TriMet and Metro are coordinating with park owners to identify mitigation measures to reduce impacts to parks.
- **Section 4.11, Noise and Vibration,** describes measures to reduce noise and vibration.
- **Section 4.12, Air Quality and Greenhouse Gases,** describes measures to avoid dust emissions during construction.
- **Section 4.16, Public Services,** describes measures to mitigate impacts to public service providers.

Chapter 3, Transportation Impacts and Mitigation, describes measures to mitigate traffic and parking impacts. Some impacts, such as concentrated areas of residential displacements that could disrupt social ties within a neighborhood, may be avoided or minimized by selecting less harmful alternatives or by redesigning some elements of the alternatives. Appendix E, Potential Design Refinement Concepts and Options, describes potential refinements to the alignment alternatives that could avoid or minimize impacts.

In addition, TriMet, Metro, the City of Portland and the City of Tigard are coordinating to identify strategies to prevent the indirect economic displacement of residents living near the light rail alignment. These strategies could include banking land for future development of affordable housing; purchasing existing, naturally occurring affordable housing to preserve its affordability; and providing financial assistance to low-income residents.

4.5. Visual Quality

This section describes the visual impacts of the project and potential mitigation measures. Appendix B4.5, Visual Quality, discusses the analysis methods and has more detail on the affected environment. The appendix also shows several visual simulations of potentially changed views.

4.5.1. Affected Environment

The project would be located within the urbanized landscape of the Portland metropolitan area. The impacts to visual quality have been evaluated by landscape unit, which are general geographic areas with similar visual conditions (see Figure 4.5-1), as described below:

- **South Portland Landscape Unit** varies in character, from highly urbanized in the eastern segment to forested hillsides to the west. Prominent features include Marquam Hill, Oregon Health & Science University (OHSU), Veterans Affairs (VA) Portland Health Care System and the South Portland Historic District. Residential areas range in character from mid to low density. Interstate 5 (I-5), SW Naito Parkway, SW Barbur Boulevard, and the Portland Aerial Tram transect the area.

- **Barbur Woods Landscape Unit** is a mid- to low-density residential part of Inner Southwest Portland, characterized by a variety of housing types secluded within verdant landscapes. It has large forested spaces, both inside the formal park boundaries of SW Terwilliger Boulevard Parkway and George Himes Park, and outside the park in semi-managed open spaces.

- **Barbur Historic**[2] **Highway Landscape Unit** is a mixed suburban commercial corridor. Developments are primarily large- and medium-format retail and mid-rise office buildings that are set near the road and have minimal landscaping. Areas of both multifamily and single-family residential uses are adjacent to this segment of SW Barbur Boulevard.

- **Far Southwest Portland Landscape Unit** has a suburban/rural character. Commercial uses are small-scale and somewhat dispersed compared to the South Portland Landscape Unit, with few residential units close to the road. Open spaces include landscaped areas of commercial lots and several stretches of non-managed vegetation adjacent to the roadway.

- **Tigard Triangle Landscape Unit** varies in character, and includes contemporary commercial developments, single-family housing and undeveloped vegetated areas. Big box retail buildings with large parking fields are located on the west end of this landscape unit. Mid-rise office buildings with landscaping are located on the eastern and southern edges of the Tigard Triangle. Undeveloped land and small residential lots are in the center and north of this landscape unit.

- **Downtown Tigard Landscape Unit** encompasses the historic town center, as well as industrial land slightly to the south. Buildings in the downtown are two to three stories and set close to the street, with regularly occurring street trees. The industrial land consists of warehouse buildings and parking/storage yards. An existing freight railway runs north/south through this unit.

- **I-5 Commercial Corridor Landscape Unit** follows I-5 south from Tigard to Bridgeport Village. It contains a mix of low-rise and mid-rise office parks, and low-rise industrial complexes. The landscape unit includes Bridgeport Village, a large outdoor shopping center.

4.5.2. No-Build Alternative Impacts

Under the No-Build Alternative, the visual character of the corridor would continue to evolve as redevelopment continues (see Section 4.2, Land Use). This could include new structures in some areas and the redevelopment of existing structures in others, especially in suburban areas of Portland and Tigard. There are several road improvement projects, listed in Appendix B4.18, that are assumed to occur under the No-Build Alternative, but they would be likely to have minor visual impacts.

4.5.3. Long-Term Impacts of the Light Rail Alternatives

Visual impacts result from changes to landscape features in areas where viewers are sensitive to visual and aesthetic conditions. Areas such as parks, places with scenic views or areas with residences often have higher levels of visual sensitivity. Industrial and commercial areas as well as corridors dominated by transportation facilities typically have lower levels of visual sensitivity.

[2] This portion of SW Barbur Boulevard in South Portland in the mid-1930s set off a chain reaction of infrastructure projects and other public improvements that would have a lasting impact on the fabric and character of the community.

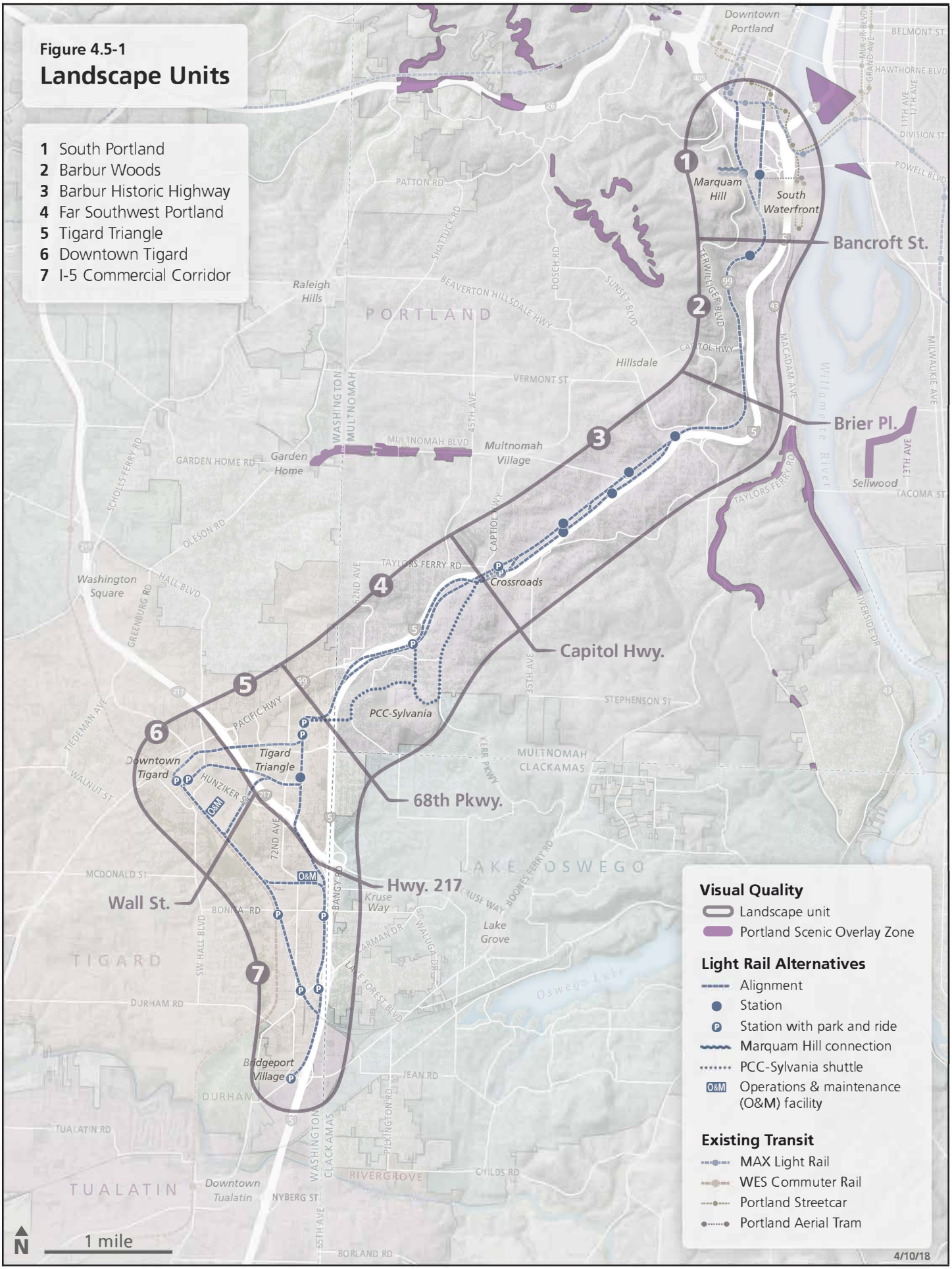


Figure 4.5-1
Landscape Units
1 South Portland
2 Barbur Woods
3 Barbur Historic Highway
4 Far Southwest Portland
5 Tigard Triangle
6 Downtown Tigard
7 I-5 Commercial Corridor
Downtown Portland
Marquam Hill
South Waterfront
Bancroft St.
Brier Pl.
Sellwood
Capitol Hwy.
68th Pkwy.
Hwy. 217
Wall St.
Raleigh Hills
PORTLAND
Hillsdale
Multnomah Village
Garden Home
Washington Square
Crossroads
PCC-Sylvania
Tigard Triangle
Downtown Tigard
Lake Grove
LAKE OSWEGO
TIGARD
TUALATIN
Bridgeport Village
Downtown Tualatin
Visual Quality
Landscape unit
Portland Scenic Overlay Zone
Light Rail Alternatives
Alignment
Station
Station with park and ride
Marquam Hill connection
PCC-Sylvania shuttle
Operations & maintenance (O&M) facility
Existing Transit
MAX Light Rail
WES Commuter Rail
Portland Streetcar
Portland Aerial Tram
N
1 mile
4/10/18

In defining the level of visual change, the following physical factors were considered: topography, vegetation, water, structures, visual pattern and blocked/altered views (described in Table 4.5-1).

Table 4.5-1. Sources of Visual Change

	Low	Moderate	High
Topography	At grade or below grade	Grade separation	Fully elevated structures
Vegetation	No removal of/full replacement of vegetation	Removal of some vegetation	Removal of all vegetation
Water	No change to water/small amount of new features	Slight change to water course or additional features	Removal/undergrounding of water body
Structures	No new structures, small changes to existing structures	Minor new structures, minor displacement of structures	Major new structures, multiple building removals
Visual Pattern	No change to street, full screening of neighborhood from alignments and project features	Changes to existing streets, partial screening of neighborhood from alignments and project features	New streets, no screening of neighborhood from alignments and project features
Blocked/Altered Views	Minor change to scenic views	Disruption of scenic views	Full blocking of scenic views

In defining the level of viewer sensitivity, the following physical and perceptual factors were considered: proximity, extent, duration, attention, focus and protection (described in Table 4.5-2).

Table 4.5-2. Viewer Sensitivity Levels

	Low	Moderate	High
Proximity	Not in project area	In adjacent neighborhood	Directly adjacent to project
Extent	Seen by few people	Seen by some people	Seen by a very large number of people
Duration	Barely glimpsed for a short amount of time	Partly seen for a limited duration	Continually seen for a long time
Attention	Unengaged, inattentive viewers	Moderately engaged, attentive viewers	Fully engaged, very attentive viewers
Focus	No, or highly dispersed, focal objects, drawing no focus	Some focal objects, drawing moderate focus	Singular focal object, drawing intense focus
Protection	No protection or interest in preservation	Some social interest in protecting views, but no legal protection	Legal, or socially agreed-upon, protected views or vistas

Some visual impacts would be common across all light rail alternatives:

- **Light rail guideway**. The light rail guideway would include steel track rails, paved concrete areas, ballast, ties, overhead wires and support poles. There would also be electrification stations and signal management structures, which are typically small buildings. The combination of these features would mainly affect foreground viewpoints and have a minimal impact on middle-ground and background views.
- **New/rebuilt roadway**. To accommodate light rail, much of the existing roadways affected by the alignment would be rebuilt. The roadway material would generally be visually similar to the existing road, with a variety of adjustments, including regrading, new lighting, modified intersections, and added or removed lanes.
- **New connecting infrastructure.** Throughout the corridor, various pedestrian and bicycle enhancements outside of the light rail alignment are proposed. These include, for example, sidewalks, bicycle lanes, crosswalks and traffic control signals. Two distinct connecting

infrastructure elements are: (1) the Marquam Hill connection, and (2) the Portland Community College (PCC) Sylvania campus connection along SW 53rd Avenue. On Marquam Hill, elements common to all connection options would be an entryway on SW Barbur Boulevard and a connection to the existing aerial tram near Kohler Pavilion at the top of the hill. The common elements of a new SW 53rd Avenue connection would include reconstruction of the street right of way with new sidewalks and street trees.

- **Streetscaping**. New streetscape elements would be added, including sidewalks, bicycle lanes, landscape buffers, bioswales, benches, lighting and signage. These elements would affect foreground views more than middle-ground or background views.
- **Stations**. Stations would include platforms, shelters, seating, lights and signage. These elements would affect foreground and middle-ground views from nearby. A few stations would be elevated above existing grade. While most stations would include center platforms between the tracks in a roadway median, some would have platforms on both sides of the trackways or both sides of the street. Some stations in Segments B and C would include park and ride structures or lots and modified transit centers.
- **Vegetation**. Some trees and vegetation along the alignment would require trimming or removal to accommodate light rail. This vegetation trimming or removal would mainly affect foreground and middle-ground views but could also reveal longer views.
- **Removed buildings and other structures**. Many of the light rail alternatives would remove existing structures (also see Sections 4.1, Acquisitions, Displacements and Relocations, and 4.6, Historic and Archaeological Resources), which would affect localized foreground and middle-ground views.

In addition to the general visual impacts described above, Tables 4.5-3 through 4.5-8 describe the impact findings by alignment alternative, considering: (1) changes to the visual environment, (2) the level of visual change, (3) the level of viewer sensitivity and (4) overall visual impact rating for each alignment alternative by landscape unit. The tables also summarize visual impacts of the Marquam Hill connection options, Bridgehead Reconfiguration option, PCC-Sylvania shuttle options, operations and maintenance (O&M) facilities options, and station access improvement options.

Table 4.5-3. Summary of Visual Impacts of Alignment Alternatives for Segment A

Landscape Unit	Alignment Alternative(s)	Changes to Visual Environment	Level of Visual Change	Level of Viewer Sensitivity	Overall Impact
South Portland	A1: Barbur	The addition of light rail within the median on SW Barbur Blvd. would widen the right of way, modify grades, add retaining walls, remove buildings and clear vegetation. Vegetation would be removed beside Lair Hill Park. Other changes include the development of a new station at SW Barbur Blvd. and SW Gibbs St. as well as new stairs to connect several places along SW Barbur Blvd. to the Lair Hill neighborhood.	Moderate	Moderate	**Moderate**
	A2-BH: Naito Bridgehead	Adding light rail to the median of SW Naito Pkwy. would widen the right of way and expand or add signalized intersections. A station would be constructed on SW Naito Pkwy. near SW Gibbs St. SW Naito Pkwy. would be completely rebuilt, replacing bridges and adding bicycle lanes and sidewalks. There would be some building removals, including two historic buildings. The Ross Island Bridgehead Reconfiguration would revise several roads around Ross Island Bridge, with some changes to road grades, but mostly within existing roadway areas.	High	Moderate	**Moderate**
	A2-LA: Naito Limited Access	The addition of light rail to the median of SW Naito Pkwy. would largely reconstruct the existing configuration to be a wider facility. There would be some building removals, including two historic buildings. The station on SW Naito Pkwy. near SW Gibbs St. would further widen the facility and add signalized crossings. Bike lanes and sidewalks would be added, but much of the street would retain its character as a limited access highway.	Moderate	Moderate	**Moderate**
Barbur Woods	A1: Barbur A2-BH: Naito Bridgehead A2-LA: Naito Limited Access	Adding light rail to the median of SW Barbur Blvd. would expand the roadway and remove vegetation in wooded sections along Terwilliger Boulevard Parkway, including George Himes Park. New retaining walls would be a prominent feature. A new station at SW Barbur Blvd. and SW Hamilton St. would also widen that intersection, remove buildings and add retaining walls.	Moderate	Moderate	**Moderate**

Table 4.5-4. Summary of Visual Impacts of Alignment Alternatives for Segment B

Landscape Unit	Alignment Alternative(s)	Changes to Visual Environment	Level of Visual Change	Level of Viewer Sensitivity	Overall Impact
Barbur Historic Highway	B1: Barbur	The addition of light rail within median along entirety of SW Barbur Blvd. would alter the streetscape to become more urbanized, with landscaping, wider sidewalks and bicycle lanes. Widening would be required, including some building removals and the replacement of several existing overpass bridges. There would be several stations in the median. The Barbur Transit Center would be rebuilt as a three-level parking garage with ground floor retail close to the street, making it more prominent than the existing facility.	Moderate	Low	**Low**
	B2: I-5 Barbur TC - 60th	Alternative B2 would be like Alternative B1 until SW 60th Ave. A prominent new light rail overpass (Crossroads Bridge - where SW Capitol Highway and SW Barbur Boulevard cross over I- 5) would cross over I-5, with a potential maximum height of 140 feet above the ground in some areas. Several new stations would be present, with platforms in the median of SW Barbur Blvd. The Barbur Transit Center would be rebuilt the same as with Alternative B1.	Moderate	Low	**Low**
	B3: I-5 26th-60th	Alternative B3 would be like Alternative B1 until SW 26th Ave. Then, where light rail would run next to I-5, there would be some structure removals, but the change would be less visible then changes in B1, and the visual sensitivity of I-5 viewers is low. This alternative would also include the visually prominent Crossroads Bridge, as described for Alternative B2. The I-5 stations would be present both on SW Barbur Blvd. and next to I-5, including the new Barbur Transit Center and parking structure, which would be like Alternative B1.	Moderate	Low	**Low**
	B4: I-5 Custer-60th	Light rail would cross over and run next to I-5 at SW Custer St., running next to I-5 for the entirety of landscape unit. Several residential and commercial structures would be removed, with some changes to street patterns near the I-5 frontage roads. These changes would mainly be visible to I-5 viewers with low sensitivity. All the stations would be along I-5, minimally visible from SW Barbur Blvd. and mostly viewed by I-5 users.	Moderate	Low	**Low**
Far Southwest Portland	B1: Barbur	The addition of light rail within the median on SW Barbur Blvd. would expand the existing right of way, removing vegetation in areas with nearby residences but also creating a more visually consistent roadway. The improvements would include rebuilt intersections and street sections with lighting, sidewalks and bicycle lanes. A new bridge over I-5 would enter Tigard at SW 60th Ave. and would be visually similar to a nearby Pacific Highway overpass. A new station and a three-story parking structure would be constructed at SW 53rd Ave., and would require removal of several structures and vegetation. This area would be most visible to travelers on SW Barbur Blvd., and would be less visible from most area residences, where it would be in mid-range to long-range views.	High	Low	**Moderate**
	B2: I-5 Barbur TC - 60th B3: I-5 26th-60th B4: I-5 Custer-60th	These alternatives would be similar to Alternative B1. There would be different layouts of the guideway, station and park and ride, but they would not have notably different visual characteristics.	High	Low	**Moderate**

Note: TC = Transit Center.

Table 4.5-5. Summary of Visual Impacts of Alignment Alternatives for Segment C *(multi-page table)*

Landscape Unit	Alignment Alternative(s)	Changes to Visual Environment	Level of Visual Change	Level of Viewer Sensitivity	Overall Impact
Tigard Triangle[3]	C1: Ash-I-5 C2: Ash-Railroad	In the north end of the Tigard Triangle, adding light rail would rebuild existing roads and extend SW 70th Ave. This would create a prominent new continuous visual feature in an area that has frequent changes in visual character, but where some residences and undeveloped lands are now present. Baylor Station, with a three-story parking structure, would be added to areas with vacant land as well as smaller buildings. Buildings and landscaping at SW Beveland St. would be removed to accommodate light rail, including widening and realignment of SW Beveland St., a Beveland Station and an extension of SW 70th Ave. A new flyover section of trackway over SW Dartmouth St. would be visually prominent in a sloping area. A 375-foot-long bridge over Hwy. 217 would be a prominent visual feature, crossing areas with wetlands and vegetation as well as areas with major transportation infrastructure and large buildings.	High	High	**High**
	C3: Clinton-I-5 C4: Clinton-Railroad	Alternative C3 would have visual changes like Alternatives C1 and C2, but affecting different areas in the Tigard Triangle and with fewer adjacent areas with sensitive viewers. At the north end of the Tigard Triangle, Alternative C3 would have a shorter extension of SW 70th Ave. than C1 or C2. The Clinton Station and its three-story parking structure would be in the same vicinity as the Baylor Station, in an area with vacant land and smaller buildings. An extended elevated section (approximately 1,600 feet long) would carry light rail through a more commercial portion of the Tigard Triangle, including areas with large parking lots. This elevated section would cross over wetlands and Hwy. 217, adding a prominent new visual feature, but removing fewer buildings and other existing features than Alternatives C1 and C2.	Moderate to High	Moderate to High	**Moderate to High**
	C5: Ash-I-5 Branched	This alternative would have similar effects as Alternatives C1 and C2 in the north end of the Tigard Triangle through the extension of SW 70th Ave. along SW Beveland St. and across Hwy. 217. It would also extend light rail at grade from the Beveland Station to the new elevated section over Hwy. 217, removing some structures in commercial areas and removing some vegetation near Hwy. 217. The additional alignment and crossing over Hwy. 217 would be in an area that has low visual sensitivity and that already has a major interchange.	High	Moderate to High, Low in east Triangle	**Moderate to High**
	C6: Wall-I-5 Branched	This alternative in the north end of the Tigard Triangle would have the same visual effects as Alternatives C1 and C2 to SW Beveland St. It also would have the same additional effects as Alternative C5's extended elevated section over Hwy. 217. The Tigard branch along SW Wall St. would remove buildings and vegetation to cross Hwy. 217 and mid-rise commercial areas, which are areas with low visual sensitivity.	High	Moderate to High	**Moderate to High**

[3] While all of the alignment alternatives in the Tigard Triangle have high levels of visual change to existing visual conditions, the area has a highly variable visual character today, and adopted plans (*2015 Tigard Triangle Strategic Plan; City of Tigard Comprehensive Plan, 2007; 2035 Transportation System Plan, 2010)* involve improved transportation facilities and more intense, mixed-used redevelopment.

Table 4.5-5. Summary of Visual Impacts of Alignment Alternatives for Segment C *(multi-page table)*

Landscape Unit	Alignment Alternative(s)	Changes to Visual Environment	Level of Visual Change	Level of Viewer Sensitivity	Overall Impact
Downtown Tigard	C1: Ash-I-5 C2: Ash-Railroad C5: Ash-I-5 Branched	Light rail would expand and realign SW Ash Ave., removing existing multifamily homes and several nearby structures. In its place, a new transit center would be built on SW Ash Ave. This would reshape visual character and increase the prominence of transportation infrastructure in this mixed-use area, which has major transportation facilities and commercial areas today as well as areas with multifamily housing.	High	High	**High**
	C3: Clinton-I-5 C4: Clinton-Railroad	Light rail would remove an existing office park near Hwy. 217 to accommodate an elevated segment that would be visually prominent. The building removal and new light rail would create a visual change and reshape the visual character. Additional structures would be removed for a new street and transit center that would also create visual change. The level of change would be similar to the Ash alignment alternatives (Alternatives C1, C2 and C5 above), but Alternatives C3 and C4 already have fewer adjacent residential properties and more existing transportation and commercial/mixed-use features, including larger commercial properties and parking areas.	High	Moderate	**Moderate**
	C6: Wall-I-5 Branched	Light rail would run along SW Wall St. and would have visual changes associated with expanding the right of way from a small local road to a wider street in a mostly industrial, less developed area. Visual changes would include a new transit center in a largely industrial area.	Low	Low	**Low**
I-5 Commercial Corridor	C1: Ash-I-5 C3: Clinton-I-5 C5: Ash-I-5 Branched C6: Wall-I-5 Branched	Light rail would run at grade in its own newly constructed right of way adjacent to I-5. This would have minor impacts to vegetation throughout the landscape units, with more vegetation removal at a new bridge over SW Upper Boones Ferry Rd. in the I-5 Commercial Corridor landscape unit. There would be new stations with multilevel park and ride structures, including a large four-story parking garage with an elevated pedestrian walkway at Bridgeport Village. Most of these facilities would be somewhat screened due to topography and are not near visually sensitive areas. The Bridgeport Station structures would be prominent but not out of scale considering the freeway, interchange and other structures, including parking structures, in the area.	Low	Low	**Low**
	C2: Ash-Railroad C4: Clinton-Railroad	Light rail would run in the existing WES rail corridor on newly constructed trackway, but with minimal contrast to the transportation-intensive corridor. A new elevated crossing over SW Bonita Rd. would be prominent and visible to residential areas and users of Fanno Creek Park. Stations and park and rides would be similar to the other Segment C alternatives discussed above.	Low	Moderate	**Low**

Note: WES = Westside Express Service.

Table 4.5-6. Summary of Visual Impacts, Additional Project Elements

	Option/Alignment Alternative	Changes to Visual Environment	Level of Visual Change	Level of Viewer Sensitivity	Overall Impact
Marquam Hill Connection Options	1A: Elevator/ Bridge and Path	An above-ground pathway would be built, which would remove a swath of trees and other vegetation on a prominent hillside. At the base of the hill, an elevator tower would be constructed, which would be visually prominent in that location. An upper elevator tower towards the top of the hill would be visually similar to existing structures near OHSU and would have less of an impact than those existing structures.	High	High	**High**
	1B: Elevator/ Bridge and Recessed Path	A combination of recessed and above-ground pathways would be built, with multiple exposed switchbacks and ramps, all of which would remove trees and other vegetation on the hillside. At the base of the hill, an elevator tower would be constructed, which would be visually prominent but mostly visible from immediately nearby areas. An upper elevator tower towards the top of the hill would be visually similar to existing structures at OHSU.	High	High	**High**
	1C: Elevator/ Bridge and Tunnel	An above-ground pathway would be constructed on the lower portion of hill, removing trees and other vegetation on the hillside. The upper section of the pathway would be in an underground tunnel and would be minimally visible. The above-ground section of the upper elevator tower would be visually similar to existing structures at OHSU.	Moderate	High	**Moderate**
	2: Full Tunnel	A pathway to a new tunnel entrance would be built, removing a moderate amount of vegetation at the bottom of the hill. The full tunnel would be underground and would not be visible. The above-ground section of the elevator tower would be visually similar to existing structures at OHSU.	Low	High	**Moderate**
Bridgehead Reconfiguration Option	A1: Barbur with Bridgehead Option	The Bridgehead Reconfiguration option would create and remove several streets in the area, and convert some streets to local access only. The overall visual character of the interchange would be maintained as a transportation hub, while the streets converted to local streets would take on a more residential character. Overall, a more "main street" visual character would be established as a result of the project. This alignment alternative would remove some buildings in the area and also the edges of local community garden areas that are already surrounded by the interchange area.	Moderate	Moderate	**Moderate**
PCC-Sylvania Shuttle Options	53rd Shuttle	Improvements would be made to SW 53rd Ave., including widening, repaving, lighting, and adding bicycle and pedestrian facilities. These improvements would remove a strip of vegetation and make the roadway's visual character more urban and active, but the wooded character of bordering areas would remain.	Moderate	Low	**Low**
	Barbur TC-Baylor Shuttle	Shuttle buses would be added to existing roads along with the minor additions of new signage and shelters. These buses would result in few changes to visual character.	Low	Low	**Low**

Note: OHSU = Oregon Health & Science University; PCC = Portland Community College; TC = Transit Center.

Table 4.5-7. Visual Impacts by Landscape Unit for O&M Facilities

Landscape Unit	Option	Changes to Visual Environment	Level of Visual Change	Level of Viewer Sensitivity	Overall Impact
Downtown Tigard	Hunziker	The O&M facility would remove an existing storage yard and industrial structure, replacing them with larger new structures. Overall, it would maintain the existing industrial visual character.	Low	Low	**Low**
I-5 Commercial Corridor	Through 72nd	The O&M facility would remove several existing industrial structures. However, the overall industrial visual character would remain unchanged.	Low	Low	**Low**
	Branched 72nd	The O&M facility would remove several existing industrial structures and rebuild a minor local roadway. Overall, it would maintain the existing industrial visual character.	Low	Low	**Low**

Table 4.5-8. Visual Impacts of Station Access Improvement Options

Segment	Project Type	Changes to Visual Environment	Level of Visual Change	Level of Viewer Sensitivity	Overall Impact
Segment A	Sidewalk	Sidewalk improvements might remove strips of vegetation but frequently would add more visual continuity and could also incorporate other landscaping elements such as street trees or plantings.	Low	Low/Moderate	**Low**
	Bicycle	New bikeways could cause minor changes to visual features and could remove strips of vegetation, but these improvements would maintain or improve the visual character of adjacent streets.	Low	Low/Moderate	**Low**
Segment B	Sidewalk	Similar changes to Segment A, but with more sidewalks from connecting streets.	Low	Low/Moderate	**Low**
	Bicycle	Similar changes to Segment A, but with more sidewalks from connecting streets.	Low	Low/Moderate	**Low**
	Pedestrian overpasses	Pedestrian overpasses are visually prominent due to their height. However, their location spanning over existing major roadways with other bridges and overpasses would be consistent with the existing visual environment.	Moderate	Low/Moderate	**Moderate**
Segment C	Sidewalk	Similar changes to Segments A and B.	Low	Low/Moderate	**Low**
	Bicycle	Similar changes to Segments A and B.	Low	Low/Moderate	**Low**

Impacts to Designated Scenic Resources

In Segments A and B, designated scenic viewpoints, drives and overlay zones (see Figure 4.5-1) near the alignment were analyzed, considering *Scenic Views, Sites and Drives Inventory* (1989); *Central City 2035 Volume 3A* (DRAFT) (2017); and City of Portland Zoning Code 33.420 *Design Overlay Zone* and 33.480 *Scenic Overlay Zone*. Broadly, the light rail elements of the project would be visible in the foreground and middle ground of these views but would not obscure the primary focal points of the views. The Marquam Hill connection options would be more visible than the light rail elements and would occur in visually protected areas. Table 4.5-9 describes the impacts. See the appendices of the plans cited in this paragraph for more detailed information on these viewpoints. There are no designated scenic resources in Segment C.

4.5.4. Short-Term Impacts

Construction would be staged and would occur over several years. Generally, existing vegetation and obstructing structures would be removed first, likely creating areas that present a barren visual aesthetic. Staging and construction sites could add temporary visual clutter. Short-term impacts would affect a greater area than the finished project, because more land would be required to stage, divert and construct the project than would be needed for the finished project. The new I-5 and Highway 217 overpasses would have a larger visual impact during construction than during operation, because they would have equipment, scaffolding and partial finishes that would temporarily lack cohesion.

Generally, all alignment alternatives would have similar short-term impacts, with some exceptions. Alternative A2-BH would have a larger impact than other Segment A alignment alternatives, because the reconstruction of the existing viaduct and bridges for SW Naito Parkway would be a major undertaking. Similarly, the removed bridges along SW Barbur Boulevard in the Barbur Woods landscape unit would have a longer demolition period and more temporary facilities than a standard roadway section. Alternatives B2, B3 and B4 would have larger impacts than Alternative B1, because all of them would require additional staging and construction area for the Crossroads Bridge.

Table 4.5-9. Impacts to Designated Scenic Resources *(multi-page table)*

Landscape Unit	Plan or Policy	View Name/ID	Location	Focal Features	Impact
South Portland	*Central City 2035 (2017), Volume 3A, Part 2*	CC-47	SW Broadway Ave. at SW 5th Ave.	View corridor looking north on SW 5th Ave., showing urban environment	Beginning of alignment would be visible, but light rail would already be an established visual element of this corridor.
	Central City 2035 (2017), Volume 3A, Part 4	SW 1st Ave. Corridor	SW 1st Ave. from I-405 to SW Market St.	Urban boulevard	A2-BH and A2-LA would be visible at SW 1st Ave. and SW Lincoln St.; however, it would be visually similar to established Orange Line.
	Scenic Views, Sites and Drives Inventory (1989)	VM 31-21	VA Portland	Mt. St. Helens; downtown skyline	A2-BH and A2-LA would be minimally visible in middle ground of viewpoint; would not impact focal features.
		VM 31-25	OHSU	Mt. Hood	Original viewpoint no longer has visibility due to new development, but views of Mt. Hood would not be obstructed.
		VM 31-26	VA Portland	Mt. Hood; eastside neighborhoods	No visibility.
		VM 31-38/Scenic Overlay 164	SW Terwilliger Blvd. above Duniway Park	Mt Hood; Willamette River	Starting section of new alignment would be minimally visible in middle ground; would not impact focal features.
		VP 31-29/Scenic Overlay 166	SW Terwilliger Blvd. below VA Portland	Panorama of downtown skyline, Marquam Bridge and Mt. Hood	A2-BH and A2-LA would be minimally visible in middle ground of viewpoint; would not impact focal features.
		VP 31-30/Scenic Overlay 179	SW Terwilliger Blvd. above Duniway Park	Panorama of eastside neighborhood, Marquam Bridge and Mt. Hood	A2-BH and A2-LA would be minimally visible in middle ground of viewpoint; would not impact focal features.
	*City of Portland Zoning Code 33.420 – Design Overlay Zone**	Central City – Downtown Subdistrict	SW Lincoln St. to I-405, and SW 4th Ave. to SW Naito Pkwy.	N/A. See CC-47, and SW 1st Ave. Corridor	All alignments would need to conform to applicable design review standards.
		Terwilliger Design District	SW Barbur Blvd. and SW Condor Ave., up to SW Terwilliger Blvd.	N/A. See VM 31-38/Scenic Overlay 164, VP 31-29/Scenic Overlay 166/179, and Scenic Overlay 162	All alignments would need to conform to applicable design review standards.
		Marquam Hill Design District	SW Terwilliger Blvd. up Marquam Hill to SW 7th Ave.	N/A. See VM 31-21, VM 31-25, VM 31-26, and Scenic Overlay 155/158.	Marquam Hill connection options would need to conform to applicable design review standards.
	City of Portland Zoning Code	Scenic Overlay 155/158	Eastern slopes of OHSU	Downtown skyline, Willamette River and Mt. Hood	A2-BH and A2-LA would be minimally visible in middle ground of viewpoint; would not impact focal features.

Table 4.5-9. Impacts to Designated Scenic Resources *(multi-page table)*

Landscape Unit	Plan or Policy	View Name/ID	Location	Focal Features	Impact
	33.480 – Scenic Overlay Zone	Scenic Overlay 162	SW Terwilliger Blvd. by junction with SW Trail #1	Terwilliger Boulevard Parkway	A1 would be minimally visible in middle ground of viewpoint; would not impact focal features.
		Scenic Overlay 174/176	SW Lowell Ln. cul-de-sac	Eastside neighborhood, Willamette River and Mt. Hood	A2-BH and A2-LA would be minimally visible in middle ground of viewpoint; would not impact focal features.
Barbur Woods	*Scenic Views, Sites and Drives Inventory (1989)*	VP 31-28	Elk Point (behind Chart House restaurant)	Panorama of city, Ross Island and Mt. Hood	Overhead catenary system (OCS) and vegetative impacts would be visible in foreground but would not block established focal features.
	*City of Portland Zoning Code 33.420 – Design Overlay Zone**	Terwilliger Design District	SW Barbur Blvd. from beginning of landscape unit south to SW Capitol Hwy., and west up past SW Terwilliger Blvd.	N/A. See VP 31-28, and the SW Terwilliger Blvd. Corridor Scenic Overlay Zone	All alignments would need to conform to applicable design review standards.
	City of Portland Zoning Code 33. 480 – Scenic Overlay Zone	SW Terwilliger Blvd. Corridor	SW Terwilliger Blvd. from SW Taylors Ferry Rd. to SW Hamilton Terr.	Verdant boulevard with enclosed vegetative segments and viewpoints	OCS and vegetative impacts on SW Barbur Blvd. would be visible in open segments of corridor; would not significantly impact the view along SW Terwilliger Blvd. itself.
Barbur Historic Highway	*Scenic Views, Sites and Drives Inventory (1989)*	VM 37-01	SW Huber St. near I-5 northbound on-ramp	Mt. Hood	Crossroads Bridge over I-5 would be visible in the foreground, and could block part of the northern edge of Mt. Hood.
	*City of Portland Zoning Code 33.420 – Design Overlay Zone**	Terwilliger Design District	Along SW Barbur Blvd. from SW 5th Ave. to SW Bertha Blvd.	N/A	All alignments would need to conform to applicable design review standards.

* While Design Overlay Zones do not designate key viewing areas nor key viewpoints in the same manner as other visual impact regulating plans, they are included in this analysis because any development within design districts will have to meet visual design criteria.

4.5.5. Potential Mitigation Measures

Long-Term Impact Mitigation

The following mitigation measures could help reduce moderate to high impacts:

- Develop potential alignments, associated facilities and station access improvements to be visually consistent with existing neighborhood pattern and scale. Where appropriate, follow local plans/policies to develop designs visually consistent with outlined future urban form.
- Design associated project structures, such as transit stops and park and ride facilities, to integrate with their visual environment, with consideration for local scale and character.
- Use project-related facilities to integrate vacant or underused areas into the neighborhood, or to improve the visual character of neighborhood areas along the project corridor. Project elements should consider their surroundings and be visually designed to have a relationship with them.
- Where projects elements are added in highly visible or sensitive areas, use high quality design and materials that mitigate the overall impact and blend into the visual environment.
- Where possible, avoid demolition or alteration of contributing historic structures.
- Reduce or buffer the loss of existing visual resources through the addition of new street trees and other landscaping elements.
- Reduce obstructions or limitations to either officially designated or socially recognized views.
- Consider aesthetic treatments for the design of new/replacement bridges, overhead structures or elevated sections of the ballasted trackway to improve compatability with surrounding areas. If more appropriate, structures should be designed to contrast with their surroundings, so as to create a visual statement.
- Where possible, make location-specific design adjustments to the street cross section (narrower lanes, elimination of a turn lane, narrower sidewalks, etc.) to avoid impacts to existing structures, slopes or vegetation.
- Use elements such as landscaping, streetscaping or fencing to provide an aesthetically pleasing visual buffer between the project and adjacent high-sensitivity viewers.
- Adopt a strategy of coordinated street furnishing to create a harmonious visual environment. Elements include signage, wayfinding, street furniture, lighting, hardscaping and public art.
- Use terraced vegetated landscaping to minimize the visual impact of large retaining walls where possible.
- Replace/restore removed vegetation and landscaping where possible.
- Consider vegetated trackway or alternatives to concrete trackway where appropriate.
- Where remnant parcels are created that are too small to be developed separately, use them for appropriate productive land use, such as public art, hardscaping, landscaping and/or community amenities, to make them visually appealing.

Short-Term Impact Mitigation

The following mitigation measures for short-term impacts would apply to all alternatives:

- Restore landscaping and streetscaping as the project is being constructed rather than waiting for the final phases of construction.
- Shield light resources used in nighttime construction.
- Create viewing areas with project-related information for pedestrians.
- Design and place construction screens or barriers to limit the visibility of work areas that are adjacent to high-activity areas, particularly where pedestrians, parks, trails or residences are present.
- Use murals or other techniques to create barriers with visual interest in high use areas.
- Minimize construction debris storage on-site.

4.6. Historic and Archaeological Resources

This section reviews historic, archaeological and cultural resources that could be impacted by the Southwest Corridor Light Rail Project. It discusses long-term, short-term, indirect and cumulative impacts, and also describes potential avoidance, minimization and mitigation measures.

This Draft Environmental Impact Statement (EIS) is being produced concurrently with the project's National Historic Preservation Act compliance efforts. The results report, *Cultural Resource Survey for the Southwest Corridor Light Rail Project, Multnomah and Washington Counties, Oregon* (Attachment C) provides further details on the methods, research and coordination being done for this Draft EIS, and the documentation required under Section 106 of the Act (see Exhibit 4.6-1 for an overview of Section 106).

For this project, FTA is consulting with interested parties after initiating consultation with the State Historic Preservation Office (SHPO) to identify and assess impacts on historic buildings, structures, districts, objects and sites. These interested parties include the following agencies, tribes and organizations:

- Advisory Council for Historic Preservation
- Confederated Tribes of the Grand Ronde Community of Oregon
- Confederated Tribes of Siletz Indians of Oregon
- Confederated Tribes of the Warm Springs Reservation of Oregon

Exhibit 4.6-1

Overview of Section 106

Section 106 of the National Historic Preservation Act requires federal agencies to consider the effects of their undertakings on historic properties. A significant historic property is a prehistoric or historic district, site, building, structure or object that is in or eligible for the National Register of Historic Places (NRHP). Archaeological sites are historic properties where evidence of past human lives and activities remain. Cultural properties are buildings, sites or objects that carry traditional religious or cultural significance to past lives and peoples.

Through the Section 106 process, federal agencies must consult with other agencies, tribes and other parties with an interest in the effects of a project on historic properties. The goal of consultation is to identify historic properties potentially affected by the project, assess the effects on these properties, and seek ways to avoid, minimize or mitigate adverse effects.

- Cowlitz Indian Tribe
- Cities of Portland, Tigard and Tualatin
- Multnomah County and Washington County
- Oregon Department of Transportation (ODOT)
- Restore Oregon

These parties were invited to participate in the environmental review and Section 106 processes, and to review and comment on the area of potential effects (APE) for the project. Consultation with tribes and other consulting parties will continue through the Final EIS to comply with Section 106. Additionally, the tribes will be consulted if any artifacts are discovered during construction.

4.6.1. Affected Environment

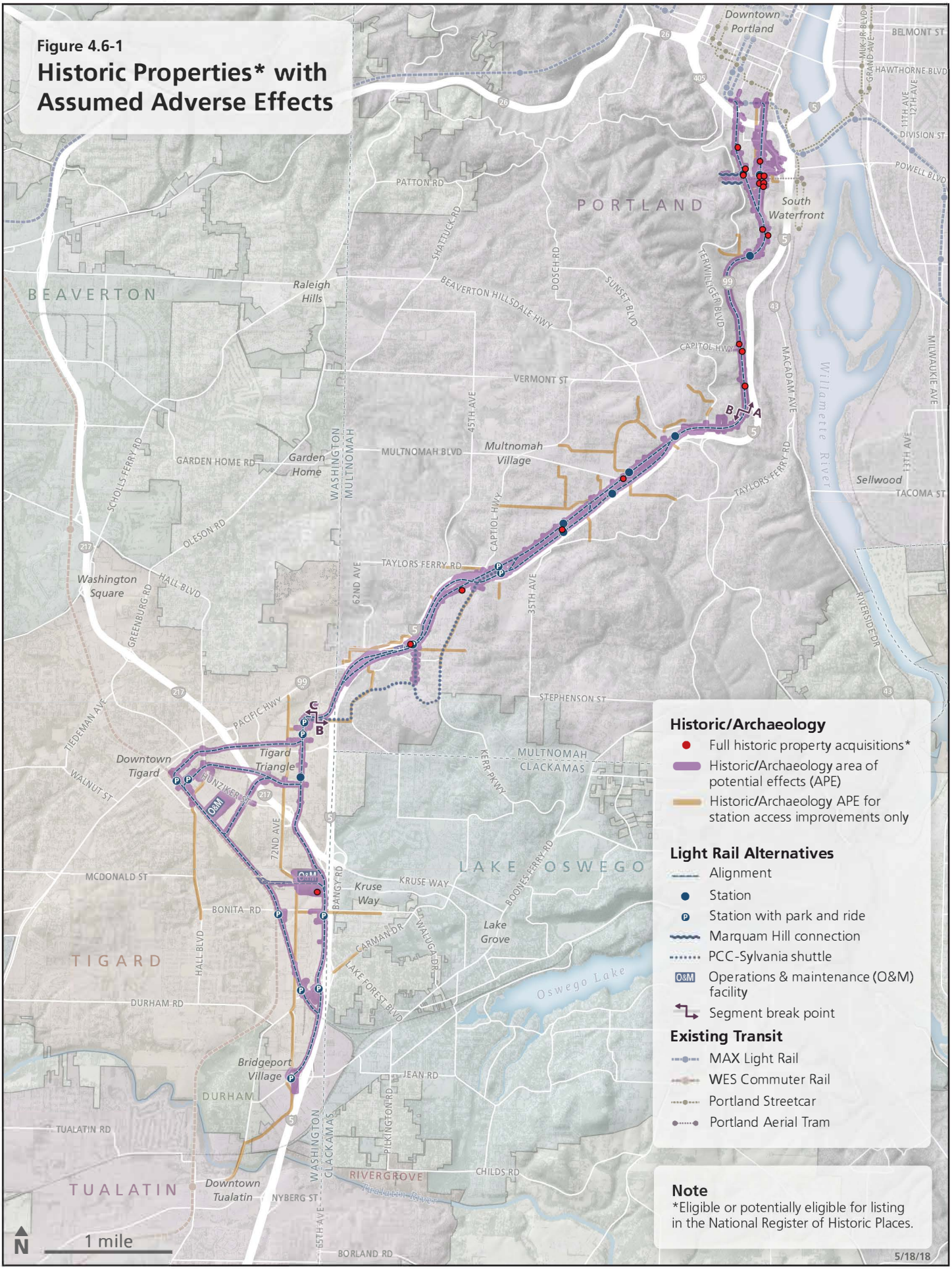
Area of Potential Effects

The APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties" (36 Code of Federal Regulations [CFR] Part 800.16). Cultural resources are included in the category of historic and archaeological resources, and no Traditional Cultural Properties (TCPs) (a place that is eligible for listing on the National Register of Historic Places [NRHP] because of its significant association with cultural practices or beliefs) are currently documented within the APE. FTA has defined the initial APE for the Southwest Corridor Light Rail Project (shown in Figure 4.6-1) as the area within 50 feet of the anticipated construction footprint for the alignment alternatives, stations, station access improvements, and operations and maintenance (O&M) facilities options. The APE can be adjusted as project designs continue to advance, and as the environmental analysis in this Draft EIS reveals areas where potential impacts might extend beyond the initial APE boundaries. Any parcel or historic property that is intersected by the APE will be evaluated, including historic districts and parks. Only those historic resources that are listed in the NRHP, are potentially eligible properties for listing in the NRHP based on recommendations, or have recognized local significance are considered to be historic properties for this Draft EIS.

The station access improvements that are also proposed as a part of the project and included in the APE may include simple restriping for bicycle lanes, widening for bicycle lanes, new sidewalks and pedestrian bridges. Station access improvements will be designed for the Preferred Alternative, and will be further described and analyzed in the Final EIS. In general, these improvements will be designed to avoid impacts to historic and archaeological resources.

Figure 4.6-1

Historic Properties* with Assumed Adverse Effects



Survey of Historic Resources

For historic resources, the project's resource specialists surveyed known and potential historic properties in the APE by documenting every building, structure, district, site (e.g., park) and object that would be 50 years old by the year 2020, which is the estimated start of early project construction.

As part of the survey, the project's historians reviewed the NRHP, the SHPO Historic Sites Database, historic property inventories of local governments (Portland, Tigard, Tualatin, Multnomah County and Washington County), and previous surveys by ODOT. Local jurisdictions were also contacted to identify resources of local interest that had not been previously recorded. The historians conducted a targeted literature review of archival and online repositories, including books, maps and photographs, to help identify historic resources and evaluate their significance.

In total, 584 historic buildings, sites, structures and objects were reviewed and documented. The review found 144 historic resources that are either listed in or are considered potentially eligible for listing in the NRHP, and these are considered significant historic properties under Section 106 and for this Draft EIS. The properties that are identified by the project team as potentially eligible for the NRHP reflect preliminary evaluations based on prior documentation and NRHP recommendations, field observations of historical integrity and known associations that might qualify the resources for inclusion in the NRHP. The results report, *Cultural Resource Survey for the Southwest Corridor Light Rail Project, Multnomah and Washington Counties, Oregon* provides a list, maps and photographs of all the properties surveyed.

All of the NRHP-listed properties in the APE are located in Segment A, which includes one of Portland's oldest neighborhoods (Lair Hill), although potentially eligible properties exist in each segment. One of the NRHP-listed properties is the South Portland Historic District, which was listed in 1998 through a process that involved identifying the individual buildings, structures, sites and objects that contribute to the district's historical significance. In addition to this historic district, there are three houses in Segment A that are listed in the NRHP (see Figure 4.6-2 for photographs):

- **Taylor, Peter & Haehlen, John & Gotlieb House #1 (2806 SW 1st Avenue, Portland).** This Italianate house was constructed in 1882 and was listed in the NRHP as an individual property in 1984. It is a contributing resource of the South Portland Historic District (listed in the NRHP in 1998) and is a City of Portland Historic Landmark.

- **Holt-Saylor-Liberto House (3625 SW Condor Avenue, Portland).** This 1888 Queen Anne house was listed in the NRHP in 1978 and is a City of Portland Historic Landmark.

- **Jewish Shelter Home (4133 SW Corbett Avenue, Portland).** Originally constructed as a private residence in 1902, this house was operated as a shelter home for Jewish children from 1919 to 1937. The house was listed in the NRHP in 1984 and is a City of Portland Historic Landmark.

Figure 4.6-2. Individual Properties in Segment A Listed in the National Register of Historic Places

Taylor, Peter & Haehlen, John & Gotlieb House #1

Holt-Saylor-Liberto House

Jewish Shelter Home

Survey of Archaeological Resources

Project archaeologists identified 16 archaeological resources that have been previously documented for other projects and that fall within the APE. Only one of these sites is NRHP-eligible; the others have not been evaluated through determinations of eligibility. The archaeologists reviewed other information sources to predict the potential for undiscovered archaeological resources, and they also performed field reconnaissance surveys.

Archaeological resources can date from either before or after contact between Native Americans and non-native people. In the Pacific Northwest, development by non-native people began in the early 19th century. Buried remnants of these developments are called historic-period sites, and they provide information about the past. The history of residential, commercial, industrial and transportation development in the Portland area occurred during the 19th and early 20th centuries.

Archaeological resources related to Native Americans may also be present, especially in less developed areas. Historical records indicate that two pre-contact Native American camps or villages may have been within the APE: one in Portland and the other in Tigard. These two reported locations of Native American use are not documented as archaeological sites, but they do help anticipate locations where buried archaeological deposits might be encountered.

Much of the project APE is paved and inaccessible to traditional archaeological survey methods. However, archaeological resources could be present beneath fill and pavement throughout the APE. Based on a preliminary analysis, project archaeologists have predicted the potential for discovering archaeological sites within the APE. They identified high probability areas (HPAs) reflecting data from available maps and records of Euro-American and Native American land use within the APE, as well as analyses of intact landforms that are typically associated with the presence of archaeological sites. An HPA indicates an expectation that a significant archaeological site may be present at that location. A total of 28 HPAs were defined within the APE. The results report lists the 28 HPAs, including a description and typical photograph of each.

4.6.2. Long-Term Impacts – Historic Resources

Section 106 provides guidance on how to identify potential adverse effects:

> An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative (36 CFR 800.5).

No-Build Alternative

With the No-Build Alternative, the Southwest Corridor Light Rail Project would not be built, and no changes to the urban environment, including to historic resources, would directly result.

Light Rail Alternatives

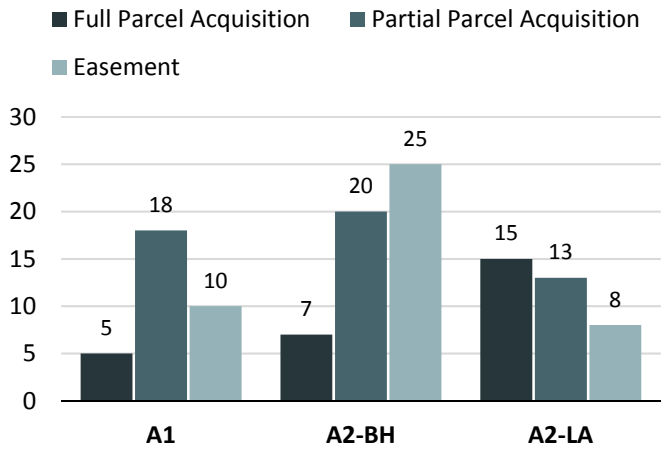
All of the light rail alternatives would acquire property, including buildings, and would alter or remove surface and subsurface features in order to construct the project. For parcels with significant historic buildings, acquisition of the entire parcel would result in an adverse effect, because the building would either be demolished or removed from its original setting. Although adverse effects are less likely when only a portion of a parcel is acquired, the building's features that are important to the property's significant historic characteristics could still be altered. A preliminary identification of cultural resources, including cultural landscapes and parkways, showed no known long-term impacts to cultural resources in the APE from the light rail alternatives.

This Draft EIS identifies an adverse effect in instances where an alternative would acquire a full parcel that includes a significant historic property. For partial parcel acquisitions and temporary construction easements, there would still be an effect, but it may or may not be adverse. For example, either a partial parcel acquisition or a construction easement could permanently remove a character-defining feature that is important to a resource's historic significance, which would result in an adverse effect. Because the level of design at the time of this Draft EIS is preliminary, the adverse effects resulting from partial parcel acquisitions are estimated based on Geographic Information Systems analysis, and temporary construction easements will be identified in the Final EIS. The results from the analysis of partial parcel acquisitions are summarized in the sections that follow. A more detailed consideration of easements and partial parcel acquisitions will be presented in the Final EIS.

Segment A: Inner Portland

Segment A has a high concentration of NRHP-listed or potentially eligible historic resources, and a high number of impacted historic properties compared to the other two segments. Figure 4.6-3 illustrates the number of properties affected by the Segment A alignment alternatives.

Figure 4.6-3. Number of Acquisitions and Easements at Historic Properties by Segment A Alignment Alternatives



Alternative A2-LA would have an adverse effect on the most properties of the Segment A alignment alternatives, because it has the most full parcel acquisitions, including seven contributing properties in the NRHP-listed South Portland Historic District. Alternative A1 would require the fewest full parcel acquisitions. Alternative A2-BH would have the most historic properties affected, including all temporary construction easements and partial parcel acquisitions.

All of the Segment A alignment alternatives would impact:

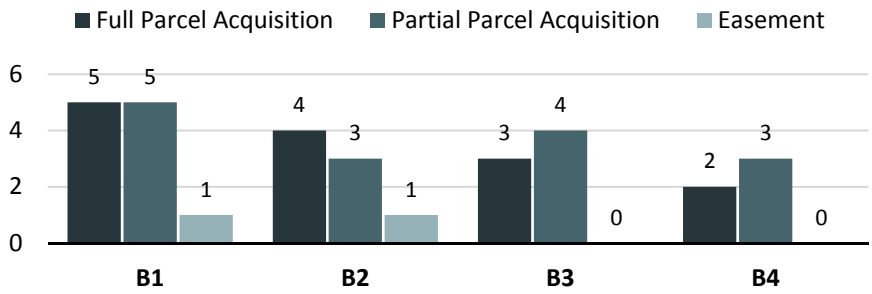
- SW Newbury Street Viaduct (Bridge #01983) on SW Barbur Boulevard, Portland
- SW Vermont Street Viaduct (Bridge #01984) on SW Barbur Boulevard, Portland
- a Tudor Revival house on 5900 block of SW Ralston Drive, Portland.

Two NRHP-eligible historic properties are located in the APE near the Marquam Hill connection options: Terwilliger Parkway and a synagogue on SW Barbur Boulevard. Both of these historic properties would be affected by the Marquam Hill connection options.

Segment B: Outer Portland

Segment B has 18 potentially eligible historic resources within the APE. Figure 4.6-4 illustrates the number of properties affected by the Segment B alignment alternatives.

Figure 4.6-4. Number of Acquisitions and Easements at Historic Properties by Segment B Alignment Alternatives



In terms of both the total number of historic properties affected and the number of anticipated adverse effects due to full acquisitions, Alternative B1 would have the greatest impact within Segment B and Alternative B4 would have the least impact. This is primarily because most of the historic resources are on SW Barbur Boulevard, which Alternative B1 follows for most of its length, while Alternative B4 runs along Interstate 5 (I-5) more than the other alignment alternatives.

All of the Segment B alignment alternatives would impact:

- a Tudor Revival house at the 5300 block of SW Pasadena Street, Portland
- a Modern Period commercial building at the 11100 block of SW Barbur Boulevard, Portland.

Alternatives B1, B2 and B3 all would have an adverse effect on a historic bridge where SW Barbur Boulevard currently crosses over the former Oregon Electric Railway. Alternatives B1 and B2 would both also have an adverse effect on two historic commercial properties that have associations with old Pacific Highway.

Segment C: Tigard and Tualatin

Compared to the other segments, there are few eligible or potentially eligible historic resources in Segment C. All six Segment C alignment alternatives would require a partial parcel acquisition at the Tigard Branch of the Southern Pacific Railroad. They would all use part of the railroad right of way but would not alter the physical features of the railroad. Alternatives C1 through C5 would acquire parts of three historic properties, while Alternative C6 would acquire parts of two.

Of the O&M facilities options, the Branched 72nd Facility is the only one that would have a direct effect on an historic property. That option would require a full parcel acquisition of a 1960s era manufacturing facility.

Summary

Table 4.6-1 summarizes the impacts to historic properties in each segment and across the corridor.

Table 4.6-1. Land Acquisitions and Easements at NRHP-Listed and Potentially Eligible Historic Resource Locations *(multi-page table)*

Alternatives and Options	Effects Due to Acquisitions (Full and Partial) and Easements at NRHP-Listed and Potentially Eligible Resource Locations		
	Full: Presumed Adverse Effect	Partial: Likely Not Adverse Effect (Potential Adverse Effect)[1]	Easement: Likely Not Adverse Effect
No-Build	0	0	0
Segment A: Inner Portland – Alignment Alternatives			
A1: Barbur	5	13 (5)	10
A2-BH: Naito Bridgehead	7	11 (9)	25
A2-LA: Naito Limited Access	15	9 (4)	8
Segment A: Inner Portland – Marquam Hill Connection Options			
1A: Elevator/Bridge and Path	0	1	0
1B: Elevator/Bridge and Recessed Path	0	1	0
1C: Elevator/Bridge and Tunnel	0	1	0
2: Full Tunnel	1	1	0

Table 4.6-1. Land Acquisitions and Easements at NRHP-Listed and Potentially Eligible Historic Resource Locations ***(multi-page table)***

Alternatives and Options	Effects Due to Acquisitions (Full and Partial) and Easements at NRHP-Listed and Potentially Eligible Resource Locations		
	Full: Presumed Adverse Effect	Partial: Likely Not Adverse Effect (Potential Adverse Effect)[1]	Easement: Likely Not Adverse Effect
Segment B: Outer Portland – Alignment Alternatives			
B1: Barbur	5	4 (1)	1
B2: I-5 Barbur TC-60th	4	2 (1)	1
B3: I-5 26th-60th	3	2 (2)	0
B4: I-5 Custer-60th	2	2 (1)	0
Segment C: Tigard and Tualatin – Alignment Alternatives			
C1: Ash-I-5	0	3	0
C2: Ash-Railroad	0	3	0
C3: Clinton-I-5	0	3	0
C4: Clinton-Railroad	0	3	0
C5: Ash-I-5 Branched	0	3	0
C6: Wall-I-5 Branched	0	2	0
Segment C: Tigard and Tualatin – O&M Facilities Options			
Hunziker	0	0	0
Branched 72nd	1	0	0
Through 72nd	0	0	0

Notes: Evaluation is based on desktop Geographic Information Systems analysis of proximity impacts.

NRHP = National Register of Historic Places; TC = Transit Center.

4.6.3. Long-Term Impacts – Archaeological Resources

Although impacts to archaeological resources might be initiated by construction activities, the impacts are considered permanent, because the sites would be permanently altered, and there would still be the potential for the destruction of artifacts and features. The HPAs indicate locations that would likely need further detailed preconstruction surveys or archaeological monitoring during construction to discover whether or not an archaeological site exists and to reduce the potential for impacts. Consultation with the tribes has identified no known TCPs that could be affected by the project.

No-Build Alternative

The No-Build Alternative would avoid all impacts to archaeological resources. No adverse effects would occur.

Light Rail Alternatives

Segment A: Inner Portland

Five HPAs and six historic-period archaeological sites are located within the APE in Segment A. The Segment A alignment alternatives each would encounter four of the HPAs. Alternative A1 intersects an eligible archaeological site, with a potential adverse effect that would depend on the type and extent of construction activities. Alternatives A1, A2-BH and A2-LA could impact unevaluated/potentially eligible archaeological sites.

The Marquam Hill connection options have not been completely surveyed for archaeological resources, but their construction footprints largely consist of raw land. Raw land can be surveyed for archaeological resources in advance, which minimizes risk during construction. Although the footprints and the construction activities for the connection options vary, all of the options are within an HPA for archaeological resources, and they all have two to three unevaluated/potentially eligible historic-period archaeological sites within the APE.

Segment B: Outer Portland

Nine HPAs could be altered by construction activities within Segment B. There are no recorded archaeological sites within the APE in Segment B, but the area has not been completely surveyed for archaeological resources.

Segment C: Tigard and Tualatin

Fifteen HPAs could be altered by construction activities within Segment C. There are no recorded archaeological sites within the APE in Segment C, but the area has not been completely surveyed for archaeological resources.

Summary

Table 4.6-2 summarizes the impacts on NRHP-eligible and unevaluated, potentially eligible archaeological resources in the APE. This table also includes HPA acreage within each alignment alternative. In addition, it shows what percentage of HPA acreage can be surveyed for archaeological resources before project construction, which is a measure of the potential for mitigation actions to avoid or minimize project impacts.

Table 4.6-2. Potential Impacts on NRHP-Eligible and Unevaluated/Potentially Eligible Archaeological Resources and HPAs

Alignment Alternatives and Options	NRHP-Eligible and Unevaluated Resources	HPAs	
		Acreage	Percent Raw Land (Survey)
Segment A: Inner Portland – Alignment Alternatives			
A1: Barbur	4	30.8	9.4%
A2-BH: Naito Bridgehead	4	36.7	7.6%
A2-LA: Naito Limited Access	4	35.1	8.3%
Segment A: Inner Portland – Marquam Hill Connection Options			
1A: Elevator/Bridge and Path	2	1.4	92.2%
1B: Elevator/Bridge and Recessed Path	2	1.7	94%
1C: Elevator/Bridge and Tunnel	2	2.6	87.8%
2: Full Tunnel	3	2.4	87.1%
Segment B: Outer Portland – Alignment Alternatives			
B1: Barbur	0	22.4	1.9%
B2: I-5 Barbur TC-60th	0	19.7	2.4%
B3: I-5 26th-60th	0	17.6	2.5%
B4: I-5 Custer-60th	0	16	2.5%
Segment C: Tigard and Tualatin – Alignment Alternatives			
C1: Ash-I-5	0	24.3	17.5%
C2: Ash-Railroad	0	29.2	27.4%
C3: Clinton-I-5	0	23.2	18.3%
C4: Clinton-Railroad	0	28.1	29.4%
C5: Ash-I-5 Branched	0	21.7	13.6%
C6: Wall-I-5 Branched	0	15.7	9.7%
Segment C: Tigard and Tualatin – O&M Facilities Options			
Hunziker	0	1.7	0%
Branched 72nd	0	5	0%
Through 72nd	0	1.6	0%

Note: HPAs = high probability areas; NRHP = National Register of Historic Places; TC = Transit Center.

4.6.4. Short-Term Impacts

Short-term impacts are those that will occur during the limited duration of project construction. Examples of construction impacts include:

- possible damage through vibrations caused by earthmoving and heavy equipment
- temporary loss of access to a historic site
- potential temporary visual impacts during construction
- increased dust and noise near the construction area.

Short-term construction impacts, such as limited community access or temporary visual effects, are not likely to result in adverse effects on historic properties. Construction impacts on historic properties can be anticipated and evaluated before project construction, thus allowing for the development of avoidance and mitigation strategies. Archaeological resources are unlikely to have only short-term impacts, because any disturbance will permanently alter the resource.

4.6.5. Potential Mitigation Measures

There is the potential to avoid and minimize impacts on historic, archaeological and cultural resources by redesigning some elements of the alignment alternatives, or by choosing alternatives that either avoid impacts or have lesser impacts to historic, archaeological and cultural properties. For unavoidable adverse effects on historic properties, FTA will develop mitigation plans in consultation with SHPO and other consulting parties.

Mitigation measures could include:

- move rather than demolish historic buildings
- provide financial assistance for the South Portland Historic District for the preparation of a new set of design guidelines
- provide assistance/funds for rehabilitation and adaptive reuse efforts
- provide financial assistance for restoration efforts that will contribute to the preservation of cultural heritage in an affected community
- develop and support interpretative public history exhibits or on-site kiosks that highlight information gained about cultural resources
- develop online history articles
- rehabilitate historic properties affected by construction to their original condition
- install residential sound insulation to mitigate project-related noise impacts on historic properties
- support updates to local government historic resource inventories to capture property information for significant historic resources
- construct sound walls to mitigate project-related noise impacts in a manner sensitive to the historic character of the building, if the building is considered a noise-sensitive property
- minimize visual impacts on historic resources (i.e., from transit stations near resources) through site-specific, culturally appropriate and historically appropriate design or visual buffers
- minimize parking and access impacts to businesses in historic buildings with signs to direct traffic and pedestrians to the businesses and services, and provide alternative access and parking during construction
- develop a monitoring and inadvertent discovery plan to provide procedures for the identification and documentation of archaeological resources encountered during project construction
- conduct advance testing of locations identified as having the potential to contain archaeological resources prior to project construction
- consider design modifications that minimize or avoid impacts to historic and archaeological resources (see Appendix E).

4.7. Parks and Recreation Resources

This section identifies parks and recreation resources in the study area and discusses potential impacts to these resources. Parks and recreation resources include publicly owned parks, greenspaces, recreation areas, trails, natural areas, and wildlife lands.

4.7.1. Affected Environment

Parks and recreation resources in the study area are owned and managed by the City of Portland Parks and Recreation, City of Tigard Public Works Department, Portland Public Schools and Metro, which owns and manages public parks and open spaces on lands throughout the tri-county Metro area.

The project must comply with federal regulations that restrict the conversion or use of certain parks and recreation resources for non-park purposes. Properties that have been acquired or improved with funds from the Land and Water Conservation Fund Act of 1965 (LWCF) are protected by Section 6(f) of the LWCF. Section 4(f) is a federal regulation that protects publicly owned parks, and recreation and wildlife preserve lands from impacts from federal transportation projects. Appendix D – Draft Section 4(f) Evaluation and Draft Land and Water Conservation Fund Section 6(f) Evaluation discusses impacted properties.

The study area for parks and recreation extends 150 feet from the edge of all alignment alternatives and options. Table 4.7-1 and Figures 4.7-1 to 4.7-3 show the trail, recreation and parks resources in the study area.

Table 4.7-1. Parks and Recreation Resources by Segment and Alignment Alternative *(multi-page table)*

Property	Location	Owner/Custodian	Recreational Use	Public Access
Segment A: Inner Portland				
Duniway Park	SW Barbur Blvd. & SW Sheridan St.	City of Portland	Lilac garden, horseshoe pit, paths, picnic tables, soccer field and track	Yes
Lair Hill Park	SW Barbur Blvd. & SW Woods St.	City of Portland	Playground, paths, picnic tables, public art, tennis backboard, tennis court and BEECN*	Yes
Terwilliger Parkway	SW Terwilliger Blvd. approximately from the intersection with SW Sam Jackson Park Rd. to the intersection with SW Capitol Hwy.	City of Portland	Paths, picnic tables, playground, and hiking and biking trails	Yes
Water and Gibbs Community Garden	SW Water Ave. & SW Gibbs St.	City of Portland	Community garden	Yes
Front and Curry Community Garden	SW Naito Pkwy Frontage Rd. & SW Curry St.	City of Portland	Community garden	Yes
George Himes Natural Area Park	Between SW Capitol Hwy., SW Terwilliger Blvd. & SW Barbur Blvd.	City of Portland	Natural area, paths, picnic tables and hiking trails (SW Trail #3)	Yes

Table 4.7-1. Parks and Recreation Resources by Segment and Alignment Alternative *(multi-page table)*

Property	Location	Owner/Custodian	Recreational Use	Public Access
Segment B: Outer Portland				
Fulton Park, Community Garden and Community Center	SW Barbur Blvd. & SW Miles St.	City of Portland	Basketball court, paths, picnic tables, playground and soccer field, community center rental hall and community garden	Yes
Markham Elementary School	10531 SW Capitol Hwy.	Portland Public Schools	Play field and baseball diamonds	Yes[1]
Sylvania Natural Area Park	SW Capitol Hwy. & SW 53rd Ave.	Portland Public Schools	Natural area and paths	Yes
Segment C: Tigard and Tualatin				
Tigard Triangle Planned Recreation Resources[2]	Unsited	City of Tigard	N/A	N/A
Planned Regional Multimodal Trail	South end of Tigard Triangle, SW 70th Ave. near NW Hampton St.	City of Tigard/Metro	Multiuse trail for walking, biking, etc.	N/A
Potso Dog Park	SW Wall St. south of SW Hunziker St.	City of Tigard	Fenced dog play areas, picnic tables and benches	Yes
Fields Natural Area (Brown Natural Area)	East of Tigard Library, between Fanno Creek and Railroad	City of Tigard/Metro	Undeveloped natural area undergoing restoration	Yes

Source: Portland Parks and Recreation Parks Finder available at https://www.portlandoregon.gov/parks/finder/ (May 2017). City of Tigard Community Dog Parks available at http://www.tigard-or.gov/community/dogparks.php (May 2017).

*Note: BEECN = Basic earthquake emergency communication node.

[1] Markham Elementary School is open for public access on weeknights, weekends, holidays and summer breaks.

[2] Potential parks and recreation facilities are identified in the *Tigard Triangle Strategic Plan*, March 2015, and the Tigard Triangle Lean Code Public Draft, May 2017.

Segment A: Inner Portland

Duniway Park

Duniway Park is located on the west side of SW Barbur Boulevard, south of SW Sixth Avenue. The 14-acre park was acquired by the City of Portland in 1918. It currently includes amenities such as a lilac garden with over 125 varieties of lilacs, a newly updated synthetic surface soccer field, a horseshoe pit, paved and unpaved paths, picnic tables and a newly resurfaced exercise track. The park has a small 11-space parking area accessed only by southbound traffic on SW Barbur Boulevard.

Lair Hill Park

Lair Hill Park is a 3.3-acre neighborhood park owned and maintained by the City of Portland and is bordered by SW Barbur Boulevard and SW Woods Street. The park features mature trees, lawns, structures and recreation amenities that include a tennis court, tennis backboard, public art, picnic tables, playgrounds and paved paths.

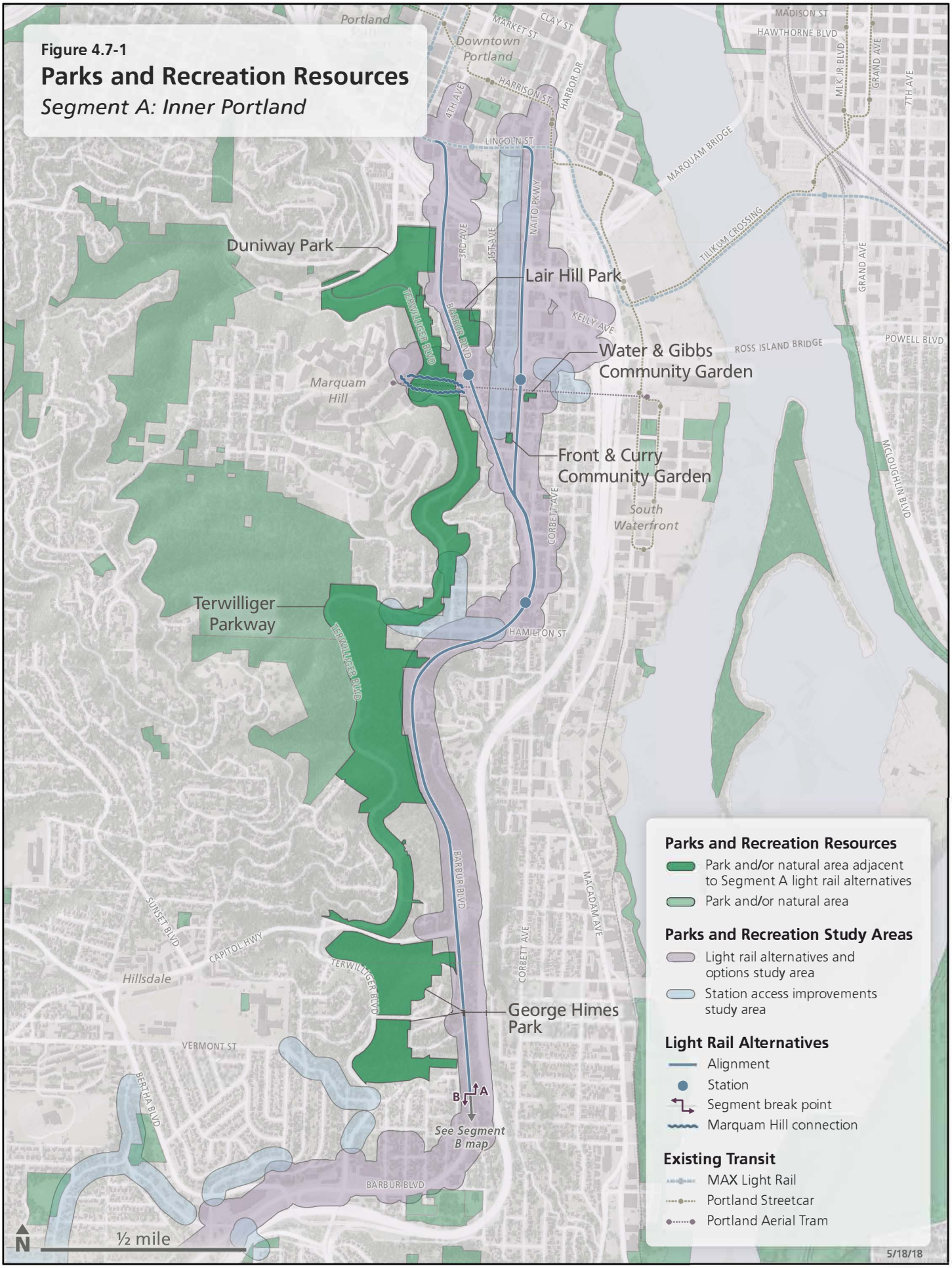
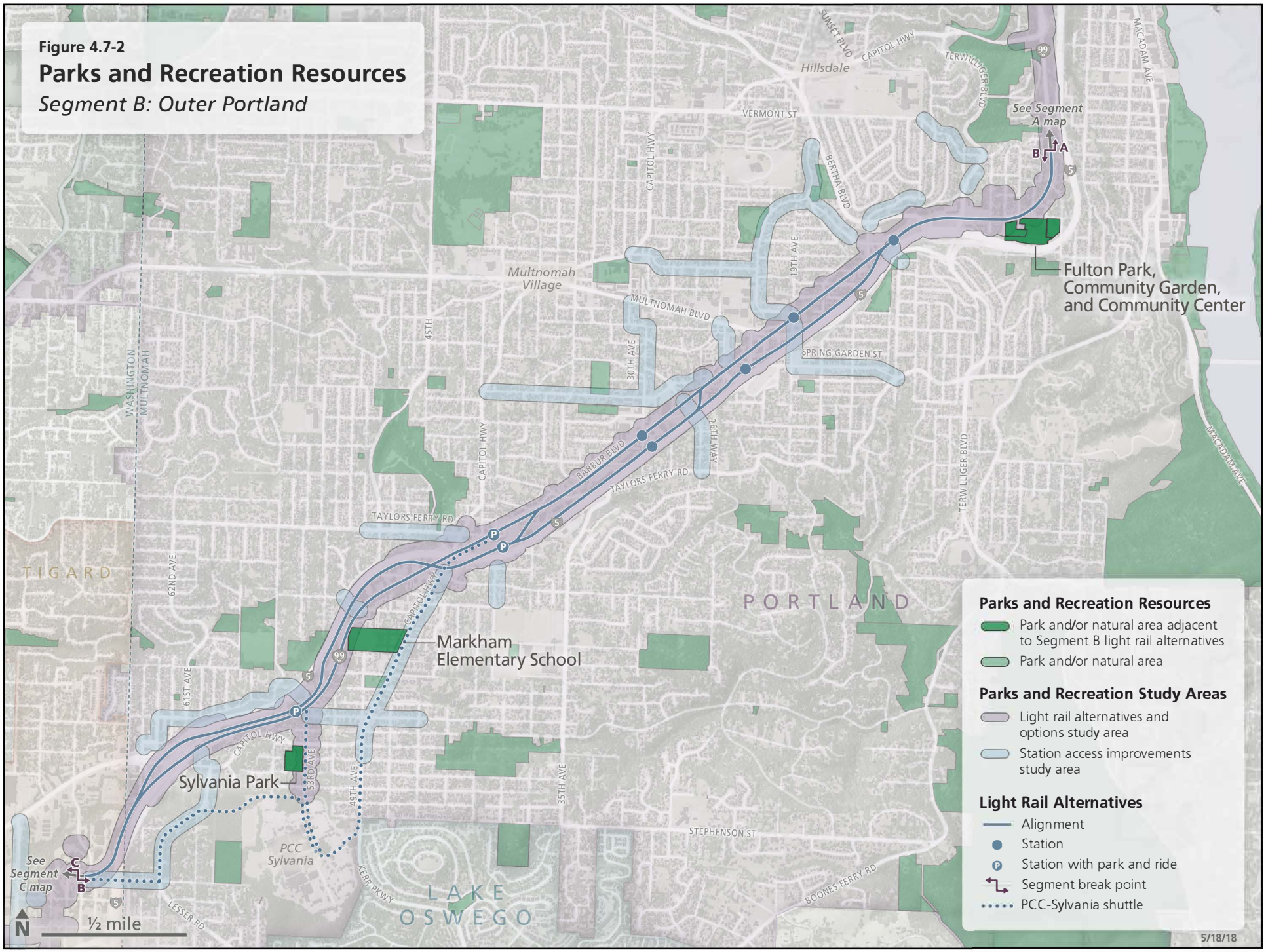


Figure 4.7-1
Parks and Recreation Resources
Segment A: Inner Portland
Portland
Downtown Portland
MARKET ST
CLAY ST
HARRISON ST
HARBOR DR
4TH AVE
LINCOLN ST
MADISON ST
HAWTHORNE BLVD
MLK JR BLVD
GRAND AVE
7TH AVE
MARQUAM BRIDGE
TILIKUM CROSSING
GRAND AVE
Duniway Park
3RD AVE
1ST AVE
NAITO PKWY
Lair Hill Park
TERWILLIGER BLVD
BARBUR BLVD
KELLY AVE
Water & Gibbs Community Garden
ROSS ISLAND BRIDGE
POWELL BLVD
Marquam Hill
Front & Curry Community Garden
CORBETT AVE
South Waterfront
MCLOUGHLIN BLVD
Terwilliger Parkway
HAMILTON ST
TERWILLIGER BLVD
BARBUR BLVD
MACADAM AVE
SUNSET BLVD
CAPITOL HWY
Hillsdale
TERWILLIGER BLVD
CORBETT AVE
George Himes Park
VERMONT ST
BERTHA BLVD
B
A
See Segment B map
BARBUR BLVD
N
½ mile
Parks and Recreation Resources
Park and/or natural area adjacent to Segment A light rail alternatives
Park and/or natural area
Parks and Recreation Study Areas
Light rail alternatives and options study area
Station access improvements study area
Light Rail Alternatives
Alignment
Station
Segment break point
Marquam Hill connection
Existing Transit
MAX Light Rail
Portland Streetcar
Portland Aerial Tram
5/18/18

Figure 4.7-2

Parks and Recreation Resources

Segment B: Outer Portland



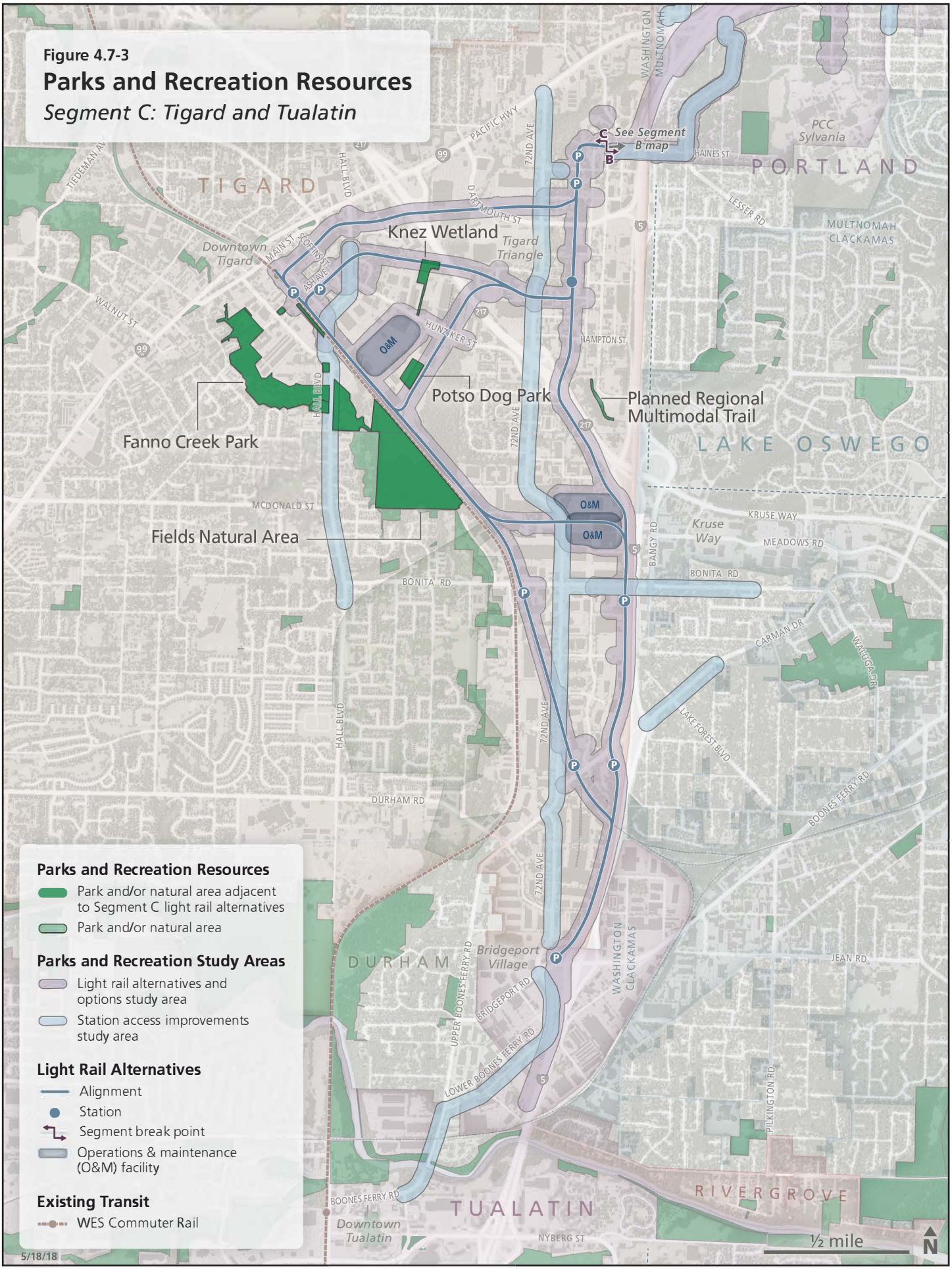


Figure 4.7-3
Parks and Recreation Resources
Segment C: Tigard and Tualatin
See Segment B map
Knez Wetland
Tigard Triangle
Potso Dog Park
Planned Regional Multimodal Trail
Fanno Creek Park
Fields Natural Area
Downtown Tigard
Kruse Way
Bridgeport Village
Downtown Tualatin
TIGARD
PORTLAND
LAKE OSWEGO
DURHAM
TUALATIN
RIVERGROVE
PCC Sylvania
MULTNOMAH CLACKAMAS
WASHINGTON MULTNOMAH
WASHINGTON CLACKAMAS
O&M
PACIFIC HWY
72ND AVE
HALL BLVD
DARTMOUTH ST
MAIN ST
SOFTNSKY ST
ASH AVE
WALNUT ST
HUNZIKER ST
HAMPTON ST
LESSER RD
HAINES ST
MCDONALD ST
BONITA RD
KRUSE WAY
MEADOWS RD
BANGY RD
CARMAN DR
WALUGA DR
LAKE FOREST BLVD
BOONES FERRY RD
DURHAM RD
JEAN RD
BRIDGEPORT RD
UPPER BOONES FERRY RD
LOWER BOONES FERRY RD
PILKINGTON RD
NYBERG ST
Parks and Recreation Resources
Park and/or natural area adjacent to Segment C light rail alternatives
Park and/or natural area
Parks and Recreation Study Areas
Light rail alternatives and options study area
Station access improvements study area
Light Rail Alternatives
Alignment
Station
Segment break point
Operations & maintenance (O&M) facility
Existing Transit
WES Commuter Rail
½ mile
N
5/18/18

Terwilliger Parkway

Terwilliger Parkway is a 99-acre linear parkway along SW Terwilliger Boulevard between SW Sam Jackson Park Road and SW Capitol Highway. The parkway was first envisioned in 1903 by landscape architect John C. Olmsted, who with his brother and father created more than 6,000 parks projects for cities and urban areas across the United States. The land for Terwilliger Parkway was acquired beginning in 1917, and today it is part of the regional 40-Mile Loop trail system and provides paved walking paths, picnic tables, viewpoints, hiking trails, bicycle paths and one playground.

One parcel (R991161410) adjacent to the project was purchased using LWCF grant funds; it is forested and does not have developed trails or other recreation amenities. Appendix D – Draft Section 4(f) Evaluation and Draft Section 6(f) of the Land and Water Conservation Fund Evaluation describes these impacts and the process for addressing them.

Water and Gibbs Community Garden

The Water and Gibbs Community Garden, one of 52 community gardens throughout the City of Portland, is located on the east side of SW Naito Parkway, south of SW Gibbs Street, and contains approximately 20 garden plot areas. The 0.25-acre garden is on City of Portland street right of way and not on a designated park parcel.

Front and Curry Community Garden

Located on the west side of SW Naito Parkway Frontage Road, south of SW Curry Street, the Front and Curry Community Garden includes approximately 25 garden plot areas. The 0.23-acre site was acquired in 1952 and also includes a storage garage.

George Himes Natural Area Park

George Himes Natural Area Park is located generally between SW Capitol Highway, SW Terwilliger Boulevard and SW Barbur Boulevard. The City of Portland acquired the park in 1903, and it includes 32.4 acres of steeply sloping forested natural area with paved and unpaved paths, picnic tables and hiking trails. One of the hiking trails (SW Trail #3) connects Terwilliger Parkway with the John's Landing neighborhood via SW View Point Terrace by passing under SW Barbur Boulevard and Interstate 5 (I-5). This recreation trail from the neighborhoods west of I-5 connects to John's Landing, the Willamette River and Willamette Park.

The section of SW Trail #3 in George Himes Natural Area Park is also considered part of the planned Red Electric Regional Trail that would create a 16-mile bicycle and pedestrian route connecting the Tualatin and Willamette rivers. Pedestrians would use the existing trail system within George Himes Natural Area Park to cross under I-5, while a future alternative for bicycles plans to use SW Parkhill Drive to access the south side of George Himes Natural Area Park, traverse switchbacks down the ravine slope and pass under I-5.

Segment B: Outer Portland

Fulton Park, Community Garden and Community Center

Located on the south side of SW Barbur Boulevard at SW Miles Street, Fulton Park consists of 8.2 acres and provides multiple recreation amenities, including a large community garden area (1.8 acres), the Metro Home Composting Demonstration Garden, a basketball court, unpaved walking paths, picnic

tables, a playground and a soccer field. The park is owned and maintained by the City of Portland and also includes the Fulton Park Community Center at the east end of the park. The community center offers one main hall that is rented out for community events and classes on a regular basis.

Markham Elementary School

Markham Elementary School is located at 10531 SW Capitol Highway. The western property boundary of the 4.4-acre school playground is located along SW Barbur Boulevard. This part of the elementary school property is at the far end of the playground from the school and is elevated above SW Barbur Boulevard. The playground contains three baseball diamonds, open grass field areas, a paved basketball court and a play structure. A pedestrian access stairwell provides access to SW Barbur Boulevard in the northwest corner of the property. Although Portland Public Schools grounds are not public parks, many school play areas are used by the public during non-school hours.

Sylvania Natural Area Park

Sylvania Natural Area Park is located on the south side of SW Capitol Highway, west of SW 53rd Avenue. The City of Portland acquired this 2.7-acre forested park in 2002, and it contains two paths that provide access to the park from all four of the adjoining streets.

Segment C: Tigard and Tualatin

Tigard Triangle Planned Recreation Resources

The Tigard Triangle has no developed parks and recreation resources, but the City of Tigard is planning new parks and recreation resources that would include natural areas with trails, two neighborhood parks, plazas and pathways, as outlined in the *Tigard Triangle Strategic Plan* (City of Tigard, 2015). Most of the new features are not yet sited, but the Strategic Plan identifies a proposed natural and recreation greenway generally along Red Rock Creek that would include a trail. The two new neighborhood park locations are unknown. The City of Tigard has also identified general locations for new off-road paths and trails within the Tigard Triangle as part of the Lean Code Tigard Triangle Transportation Network Map.

The City of Tigard is working closely with Metro and TriMet on the consideration of light rail alignment alternatives for the project. This coordination will include discussions regarding the benefits and constraints of future park and recreation locations.

Planned Regional Multimodal Trail

The approved extension of the Regional Multimodal Trail would enter Tigard at the south end of the Tigard Triangle and extend through the Triangle Pointe property to SW 70th Avenue just south of NW Hampton Street.

Potso Dog Park

The City of Tigard's Potso Dog Park is a 1.5-acre site located on the west side of SW Wall Street south of SW Hunziker Street. It includes perimeter fencing, a walking path, a smaller fenced area for smaller dogs and puppies, shaded picnic tables and benches. The park includes 30 off-street parking spaces.

Fields Natural Area (Brown Natural Area)

The Fields Natural area, also known as the Brown Natural Area, consists of approximately 26 acres of woods and open fields. It is located east of the Tigard Library, between Fanno Creek and the railroad. Metro owns the property and has been actively conducting restoration activities to restore native Oregon white oak habitat in portions of the site.

4.7.2. Long-Term Impacts

No-Build Alternative

Under the No-Build Alternative, the parks and recreation resources within the study area would continue to exist in their current configurations. The amenities available at each park and access to each park would not change. The owners and managers of parks facilities would continue to plan for future maintenance and improvements throughout their park systems and would continue to develop plans for new parks where needed. No direct impacts would occur under the No-Build Alternative.

Segment A: Inner Portland

The parks that are affected within Segment A are described by alignment alternative and illustrated in Figure 4.7-1.

Alternative A1: Barbur

- **Duniway Park.** The northeast corner and eastern edge of the Duniway Park property would have minor direct long-term impacts under Alternative A1. None of the impacts would permanently change the recreation uses offered by the park, although widening of and improvements to SW Barbur Boulevard could reduce the buffering area around a portion of the exercise track. Small trees between the track and the sidewalk in the northeast corner of the park would be removed as part of reconfiguring SW Barbur Boulevard and the nearby intersection to accommodate light rail and improve bicycle and pedestrian facilities. Small trees and vegetation between the parking lot and the street would also be removed. The on-site parking would remain.

  The project would not change the existing access to the parking lot (access is currently restricted to right-in, right-out movements from southbound traffic on SW Barbur Boulevard). Light rail infrastructure would be visible to park users within the track and soccer field area, especially in the park's northeast corner. Because these are active recreation uses that do not depend on a secluded park setting, and because the park is adjacent to a major roadway in a highly active urban area, Alternative A1 would not adversely affect activities involving the track and field facilities in the park. There would be negligible change to any other areas of the park.

- **Lair Hill Park.** Alternative A1 would widen SW Barbur Boulevard along Lair Hill Park. The permanent project footprint would require a partial acquisition of a narrow strip of land along the western boundary of the park. This expansion would cause a permanent direct impact to the entrance path and the edge of the tennis backboard court in the northwest corner of the park, and would remove mature evergreen and deciduous trees and plantings adjacent to SW Barbur Boulevard. The loss of mature trees and vegetation would change the character of this side of the park by making it more open to SW Barbur Boulevard, although it would retain a grade separation from the roadway. The interior of the park on its western side still would contain many mature

trees, so the loss of perimeter trees would reduce but not remove the buffering function, and the interior trees would continue to provide shade and a semi-forested feeling in this part of the park. Redeveloping the western edge of the park would change the setting of the metal art sculpture that is approximately 10 feet from the fence by removing the trees between the sculpture and the roadway.

The road widening would also likely require reconstruction of the existing retaining wall and changes to the sidewalks along SW Barbur Boulevard and the streets north and south of the park. These perimeter changes could introduce new materials that would contrast with the older features of the park. See Section 4.6, Historic and Archaeological Resources, for more discussion of the historic features of the park.

The light rail would run in the middle of SW Barbur Boulevard at this location and would not restrict access to Lair Hill Park. Light rail infrastructure would be visible to park users, primarily in the western half of the park and in the northwest corner of the park. Uses in these areas range from passive (viewing public art) to active (playing on the swing set or using the tennis backboard). These recreation uses are not dependent on a secluded park setting, and the park is adjacent to a major roadway in a highly active urban area. As such, Alternative A1 would not affect activities involving passive park use or playground use. The tennis backboard court could continue to be functional even with a smaller court area, so there would be negligible change to that use and to all other areas of the park.

- **Terwilliger Parkway.** One open space parcel that is connected to Terwilliger Parkway and that appears to be managed as part of it would have a partial acquisition of approximately 0.06 acre along SW Barbur Boulevard to accommodate widening. The parcel consists of compacted gravel in the area of acquisition, so no long-term vegetation removal or removal of recreation resources would occur.

  Direct long-term impacts to Terwilliger Parkway near Oregon Health & Science University (OHSU) for pedestrian access are discussed in the Marquam Hill connection options section, below.

- **George Himes Natural Area Park.** Alternative A1 would impact a strip along two parcels that make up George Himes Natural Area Park because of the need to widen beyond the existing edge of SW Barbur Boulevard and to replace the Newbury trestle bridge. The widening of SW Barbur Boulevard might also remove trees and vegetation in the vicinity of the roadway.

  SW Trail #3, which shares a pedestrian route with the planned Red Electric Regional Trail, is identified as part of a network of trails in southwest Portland. There would be no direct long-term impact to SW Trail #3 and, after construction ends, the trail connection to John's Landing would be available.

  The bicycle route planned for the Red Electric Regional Trail would traverse the south side of the ravine near the Newbury trestle bridge. If it is constructed before the Southwest Corridor Light Rail Project, this section of the bicycle trail is anticipated to have no direct long-term impact, and after construction ends, the trail connection would be available.

Views of the light rail infrastructure on SW Barbur Boulevard would be very limited for users in George Himes Natural Area Park. Users would see only glimpses of light rail features above the roadway while approaching the bridge undercrossing directly. The majority of the experience of using the trails within the park would be unchanged, and no access changes would occur with Alternative A1.

Alternative A2-BH: Naito with Bridgehead Reconfiguration and Alternative A2-LA: Naito with Limited Access

Alternatives A2-BH and A2-LA share many of the same impacts to parks because their alignments, stations and major features are similar. Their differences are mostly a result of design variations related to the Ross Island Bridge and the reconstruction of SW Naito Parkway; for that reason, their parks impacts are discussed together.

- **Water and Gibbs Community Garden.** Both alignment alternatives would widen SW Naito Parkway at the location of the Water and Gibbs Community Garden. Under Alternative A2-BH, the western 55 feet of the garden and the northern 15 feet of the garden would be converted into permanent sidewalk and roadway area. This action would remove mature trees along the sidewalk that provide shade for portions of the garden plots and would fully or partially displace approximately nine garden plots. Alternative A2-LA would have a slightly different alignment, but would have approximately the same long-term direct impacts. The garden is located on property that is part of City of Portland transportation right of way.

  Garden users would have direct views of light rail infrastructure and the Gibbs Naito Station that would be in the center of SW Naito Parkway. The garden is located in a highly urbanized area near downtown Portland and is under the path of the Portland Aerial Tram. Still, some garden users would be more aware of the increased proximity of transportation infrastructure and operations to the garden. Neither of these two alignment alternatives would change access from SW Naito Parkway to the community garden, which is currently limited to right-in, right-out access from northbound traffic.

- **Front and Curry Community Garden.** For both Alternative A2-BH and Alternative A2-LA, SW Naito Parkway would be widened adjacent to the Front and Curry Community Garden. Alternative A2-BH would impact the eastern 5 feet and the northern 15 feet of the garden area, removing mature trees that offer shading and a buffer from SW Naito Parkway. Alternative A2-LA would impact the northern 15 feet of the garden on the western half of the site. Both alignment alternatives would displace two garden plots.

  Garden users would have direct views of light rail infrastructure in the center of SW Naito Parkway. As with the Water and Gibbs Community Garden, the Front and Curry Community Garden is in an active urban area, but the transportation facility would be prominent. Alternatives A2-BH and A2-LA would not change access from SW Naito Parkway to the community garden, which is currently limited to right-in, right-out access from southbound traffic.

- **Terwilliger Parkway.** Impacts to Terwilliger Parkway on the southern end of both Alternative A2-BH and Alternative A2-LA are the same as those for Alternative A1 and are discussed above.

- **George Himes Natural Area Park.** Impacts to George Himes Natural Area Park are the same as those for Alternative A1 and are discussed above.

Marquam Hill Connection Options

There are four options for the connection between SW Barbur Boulevard and Marquam Hill:

- Connection 1A: Elevator/Bridge and Path
- Connection 1B: Elevator/Bridge and Recessed Path
- Connection 1C: Elevator/Bridge and Tunnel
- Connection 2: Full Tunnel

Connections 1A and 1B would have very similar direct long-term impacts; Connection 1A would impact approximately 0.68 acre of Terwilliger Parkway and Connection 1B would impact approximately 0.88 acre of parkway. Connections 1A and 1B would have a direct long-term impact along approximately 450 feet of currently undisturbed forested area between SW Terwilliger Boulevard and SW Barbur Boulevard, and approximately 50 feet of moderately disturbed area between SW Terwilliger Boulevard and the OHSU campus property. Developed recreation resources along the parkway in this area consist of a paved walking trail and bicycle lanes on the east side of SW Terwilliger Boulevard.

Connections 1C and 2 would affect a similar area within Terwilliger Parkway totaling 1.19 acres, but because they incorporate a tunnel, long-term impacts to the natural setting in the area would be less than with Connections 1A and 1B, assuming that replanting and natural cover would be placed over the tunnel area.

All of the Marquam Hill connection options would remove mature trees and shrubs, which also provide ecosystems functions. These impacts are discussed in Section 4.9, Ecosystems. For recreation use, the removal of trees and shrubs would change the appearance of this part of the hillside from the paved trail. The recreation impact would be negligible, because many acres of forested parkway would remain unchanged and largely inaccessible for public use, similar to existing conditions.

Developing the Marquam Hill connection options with above-ground components would alter the setting of the parkway in this area. Currently the slope below Terwilliger Parkway is forested, with limited visible development. With the connection options, developed infrastructure would displace the mature vegetation. However, because the OHSU campus is directly uphill of Terwilliger Parkway here and is the dominant feature experienced by parkway users in this location, the change to the setting would be localized and reduced by the existing presence of large buildings and transportation infrastructure.

Segment B: Outer Portland

Many of the impacts in Segment B are the same for all of the alignment alternatives, but are described for the first alternative where they occur, and then referenced in the following alternatives. The locations of these parks are illustrated on Figure 4.7-2.

Alternative B1: Barbur

- **Fulton Park, Community Garden and Community Center.** The western end of Fulton Park is entirely developed with community garden plots. The widening of SW Barbur Boulevard at this location would impact the community garden, because the northern 15 feet of the property all along the northern boundary would be incorporated into the widened facility. This would eliminate

parts of four garden plots and remove mature trees along the sidewalk. The trees buffer the garden from the roadway. The Metro Home Composting Demonstration Garden is located approximately 20 feet to the east of the area that would be impacted. This garden is currently visually separated from the roadway by vegetation, but would still be functional without the visual buffer.

Similarly, the light rail infrastructure in the center of SW Barbur Boulevard would be visible to garden users toward the top of the hill near the roadway, but this would likely not affect garden users.

- **Markham Elementary School Grounds.** Alternative B1 would widen SW Barbur Boulevard at the Markham Elementary School grounds, impacting about 12 feet along the eastern boundary of the school grounds. The school grounds are elevated above SW Barbur Boulevard. The widening would remove mature trees along SW Barbur Boulevard but would not remove any developed play structures. The roadway would then be within 12 feet of a baseball diamond. Ballfield users on the west side of the field would see parts of the light rail infrastructure, but the recreation uses within the grounds are active and do not depend on a secluded environment.
- **Sylvania Natural Area Park.** The walking and biking improvements to SW 53rd Avenue, which are included in all Segment B alignment alternatives, would remove a narrow strip of vegetation, potentially including mature trees, along the western edge of Sylvania Natural Area Park. This vegetation, though not within park property, functions as the edge of the park. The roadway improvements would create a more formal edge to the park, but would still be within the existing street right of way and would not impact park property. SW Trail #7 uses the SW 53rd Avenue right of way from SW Buddington Street to SW Vacuna Street; after completion of the project, the trail would be on an improved roadway.

Alternative B2: I-5 Barbur Transit Center (TC) to 60th Alternative, B3: I-5 26th to 60th and Alternative B4: I-5 Custer to 60th

See Alternative B1 for impacts to Fulton Park recreation resources and Sylvania Natural Area Park.

Segment C: Tigard and Tualatin

The City of Tigard is planning to develop trails, two neighborhood parks, plazas and pathways in the Tigard Triangle; however, except for having general plans for the future Red Rock Creek greenway and trail area, the city has not yet sited these other planned facilities. As the Southwest Corridor Light Rail Project develops, TriMet, Metro and the City of Tigard will continue to coordinate their planning to support the goals of the *Tigard Triangle Strategic Plan* for the Tigard Triangle. All of the Segment C alignment alternatives would need to acquire properties in the Tigard Triangle area, because they would either expand existing street rights of way or they would traverse a mix of developed and undeveloped parcels. Areas acquired and permanently occupied by the project would no longer be available to become future parks, but property that is not permanently needed could later be available for development as parks.

Existing City of Tigard parks are illustrated on Figure 4.7-3.

Alternative C1: Ash to I-5, Alternative C2: Ash to Railroad (Initial Route Proposal), Alternative C3: Clinton to I-5 and *Alternative C4: Clinton to Railroad*

Alternatives C1, C2, C3 and C4 would not have impacts to existing parks facilities. However, Alternatives C3 and C4 would cross Red Rock Creek, which is not currently a designated park and recreation facility but is named in the City of Tigard's plans as the focus of a future greenway.

Alternatives C1, C2, C3 and C4 would be located to the northeast of Fields Natural Area across six sets of heavy railroad tracks. The light rail infrastructure would be visible to future natural area users.

Alternative C5: Ash and I-5 Branched and Alternative C6: Wall and I-5 Branched

Alternatives C5 and C6 would be similar to Alternatives C1 and C2, with no effects on existing parks facilities or to the Red Rock Creek area.

In downtown Tigard, Alternative C6 would widen and rebuild SW Wall Street with light rail in the roadway median. No impacts to the Potso Dog Park property to the west are anticipated. The alignment alternative includes new sidewalks and landscaping along SW Wall Street, which would improve the area adjacent to the park. The light rail infrastructure would be visible from the park, but the park is in an industrial area, and its functions and values do not depend on a secluded natural setting. The existing driveway at the south end of the park would be restricted to right-in, right-out only, but there would be new intersections nearby that would allow vehicles to turn around if needed.

Alternatives C5 and C6 would each intersect with the approved extension of the Regional Multimodal Trail that would pass through the Triangle Pointe property to SW 70th Avenue, just south of NW Hampton Street. The light rail infrastructure would be visible from this part of the trail.

Operations and Maintenance (O&M) Facilities Options

There are no parks and recreation impacts related to the sites proposed for the maintenance facilities. The Hunziker Facility would be a half block west of the Potso Dog Park, on an existing industrial site that is separated from the park by another parcel.

Portland Community College (PCC) Sylvania Campus (PCC-Sylvania) Shuttle Options

The 53rd Shuttle would add small shuttle buses on SW 53rd Avenue adjacent to Sylvania Natural Area Park but would have a negligible impact on park users, because the interior of the park is densely forested. Users cannot see the streets on any side of the park except when very close to the trail entrances, so visibility of the shuttle buses would be limited. SW Trail #7 uses the SW 53rd Avenue right of way from SW Buddington Street to SW Vacuna Street; with the 53rd Shuttle, small shuttle buses would be visible from this portion of the trail.

Station Access Improvement Options – All Segments

The station access improvements in all segments include improved or new sidewalks, bicycle lanes and road crossings (see Appendix A, Figures A-30 to A-32). Where these improvements would be adjacent to park and recreation sites, they would improve access to those sites both to and from the light rail alignment. The following station access improvement options would be adjacent to parks or recreation

sites, and would have minimal to no physical impacts that would alter their primary features or functions:

- Hamilton Sidewalks and Bikeway would improve facilities in a section of Terwilliger Parkway to provide access to the Hamilton Station.
- Custer Walk/Bike Bridge over I-5 at SW 13th Avenue would cross a small area of Burlingame Park property and provide access to the Custer Station from east of I-5.
- Capitol Sidewalks and Bikeway would pass Custer Park and Stephens Creek Nature Park, providing access to the Custer Station.
- Spring Garden and Dolph Sidewalks and Bikeway would pass by Capitol Hill Elementary School and Spring Garden Park, providing access to the Spring Garden Station.
- Hall Sidewalks would pass through Fanno Creek Park on developed right of way and pass by Jim Griffith Memorial Skate Park, providing access to the Tigard Transit Center.
- Lower Boones Ferry and Boones Ferry Walk/Bike Improvements would pass through Tualatin River Greenway on existing developed right of way, providing access to the Bridgeport Station.

4.7.3. Short-Term Impacts

Access to parks and recreation sites near construction activities could be affected by detours and street closures, and by increased congestion caused by construction traffic. Visual impacts, light, glare, dust and noise could also affect users in some of the parks, although most of these impacts would affect small portions of the parks closest to the light rail infrastructure. Visual and noise impacts would be temporary and would not inhibit park use.

The parks and recreation facilities with direct long-term impacts from one or more of the alignment alternatives (Duniway Park, Lair Hill Park, Fulton Park and Community Garden, Water and Gibbs and Front and Curry Community Gardens, Terwilliger Parkway and Sylvania Natural Area Park) could have areas that are temporarily affected to allow construction access, staging, utility relocation or other construction activities.

Duniway Park's limited parking spaces would be temporarily impacted and could be unavailable during project construction.

The construction footprint of the project in Lair Hill Park would directly impact the western end of the tennis backboard court area. Construction would also be directly adjacent to the 1918 building at the southern end of the site. (The park and the building are also discussed in Section 4.6, Historic and Archaeological Resources.)

Construction to widen SW Barbur Boulevard and replace the Newbury trestle bridge would temporarily close SW Trail #3 below the Newbury trestle bridge. The planned Red Electric Regional Trail bicycle route traversing the south side of the ravine would also be temporarily closed during construction.

The forested, steeply sloping area of Terwilliger Parkway across from SW Campus Drive would be impacted by construction activities to develop any of the Marquam Hill connection options. Heavy construction equipment vehicles, including cranes, would be required within the parkway to excavate

and grade the soil and construct the facility. Areas disturbed by construction would be revegetated as necessary.

Portland Parks and Recreation property adjacent to SW Barbur Boulevard and generally considered part of Terwilliger Parkway was acquired with an LWCF grant, and is identified as being one of the parcels needed for a temporary construction access easement. This parcel does not contain any developed recreation resources or public access features. Vegetation removal, including shrubs and trees, might be necessary for construction, and this vegetation could be replaced at the end of construction.

4.7.4. Potential Mitigation Measures

Long-Term Impacts Mitigation

TriMet and Metro developed design refinements (see Appendix E) that avoid or minimize impacts to the resources discussed in this section. Specifically, Refinement 1: Barbur Woods East-Side Running would minimize vegetation removal along the west side of SW Barbur Boulevard on Terwilliger Parkway and at George Himes Natural Area Park. Potential mitigation measures related to Section 4(f) and LWCF resources will be determined and agreed upon prior to the Final EIS.

TriMet and Metro are coordinating with Portland Parks and Recreation and the City of Tigard for project features and appropriate mitigation measures to reduce impacts to the parks and recreation properties. Where long-term impacts to parks or recreation lands are unavoidable, TriMet would work with the park owner to determine appropriate compensation or other agreements needed to allow use of the land for the project.

Removal of mature trees and shrubs would be quantified at the time of development permit review, and appropriate mitigation would be provided.

Short-Term Impacts Mitigation

Similar to long-term mitigation, short-term mitigation measures would be closely coordinated with park owners. Mitigation measures could include providing detour routes around construction areas and temporarily modifying access points to maintain access to park resources where possible. Construction duration around park facilities would be minimized to the extent possible, and the park facilities would be restored to the same condition as or better condition than before the project started.

4.8. Geology, Soils and Hydrogeology

This section describes the existing geology, soils and hydrogeologic conditions that could affect or be affected by the Southwest Corridor Light Rail Project, including geology, soils, groundwater, and earthquakes and other geologic hazards.

4.8.1. Affected Environment

The study area for geology, soils and hydrogeology is any contiguous set of conditions that are adjacent to the edge of construction. The scale differs depending on the resource being discussed. For example, steep slopes are generally right next to where construction occurs, but groundwater can be a large area underneath the project that could be impacted.

Geology and Soils

The entire region has an underlying mix of volcanic and sedimentary rocks and alluvium (sediments deposited by flowing water). Soils have formed on top of these materials. The slopes south of downtown Portland and along SW Barbur Boulevard contain basalt formations. Mount Sylvania, an extinct volcanic vent, lies within the corridor.

From downtown Portland and the South Waterfront to Tigard and Tualatin, there are areas underlain by catastrophic flood deposits (alluvium) of the Missoula Floods. Some areas near downtown Portland and along the major highways and roadways have artificial fill sitting on top of the ancient alluvial soils. More recently, smaller streams have created additional alluvial deposits.

Many of the original soils within the study area have been removed or modified by cut, fill and grading associated with land development, and are classified as urban land. Where soils within the study area are undisturbed, they consist of loam to silt clay loam. There are no existing commercial soil, aggregate or rock resources within the study area.

Groundwater Resources

The study area straddles both the Portland and Tualatin sub-basins, which are largely separated by the Tualatin Mountains and hills. The groundwater is shallow in some areas close to the Willamette River in the vicinity of the South Waterfront (Portland Sub-basin) and in the area of downtown Tigard (Tualatin Sub-basin), where groundwater has been encountered at less than 5 feet below ground. Groundwater depths of more than 200 feet below ground have been found near Marquam Hill and the other west hills of Portland. There are no sole-source aquifers within the study area. Groundwater is recharged to subsurface layers through infiltration.

Seismic Hazards

The study area is in a seismically active region, largely related to the North American continental plate converging with the Juan de Fuca oceanic crustal plate approximately 100 miles off the Pacific coast. The resulting fault zones generally trend northwest. There are several crustal faults within or near the project area that are potentially active and could present a seismic hazard. These faults include the East Bank Fault, the Portland Hills Fault, the Oatfield Fault and the Lake Oswego Fault, and are considered potential sources for an earthquake that could cause severe ground shaking in the project area.

Landslides and Steep Slopes

Landslide and rock fall hazard areas occur due to slope, local geology and soil conditions; precipitation and groundwater flow; freeze/thaw cycles; seismic events; and human activity. Historic landslides mapped in the study area include the slopes of hills along SW Barbur Boulevard (see Appendix B4.8). The original construction of SW Barbur Boulevard contributed to a number of historical landslides. Marquam Hill and the other west hills of Portland along SW Terwilliger Boulevard and SW Barbur Boulevard comprise the majority of steep slopes (over 25 percent slope) in the study area. Steep slopes are more prone to erosion and have higher landslide and rock fall risks, and require special treatment to stabilize them if they are altered by project activities.

Hazardous Soil Properties

Corrosive soils and hydric soils can be hazards to development and infrastructure projects. Soils with particular textures, and pH and salt contents can be corrosive to both concrete and uncoated steel. The northern portion of the study area, west of SW Barbur Boulevard, contains some soils that can be corrosive (see Appendix B4.8).

Hydric soils are soils that have formed in water-saturated conditions and often are located in areas where groundwater is close to the surface. These soils lead to standing water and are generally limiting for construction purposes. In the study area, hydric soils are found primarily in downtown Tigard and the Tigard Triangle, with discrete zones from Tigard south to Bridgeport Village (see Appendix B4.8).

4.8.2. Long-Term Impacts

Long-term impacts are effects that might occur after construction of the Southwest Corridor Light Rail Project is complete. These impacts could affect the study area and the surrounding areas, as well as extend region-wide.

No-Build Alternative

Under the No-Build Alternative, the light rail alternatives would not be constructed; consequently, there would be no direct impacts to soils, geologic or hydrogeologic conditions.

Light Rail Alternatives

Proposed light rail and O&M facilities options for the project generally would traverse highly urbanized land. Long-term effects on soils, geologic and hydrogeologic conditions would be limited. The light rail alternatives would:

- change localized topography and drainage patterns, which could affect existing landslide-prone areas and areas with unstable slopes
- cause minor settlement near surface features
- encounter corrosive soils that could compromise concrete and steel structures.

There are no appreciable differences among the various alignment alternatives for the project, the various design and connection options, or the O&M facility locations.

4.8.3. Short-Term Impacts

No-Build Alternative

Under the No-Build Alternative, the light rail alternatives would not be constructed, and there would be no impacts to soils, geologic or hydrogeologic resource conditions.

Light Rail Alternatives

During construction of the project, the following potential short-term effects might occur:

- wind or water erosion of soils within the construction area
- degradation of shallow groundwater quality from construction activities

- lowered groundwater levels due to dewatering (changing the direction of groundwater flow), along with potential localized ground settling
- increased landslide risk due to destabilization of steep slopes or reactivation of historic landslides.

Because these conditions are general throughout the study area, there are no appreciable differences among the various alternatives and options for the project, although there are differences between segments. Increases to landslide risks are more applicable to the Segment A alignment alternatives and the Marquam Hill connection options, particularly in the vicinity of SW Barbur Boulevard between SW Hamilton Street and Fulton Park. Impacts to shallow groundwater are more likely with the Segment C alignment alternatives and the O&M facility.

4.8.4. Potential Mitigation Measures

Long-Term Mitigation

The potential long-term impacts identified in Section 4.8.2 can all be mitigated through design in accordance with engineering standards and applicable regulations. The Southwest Corridor Light Rail Project already assumes that best management practices and standard geotechnical engineering practices would address site-specific geologic conditions and related risks and hazards. TriMet will meet applicable design and construction codes for transportation projects. No additional mitigation measures for long-term impacts are proposed.

Short-Term Mitigation

Project-specific mitigation measures will be considered in subsequent geotechnical evaluations for the project. In specific cases where geologic hazards are not avoidable in the study area, the impacts of these hazards would be mitigated through the use of appropriate engineering controls and practices. These hazards and possible mitigation measures are described below.

- **Erosion.** Potential erosion by wind and water would be mitigated by minimizing areas cleared of vegetation, providing temporary cover or mulch for exposed soil stockpiles, and using erosion control blankets or mulch on exposed slopes.
- **Slope stability.** In areas of steep slopes and historical landslides or rock falls, affected slopes would be evaluated and designed for adequate stabilization using best management practices, including limited slope inclination, retaining structures and reinforcement, and limitations on loads.
- **Settlement.** In areas where increased loads from new embankments and soil stockpiles might cause settlement, areas of soft soils would be identified and avoided. In areas where dewatering might be necessary, the settlement of associated soils would be mitigated by restricting dewatering to localized areas, using sheet piles to restrict flow and reinjecting groundwater. Surcharging soils could also be considered to mitigate settlement.
- **Groundwater quality.** Best management practices for the protection of water quality in areas of shallow groundwater would include containing and controlling waste and hazardous materials on-site, and confining maintenance and refueling activities to areas where open excavations would not be impacted.

4.9. Ecosystems

This section describes aquatic habitat and species, vegetation and wildlife species and habitat, wetlands, and other biological resources that could affect or be affected by the Southwest Corridor Light Rail Project. Many of these resources are subject to federal, state and local regulations that will shape how impacts and potential mitigation measures are characterized.

The *Ecosystems Results Report* (Attachment D) contains additional background details on both the affected environment and the impacts.

4.9.1. Affected Environment

The boundaries of the study area for ecosystems for direct effects extend 50 feet from the edge of construction for the light rail alternatives. This study area includes rivers, streams, wetlands, floodplains, vegetation and riparian corridor functions that intersect with the study area boundary.

An expanded analysis area addresses indirect, downstream impacts to fish related to stormwater quality and hydrologic modifications. These fish include those listed under the federal Endangered Species Act (ESA) and the Magnuson-Stevens Fishery Conservation and Management Act. During ESA consultation, an analysis area known as an "action area" will be considered that extends to the ocean because of these indirect effects on these species. The study area for conducting an inventory for wildlife species is 0.25 mile from the edge of construction.

Much of the study area is along existing transportation corridors with adjacent urbanized land uses. These land uses include commercial and residential buildings, schools, roads, sidewalks, railways and other infrastructure. The remainder of the study area consists of forested lands and undeveloped areas adjacent to the northern portion of SW Barbur Boulevard and within road and railway rights of way. Specific habitats and ecosystem resources that exist in the study area are described below.

Aquatic Habitat and Species

The aquatic environment is analyzed at the subwatershed level, which is the finest detail mapped in the project area. The project crosses the following four subwatersheds (6th-field hydrologic unit code):

- Willamette River subwatershed
- Oswego Creek-Willamette River subwatershed
- Fanno Creek subwatershed
- Saum Creek-Tualatin River subwatershed

The light rail alternatives cross a total of 24 streams within Segments A, B and C. Based on mapping (see Figures 4.9-1 to 4.9-3), 20 of these streams currently flow under the proposed alignments in pipes or culverts, while the others flow on the surface. Streams that run through pipes or culverts have been previously impacted by development and are largely paved over within the study area. Minimal natural habitat associated with these streams is present within the study area. The stream locally known as Red Rock Creek is the largest stream that flows mainly on the surface in the study area. Another six streams flow partially on the surface and partially through pipes or culverts in the study area.

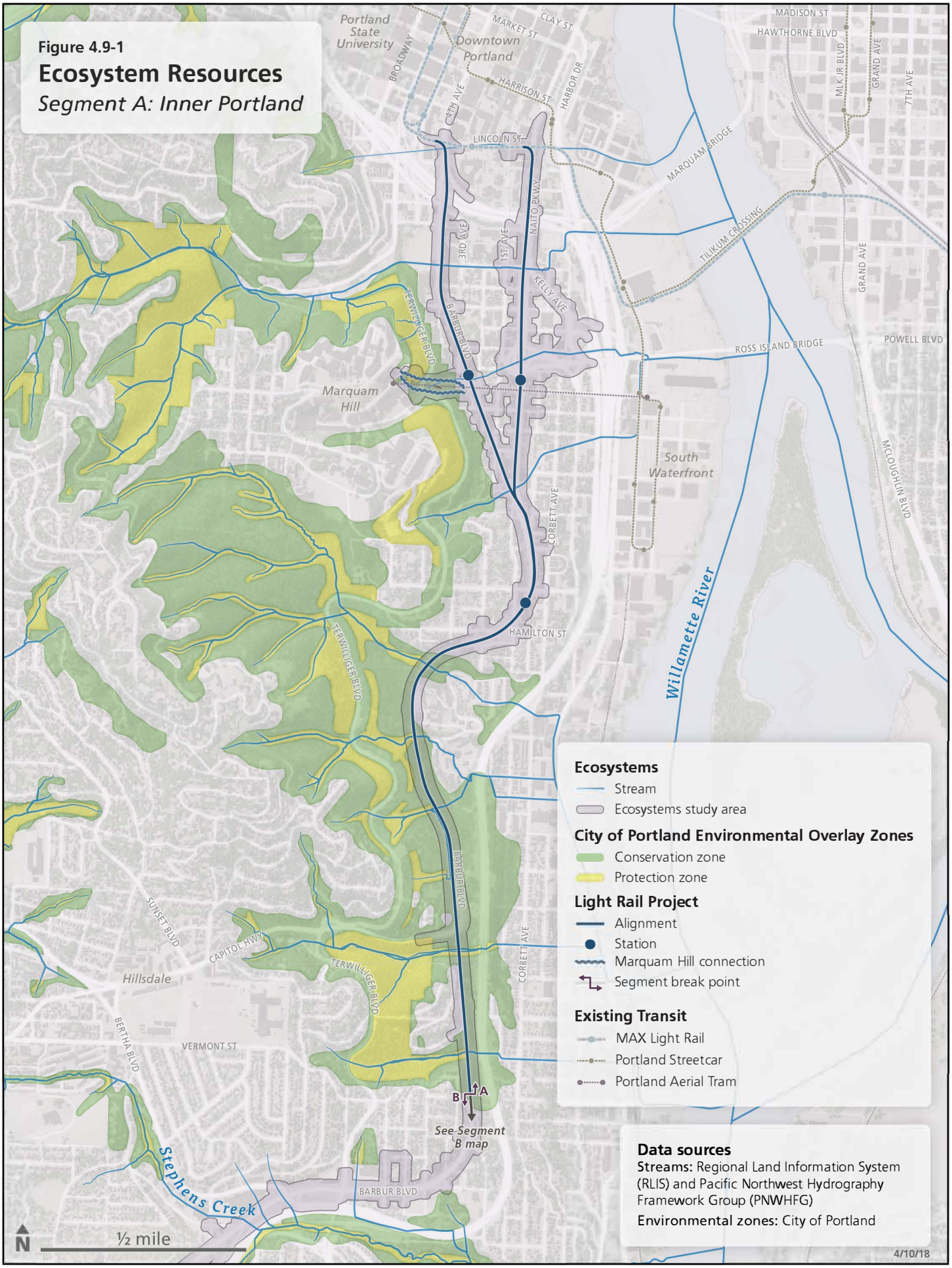


Figure 4.9-1
Ecosystem Resources
Segment A: Inner Portland
Portland State University
Downtown Portland
Marquam Hill
South Waterfront
Hillsdale
Willamette River
Stephens Creek
BROADWAY
MARKET ST
CLAY ST
HARRISON ST
HARBOR DR
12TH AVE
LINCOLN ST
MADISON ST
HAWTHORNE BLVD
MLK JR BLVD
GRAND AVE
7TH AVE
MARQUAM BRIDGE
TILIKUM CROSSING
NAITO PKWY
3RD AVE
1ST AVE
KELLY AVE
TERWILLIGER BLVD
BARBUR BLVD
ROSS ISLAND BRIDGE
POWELL BLVD
MCLOUGHLIN BLVD
CORBETT AVE
HAMILTON ST
SUNSET BLVD
CAPITOL HWY
BERTHA BLVD
VERMONT ST
B
A
See Segment B map
Ecosystems
Stream
Ecosystems study area
City of Portland Environmental Overlay Zones
Conservation zone
Protection zone
Light Rail Project
Alignment
Station
Marquam Hill connection
Segment break point
Existing Transit
MAX Light Rail
Portland Streetcar
Portland Aerial Tram
Data sources
Streams: Regional Land Information System (RLIS) and Pacific Northwest Hydrography Framework Group (PNWHFG)
Environmental zones: City of Portland
N
½ mile
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Figure 4.9-2

Ecosystem Resources

Segment B: Outer Portland

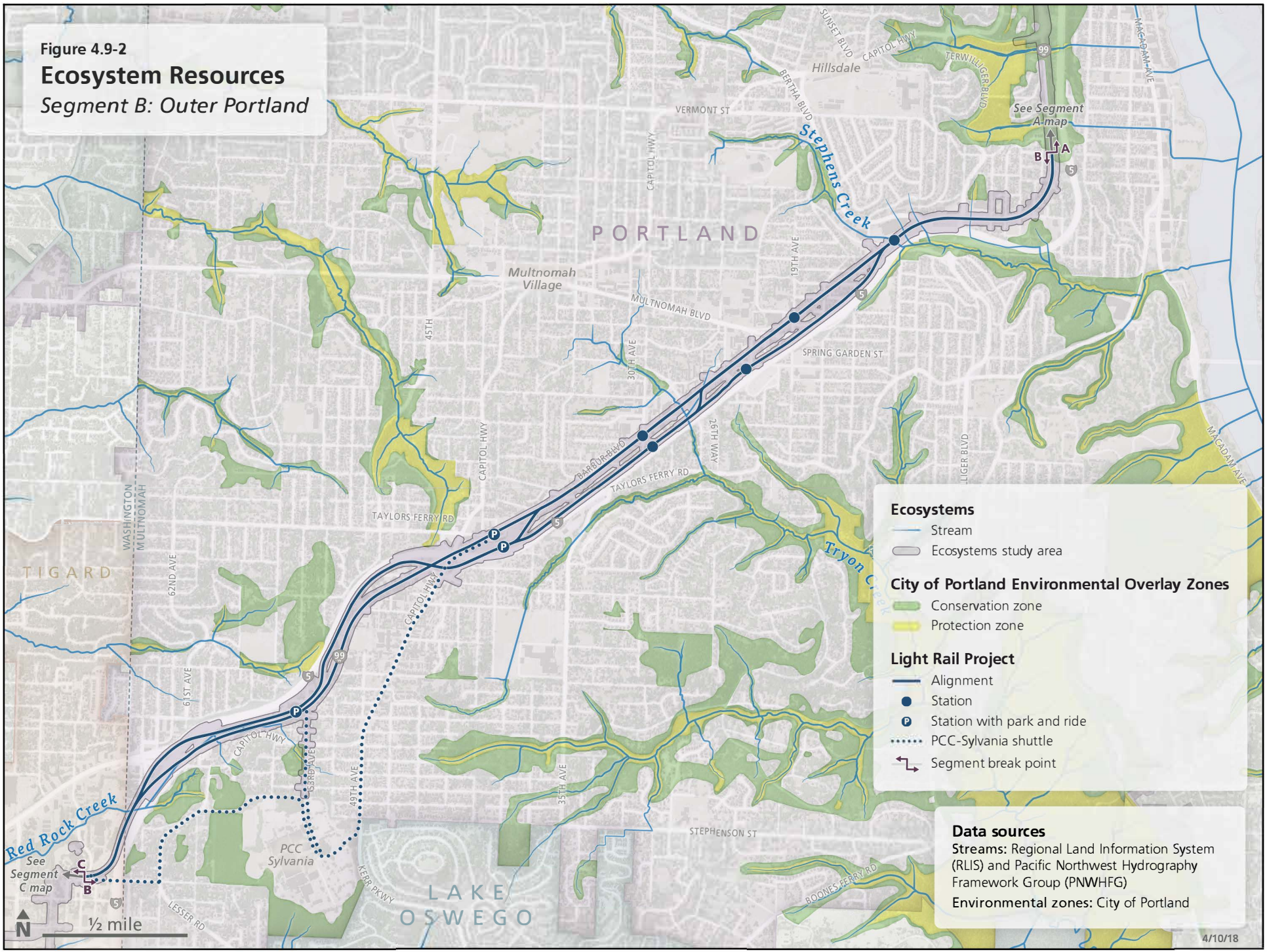
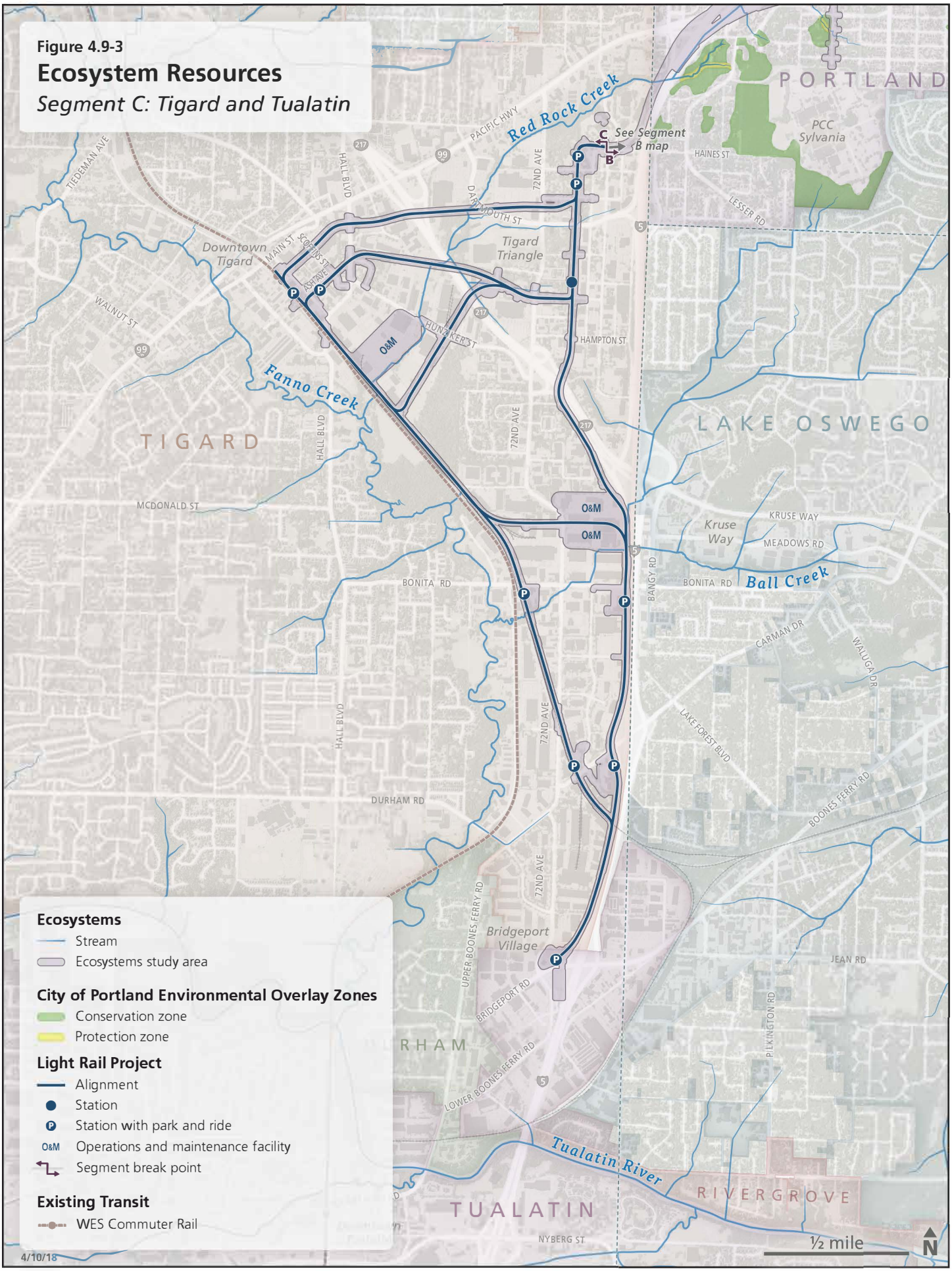


Figure 4.9-3

Ecosystem Resources

Segment C: Tigard and Tualatin



Several databases were queried for potential species presence in the study area, including the Oregon Biodiversity Information Center (ORBIC) database; publicly available data from the United States Fish and Wildlife Service (USFWS) Information, Planning, and Consultation System (IPaC); USFWS county lists; and the Oregon Department of Fish and Wildlife (ODFW) Centralized Oregon Mapping Products and Analysis Support System (COMPASS). The database searches revealed the potential presence within the expanded analysis area, but not within the study area for direct effects, of eight species of fish listed under the federal or state ESA or as federal species of concern or state sensitive:

- **Green sturgeon** (*Acipenser medirostris*)**.** Federal listed threatened; critical habitat designated; state sensitive-critical
- **Pacific lamprey** (*Entosphenus tridentata*)**.** Federal species of concern; state sensitive
- **Coastal cutthroat trout** (*Oncorhynchus clarki*)**.** State sensitive
- **Chum salmon** (*Oncorhynchus keta*)**.** Federal listed threatened; critical habitat designated; state sensitive-critical
- **Coho salmon** (*Oncorhynchus kisutch*)**.** Federal listed threatened; critical habitat designated; state listed endangered
- **Steelhead** (*Oncorhynchus mykiss*)**.** Federal listed threatened; critical habitat designated; state sensitive-critical or sensitive (depending on population)
- **Chinook salmon** (*Oncorhynchus tshawytscha*)**.** Federal listed threatened; critical habitat designated; state sensitive-critical, sensitive or threatened (depending on population)
- **Pacific eulachon** (*Thaleichthys pacificus*). Federal listed threatened; critical habitat designated

Because of fish passage barriers, none of these fish species or other resident or migratory fish are likely to occur in streams within the study area; however, these streams flow into water bodies where there are suitable anadromous and resident fish habitat and occurrence. Further investigations will occur to confirm these assumptions.

ESA consultation will occur after the Preferred Alternative is selected and be completed prior to publishing the Final EIS. ESA consultation will address fish species that utilize the lower Columbia River for migration and rearing, including those species originating in the Upper Willamette River, Snake River, Upper Columbia River and Middle Columbia River sub-basins, because of the potential effects of stormwater runoff from the project.

Potential impacts to floodplains can also affect aquatic habitats and fish. There are no 100-year floodplains mapped within Segments A or B in the study area, but they are present in Segment C. Section 4.10, Water Resources, addresses floodplains in greater detail.

Additional detail on the potential for impacts on water resources, including floodplains and water quality, is included in Section 4.10, Water Resources.

Vegetation and Wildlife Species and Habitat

Database searches for threatened, endangered or sensitive terrestrial species revealed the presence of 8 species of plants, 14 species of birds, 5 mammals, 2 reptiles, 1 amphibian, 1 insect and 1 mollusk

potentially occurring within or near the study area. As with the other database queries, not all of the species identified in the databases are likely to occur within the ecosystems study area.

The presence of wildlife or plant species listed as threatened or endangered under the federal ESA within Segments A and B is not likely. A few state-sensitive bird and mammal species could inhabit the forested areas along SW Barbur Boulevard. The presence of wildlife species listed as threatened or endangered under the federal ESA within Segment C is not likely; however, the plant species Nelson's checkermallow could occur in the Knez Wetland (see the discussion in the Wetlands section below). State-sensitive bird, mammal and reptile species, including purple martin, Townsend's big-eared bat and western pond turtle, likely inhabit the vegetated and wetland areas along Red Rock Creek.

Urban areas, which are usually characterized by fragmented, noncontiguous habitats, generally limit the movement of ambulatory wildlife (species that walk or run). In Segments A and B, the City of Portland has mapped environmental overlay zones (E-zones) that are intended to protect environmental resources and functional values providing public benefits during development activities. The E-zones, classified as either conservation or protection zones depending on the level of protection provided in the city development code, are mainly located within forested areas along SW Barbur Boulevard and within adjacent parks and natural areas in Segments A and B, including the Marquam Hill connection options. Segment C is in the cities of Tigard and Tualatin, where the City of Portland E-zone designations do not apply; however, vegetated riparian corridors are designated in Tigard and Tualatin.

Wetlands

Wetlands in the study area were identified using a combination of mappings and databases from a number of sources, as well as with reviews of aerial photography and field visits. Figure 4.9-4 includes the mapped wetlands that are located in Segment C.

Segments A and B contain few mapped wetland resources, ranging from 0.1 acre to 0.2 acre in each segment. Segment C contains by far the greatest amount of wetland resources, which are associated with streams such as Red Rock Creek, Ball Creek and Fanno Creek in level areas near Tigard. The portions of these wetlands near the light rail alternatives are generally surrounded by development.

Historically, the area associated with Red Rock Creek was part of a larger wetland. The historical "Red Rock Creek Wetland" was probably more than 25 acres in size and contained a mix of forested, shrub, emergent and open water wetland types. The construction of Highway 217 severed the wetland into two portions: a 6.7-acre wetland/pond complex on the southwest side of the highway that contains the Knez Wetland and a 15-acre wetland area on the northeast side of the highway. The two wetlands are still hydrologically connected by Red Rock Creek, which passes under the highway in a culvert. Both wetlands are mapped by the National Wetlands Inventory and Regional Land Information System as wetland.

The Knez Wetland, a 1.87-acre site, contains a relatively high-quality, remnant Willamette Valley wet prairie plant community. According to the wetland site's management plan, Knez Building Materials, Inc. donated the property to the City of Tigard in 1992. The Wetlands Conservancy assisted the city in site management, and in 1994 the property was donated to The Wetlands Conservancy by the city (TWC, 2004).

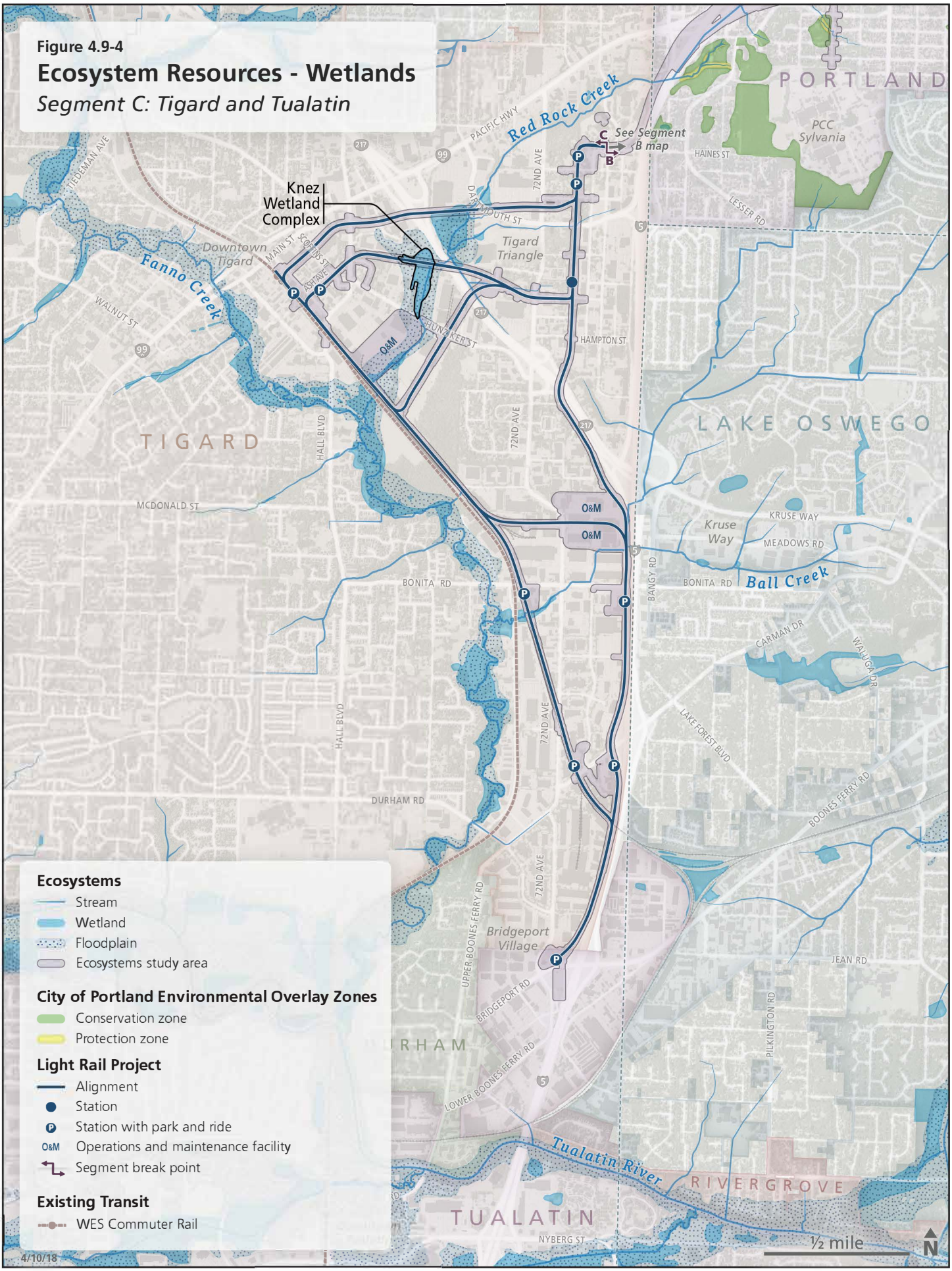


Figure 4.9-4
Ecosystem Resources - Wetlands
Segment C: Tigard and Tualatin
Knez Wetland Complex
See Segment B map
Red Rock Creek
Fanno Creek
Ball Creek
Tualatin River
Downtown Tigard
Tigard Triangle
Kruse Way
Bridgeport Village
PCC Sylvania
PORTLAND
TIGARD
LAKE OSWEGO
TUALATIN
RIVERGROVE
O&M
PACIFIC HWY
72ND AVE
HAMPTON ST
MCDONALD ST
BONITA RD
DURHAM RD
BRIDGEPORT RD
BOONES FERRY RD
LOWER BOONES FERRY RD
UPPER BOONES FERRY RD
HALL BLVD
BANGY RD
KRUSE WAY
MEADOWS RD
CARMAN DR
WALUGA DR
LAKE FOREST BLVD
JEAN RD
PILKINGTON RD
LESSER RD
HAINES ST
NYBERG ST
Ecosystems
Stream
Wetland
Floodplain
Ecosystems study area
City of Portland Environmental Overlay Zones
Conservation zone
Protection zone
Light Rail Project
Alignment
Station
Station with park and ride
Operations and maintenance facility
Segment break point
Existing Transit
WES Commuter Rail
½ mile
N
4/10/18

Red Rock Creek flows south along the eastern edge of the Knez Wetland site and then continues south through a narrow strip of land that ends at SW Hunziker Street. The wetland extends onto adjacent properties to the north, west and east of The Wetlands Conservancy parcel and contains additional wetland prairie, a hydrologically connected 1.3-acre stormwater detention pond and a short unnamed tributary of Red Rock Creek that enters the site from the northwest. The total area of the wetland/pond complex is approximately 6.7 acres, with about 4.4 acres of wetland prairie.

4.9.2. Long-Term Impacts

No-Build Alternative

The No-Build Alternative would not include any of the proposed changes to the transportation system in the corridor. Impacts would be limited to activities and conditions that already exist.

The potential ecosystem impacts from the No-Build Alternative are relatively few. Untreated stormwater runoff would continue to flow from unimproved impervious surfaces that, with the light rail alternatives, would be upgraded; stormwater would continue to flow untreated to project area streams in many locations.

Light Rail Alternatives

The light rail alternatives in Segments A and B are largely in developed areas, and they share similar alignments in locations where they are adjacent to ecosystem resources. The discussions of impacts in Segments A and B below include impacts that apply to all alignment alternatives. In Segment C, different alignment alternatives have different localized effects, and the impacts are discussed by alternative and facility where they differ from one another.

The station access improvement options generally involve localized improvements such as new sidewalks and bicycle lanes and crossings that are primarily adjacent to roadways. Impacts from the station access improvements to contiguous, high-quality ecosystem resources are expected to be relatively few. Upgraded facilities that would be part of these improvements could include stormwater runoff treatment and management, which could provide a net benefit to ecosystems.

Segment A: Inner Portland

- **Aquatic Habitat and Species.** Direct impacts to fish are not anticipated within this segment, because there are no streams that contain fish within the study area. Other aquatic species, such as amphibians and invertebrates, might be affected in those streams that still contain surface connections to other streams.

- **Vegetation and Wildlife Species and Habitat.** Within Segment A, impacts to mapped E-zones are similar between all of the alignment alternatives and Marquam Hill connection options. E-zone conservation area impacts within the study area for all three Segment A alignment alternatives are approximately 31 acres. Impacts to E-zone protection areas within the study area are approximately 2.5 acres for each of the three alignment alternatives. Most of these E-zone area impacts are associated with the forested area along SW Barbur Boulevard.

- **Wetlands.** Approximately 0.1 acre of impacts to mapped wetland areas could occur in Segment A for all of the light rail alignment alternatives. Unmapped, small riverine wetlands are likely found along small unnamed tributaries that lead from forested slopes west of the light rail alternatives, and if they are present, they could slightly increase total wetland impacts. For the Marquam Hill connection options, no wetlands are mapped within the footprints of the connection options. Impacts to smaller, undiscovered wetlands are possible but would be limited. Overall, the level of potential impacts to wetlands in Segment A including Marquam Hill connection options is considered minor (likely less than 0.2 acre).

- **Threatened and Endangered Species.** No threatened or endangered species are likely present within this segment. Impacts to downstream fish from stormwater runoff would be possible; however, increased stormwater treatment could provide a net benefit to water quality in the long term. Sensitive bird and mammal species could inhabit the forested areas along SW Barbur Boulevard. Removal of trees would have a negative impact on these species, but the impact would be minimal in the context of the remaining habitat in the area.

Segment B: Outer Portland

- **Aquatic Habitat and Species.** Direct impacts to fish are not anticipated within this segment, because there are no streams within the study area that contain fish. Other aquatic species, such as amphibians and invertebrates, might be affected in those streams that still contain surface connections to other streams.

- **Vegetation and Wildlife Species and Habitat.** Within Segment B, impacts to mapped E-zones are similar between all four of the alignment alternatives. E-zone conservation area impacts within the study area for all four alignment alternatives total 1.5 acres. Impacts to E-zone protection areas are approximately 1.4 acres. Most of these impacted areas are associated with the forested area along SW Barbur Boulevard.

- **Wetlands.** It is possible that negligible impacts to mapped wetland areas could occur in Segment B, but there are limited amounts of wetlands mapped in this mostly developed segment. A few unmapped, riverine wetlands can likely be found along small unnamed tributaries that lead from forested slopes west of the light rail alternatives, and if they are present, they could slightly increase the impacts to wetlands in Segment B, but such impacts would be minor (likely less than 0.1 acre).

- **Threatened and Endangered Species.** No threatened or endangered species are likely present within this segment, and no impacts are identified. Impacts to fish from stormwater runoff are possible for species using downstream waters; however, increased stormwater treatment could provide a net benefit in the long term. Sensitive bird and mammal species may inhabit the forested areas along SW Barbur Boulevard. Removal of trees would have a negative impact on these species, but the impact would be minimal in the context of the remaining habitat in the area.

Segment C: Tigard and Tualatin

- **Aquatic Habitat and Species.** Direct impacts to fish are not anticipated for the alignment alternatives within this segment, because there are no fish-bearing streams within the study area. Impacts to other aquatic species, including turtles, amphibians and invertebrates, are possible within Red Rock Creek, because potential habitat is present in that stream.

- **Vegetation and Wildlife Species and Habitat.** Tigard has mapped vegetated corridors within the city. The areas do not have specific protection. Impacts to these vegetated corridors in this segment range from approximately 4 to 5 acres within the study areas of all six alignment alternatives. Most of these impacts are associated with the forested areas along Red Rock Creek and Fanno Creek.

  Vegetation at the operations and maintenance (O&M) facilities options is mapped as grass/open area, with no forested vegetation present. The O&M facilities options would be located in an area with existing development, and no direct impacts are anticipated.

- **Wetlands.** Table 4.9-1 shows the impacts to significant and jurisdictional wetlands for the Segment C alignment alternatives. The City of Tigard's local wetland inventory mapping results are used here, because they indicate the highest level of impacts. The direct construction impact and the impact in the 50-foot buffer that makes up the study area are shown separately in the table to illustrate the potential level of direct impacts from construction compared to what was analyzed (the study area). The *Ecosystems Results Report* includes additional calculations of wetland areas that provide more details about these results, as well as the results obtained using wetlands mapped through processes other than the City of Tigard's local wetland inventory mapping. Alternatives C1 and C2 would impact the Knez Wetland; Alternatives C3 and C4 would impact the wetland complex north of Highway 217.

Table 4.9-1. Approximate Area of Impacts to Significant and Jurisdictional Wetlands for Segment C: Tigard and Tualatin, in Acres

Alignment Alternatives and Options	Wetland Impacts (Acres)		
	Construction Footprint	50-Foot Buffer	Total Impact
Segment C: Tigard and Tualatin			
C1: Ash-I-5	1.3	1.6	2.9
C2: Ash-Railroad	1.4	1.8	3.2
C3: Clinton-I-5	1.6	2.0	3.6
C4: Clinton-Railroad	1.6	2.2	3.8
C5: Ash-I-5 Branched	1.3	1.3	2.6
C6: Wall-I-5 Branched	0.4	0.7	1.1
O&M Facilities Options			
Hunziker	0.7	0.7	1.4
Through 72nd	No wetland impacts		
Branched 72nd	No wetland impacts		

- **Threatened and Endangered Species.** No threatened, endangered or sensitive fish or wildlife species are likely present within this segment. One federally listed plant, the Nelson's checkermallow, was noted as being planted within the Knez Wetland as part of a restoration effort. It is unknown whether it is currently present, but the species could be impacted by Alternative C1 or Alternative C2. In addition, potential habitat for Nelson's checkermallow is likely present within the wetland complex north of Highway 217 that would be impacted by Alternatives C3 and C4. Further analysis of these potential impacts will be addressed through federal ESA consultation and coordination with Oregon Department of Fish and Wildlife.

  Impacts to fish from stormwater runoff are possible for species using downstream waters; however, increased stormwater treatment could provide a net benefit in the long term. Additional details related to stormwater runoff for the light rail alternatives are included in the general discussion of long-term impacts above. Sensitive bird, mammal and reptile species, including purple martin, Townsend's big-eared bat and western pond turtle, likely inhabit the vegetated and wetland areas along Red Rock Creek. Removal of trees and modification of wetland and pond areas would have a negative impact on these species, but the impact would be minimal in the context of the remaining habitat in the area.

4.9.3. Short-Term Impacts

Short-term impacts from construction would be similar for all light rail alternatives. Construction of the Southwest Corridor Light Rail Project could result in soil disturbance and compaction and/or soil erosion and tree and other vegetation removal in or adjacent to wetlands and streams. Soil compaction could cause changes in hydrology, and if severe enough, these changes could be permanent. Soil erosion and vegetation removal could cause soils to enter the wetlands and streams, possibly raising turbidity levels and degrading water quality. Any temporary removal of tree and shrub vegetation for construction would also likely result in decreased shading of project area wetlands and potential habitat loss.

In addition, noise, lights and other disturbance from construction could negatively affect breeding, foraging and dispersal of both common and protected terrestrial wildlife that may avoid loud machinery, and migratory birds that may no longer rest or feed near the construction areas. Lights used for night work could disturb nocturnal animals such as owls or bats, or disrupt night-migrating birds. Construction impacts involving the removal of vegetation during the breeding season could destroy nests or eggs and kill birds protected under the federal Migratory Bird Treaty Act.

No appreciable temporary construction effects are anticipated outside of the construction area, primarily because impact minimization measures, pollution control measures, sediment and erosion control, and stormwater management would be implemented. If in-water work in streams that contain fish or other aquatic species occurs, relocation may be necessary, which would result in direct effects to those organisms.

4.9.4. Potential Mitigation Measures

During construction, best management practices would be used to avoid impacts to wetlands, waters and other jurisdictional resources from erosion, spills, damage to vegetation or disruption of hydrology. Standard specifications and special provisions would direct contractors to avoid and minimize impacts.

In addition, standard terms and conditions of approvals from local, state and federal regulatory agencies would be incorporated into the preliminary designs that are analyzed in this Draft EIS. The project team would work collaboratively with local, state and federal permitting agencies to determine appropriate impact avoidance and compensatory mitigation after a preferred alternative is selected.

Compensatory mitigation for direct wetland impacts is regulated by federal, state and local jurisdictions, and would typically require restoring or enhancing degraded wetland areas or establishing new wetlands nearby to compensate for functions lost or degraded by those impacts.

Within Segments A and B, potential compensatory mitigation for wetland impacts could include on-site or off-site enhancement or restoration of existing wetlands, or creation of new wetlands. Sites for the creation of new wetlands would be identified after the selection of a preferred alternative. The selection of these sites would depend on the area needed for mitigation, current and future ownership of potential mitigation sites, and site characteristics. Mitigation sites would be selected based on soil types and topographic position that would increase the likelihood of successful restoration or establishment of wetland conditions. Additionally, mitigation could include daylighting some piped streams if deemed beneficial through the permitting process.

Within Segment C, where wetland impacts could occur, compensatory mitigation could consist of restoration or enhancement of wetlands or purchasing credits through an approved mitigation bank or in-lieu-fee program. In addition, impacts to the existing Knez Wetland could be mitigated through enhancement or restoration of the existing wetland complex, or purchase of adjacent parcels for the benefit of protecting the existing wetland complex.

4.10. Water Resources

This section covers the Southwest Corridor Light Rail Project potential long-term, short-term, indirect and cumulative impacts, and mitigation measures for water resources, which consist of:

- surface waters, including streams, rivers and lakes
- floodplains, based on mappings of the areas affected by a 100-year flood event
- drainage systems, including drainage sub-basins defined for stormwater management, and the related major facilities for managing stormwater, such as outfall locations
- groundwater, including critical aquifer recharge areas, sole-source aquifers and wellhead protection areas.

Wetlands, aquatic habitat and other biological resources are discussed in Section 4.9, Ecosystems.

4.10.1. Affected Environment

The study area for water resources consists of the drainage basins where the light rail alternatives will be located and covers the water resources within those basins, as well as in downstream receiving waters. Figure 4.10-1 shows the applicable water basins, mapped water resources, and the project's alignment alternatives and options.

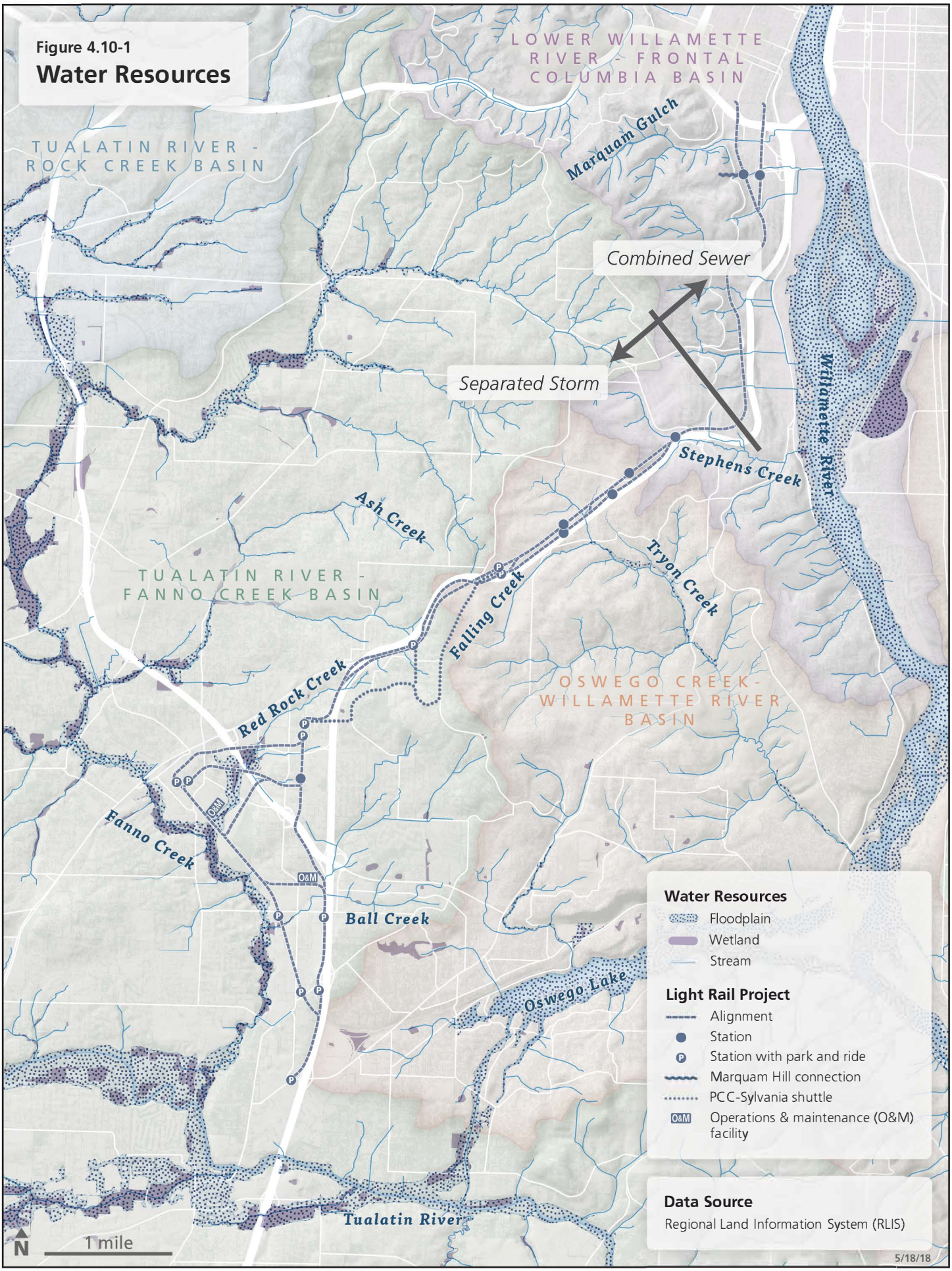


Figure 4.10-1
Water Resources
LOWER WILLAMETTE RIVER - FRONTAL COLUMBIA BASIN
TUALATIN RIVER - ROCK CREEK BASIN
Marquam Gulch
Combined Sewer
Separated Storm
Willamette River
Stephens Creek
Ash Creek
TUALATIN RIVER - FANNO CREEK BASIN
Tryon Creek
Falling Creek
OSWEGO CREEK - WILLAMETTE RIVER BASIN
Red Rock Creek
Fanno Creek
O&M
Ball Creek
Oswego Lake
Tualatin River
N
1 mile
Water Resources
Floodplain
Wetland
Stream
Light Rail Project
Alignment
Station
Station with park and ride
Marquam Hill connection
PCC-Sylvania shuttle
Operations & maintenance (O&M) facility
Data Source
Regional Land Information System (RLIS)
5/18/18

Surface Water and Floodplains

The surface water in the study area discharges to the Willamette River through tributary streams and conveyance system outfalls. In general, the streams in the study area have been affected by the surrounding urban environment, and many of the streams have reaches that are channelized or have been piped.

Stream 1227626454239 (Red Rock Creek) is the only stream that has a Federal Emergency Management Agency (FEMA)-mapped floodplain (the land area adjacent to a stream channel in which flood waters are stored) extending beyond its banks (Metro, 1992) (see Figure 4.10-1). FEMA has conducted technical analyses to delineate the floodway (the part of the stream channel and portion of adjacent land area in which flood waters are conveyed to drain the floodplain) for some streams in the area, but Red Rock Creek was not included in the scope of that analysis. Where no floodway has been mapped by FEMA, a detailed engineering study would be required to determine the base (100-year) flood elevation and floodway boundary. For the purposes of the water resource impact analysis, it is assumed that the Red Rock Creek floodway boundary could potentially extend the entire width of the floodplain. Executive Order 11988 requires federal agencies to avoid supporting development within floodplains wherever there is a practicable alternative. For any development within floodplains or floodways, the City of Tigard requires a detailed engineering study to confirm that no increase in the base-flood elevation would occur. In addition, the City of Tigard has more restrictions regarding the types of development allowed in the floodway, once it is delineated. The City of Portland also regulates floodplains associated with "unidentified watercourses" that drain one or more acres but are not mapped by FEMA. Development within or near these watercourses would require engineering studies to determine base-flood elevations and potential impacts. Streams and associated FEMA floodplains that would be crossed by the proposed light rail alignment alternatives are listed in Table 4.10-1.

Water quality of the surface water resources is evaluated through the Oregon Department of Environmental Quality (DEQ) Water Quality Assessment (the Clean Water Act Section 303(d) list; DEQ, 2016). The 303(d) list designates waters that have beneficial uses—such as drinking, recreation, aquatic habitat and industrial use—but that are impaired by pollution. Limits called Total Maximum Daily Loads (TMDLs) are established for impaired waters to set the maximum amount of a pollutant allowed to enter a waterbody. Impaired waters are those designated as Category 5 (TMDL needed), Category 4A (TMDL approved), Category 4B (TMDL-equivalent plan in place) and Category 4C (cannot be addressed through a TMDL).

In the study area, the streams shown in Table 4.10-1 are listed as impaired. Tables 4.10-2a, b and c show what streams cross within each segment.

Table 4.10-1. 303(d)-Impaired Waterbodies in the Study Area

Oregon Stream ID Number	Stream Name	303(d) List Parameters by Category[1]		
		Category 5	Category 4A	Category 4B
1227618456580	Willamette River	Aldrin Biological Criteria Chlordane Chlorophyll a Copper Cyanide DDE 4,4 DDT 4,4 Dieldrin Hexachlorobenzene Iron Lead Mercury Polychlorinated Biphenyls (PCBs) Polynuclear Aromatic Hydrocarbons (PAHs)	Dioxins *E. coli* Temperature	Pentachlorophenol
1226667454690	Stephens Creek	Biological Criteria	N/A	N/A
1226557454227	Tryon Creek	Biological Criteria Dissolved Oxygen	Temperature	N/A
1226500453377	Tualatin River	Ammonia Biological Criteria Copper Iron Lead Mercury Zinc	Aquatic Weeds Or Algae Chlorophyll a Dissolved Oxygen *E. coli* Phosphorus Temperature	N/A
1227639453931	Fanno Creek	Arsenic Copper Dieldrin Dissolved Oxygen Iron Lead Tetrachloroethylene Thallium Zinc	Biological Criteria Dissolved Oxygen *E. coli* Phosphorus Temperature	N/A

[1] There are no Category 4C waters in the study area.

Table 4.10-2a. Stream Crossings in Segment A: Inner Portland

Stream Crossing Landmark(s)	Oregon Stream ID Number (Name, if any)	Open Channel	Floodplain Beyond Banks	303(d) List	Alignment Alternative		
					A1	A2-BH	A2-LA
Lower Willamette River Watershed – Frontal Columbia Basin							
Duniway Park; SW Arthur St.	1226675455059				●	●	●
Marquam Gulch; SW Grover St.	1226653455017				●	●	●
SW Lane St.	1226714455006				●	●	●
4800 Block SW Barbur Blvd., SW 2nd Ct.	1226780454885				●	●	●
4900 Block SW Barbur Blvd.	1226696454865				●	●	●
5400 Block SW Barbur Blvd. (branched stream)	1226783454858 / 1226817454846				●	●	●
SW Iowa St.	1226690454806 / 1226790454797				●	●	●
SW Vermont St.	1226662454766				●	●	●

Table 4.10-2b. Stream Crossings in Segment B: Outer Portland

Stream Crossing Landmark(s)	Oregon Stream ID Number (Name, if any)	Open Channel	Floodplain Beyond Banks	303(d) List	Alignment Alternative			
					B1	B2	B3	B4
Lower Willamette River Watershed – Frontal Columbia Basin								
SW Terwilliger Blvd.	1226790454686				●	●	●	●
SW Custer St.	1226667454690 (Stephens Creek)			●	●	●	●	●
Lower Willamette River Watershed – Lake Oswego Basin								
SW Spring Garden St.	1227048454606				●	●	●	
SW 26th Way	1226557454227 (Tryon Creek)			●	●	●	●	●
Tualatin River Watershed – Fanno Creek Basin								
SW 57th Ave. (branched stream)	1227355454448 / 1227422454406				●	●	●	●
SW 58th Ct.	1227375454443				●	●	●	●
SW Lesser Way	1227626454239 (Red Rock Creek)				●	●	●	●

Table 4.10-2c. Stream Crossings in Segment C: Tigard and Tualatin

Stream Crossing Landmark(s)	Oregon Stream ID Number (Name, if any)	Open Channel	Floodplain Beyond Banks	303(d) List	Alignment Alternative					
					C1	C2	C3	C4	C5	C6
Tualatin River Watershed – Fanno Creek Basin										
SW Dartmouth St. north of Hwy. 217, Knez Wetland	1227626454239 (Red Rock Creek)	•	•				•	•		
SW Dartmouth St. and SW 70th Ave.	1227575454326	•			•	•			•	•
SW Beveland Rd.	1227562454301				•	•			•	•
Hwy. 217 near SW Beveland Rd.	1227575454314	•			•	•			•	•
SW Ash Ave., Knez Wetland south of Hwy. 217 (branched stream)	1227589454310 / 1227626454239 (Red Rock Creek)	•	•		•	•			•	
Railroad at SE Wall St. [second crossing]	1227626454239 (Red Rock Creek)	•	•		•	•	•	•	•	
SW Tech Center Dr.	1227580454188				•	•	•	•		
SW Meadows Rd. (branched stream)	1227534454137 (Ball Creek) / 1227449454171	•			•		•		•	•
Railroad south of SW Bonita Rd.	1227534454137 (Ball Creek)	•				•		•		

Drainage System

Much of the study area has been developed, and stormwater runoff is collected by piped or ditched municipal systems that discharge to tributary streams. In all of Segment A and the first few miles of Segment B, stormwater runoff is collected by the City of Portland combined sewer system (City of Portland, 2010). This system collects stormwater and municipal sewage, and conveys the mixture to a treatment plant before discharge to the Willamette River. In many combined sewer systems such as this one, heavy rains can increase the risk that the untreated stormwater/sewage mixture will overflow to surface waters before treatment. In the remainder of the study area, stormwater runoff is collected by municipal storm drainage systems that are separated from sewage systems.

Groundwater

The majority of federal and state programs relating to groundwater in Oregon is implemented by four state agencies: Oregon DEQ, the Oregon Department of Human Services Drinking Water Program, the Oregon Water Resources Division (OWRD), and the Oregon Department of Agriculture. Oregon DEQ, the primary agency responsible for groundwater quality protection, has not found elevated pollution concentrations in aquifers in the study area (DEQ, 2017). The U.S. Environmental Protection Agency (EPA) protects aquifers that it identifies as the main supply, or "sole-source," of drinking water for a local population; EPA has not designated any sole-source aquifers in the study area (EPA, 2013).

OWRD and Washington County cooperatively regulate water supply management (groundwater quantity) within the Tualatin, Lake Oswego and Lower Willamette Drainage Basins. Other state and local agencies are responsible for regulating groundwater quantity. Segment C has two groundwater management areas. The Sherwood, Dammasch-Wilsonville Ground Water Limited Area has been designated with special

restrictions in place to help stabilize groundwater levels. The Cooper Mountain-Bull Mountain Critical Ground Water Area has been protected against pumping of groundwater that has historically exceeded the long-term natural replenishment of the underground water reservoir (Washington County, 2017).

4.10.2. Long-Term Impacts

No-Build Alternative

Under the No-Build Alternative, other regional development and transportation projects would occur, which could increase impervious surface area and its related water quality impacts. Without light rail service, traffic and congestion could potentially increase over time and result in increased pollutant loading. Increased traffic and congestion leads to increases in metals, oil and grease on roadways and parking lots. These pollutants subsequently are transported to area streams by stormwater runoff.

Light Rail Alternatives

There are several potential impacts to water resources that have been evaluated for each of the light rail alignment alternatives. These impacts include increases in stream flow that can lead to scour and sedimentation, contamination of runoff that can impact water quality, changes to stream geometry at a crossing that can pinch flows and cause flooding and scour, and changes to floodplain storage that can push floodwaters to adjacent properties. The factors discussed below and summarized in Table 4.10-3 are project components that can potentially result in these types of impacts.

- **Land conversion.** When vegetation is permanently replaced by impervious areas or track sections with ballast, it can affect water quality as well as stormwater runoff and infiltration levels in a basin. Impervious surfaces and ballast can reduce groundwater recharge and increase runoff volumes, which can increase flow rates and flooding frequencies, and which in turn can contribute to stream erosion and aquatic habitat degradation. When a roadway is widened to make space for new light rail, the increased impervious surface area can capture more contaminants from the road uses. These contaminants can pollute water bodies by stormwater runoff or infiltration into the groundwater. Throughout all of the segments, conversion of land would trigger stormwater management requirements. Applicable flow control and water quality facilities would be incorporated into the project design, as discussed in Section 4.10.6, Potential Mitigation Measures.

- **Operations and Maintenance (O&M) facilities.** Activities at O&M facilities, where light rail vehicles are stored and maintained, use hazardous materials like petroleum products and metals in areas that can come into contact with rainfall or stormwater runoff. This potential transport of hazardous materials by stormwater runoff can impact stormwater quality. Such facilities are subject to stormwater management requirements. Operations would follow procedures to protect water quality, and the facilities would be designed with appropriate stormwater facilities, as discussed in Section 4.10.6.

- **New stream crossings.** Adding new guideways and columns in and over streams and buffers, as part of project construction, can reduce buffer quality. More detailed discussion of stream buffer quality is presented in Section 4.9, Ecosystems.

- **Replacement of existing stream crossings.** When an existing stream crossing—either a culvert or bridge over an open stream, or an underground segment of a piped stream—is replaced, there is an opportunity to improve the crossing by making it larger, resulting in a benefit to the stream compared to the existing condition.

- **Floodplain and floodway encroachment.** Light rail projects that cross floodplains can necessitate placement of guideway columns within the floodplain boundaries. In addition, stations, O&M facilities, and other non-linear components of a light rail project might place fill soil in the floodplain. The columns or fill soil can displace the storage volume of the floodplain, which would then require the project to conduct an engineering study and provide compensatory storage. Typically, no type of structure or fill is allowed to be placed in the floodway. In some cases, development in the floodway will be allowed with a detailed engineering analysis and zero-rise certification.

Throughout the study area, the rebuilding of roadway, as well as conversion of other land by the project, would trigger the latest stormwater management requirements. Applicable flow control and water quality facilities would be incorporated into the project design to prevent impacts to water resources, as discussed in Section 4.10.6. All of the streams that have existing crossings along the proposed alignments would have the crossings replaced. These crossing replacements are expected to result in either no impact to the streams or a beneficial effect from the widening of the crossings and improved stormwater management facilities.

Table 4.10-3. Water Resources: Comparison of Alignment Alternatives

Alignment Alternative by Segment	Total Proposed Project Area (acres)	Land Conversion (acres)[1]	Number of Stream Crossing(s)		Floodplain Impact?[2]
			New	Replaced	
Segment A: Inner Portland					
A1: Barbur	64	32	0	8	No
A2-BH: Naito Bridgehead	73	24	0	8	No
A2-LA: Naito Limited Access	65	24	0	8	No
Segment B: Outer Portland					
B1: Barbur	75	31	0	7	No
B2: I-5 Barbur TC-60th	69	34	0	7	No
B3: I-5 26th-60th	61	35	0	7	No
B4: I-5 Custer-60th	52	35	0	6	No
Segment C: Tigard and Tualatin					
C1: Ash-I-5	38	32	1	6	Yes
C2: Ash-Railroad	35	32	1	6	Yes
C3: Clinton-I-5	37	30	1	3	Yes
C4: Clinton-Railroad	34	30	1	3	Yes
C5: Ash-I-5 Branched	35	33	1	5	Yes
C6: Wall-I-5 Branched	40	33	0	5	No

Notes: TC = Transit Center.

[1] **Land conversion:** Approximate amount of vegetation that would be converted to impervious surface based on estimates of existing pavement width and proposed pavement width along each alignment alternative. The general estimate includes the highest-impact options for the Marquam Hill connection options in Segment A and the Portland Community College (PCC) Sylvania campus (PCC-Sylvania) shuttle options in Segment C. Potential O&M facility locations are all currently impervious and are not included in the land conversion estimates.

[2] **Floodplain impacts:** Comparison of potential floodplain impacts between Segment C alternatives is shown in Figure 4.10-2.

Segment A: Inner Portland

Conversion of land and associated impacts to water resources throughout Segment A would be similar for all of the alignment alternatives. The existing land use affected by alternatives in Segment A is primarily roadway, with bordering areas that include vegetated shoulders as well as mixed-use commercial (mostly impervious surface with some vegetation) and residential uses (a mix of impervious surface and vegetation). All of the Segment A alignment alternatives would replace the existing roadway with expansion into either vegetated borders or adjacent commercial and residential properties.

Conversion of land in Segment A could potentially increase stormwater runoff to the City of Portland combined sewer system. During very heavy rainstorms, higher stormwater volumes interacting with other components of the combined sewer system can exacerbate the possibility of the discharge of an untreated stormwater-sewage mix, known as a combined sewer overflow (CSO).

Marquam Hill Connection Options

Connection 1A: Elevator/Bridge and Path and Connection 1B: Elevator/Bridge and Recessed Path would result in a similar amount of forested vegetation being converted to impervious pedestrian pathways. Connection 1C: Elevator/Bridge and Tunnel and Connection 2: Full Tunnel would result in less vegetation being converted to impervious area than would Connections 1A or 1B.

Segment B: Outer Portland

Conversion of land throughout Segment B would generally fall into two categories:

1. **Existing Roadway.** The project would be added to the existing SW Barbur Boulevard. Much of the widening would be accomplished by converting existing impervious two-way center turn lanes and on-street parking to new impervious light rail tracks, bicycle lanes and sidewalks. The remainder of the widening would be accomplished by converting some of the vegetated right of way to new impervious surface.
2. **Interstate 5 (I-5) Right of Way.** The project would be constructed by converting vegetated I-5 right of way to new impervious surface.

Alignment alternatives that would be located in longer segments of the I-5 right of way would result in more vegetation removal and creation of new impervious surfaces. Listed in order, the alignment alternatives in Segment B that would result in the least amount of new impervious surface to the most would be: Alternatives B1, B2, B3 and B4 (see Table 4.10-3).

All of the Segment B alignment alternatives are assumed to include two park and rides located at the stations near the Barbur Transit Center and SW 53rd Avenue, each of which would consist of a three-level structured park and ride for all alignment alternatives.

- **Barbur Transit Center (TC) Park and Ride.** The existing land cover at the transit center is impervious parking. Conversion to new impervious parking would trigger stormwater management requirements, with either no impact or a benefit to water resources through additional flow control and water quality treatment.

- **53rd Park and Ride.** The existing land cover at the 53rd Park and Ride location is light commercial, with a mix of about 50 percent impervious and 50 percent vegetated land cover. Conversion to new impervious parking would result in vegetation removal. Stormwater management requirements would be triggered; therefore, the land conversion at the 53rd Park and Ride is not expected to result in impacts to water resources.

Land conversion in Segment B could potentially increase stormwater runoff to the City of Portland combined sewer system and exacerbate the possibility of a CSO.

Portland Community College (PCC) Sylvania Campus (PCC-Sylvania) Shuttle Options

- **Barbur Transit Center (TC) and Baylor Shuttle.** This shuttle would be a new service operating on existing roadways. No changes to existing land covers or land uses are expected, resulting in no impacts to water resources.

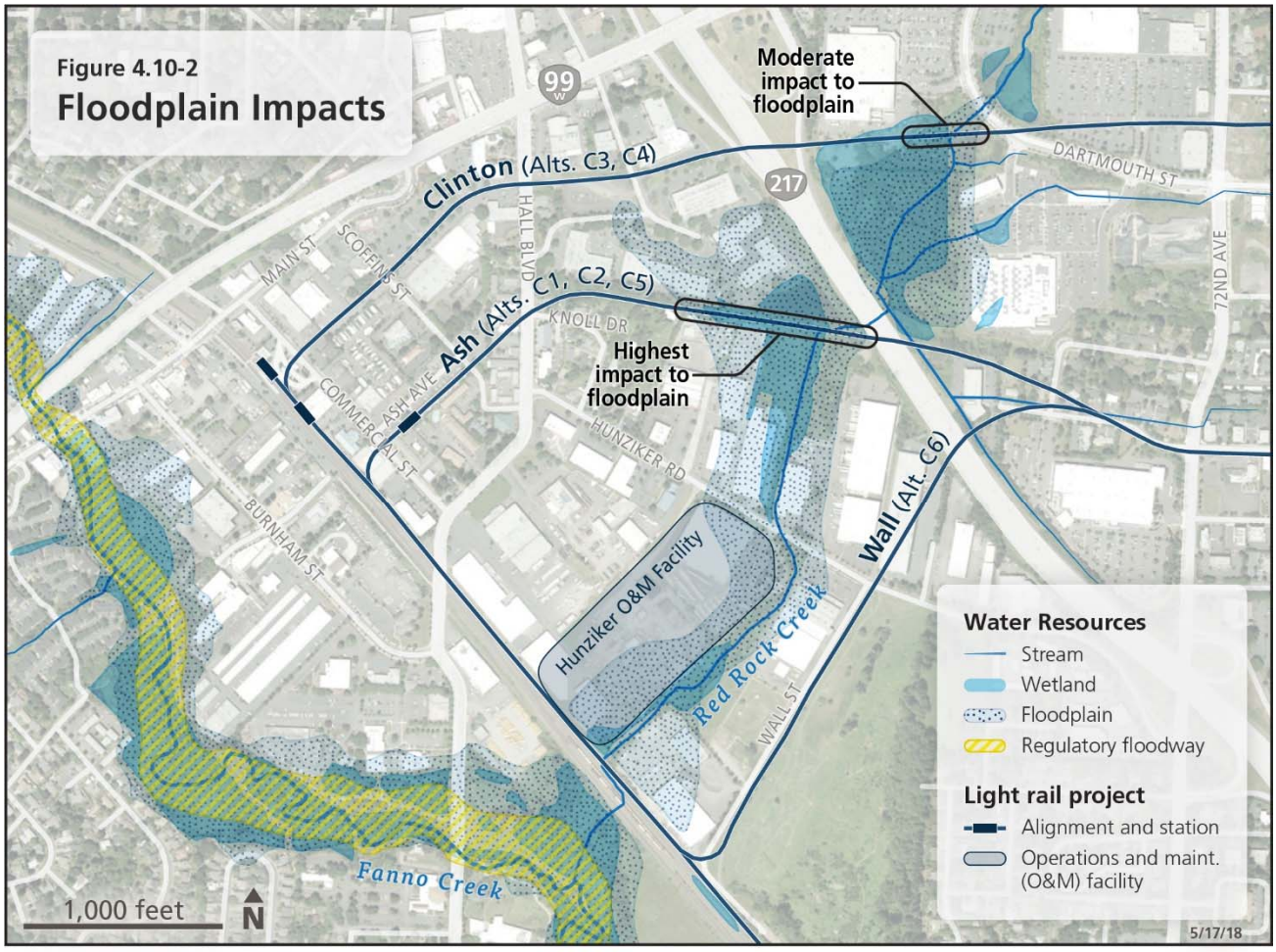
- **53rd Shuttle.** This PCC-Sylvania shuttle option would include rebuilding a portion of the currently paved SW 53rd Avenue with new pavement, sidewalks and stormwater controls, which would benefit water resources.

Segment C: Tigard and Tualatin

East of SW 72nd Avenue, all of the alignment alternatives would have similar types of water resource impacts. Light rail track would be added by converting existing commercial parcels, highway, municipal roadway and vegetated areas to new impervious surface.

Approaching Highway 217, differences emerge in stream and floodplain impacts, as shown in Figure 4.10-2. The Ash alignment (Alternatives C1, C2 and C5) and Clinton alignment (Alternatives C3 and C4) would require placement of columns near the stream buffer and in the floodplain of Red Rock Creek (Stream Number 1227626454239), while the Wall alignment (Alternative C6) would avoid the floodplain completely. Placement of columns within the floodplain would likely require an engineering study to determine the base-flood elevation, evaluate floodplain protections and quantify fill restrictions. A detailed study of required stream buffer replacement would likely be required, as well. Therefore, Alternatives C1, C2, C3, C4 and C5 are expected to have notably greater impacts on stream buffers and floodplain areas than Alternative C6.

In the southern portion of Segment C, land conversions along the I-5 alignment (Alternatives C1, C3 and C5) would involve less vegetation removal than those along the Railroad alignment (Alternatives C2 and C4). Light rail would be added along the I-5 alignment by converting existing commercial parcels and vegetated road right of way to impervious track structure. Alternatives with the Railroad alignment (Alternatives C2 and C4) would convert mostly vegetated railroad right of way and some impervious commercial areas to impervious track structure. It is assumed that some of the light rail track structure along the Railroad alignment would be on ballast. Alternative C6 would have segments partly along the railroad and partly along I-5, and would convert the same amounts of land as Alternative C5.



Note: Where no floodway has been mapped, a detailed engineering study would be required to determine the base (100-year) floor elevation and floodway boundary. For the purpose of the water resource impact analysis, it is assumed that the floodway boundary could potentially extend the entire width of the floodplain.

Because stormwater management requirements would be incorporated into the design of the light rail project regardless of alignment choice, there would be similar long-term impacts to water resources for the Segment C alignment alternatives. The greatest potential impacts would occur at station sites, as described below, where there could be larger changes in the area of impervious surface. These changes would trigger stormwater management requirements, and the inclusion of flow control and water quality facilities in the design of these areas.

- **Northern Triangle Stations.** The Baylor and Clinton stations would result in the same land conversion for all Segment C alignment alternatives. They both have park and rides that would convert existing residential area that is mostly vegetated to impervious parking area.

- **Tigard Transit Center.** The Tigard Transit Center Park and Ride would result in approximately the same land conversion for all Segment C alignment alternatives. The park and ride would convert existing impervious commercial area to impervious parking area. If existing runoff does not currently have stormwater management, then a potential benefit to water resources would result.

- **Bonita.** The Bonita Park and Rides (both Bonita I-5 and Bonita Railroad) would result in approximately the same land conversion for all Segment C alignment alternatives. Both the I-5 and Railroad alignments would add the park and ride by converting existing impervious commercial area to impervious surface for parking. The Bonita Railroad Park and Ride would be located immediately adjacent to Ball Creek (Stream Number 1227534454137); therefore, the facility design for this park and ride would need to include protection of the stream buffer.

- **Upper Boones Ferry.** The Upper Boones Ferry Park and Rides (both Upper Boones Ferry I-5 and Upper Boones Ferry Railroad) would result in approximately the same land conversion for all Segment C alignment alternatives. Both the I-5 and Railroad alignments would add the park and ride by converting existing impervious commercial area to impervious parking area.

- **Bridgeport Village.** The Bridgeport Park and Ride would have approximately the same land conversion for all Segment C alignment alternatives. The existing land area is impervious parking, and reconfiguration and replacement of the impervious parking would trigger stormwater management requirements, which would benefit water resources.

O&M Facilities Options

O&M facilities, where light rail vehicles are stored and maintained, engage in activities that use hazardous materials, including petroleum products and metals, in areas that can come into contact with rainfall or stormwater runoff, thus impacting stormwater quality. Such facilities are subject to stormwater management requirements. Operations would follow procedures to protect water quality, and the facilities would be designed with appropriate stormwater facilities, which would benefit water resources. The issues, by potential O&M facility site, include:

- **SW Hunziker Street.** The proposed location for the O&M facility near SW Hunziker Street is adjacent to the stream buffer and within the floodplain of Red Rock Creek (see Figure 4.10-2). This location was selected because there are no other flat sites that serve the increased service. Design of the facility would likely require an engineering floodplain study to determine the base-flood elevation, evaluate floodplain protections and quantify fill restrictions. Uncontrolled spills during operation of the facility would impact water quality within the stream.

- **SW 72nd Avenue (north).** For Alternatives C1 and C3, the proposed location for the O&M facility near SW 72nd Avenue has no streams immediately adjacent to it, and the effects would be primarily beneficial due to new stormwater management facilities.

- **SW 72nd Avenue (south).** For Alternatives C5 and C6, a southern location would be used for the O&M facility near SW 72nd Avenue, immediately adjacent to Ball Creek (Stream Number 1227534454137). Uncontrolled spills during operation of the facility could impact water quality within the stream. New stormwater management facilities would benefit water resources.

Station Access Improvement Options

The station access improvements would convert or expand existing impervious area and some vegetation to new impervious area, such as sidewalks or bicycle lanes. Some options would use existing surfaces and would not convert appreciable amounts of other land cover. As with the alignment

alternatives, stormwater management facilities meeting applicable jurisdictional standards would be included in the designs. The station access improvements are not expected to impact water resources.

4.10.3. Short-Term Impacts

Construction activities would be similar among the different alignment alternatives; therefore, potential short-term impacts to water resources from each alternative are expected to be similar. Activities associated with construction that could affect surface water resources include:

- **Earthwork, footings, trench work, stockpiling and delivery of materials.** Clearing and grubbing (removing trees and vegetation that are within the new cut/fill limits) and regrading, including fill and/or excavation, exposes and destabilizes soil by removing roots that anchor it in place. If exposed soil becomes dry, wind and water can erode it and carry it off-site to stormwater channels or streams, where it can increase turbidity in the water. Construction vehicle tires can track soil onto roadways, from which the soil can be carried into ditches or streams during storms.
- **Concrete work and road paving.** Concrete work is associated with the construction of track structures; stations; retaining walls; and park and ride curbs, sidewalks and traffic barriers. The pH in surface water can be increased to levels that are harmful to fish and wildlife if runoff comes in contact with process water or slurry from concrete work or from curing of concrete.
- **Construction machinery and material storage.** Water quality in surface water bodies and groundwater can be impacted by leaks or spills from construction machinery or stored materials. Hydrocarbons, metals and other hazardous materials associated with construction can increase turbidity or affect other water quality parameters, such as pH levels or the amount of available oxygen in the water.
- **Construction activity in or near a water body or sensitive area.** Over-water work and construction in and near stream buffers can pose a direct risk to water quality through pollutant spills, sediment transport or wind deposition of stockpiled materials.
- **Dewatering.** Unrestricted construction subsurface dewatering can impact the water supply to underground aquifers. In addition, uncontrolled surface discharge of dewatering water can increase flows and therefore result in the erosion of surface soils.

4.10.4. Potential Mitigation Measures

The project would be designed to comply with all federal, state and local regulations, which would prevent or minimize potential impacts to water resources. Through project planning, design and the application of required best management practices (BMPs), the light rail alternatives would provide water quality treatment and flow control to prevent impacts to water resources, including mitigating flow changes to combined sewer systems.

BMPs would generally be designed to comply with guidance outlined in the applicable stormwater design manuals (i.e., *City of Portland Stormwater Management Manual*, *Clean Water Services Design and Construction Standards for Sanitary Sewer and Surface Water Management*). Water quality treatment BMPs might include settling ponds, filter strips, sand filter, or bioinfiltration facilities. Flow control BMPs might include detention or retention ponds or vaults. Required stormwater management

facilities would likely be larger in areas where more vegetation is converted to new impervious surfaces. Also, project design would be more constrained in areas adjacent to or within stream buffers or floodplains. The project would be designed to avoid stream buffers and floodplains wherever possible, and in locations where the project would encroach upon these areas, the project would implement required studies, stream buffer replacement and floodplain compensatory storage.

Construction-related impacts on water resources would be prevented or minimized by complying with the federal, state and local regulations, and by implementing construction-related BMPs. Examples of construction BMPs that could be implemented include:

- phasing the work to minimize the amount of disturbed area at any one time
- developing construction plans for sensitive areas such as wetlands and their buffers
- marking and fencing of construction limits
- clearing only a portion of the construction site at any one time to minimize exposed soils
- stabilizing construction entrances and haul roads
- washing truck tires at construction entrances
- constructing silt fences downslope from exposed soil
- temporary and permanent seeding to stabilize exposed soil
- protecting catch basins from sediment
- containing and controlling concrete and hazardous materials on-site
- installing temporary ditches to route runoff around or through construction sites
- providing temporary plastic or mulch to cover soil stockpiles and exposed soil
- using wattles to reduce the length of unbroken slopes and minimize runoff concentration
- protecting steep slopes with temporary erosion control blankets, mulch covering, tightline conveyances, etc.
- using temporary sedimentation ponds to remove solids from runoff and dewatering water
- conducting vehicle fueling and maintenance activities away from waters of the state
- implementing stream protection measures, as necessary, including diverting stream flow around the construction area and limiting the construction period to the required "work window," a period of the year when fish would be minimally affected
- incorporating design refinements that avoid or minimize impacts to water resources (see Appendix E).

Through compliance with applicable construction regulations and implementation of required BMPs, the light rail alternatives are not expected to adversely affect water resources during construction.

4.11. Noise and Vibration

This section describes the results of the noise and vibration analysis, which considers the potential for impacts to more than 1,400 noise- and vibration-sensitive properties along the light rail alternatives. The discussion includes potential long-term, short-term, indirect and cumulative impacts, and includes potential mitigation measures. The *Noise and Vibration Results Report* (Attachment E) has additional detail on the analysis and the methods used.

4.11.1. Introduction to Noise and Vibration

This section discusses the fundamentals of the noise and vibration analysis and regulatory information governing noise and vibration for federally funded projects. Additional information on noise and vibration, and the measurement and analysis of noise and vibration, is provided in the *Noise and Vibration Results Report*.

Noise

Noise is defined as unwanted sound; it is measured in terms of sound pressure level and is usually expressed in decibels (dB), a conversion of the air pressure to a unit of measurement that represents the way humans hear sounds. The human ear is less sensitive to higher and lower frequencies than it is to midrange frequencies. To provide a measurement meaningful to humans, a weighting system was developed that reduces the sound level of higher and lower frequency sounds, similar to what the human ear does. This filtering system is used in virtually all noise ordinances. Measurements taken with this "A-weighted" filter are referred to as A-weighted decibel (dBA) readings.

Two primary noise measurement descriptors are used to assess noise impacts from traffic and transit projects: the equivalent sound level (Leq) and the day-night sound level (Ldn). The Leq is the level of a constant sound for a specified period of time that has the same sound energy as an actual fluctuating noise over the same period of time. The peak-hour Leq is used for all traffic noise analyses and for light rail noise analyses at locations with noise-sensitive daytime use, such as schools and libraries. The Ldn is an Leq over a 24-hour period, with 10 dBA added to nighttime sound levels (between 10 p.m. and 7 a.m.) as a penalty to account for the greater sensitivity and lower background sound levels during this time. The Ldn is the primary noise-level descriptor for light rail noise at residential land uses.

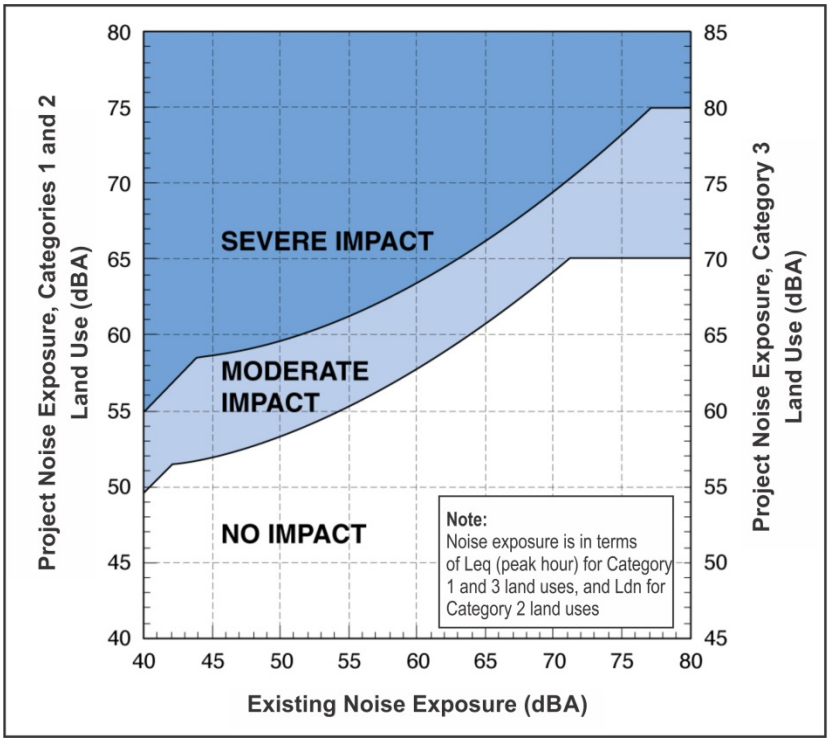
Because this project is funded by FTA, the FTA methods are the governing methods for the noise and vibration analysis (2006 FTA Transit Noise and Vibration Impact Assessment [FTA, 2006]). Other criteria that are applicable to specific parts of this analysis, including those from the Federal Highway Administration (FHWA) and local noise control ordinances, are provided in the *Noise and Vibration Results Report*.

The FTA noise impact criteria group noise-sensitive land uses into the following three categories: Category 1 for areas where quiet is an essential element in their intended purposes; Category 2 for residences, hospitals and hotels where nighttime sensitivity is assumed to be of utmost importance; and Category 3 for schools, libraries, theaters and churches. Category 2 uses the Ldn to identify impacts, while Categories 1 and 3 use the peak-hour Leq. There are no Category 1 land uses in the study area.

There are also two levels of noise impact included in the FTA criteria: "severe impacts," which are considered "significant" according to the usage of this term in the National Environmental Policy Act (NEPA); and "moderate impacts," which require the consideration of factors, including existing and planned land use and the cost of mitigation, in order to determine the need for mitigation.

The existing noise level is used to determine the FTA criteria for moderate or severe impacts. As the existing noise level of the environment increases, the allowable noise from the transit project is decreased. The FTA impact criteria are shown on Figure 4.11-1, and additional information can be found in the *Noise and Vibration Results Report*.

Figure 4.11-1. FTA Noise Impact Criteria



Vibration

Vibration generated from train operations of the Southwest Corridor Light Rail Project would be transmitted from the tracks through the soil to nearby properties. Vibration above certain levels can disrupt sensitive operations and cause annoyance to humans within buildings. Transit systems rarely produce vibration with sufficient magnitude to cause any structural damage. The response of humans, buildings and equipment to vibration is most accurately described using vibration velocity level in decibels (VdB). The abbreviation VdB is used in place of dB to avoid confusing vibration decibels with sound decibels.

For transit systems with 70 light rail train pass-bys or more per day, the general vibration impacts criterion for residences, hospitals and hotels is 72 VdB. For institutional land uses, including schools, libraries and churches, the criterion is 75 VdB. Any sites that will have vibration impacts from the project will undergo, during project final design, a revised, detailed vibration analysis to consider mitigation measures.

4.11.2. Affected Environment

The noise and vibration analysis predicts where the project would increase noise and vibration to levels above impact thresholds defined by FTA and FHWA. The thresholds relate to land uses where quiet and stillness are important to human activity, including places where people sleep, where quiet is essential to an activity (such as a church or concert hall, certain parks, and schools), or where sensitive equipment might exist. The *Noise and Vibration Results Report* has more details on the standards and measurements used in the noise and vibration analysis.

The study area was determined using the FTA-recommended analysis distance of up to 350 feet, along with information on noise propagation from existing TriMet light rail vehicles, land use, topographical conditions and structural shielding. To ensure that all of the potential noise impacts were identified, the analysis started at 350 feet from the edge of construction and expanded to include structures that were far enough from the trackway as not to have any noise or vibration impacts. This method ensures that all potential noise and vibration impacts are identified, regardless of the distance from the trackway. Figures 4.11-2 through 4.11-4 outline the study area considered for the noise and vibration analysis.

Land use in Segment A consists of single-family and multifamily residential, churches and commercial uses. There are also several schools and parks located near the proposed Segment A alignment alternatives. Land use in Segment B is residential at the connection to Segment A, and then changes to commercial and mixed use along SW Barbur Boulevard until the connection with Segment C. There are also several schools and parks near the Segment B light rail alternatives. Land use in Segment C includes single-family and multifamily residences between the Segment B connection and the Highway 217 crossings. There are additional residences near the Tigard Transit Center, and land use south of the downtown core of Tigard is primarily commercial and industrial, with retail at the project terminus. Section 4.2, Land Use, has additional details on land use in the corridor.

Noise

Noise measurements were taken at a total of 33 sites: 11 sites in Segment A, 16 sites in Segment B and 6 sites in Segment C. Twenty-five of the 33 sites were monitored continuously for approximately 48 hours, while the remaining 8 sites were monitored twice during normal daytime hours for 30 minutes each. Monitoring site selection was based on several factors, including the site's ability to represent multiple noise-sensitive receivers in a specific area, provide information on traffic noise levels and provide a detailed understanding of the existing noise levels throughout the Southwest Corridor. Using this measured data, standard acoustical propagation characteristics, area maps and local shielding, the measured noise levels were used to calculate and predict the Ldn noise levels for Category 2 uses and the peak-hour noise level in Leq for Category 3 land uses. Project alignments, noise-monitoring survey sites and potential noise impacts are identified in Figures 4.11-2 through 4.11-4.

The dominant noise source in Segments A and B is traffic along Interstate 5 (I-5). Other major contributors to the existing noise environment in Segment A include Interstate 405 (I-405), U.S. 26 and other major roads (SW Barbur Boulevard, SW Naito Parkway, SW Terwilliger Boulevard and SW Capitol Highway), along with existing light rail and Portland Streetcar operations. The measured Ldn in Segment A ranged from 59 dBA to 71 dBA, and in Segment B the Ldn ranged from 61 dBA to 82 dBA. In Segment C, the dominant noise sources include the highways I-5 and Highway 217. Other noise sources are the Westside Express Service (WES) Commuter Rail, freight rail traffic, SW Hall Boulevard, Pacific

Highway (99W) and other major arterial roadways, and substantial industrial and commercial activities. Noise levels in Segment C ranged from 59 dBA to 74 dBA Ldn.

The measured noise levels in Segment A were fairly typical for a busy urban area, with the highest levels near I-5 and adjacent to SW Barbur Boulevard. Noise levels in Segment B were notably louder because of the proximity of some sites to I-5, and some locations have noise levels higher than what FTA or FHWA would allow for a new project. Noise levels in Segment C were similarly high in some locations.

Vibration

Existing vibration levels along the proposed alignment alternatives are primarily the result of heavy truck traffic on public roadways; however, at two locations, trains are the major vibration source. The first of these locations is in Segment A, along SW Lincoln Street, where the existing light rail is also a source of vibration. However, testing shows that vibration levels in nearby residences are below the FTA criteria. The second location with rail traffic is in Segment C near downtown Tigard, where the WES Commuter Rail service, which is heavy rail, runs along with freight rail traffic. Vibration levels from heavy rail, such as the WES and freight rail, could produce short-term maximum vibration levels above the FTA criteria for certain sites adjacent to the tracks. No other major sources of vibration were identified in the corridor.

4.11.3. Long-Term Impacts – Noise

This section summarizes and identifies locations where noise levels are predicted to exceed the FTA impact criteria. Noise sources in this analysis include light rail operations, stations (bells and announcements), and maintenance and other ancillary facility operations. The *Noise and Vibration Results Report* has more information on the technical assessment of noise impacts, including maps.

No-Build Alternative

With the No-Build Alternative, noise levels in the project corridor would continue to be dominated by other transportation-related noise sources, including cars, trucks and, in Tigard, the WES Commuter Rail. Under the No-Build Alternative, other transportation projects (see Appendix B4.18) and general regional growth are anticipated to result in increased noise levels in the area.

Full-Corridor Light Rail

The number and severity of noise impacts for the full-corridor light rail would depend on the combination of alignment alternatives selected. Many of the impacts are at multi-unit apartments and condominiums, and therefore the analysis estimates the number of units with impacts, based on site visits, window counts and unit numbers. Figures 4.11-2 through 4.11-4 illustrate the locations for noise impacts for each segment. The actual number of impacts is expected to be less than this estimate and will be revised when a more detailed review of these multifamily units is performed. This information will be presented in the Final Environmental Impact Statement (EIS). In addition, the analysis will be updated to more accurately account for structural shielding along the project alignments. Therefore, the number of noise impacts presented here is a worst case and could be higher than what would actually occur. In addition, because of the additional trains necessary under the Branched Route (Alternatives C5 and C6), full-corridor combinations using those alternatives also would have a greater

number of total noise impacts in Segments A and B than would the Through Route alternatives (Alternatives C1 through C4).

Table 4.11-1 summarizes the projected number of units that would have noise impacts for each segment, by alignment alternative, for the Through and Branched Routes. A "unit" in this discussion is an individual residence, apartment, condominium or hotel/hospital room in the case of a Category 2 land use or, in the case of an institutional Category 3 land use, a building. The highest numbers of impacts are in Segment A under the Branched Route because of the high density of residential land use located near these alignments. The fewest numbers of impacts are in Segment C for Alternatives C3 and C4, because these two alignment alternatives remain to the north of SW Dartmouth Street, avoiding many of the residential areas in Segment C. Alternatives identified as "N/A" (meaning "Not Applicable") in the table do not exist in the configuration indicated for that column; for example, there is no Alternative C1 with the Branched Route. More detailed maps of the impacts, along with tables and supporting data, are provided in the *Noise and Vibration Results Report*.

Table 4.11-1. Summary of Potential Noise Impacts in Number of Units

Alignment Alternative	Through		Branched	
	Moderate Noise	Severe Noise	Moderate Noise	Severe Noise
Segment A: Inner Portland				
A1: Barbur	293	5	353	8
A2-BH: Naito Bridgehead	167	1	188	4
A2-LA: Naito Limited Access	161	1	195	4
Segment B: Outer Portland				
B1: Barbur	55	0	147	1
B2: I-5 Barbur TC-60th	49	0	115	1
B3: I-5 26th-60th	44	0	98	1
B4: I-5 Custer-60th	80	0	140	1
Segment C: Tigard and Tualatin				
C1: Ash-I-5	72	15	N/A	N/A
C2: Ash-Railroad	72	15	N/A	N/A
C3: Clinton-I-5	12	0	N/A	N/A
C4: Clinton-Railroad	12	0	N/A	N/A
C5: Ash-I-5 Branched	N/A	N/A	38	12
C6: Wall-I-5 Branched	N/A	N/A	37	3

Source: Michael Minor & Associates, Inc. modeling using methods from FTA (2006).

Note: N/A = Not Applicable; TC = Transit Center.

Light Rail Alternatives

The following sections provide a review of noise impacts for each of the light rail alignment alternatives without mitigation. Complete maps and tables of the noise impacts are provided in the *Noise and Vibration Results Report*. It is important to note that even though the alignment alternatives in Segments A and B are identical under the Through and Branched Routes, the number of noise impacts with the Branched Route is greater. The increase in the number and severity of noise impacts under the Branched Route is due to the increased headways during off-peak hours required to maintain light rail service south of the Beveland Station.

Wheel Squeal

Wheel squeal is caused by the oscillation of the wheel against the rail on curved sections of rail. Based on measurements of curves with radii of less than 300 feet along existing TriMet lines, tight-radius curves can produce maximum wheel squeal noise levels of 80 dBA to 90 dBA at 50 feet. The analysis examined each alignment alternative and identified all curves with a radius of 300 feet or less; these curves will be reviewed for lubrication if squeal is identified during initial system testing. Table 4.11-2 lists all of the tight-radius curves based on the current project design, and the locations of the tight curves are shown, along with the impacts, on Figures 4.11-2 through 4.11-4.

Table 4.11-2. Tight-Radius Curves with the Potential for Wheel Squeal

Alignment Alternative	Location	Curve Radius (feet)
Segment A: Inner Portland		
A1: Barbur	SW Lincoln St. at SW 4th Ave.	110
A2-BH: Naito Bridgehead	SW Lincoln St. at SW Naito Pkwy.	95
A2-LA: Naito Limited Access	SW Lincoln St. at SW Naito Pkwy.	95
Segment B: Outer Portland		
B1: Barbur	None	N/A
B2: I-5 Barbur TC-60th	Barbur Transit Center	250
B3: I-5 26th-60th	SW Barbur Blvd. at SW 26th Ave.	150
B4: I-5 Custer-60th	SW Barbur Blvd. at SW Custer Ave.	300
Segment C: Tigard and Tualatin		
C1: Ash-I-5	SW Atlanta St. at SW 70th Ave. SW 70th Ave. at SW Beveland St. SW Ash Ave. at SW Commercial St.	100 100 150
C2: Ash-Railroad	SW Atlanta St. at SW 70th Ave. SW 70th Ave. at SW Beveland St. SW Ash Ave. at SW Commercial St. At railroad corridor to I-5 transition	100 100 150 200
C3: Clinton-I-5	SW Atlanta St. at SW 70th Ave. SW 70th Ave. at SW Clinton St. SW Commercial St. north of Ash Ave.	100 100 100
C4: Clinton-Railroad	SW Atlanta St. at SW 70th Ave. SW 70th Ave. at SW Clinton St. SW Commercial St. north of Ash Ave. At railroad corridor to I-5 transition	100 100 100 200
C5: Ash-I-5 Branched	SW Atlanta St. at SW 70th Ave. SW 70th Ave. at SW Beveland St. Ash Ave. at SW Commercial St.	100 100 150
C6: Wall-I-5 Branched	SW Atlanta St. at SW 70th Ave. SW 70th Ave. at SW Beveland St. SW Wall St. at SW Commercial St.	100 100 134

Source: Review of project design files and drawings.

Note: TC = Transit Center.

Figure 4.11-2

Noise Study Area, Monitoring Locations and Potential Impacts

Segment A: Inner Portland

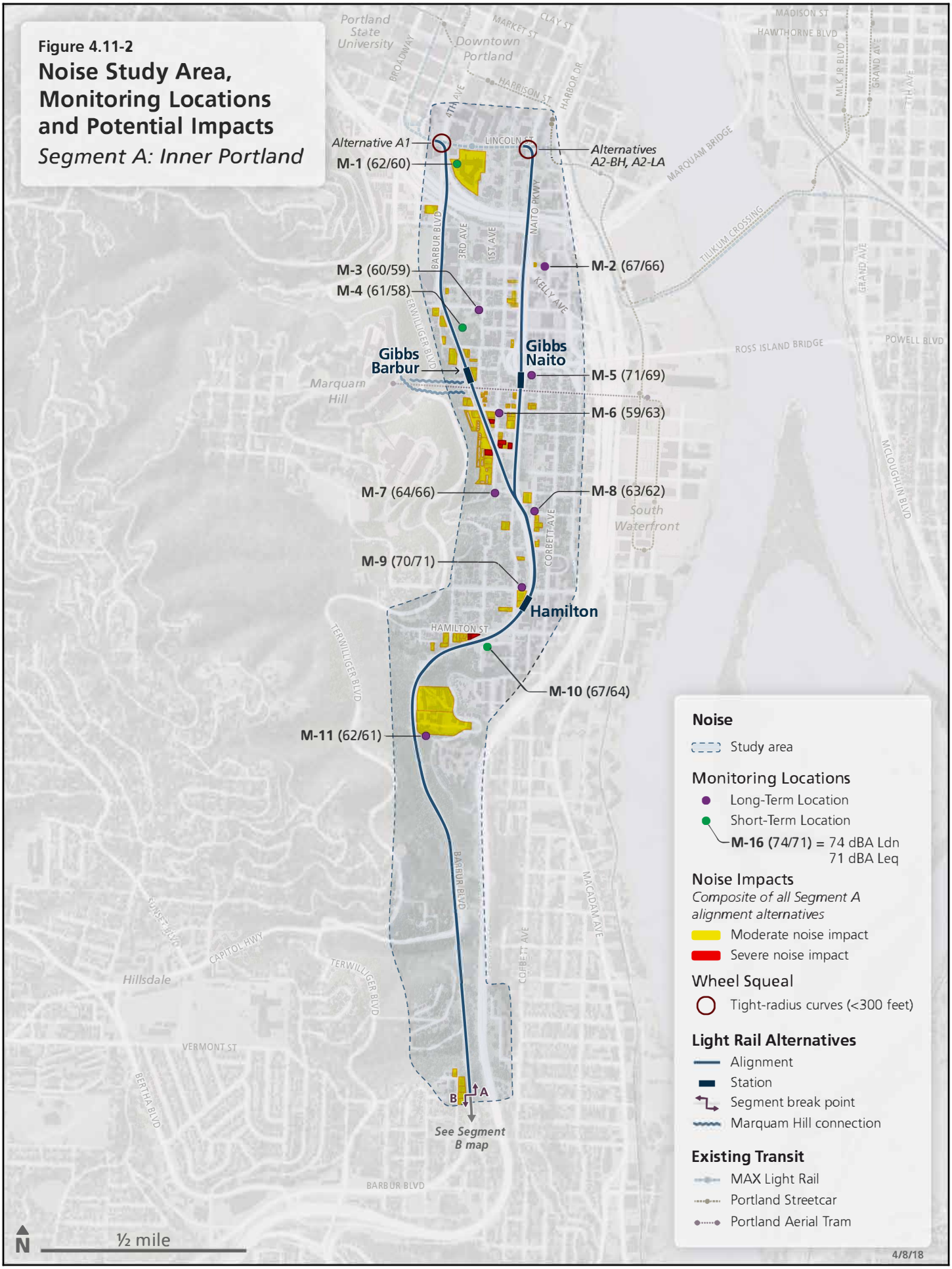
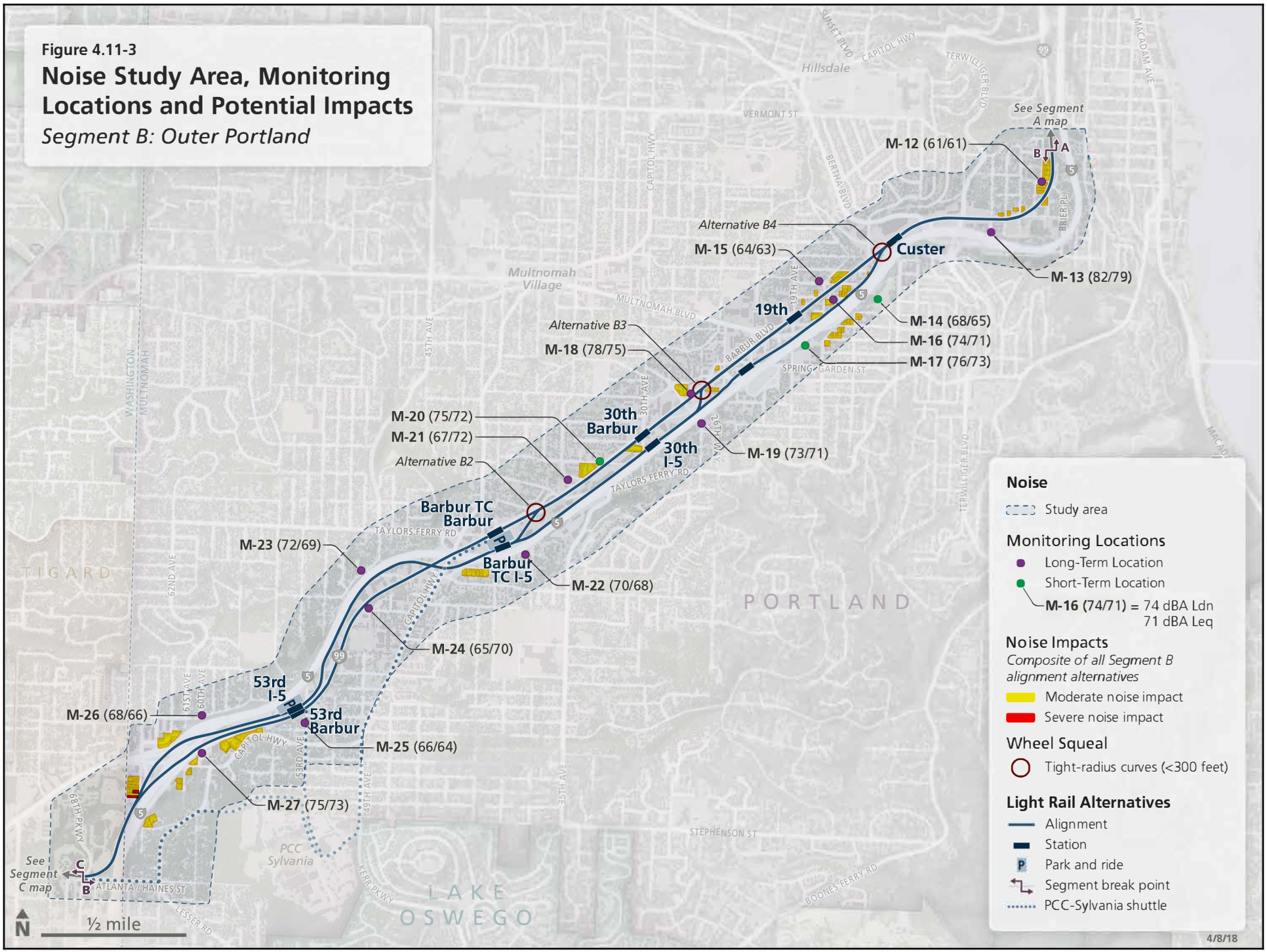


Figure 4.11-3

Noise Study Area, Monitoring Locations and Potential Impacts

Segment B: Outer Portland



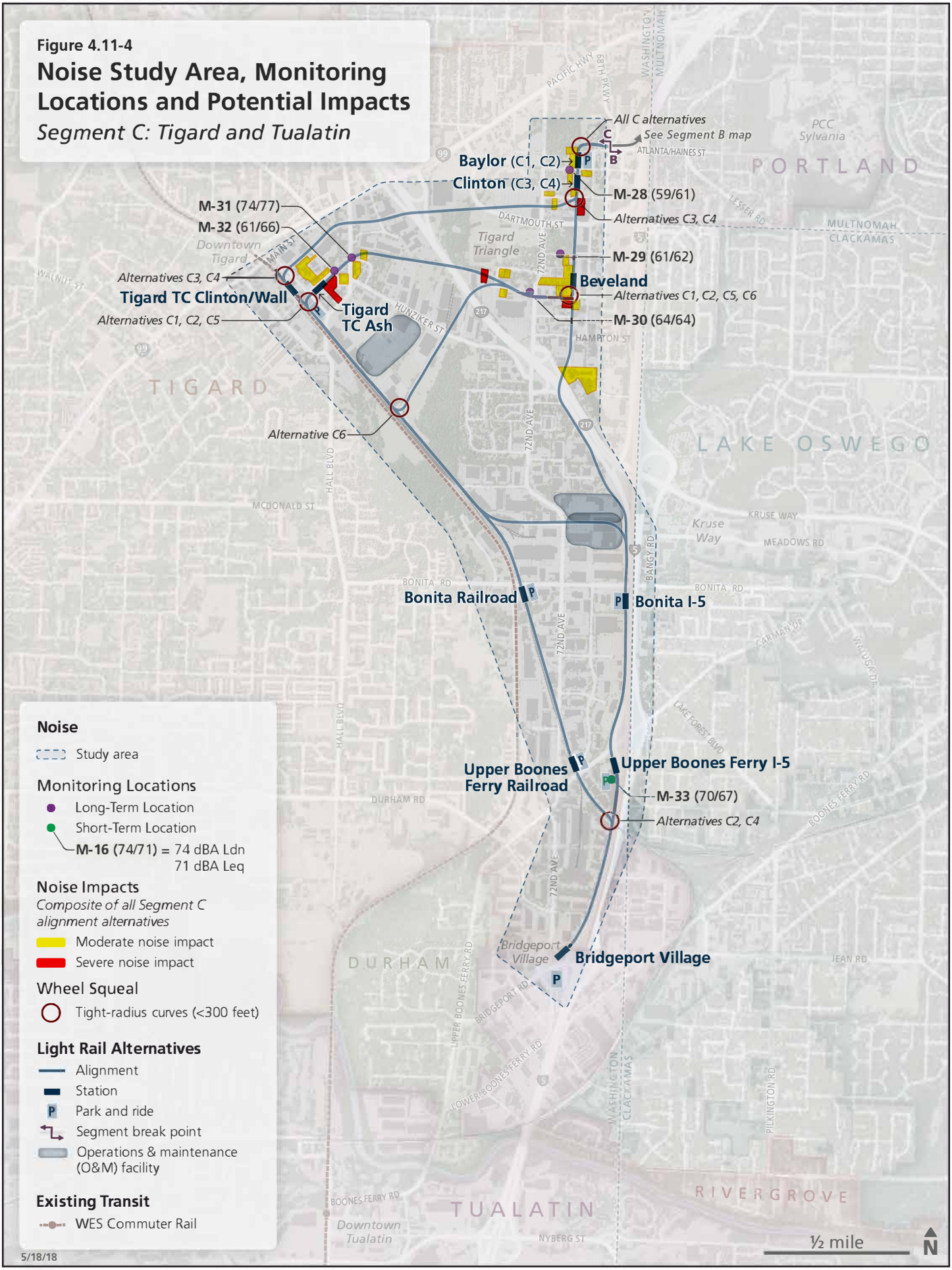


Figure 4.11-4
Noise Study Area, Monitoring Locations and Potential Impacts
Segment C: Tigard and Tualatin
All C alternatives
See Segment B map
Baylor (C1, C2)
Clinton (C3, C4)
M-28 (59/61)
Alternatives C3, C4
M-31 (74/77)
M-32 (61/66)
Downtown Tigard
Tigard Triangle
M-29 (61/62)
Beveland
Alternatives C1, C2, C5, C6
M-30 (64/64)
Alternatives C3, C4
Tigard TC Clinton/Wall
Alternatives C1, C2, C5
Tigard TC Ash
Alternative C6
Bonita Railroad
Bonita I-5
Upper Boones Ferry Railroad
Upper Boones Ferry I-5
M-33 (70/67)
Alternatives C2, C4
Bridgeport Village
Bridgeport Village
PORTLAND
TIGARD
LAKE OSWEGO
DURHAM
TUALATIN
RIVERGROVE
Kruse Way
Downtown Tualatin
PCC Sylvania
Noise
Study area
Monitoring Locations
Long-Term Location
Short-Term Location
M-16 (74/71) = 74 dBA Ldn 71 dBA Leq
Noise Impacts
Composite of all Segment C alignment alternatives
Moderate noise impact
Severe noise impact
Wheel Squeal
Tight-radius curves (<300 feet)
Light Rail Alternatives
Alignment
Station
Park and ride
Segment break point
Operations & maintenance (O&M) facility
Existing Transit
WES Commuter Rail
5/18/18
½ mile
N

Segment A: Inner Portland (including Marquam Hill Connection Options)

Alternative A1 in Segment A would have the highest number of noise impacts due to the large number of residences along SW Barbur Boulevard. Alternative A1 impacts would occur along both sides of SW Barbur Boulevard between the existing Lincoln Station and SW Hamilton Street.

Under Alternatives A2-BH and A2-LA, noise impacts would begin along SW Naito Parkway just south of SW Arthur Street, and occur along the alignment at many front-line receivers until the connection with SW Barbur Boulevard near SW Abernethy Street. Under Alternative A2-LA, there would be additional displacements along SW Naito Parkway between SW Hooker Street and SW Curry Street that would not occur under Alternative A2-BH. Therefore, the number of noise impacts under Alternative A2-BH would be higher than under Alternative A2-LA because of impacts at these non-displaced homes.

South of SW Hamilton Street, Alternatives A1, A2-BH and A2-LA would have the same noise impacts, with moderate impacts occurring at several multifamily units and a group of single-family homes located at the connection to Segment B along SW 2nd Avenue.

Severe noise impacts in Segment A under the Through Route would include three units in the 3500 block of SW 1st Avenue and SW Barbur Boulevard, and one on SW Condor Avenue that would occur under Alternative A1 only. One additional severe impact was identified at a residence on SW Hamilton Street, which would occur under all of the Segment A alignment alternatives.

Severe impacts are increased under the Branched Route, with additional severe impacts occurring on SW Condor Avenue, SW 1st Avenue and SW Barbur Boulevard under Alternative A1. Under Alternative A2 with the Branched Route, there would be additional severe impacts in the 100 block of SW Hamilton Street.

All noise-producing sources associated with elevator systems, including drive motors and ancillary operating equipment, are required to meet the City of Portland Noise Control Ordinance, which is more stringent than the FTA noise criteria. Therefore, none of the Marquam Hill connection options are predicted to have any long-term noise impacts.

Figure 4.11-2 provides an overview of Segment A and identifies the monitoring sites and worst-case potential noise impacts under Alternatives A1, A2-BH and A2-LA. The impacts shown are based on the outline of each property parcel, and therefore a large apartment complex that has impacts near the light rail alignment will show up as impacts to the entire complex, even though only a few units at that complex actually would be affected. Further, the noise impacts presented in the figure are the worst case and assume the Branched Route. More detailed maps of the impacts, along with tables and supporting data, are provided in the *Noise and Vibration Results Report*.

Segment B: Outer Portland

All four of the Segment B alignment alternatives would have noise impacts at residences north of SW Terwilliger Boulevard. South of SW Terwilliger Boulevard, the location and severity of noise impacts would be based on the alternative selected, with moderate noise impacts occurring along both sides of the SW Barbur Boulevard alignments and to the west of the I-5 alignments. Noise impacts were also identified on the east side of I-5 under Alternatives B2, B3 and B4 due to the elevated structure over I-5.

There would be no severe noise impacts in Segment B under the Through Route; however, under the Branched Route, one severe impact was identified near the elevated structure over I-5 near the beginning of Segment C.

Figure 4.11-3 provides an overview of Segment B, and identifies the monitoring sites and worst-case potential noise impacts under Alternatives B1, B2, B3 and B4. As described under Segment A, these impacts are based on the Branched Route, and the impacts are identified by highlighting the entire parcel, even though, for many of the parcels, only a portion actually would have noise impacts.

Segment C: Tigard and Tualatin

In Segment C, noise impacts would occur between the Baylor Park and Ride, near the connection to Segment B, and SW Beveland Street, continuing to the elevated structure over Highway 217. Additional noise impacts occur at multifamily units and a manufactured home park near downtown Tigard. Severe noise impacts were identified under Alternatives C1, C2, C5 and C6 near SW Clinton Street and SW 70th Avenue. Additional severe impacts under Alternatives C1, C2 and C5 would occur near the elevated structure over Highway 217 and near downtown Tigard on SW Ash Avenue. All of the noise impacts under Alternatives C3 and C4 would be in the moderate category. Figure 4.11-4 provides an overview of Segment C, and identifies the monitoring sites and potential noise impacts under Alternatives C1, C2, C3, C4, C5 and C6. More detailed maps of the impacts, along with tables and supporting data, are provided in the *Noise and Vibration Results Report*.

Traffic Noise and Potential Impacts

The potential to create or increase exposure to traffic noise as a result of the transit project was evaluated qualitatively. As defined in FHWA noise abatement policy (FHWA, 2011), changes in the traffic noise environment could occur if the project creates new roadways or alters existing roadways in relation to noise-sensitive properties, or changes the pathway for traffic noise by removing or altering barriers (buildings, berms or walls) that currently provide some level of shielding from traffic noise.

In Segment A, these types of noise impacts would occur at some locations along SW Barbur Boulevard and SW Naito Parkway and, under Alternative A2-BH, at the access to the Ross Island Bridge. In Segment B, there would be some displacements along SW Barbur Boulevard, and between SW Barbur Boulevard and I-5 under Alternatives B3 and B4, where increased traffic noise levels could occur due to the removal of shielding. There are no major roadway realignments that would trigger a traffic noise study in Segment B. In Segment C, the major concern for traffic noise is the removal of shielding and construction of new roads for access to station locations near the downtown Tigard core and SW Hall Boulevard, where noise levels are already above the traffic noise criteria.

Once the Preferred Alternative is selected, locations where the project could result in increased traffic noise will be modeled using the methods defined by FHWA and ODOT. This analysis will be presented in the Final EIS. More information on traffic noise can be found in the *Noise and Vibration Results Report*.

Operations and Maintenance (O&M) Facilities Options

This analysis also included noise and vibration impacts from the O&M facilities options. The Hunziker Facility site is located in established industrial areas. The nearest noise-sensitive receivers are more than 500 feet away and are well-shielded from facility operations. Therefore, no noise impacts are predicted from the operations of the Hunziker Facility option.

Similarly, the Through 72nd Facility and Branched 72nd Facility sites, which are also in established industrial areas, are not anticipated to create any noise impacts. The only nearby noise-sensitive property for either of these facilities is a hotel on the other side of I-5, approximately 350 feet away, where noise will continue to be dominated by traffic along I-5.

4.11.4. Long-Term Impacts – Vibration

This section summarizes locations where vibration levels are predicted to exceed the FTA vibration impact criteria. The number of potential vibration impacts is based on a count of buildings that would have levels above the FTA criteria. Furthermore, additional vibration propagation testing will be performed to verify impacts as the project design is refined. Details on vibration impacts and maps showing the locations are provided in the *Noise and Vibration Results Report*.

No-Build Alternative

With the No-Build Alternative, vibration levels would continue to be dominated by other transportation-related vibration sources, primarily heavy trucks and, in Tigard, the WES Commuter Rail. Other vibration sources could include miscellaneous industrial activities and local construction projects.

Full-Corridor Light Rail

Table 4.11-3 summarizes the projected number of structures with vibration impacts for the alignment alternatives in each segment. The largest number of vibration impacts would occur under Alternative A1 because of the proximity of this alignment to residences. The alignment alternatives with the fewest impacts are Alternatives C3 and C4, because these two alignments remain to the north of SW Dartmouth Street, avoiding many residences. Full-corridor vibration impacts can be derived by summing the impacts for each of the three segments using a selected alignment alternative; for example, using Alternatives A1, B2 and C1, there are 122 potential vibration impacts. The majority of the vibration impacts would occur at single-family and multifamily residences, with impacts also occurring at seven hotels and one church. No vibration impacts to vibration-sensitive commercial structures were identified.

Table 4.11-3. Summary of Potential Vibration Impacts

Alignment Alternative	Vibration Impacts
Segment A: Inner Portland	
A1: Barbur	76
A2-BH: Naito Bridgehead	31
A2-LA: Naito Limited Access	35
Segment B: Outer Portland	
B1: Barbur	29
B2: I-5 Barbur TC-60th	26
B3: I-5 26th-60th	17
B4: I-5 Custer-60th	23
Segment C: Tigard and Tualatin	
C1: Ash-I-5	20
C2: Ash-Railroad	20
C3: Clinton-I-5	2
C4: Clinton-Railroad	2
C5: Ash-I-5 Branched	21
C6: Wall-I-5 Branched	20

Source: Michael Minor & Associates, Inc. modeling using methods from FTA (2006).
Note: TC = Transit Center.

Light Rail Alternatives

The following sections provide a summary of the potential vibration impacts for each segment. Complete maps and tables of the vibration impacts are provided in the *Noise and Vibration Results Report*.

Segment A: Inner Portland (including Marquam Hill Connection Options)

Alternative A1 would have the highest number of vibration impacts of the Segment A alignment alternatives, with vibration impacts identified along both sides of SW Barbur Boulevard. Alternatives A2-BH and A2-LA would have similar impacts, with variations occurring mainly as a result of displacements along SW Naito Parkway under the limited access alternative. Alternatives A2-BH and A2-LA would have a lower number of impacts than Alternative A1, because there are fewer vibration-sensitive uses along SW Naito Parkway than along SW Barbur Boulevard. South of SW Hamilton Street, Alternatives A1 and A2 would have the same vibration impacts, including the impacts to the southernmost group of single-family homes located at the connection to Segment B along SW 2nd Avenue. Finally, there would be no vibration impacts related to the Marquam Hill connection options.

Segment B: Outer Portland

All four of the Segment B alignment alternatives would have the same vibration impacts north of SW Terwilliger Boulevard near SW 2nd Avenue. Vibration impacts under Alternatives B1 and B2 would be essentially the same, with impacts along both sides of SW Barbur Boulevard and with slightly fewer vibration impacts south of SW Capitol Highway under Alternative B2. Vibration impacts under Alternative B3 would be similar to those under Alternative B2 north of SW 26th Avenue, but Alternative B3 would have fewer impacts, because the alignment transitions to I-5. Under Alternative B4, there would be several vibration impacts between SW 13th Avenue and SW 26th Avenue that would occur only under this alternative. Between SW 26th Avenue and the Barbur Transit Center, there would be no vibration impacts under Alternative B4. South of the Barbur Transit Center, impacts under Alternative B4 would be the same as those for Alternatives B2 and B3.

Segment C: Tigard and Tualatin

The majority of vibration impacts under Alternatives C1, C2, C5 and C6 would occur in the northern part of the corridor south of the Baylor Park and Ride, with additional vibration impacts near the Tigard Transit Center. Alternatives C3 and C4 would have the fewest number of vibration impacts, because these alignments would avoid the residential area south of SW Dartmouth Street and would remain north of the downtown residential areas.

O&M Facilities Options

Vibration impacts from the potential O&M facilities options were also included in this analysis, and none were found to have a potential for increased vibration at any nearby vibration-sensitive property.

4.11.5. Short-Term Impacts – Noise and Vibration

Construction Noise Regulatory Information

Local noise ordinances and regulations govern noise for project construction. Regulations and ordinances that are applicable to project construction include those from the cities of Lake Oswego, Portland, Tigard and Tualatin. Each of these jurisdictions has periods when most construction activities are exempt. General exemptions for construction during daytime hours by jurisdiction are:

- 7 a.m. to 6 p.m. in Lake Oswego
- 7 a.m. to 6 p.m. in Portland

- 7 a.m. to 8 p.m. in Tigard
- 7 a.m. to 6 p.m. in Tualatin

Any proposed construction outside the hours listed above would require a noise variance from the local jurisdiction. Noise variances typically limit noise levels and construction times depending on the land use in the area and the type of construction.

Construction Noise

Construction of any alignment alternative would result in construction-related noise. Noise related to construction varies greatly depending on the type of construction activity, the duration of the activity, the distance between the receiver and the source, and the topographical conditions between the source and receiver. In general, construction noise levels produced for this project would be similar to noise produced for most major transportation projects. As provided in the FTA Manual (2006), typical construction noise levels were predicted using the FHWA *Roadway Construction Noise Model* (FHWA, 2006). These predictions use reference noise levels from typical construction equipment and account for typical equipment operation, including typical noise levels when the equipment is loaded and typical operational times. The actual noise levels expected during construction would generally be lower than those presented, because it is unlikely that all of the equipment would be running at once at a given site. Table 4.11-4 provides a summary of the major construction phases for a typical light rail project and the worst-case noise levels for each of these phases as measured at a distance of 50 feet from the construction site.

Table 4.11-4. Summary of Construction Phases and Noise Levels

Scenario	Equipment	Lm (dBA)[1]	Leq (dBA)[2]
Demolition, site preparation and utility relocation	Air compressors, backhoe, concrete pumps, crane, excavator, forklifts, haul trucks, loader, pumps, power plants, service trucks, tractor trailers, utility trucks, vibratory equipment	94	87
Structure construction, track installation and paving	Air compressors, backhoe, cement mixers, concrete pumps, crane, forklifts, haul trucks, loader, pavers, pumps, power plants, service trucks, tractor trailers, utility trucks, vibratory equipment, welders	94	88
Miscellaneous activities	Air compressors, backhoe, crane, forklifts, haul trucks, loader, pumps, service trucks, tractor trailers, utility trucks, welders	91	83

Source: Michael Minor & Associates, Inc. modeling of construction noise using the FHWA Construction Noise Model (FHWA, 2006).

[1] Lm is approximately equal to the Lmax, or the loudest one-second period.

[2] The Leq is for a typical worst-case hour of active construction.

For areas with elevated structures, or occasionally for shoring up weak soils, driving of support piles or sheet piles may be required. Workers would install piles using a standard pile-driver, which can produce impact noise levels up to 105 dBA Lmax (the loudest one-second period) at 50 to 100 feet.

Construction Vibration

Construction-related vibration levels depend greatly on the construction equipment and methods in use. Major sources of construction vibration include impact pile drivers, large track-mounted jackhammers used for demolition (hoe-rams) and vibratory rollers used for compacting soils. Construction has the potential to affect vibration-sensitive equipment, produce rumbling, and in rare circumstances, cause damage to buildings. In general, construction-related vibrations are assessed where prolonged annoyance or damage could be expected.

4.11.6. Potential Mitigation Measures

Light Rail Operational Noise

TriMet is committed to maintaining a quiet and effective transit system. This commitment includes using state-of-the-art vehicles equipped with wheel skirts, periodic rail grinding or replacement, wheel truing or replacement, vehicle maintenance and operator training, which all help to reduce noise levels along transit corridors. For noise impacts that would still exist after these source noise treatments, potential noise mitigation measures that are consistent with the FTA requirements would be considered.

The potential mitigation options available for noise would primarily be sound walls. Sound walls would be proposed where they can be feasibly and reasonably constructed. Sound walls would be located along the side of the light rail infrastructure for elevated profiles, and on the ground for at-grade or cut profiles. Sound walls are usually the first option for noise mitigation, because they are effective at reducing noise near the source, along the path between the source and the receiver.

Another potential mitigation measure is special track work. Special track work includes movable point or spring rail frogs, which eliminate the gap between tracks at crossovers that causes noise and vibration at these locations.

When source mitigation measures or sound walls are infeasible or not entirely effective at reducing noise levels below the FTA impact criteria, residential sound insulation would be evaluated on a case-by-case basis. This form of mitigation is implemented only for affected properties where the existing building does not already achieve a sufficient exterior-to-interior reduction of noise levels. Most newer buildings have good exterior-to-interior noise reduction, and additional sound insulation might not be necessary.

TriMet's primary method of mitigating wheel squeal is through the use of a vegetable-based trackside lubrication system. These systems periodically apply a lubricant or friction modifier near the location of the squeal, which allows the light rail wheels to slip on the rail without producing noise. In some cases, TriMet uses personnel to manually lubricate tracks in specific areas where wheel squeal occurs infrequently. Because of this fact, the noise model did not account for wheel squeal; however, TriMet's policy of providing lubrication to mitigate noise from wheel squeal would ensure that all squeal impacts would be mitigated.

Noise mitigation for the park and rides includes station design and sound walls. Station design can include short noise barriers, and modifying the entrances and exits to place them away from nearby noise-sensitive properties. In addition, noise barriers can be placed between the station and the noise-sensitive properties, thus reducing noise levels and eliminating noise impacts.

With noise mitigation measures, the majority of, if not all, noise impacts would be mitigated.

Light Rail Operational Vibration

Vibration impacts that exceed the FTA criteria would be mitigated when such mitigation was determined to be reasonable and feasible. The specific locations requiring mitigation would be determined during the final design process. Because there are locations where the alignment would be close to buildings, mitigation of some vibration impacts could be difficult. As the design is further developed, vibration propagation testing will be performed and data used to further refine the

identification of impacts and the incorporated mitigation measures. This information will be presented in the Final EIS.

Mitigation could include the use of high compliance direct fixation fasteners, also known as HCDF fasteners, to provide vibration isolation between rails and concrete slabs. These fasteners include a resilient element between the rail and concrete to provide greater vibration isolation than standard rail fasteners.

For at-grade segments, where ballast and tie track are used, the primary form of vibration mitigation are ballast mats. Ballast mats consist of a pad made of rubber or rubberlike material placed on an asphalt or concrete base, with the normal ballast, ties and rail on top. The reduction in vibration provided by a ballast mat depends greatly on the vibration frequency content and the design and support of the mat. For direct fixation track and along elevated trackways, resilient fasteners are commonly used. Resilient fasteners are also made of vibration-reducing materials, and are placed between the rails and the concrete base or ties.

To mitigate vibration impacts related to the added vibration from track crossovers, special track work could be employed. Special track work includes movable point or spring rail frogs, which eliminate the gap between tracks at crossovers that causes increased vibration.

With vibration mitigation measures, the majority of, if not all, vibration impacts could be mitigated.

Construction Noise

Project construction noise would be in accordance with the local noise-control regulations. Generally, most work will occur between 7 a.m. and 7 p.m. Any potential nighttime construction noise would be restricted to the levels authorized by applicable regulations or variances issued to the project. The contractor would have the flexibility of either prohibiting certain noise-generating activities during nighttime hours or providing additional noise-control measures to meet these noise limits. Noise control for nighttime or daytime work could include the following measures, as necessary, to meet required noise limits:

- install construction site sound walls by noise-sensitive receivers
- during nighttime work, use smart backup alarms that automatically adjust or lower the alarm level or tone based on the background noise level
- use low-noise emission equipment
- implement noise-deadening measures for truck loading and operations
- conduct monitoring and maintenance of equipment to meet noise limits
- use lined or covered storage bins, conveyors and chutes with sound-deadening material
- use acoustic enclosures, shields or shrouds for equipment and facilities
- install high-grade engine exhaust silencers and engine-casing sound insulation
- prohibit nighttime above-ground jack-hammering and impact pile-driving
- minimize the use of generators or use whisper-quiet generators to power equipment

- limit use of public address systems
- use movable noise barriers at the source of the construction noise
- implement pile-driving mitigation measures that focus on limiting the time of day the activity can occur.

Construction Vibration

Measures to minimize short-term annoyance from construction vibration include use of alternate methods with less vibration, such as drilled shafts in place of driven piles or the use of static roller compactors rather than vibratory roller compactors. Activities with potential for short-term annoyance could also be restricted to shorter periods and daytime hours, when vibration is less noticeable.

4.12. Air Quality and Greenhouse Gases

This section reviews potential effects on air quality and greenhouse gases (GHGs) from the project. Air pollutants can affect human and environmental (flora and fauna) health. Transportation systems, including light rail projects, can have beneficial and adverse effects to air quality and GHG emissions during construction, operation and maintenance activities.

4.12.1. Affected Environment

The federal government has established National Ambient Air Quality Standards (NAAQS) for six pollutants known as "criteria pollutants." These include carbon monoxide (CO), lead, ozone, nitrogen dioxide, sulfur dioxide, and particulate matter (PM). Oregon also has State Ambient Air Quality Standards (SAAQS), which are at least as stringent as the NAAQS. The U.S. Environmental Protection Agency (EPA) has delegated the implementation of the air quality program to the Oregon Department of Environmental Quality.

Nonattainment areas are geographical regions where air pollutant concentrations exceed the NAAQS for a pollutant. Air quality maintenance areas are regions that have historically been in nonattainment for an air quality standard but have achieved compliance through improved planning and control measures. As of October 2017, the Portland area maintenance period ended, and transportation conformity no longer applies for CO NAAQs. However, the terms of the maintenance plan remain in effect. For example, the region must comply with transportation control measures and all measures and requirements contained in the plan until the state submits a revision to the plan and it is approved by the EPA. The region is in compliance for all other criteria pollutants.

Executive Order 13783 (March 28, 2017) required federal agencies to revise or rescind climate change rules and policies; therefore, there is currently no federal guidance on how to address GHG emissions in environmental documents for transportation projects. As a result, this document assesses GHG emissions in a manner consistent with the Council on Environmental Quality guidance from August 2, 2016.

4.12.2. Long-Term Impacts

The project's regional impact assessment for air quality and GHGs consists of emissions estimates associated with three scenarios: (1) existing conditions; (2) the No-Build Alternative, which looks at future conditions without the project; and (3) a Light Rail Alternative, which looks at future conditions with the maximum build-out (full-length light rail alignment that assumes the largest capacity under

consideration for each proposed park and ride) of the Southwest Corridor Light Rail Project. These emissions were estimated using vehicle activity data generated by the regional transportation model and local emissions rates produced by the current version of the EPA's emissions model (MOVES 2014a). For CO and GHGs, the estimates represent average weekday conditions in July, the time of year with the greatest impact of these pollutants due to weather conditions and seasonal traffic patterns. Estimates include emissions associated with passenger and freight vehicles, and correspond to the entirety of the four counties present in the regional transportation model network: Clackamas, Multnomah and Washington counties in Oregon and Clark County in Washington. Given that the analysis region contains vehicles subject to multiple inspection and maintenance regimes, separate sets of emissions rates were produced for the following fleets: (1) Oregon-inspected vehicles, (2) Washington-inspected vehicles and (3) non-inspected vehicles. GHG emissions are reported in terms of carbon dioxide (CO_2) equivalent, which includes the three primary GHGs (CO_2, methane [CH_4] and nitrous oxide [N_2O]). The idea is to express the impact of each different GHG in terms of the amount of CO_2 that would create the same amount of potential global warming. In this way, GHGs can be expressed as a single number.

Chapter 1 – Project Introduction summarizes the expected increase in growth for the region and corridor over the next 20 years. Based on that expected growth and the impacts assessment, Table 4.12-1 summarizes the difference in daily emissions between the three scenarios. Despite the growth in population and households that would result in more people driving, vehicle emissions are projected to be much lower in 2035 than today for the Light Rail Alternative and the No-Build Alternative. The reductions in emissions are primarily a result of improvements in technology and more stringent vehicle inspection and maintenance programs. Because of these improvements, there is no meaningful difference between the No-Build Alternative and the Light Rail Alternative in future (2035) regional daily emissions. Similarly, there would be negligible differences among the various alignment alternatives.

Table 4.12-1. Regional Daily Emissions

Scenario	GHGs (pounds)[1]	CO (pounds)
Existing Conditions (2015)	44,196,163	384,789
No-Build Alternative (2035)	35,891,438	134,589
Light Rail Alternative (2035)	35,849,052	134,485

[1] GHG emissions are reported in terms of carbon dioxide (CO_2) equivalent, which includes the three primary GHGs: CO_2, methane (CH_4) and nitrous oxide (N_2O).

This analysis also referenced the FTA-issued *Greenhouse Gas Emissions from Transit Projects: Programmatic Assessment* (January 2017) and the *Greenhouse Gas Emissions Estimator Tool* (November 2016) developed to estimate GHG emissions of the light rail alternatives for construction and ongoing operations and maintenance. Consistent with the regional transportation model, the programmatic assessment and estimator tool indicate a reduction in GHG emissions with construction, maintenance and operation of the project.

4.12.3. Short-Term Impacts

Construction of the light rail alternatives would involve activities that could temporarily affect air quality, such as operating heavy construction equipment, on-road construction activities and potential activities at staging sites. Traffic congestion will occur on some roadways during construction, and

potentially along detour or construction haul routes. The primary impacts will be the generation of dust from demolition, site clearing, excavation and grading activities; direct exhaust emissions from construction equipment; and increased congestion on SW Barbur Boulevard and local streets.

4.12.4. Mitigation

The region is in attainment for criteria pollutants, so no long-term mitigation is proposed.

During construction, contractors are required to comply with state regulations (Oregon Administrative Rule [OAR] 340-208-0210) requiring that reasonable precautions be taken to avoid dust emissions. Mitigation measures normally used include applying water or suppressants during dry weather and taking other measures, such as truck and equipment washing, to prevent the transport of dirt and dust from construction areas onto nearby roads.

Strategies to minimize the occurrence and effects of construction-related congestion will be developed throughout the design of the project. These strategies will include refining alternatives, further analyzing traffic impacts and developing detailed construction traffic mitigation plans.

4.13. Energy

This section summarizes transportation energy consumption and evaluates the impacts to energy demand on utilities in the Portland metropolitan area for the Southwest Corridor Light Rail Project. It discusses long-term, short-term, indirect and cumulative impacts. The analysis considers the consumption impacts during construction, maintenance and operation.

4.13.1. Affected Environment

The study area for this analysis includes the entirety of Clackamas, Multnomah and Washington counties in Oregon, and Clark County in Washington. Transportation energy consumption for the base year (2015) in this area is composed of energy used for passenger vehicles, heavy-duty trucks and transit, which includes buses, streetcar, light rail and commuter rail. Table 4.13-1 summarizes daily energy consumption for each vehicle type based on daily vehicle miles traveled (VMT) and assumed energy consumption factors (fuel use) for each. In 2015, total daily transportation energy consumption in the Portland metropolitan area is estimated at 251,723 million British thermal units (Btu) per day (Btu/day).

Operation of the light rail system is powered by electricity. Renewable energy sources, such as hydroelectric power and wind, contribute to more than half of the net electricity generated in Oregon. The State of Oregon's Renewable Portfolio Standard requires, by 2040, that 50 percent of the electricity Oregonians use come from renewables.

4.13.2. Long-Term Impacts

No-Build Alternative

Under the No-Build Alternative, the daily VMT for the Portland metropolitan area is expected to increase from approximately 44.4 million VMT in 2015 to approximately 54.0 million VMT in 2035. The increase in VMT would result in an expected transportation energy consumption of 327,009 million Btu/day. The increase in the number of passenger vehicles is expected to create greater levels of

congestion and slower speeds on the transportation system, which could place additional demands on energy in the region.

Table 4.13-1. Existing (2015) and No-Build (2035) Daily Vehicle Miles Traveled and Energy Consumption

Vehicle Type	Consumption Factor[1]	Existing Conditions		No-Build Conditions	
		Daily VMT	Million Btu/Day	Daily VMT	Million Btu/Day
Passenger vehicle	4,839	42,285,435	204,619	51,474,286	249,084
Heavy-duty trucks	21,573	1,995,645	43,052	3,389,982	73,132
Transit bus[2]	35,419	84,301	2,986	100,122	3,546
Light rail (transit)[3]	64,964	16,415	1,066	19,189	1,247
Total		44,381,796	251,723	54,983,579	327,009

Source: Metro, 2017; TriMet, 2017.

Notes: VMT = vehicle miles traveled; Btu = British thermal unit.

VMT data correspond to the entirety of Clackamas, Multnomah, Washington and Clark (WA) counties.

[1]Transportation Energy Data Book: Edition 35, 2016. Table 2.14, Table 2.15 and Table 2.17.

[2]Transit VMT include service miles only.

[3]Includes streetcar and commuter rail.

Light Rail Alternatives

The long-term direct energy impacts of the full-corridor light rail are based on projected year 2035 regional traffic volumes and daily VMT consistent with Metro data and the transit modeling performed as part of the transportation analysis for the project. The anticipated energy required to operate the project was estimated using the daily VMT estimates for what is referred to in this section as the Light Rail Alternative, which looks at future conditions with the maximum build-out (full-length light rail alignment that assumes the largest capacity under consideration for each proposed park and ride) of the Southwest Corridor Light Rail Project compared to the No-Build Alternative.

The daily VMT, energy consumption rate and total energy consumption for the No-Build Alternative and the Light Rail Alternative are presented in Table 4.13-2. Compared to the No-Build Alternative, the Light Rail Alternative would result in a reduction of passenger vehicle and transit bus VMT as people shift their demand to the light rail system.

Table 4.13-2. 2035 Daily Vehicle Miles Traveled and Energy Consumption

Vehicle Type	Consumption Factor[1]	No-Build Conditions		Light Rail Alternative	
		Daily VMT	Million Btu/Day	Daily VMT	Million Btu/Day
Passenger vehicle	4,839	51,474,286	249,084	51,415,071	248,798
Heavy-duty trucks	21,573	3,389,982	73,132	3,389,288	73,117
Transit bus[2]	35,419	100,122	3,546	97,501	3,453
Light rail (transit)[3]	64,964	19,189	1,247	21,200	1,377
Total		54,983,579	327,009	54,923,060	326,745

Source: Metro, 2017; TriMet, 2017.

Notes: VMT = Vehicle Miles Traveled; Btu = British thermal unit.

VMT data correspond to the entirety of Clackamas, Multnomah, Washington and Clark (WA) counties.

[1]Transportation Energy Data Book: Edition 35, 2016. Table 2.14, Table 2.15 and Table 2.17.

[2]Transit VMT include service miles only.

[3]Includes streetcar and commuter rail.

Expanding the light rail system would place increased demand on the local electricity utilities, but there is no shortage of power in the Portland region that would indicate the utilities could not handle the increased demand. Overall daily energy use during project operation is expected to result in approximately 0.07 to 0.08 percent less energy use than the No-Build Alternative. This percentage is the equivalent of the daily energy consumption of just over two households.

4.13.3. Short-Term Impacts

For assessing impacts to energy consumption that would occur from construction of the Southwest Corridor Light Rail Project, the analysis focused on the Light Rail Alternative described above.

The estimated energy consumption during construction of the project is 5,886,876 million Btu. The level of energy required for project construction is based on preliminary engineering and anticipated construction costs developed by the project team in October 2017. Using this information, estimated levels of energy consumption are developed. This amount (5,886,876 million Btu) represents less than 8 percent of the total Portland General Electric 2016 power distribution and would be a temporary impact to energy resources for the duration of construction. The one-time energy use required to construct the Light Rail Alternative would be offset by the project's long-term, beneficial operational impacts.

4.13.4. Potential Mitigation Measures

Operation of the project would not affect the regional power supply and would reduce overall energy consumption for the total transportation system compared to the No-Build Alternative. Therefore, no mitigation measures are necessary.

4.14. Hazardous Materials

This section summarizes potential impacts caused by existing hazardous materials sites that could be encountered by the light rail alternatives for the Southwest Corridor Light Rail Project. Some of these sites may require further measures to address existing contamination or to avoid risks to human health and the environment. The section also considers the potential for the light rail alternatives to expose people or the environment to hazardous materials, and discusses potential long-term, short-term, indirect and cumulative impacts, as well as potential mitigation measures.

4.14.1. Affected Environment

The hazardous materials analysis study area comprises the construction limits of the project plus a 400-foot buffer. The study area is largely developed and contains 909 potential hazardous materials sites. Many of the potential hazardous materials sites are listed on state and federal regulatory databases. This analysis considers how close a site of concern is to the construction footprint, whether known hazardous materials have been released, the type of hazardous materials released and the cleanup status of the site. Appendix B4.14 has more details on these methods and individual sites.

The hazardous materials analysis reviewed past land uses that could have involved hazardous materials, using fire insurance maps dating back to 1909. This approach helped identify businesses that might have used or stored hazardous materials or petroleum products, including gasoline/service stations, wrecking yards, machine shops, dry cleaners and foundries; there were 15 such sites.

Figure B4.14-1 in Appendix B4.14 shows all of the hazardous material sites identified in the study area, and highlights those that would potentially pose the highest concerns for construction, containment or cleanup during project development. Any hazardous material site within the study area could impact humans or the environment; however, for the remaining discussion, potential impacts are focused on parcels that will be acquired, whether in their entirety or only a portion of the parcel, because cleanup for these sites may be triggered as part of project construction activities. These sites are described in this analysis as "priority hazardous material sites." In the study area, the priority hazardous material sites identified for acquisition are described below. The identification numbers correspond to the site numbers assigned in Appendix B4.14:

- **Heating oil tank (197, 201, 329).** Two of the three heating oil tanks had reported leaks, but no completed cleanup was reported to the State of Oregon. Cleanup of such sites, which often consists of excavating and disposing of contaminated soils, is typically more minor than cleanup of contaminated sites that might require remediation over time.

- **Fuel station (220).** The former fuel station site historically had underground storage tanks that required cleanup, and underground tanks still exist on-site. To re-use this site, any remnants of the fuel system and tanks would need to be decommissioned, and any soil or groundwater contamination would require cleanup and potential remediation.

- **Pesticide manufacturing facility and associated properties (318, 325, 326).** This facility (with two parcels) and adjacent railroad right of way were impacted by the manufacturing and transport of pesticides and associated ingredients. Institutional and engineering controls were implemented at the site, though contamination likely remains.

- **Electronic and automotive manufacturing facility (380).** This facility has documented trichloroethane (TCE) contamination in shallow groundwater and soil contamination. The Oregon Department of Environmental Quality (DEQ) considers this site to be of particular concern, and even if the party responsible for the release undertakes the cleanup and remediation, this site could require additional investigation, and will likely require cleanup and remediation as well, before or during project construction.

- **Metals manufacturing facility (382, 392)**. One of the two facilities had both state and federal actions related to soil and surface water contamination from chrome plating activities at the site. Although the federal requirements for cleanup were met, remaining soil contamination and likely surface water impacts at the site are still of concern to the state.

- **Warehouse with underground storage tank (UST) (342).** This site had a leaking diesel UST that was decommissioned and cleaned up. Though a matrix soil cleanup was completed, there is the potential that soil contamination remains. Any additional cleanup at this site is likely to be relatively minor in scale.

- **Foundry (352).** This site had multiple releases that have been cleaned up as required by the state, but site restrictions remain in place because of remaining lead contamination in the soil, benzene in the groundwater and potential impacts to nearby surface water.

4.14.2. Long-Term Impacts

Permanent property acquisition for the project can trigger hazardous materials impacts where any hazardous material site requires additional investigation, and possible cleanup and remediation before or during construction. These impacts are described in this section as long-term impacts, although some of the actions occur during construction (construction impacts are typically considered to be short-term impacts). Long-term impacts can occur where hazardous materials might remain present on properties acquired for the project and could potentially impact humans or the environment after the project is constructed. Some of the activities involved, such as ongoing cleanup and remediation on previously contaminated sites, could extend beyond project completion. Potential cleanup or remediation of contaminated sites is discussed further in Appendix B4.14.

Section 4.13, Energy, discusses the predicted future increase in vehicle miles traveled for passenger vehicles, heavy-duty trucks and transit buses for the full-corridor light rail alternatives based on 2035 regional traffic volumes. Assuming these vehicles continue to operate using petroleum products, all of the study alternatives, including the No-Build Alternative, will have the potential for hazardous materials releases due to accidents. However, in most cases the quantities of hazardous materials released would be low.

No-Build Alternative

Under the No-Build Alternative, any potential hazardous materials impacts would be related to the implementation of projects other than the Southwest Corridor Light Rail Project. Given the uncertainty in scope and number of projects that could be implemented within the study area, potential impacts from hazardous materials is unknown.

Light Rail Alternatives

Segment A: Inner Portland (Including Marquam Hill Connection Options)

There are no priority hazardous material sites located on parcels to be acquired for the project within Segment A.

Segment B: Outer Portland

All four of the Segment B alignment alternatives have the same three priority hazardous material sites that would be acquired (see Table 4.14-1). Two of the sites involve heating oil tank releases where contaminated soils might still be present but do not appear likely to be a long-term concern (heating oil tank releases generally impact soils only and are limited in extent). The other site is a former fuel station that may require cleanup and remediation activities that could extend beyond project completion.

Table 4.14-1. Priority Hazardous Material Sites Impacting Alignment Alternatives in Segment B: Outer Portland

ID Number	Site Type	Address	Alignment Alternatives			
			B1	B2	B3	B4
197	Heating Oil Tank Release	9400 SW Pacific Hwy.	●	●	●	●
201	Heating Oil Tank Release	9511 SW Barbur Blvd.	●	●	●	●
220	Fuel Station	10000 SW Barbur Blvd.	●	●	●	●

Notes: ID numbers correspond to site numbers assigned in Appendix B4.14.

Segment C: Tigard to Tualatin

The alignment alternatives in Segment C traverse an area with a long history of manufacturing and industrial uses, many of which continue today. All of the Segment C alignment alternatives would acquire parcels with hazardous materials. There are seven priority hazardous materials sites on parcels to be acquired for the project in this segment (see Table 4.14-2). Five of these seven priority hazardous material sites will likely have existing contamination issues that could require additional cleanup and remediation activities that could extend beyond project completion.

Table 4.14-2. Priority Hazardous Material Sites Impacting Alignment Alternatives in Segment C: Tigard and Tualatin

ID Number	Site Type	Address	Alignment Alternatives					
			C1	C2	C3	C4	C5	C6
318	Railroad Right of Way (contamination associated with Former Pesticide Manufacturing and Storage)	Railroad Right of Way West of 8900 SW Commercial St.	●	●	●	●	●	●
325	Former Pesticide Manufacturing and Storage	8900 SW Commercial St.	N/A	N/A	●	●	N/A	●
326	Former Pesticide Manufacturing and Storage, Currently Automotive	8848 SW Commercial St.	N/A	N/A	●	●	N/A	●
329	Heating Oil Tank and Hardware/Garden	12545 SW 72nd Ave.	●	●	N/A	N/A	●	●
380	Manufacturing/Electronic/ Automotive, with soil and groundwater contamination	14100 SW 72nd Ave.	●	N/A	●	N/A	N/A	N/A
382	Metals/Manufacturing	7350 SW Landmark Ln.	●	N/A	●	N/A	N/A	N/A
392	Metals/Manufacturing, with soil and groundwater contamination	7320 SW Bonita Rd.	N/A	●	N/A	●	N/A	N/A

Notes: ID numbers correspond to site numbers assigned in Appendix B4.14.
N/A = Not Applicable.

Although there are seven priority hazardous material sites in Segment C, any one individual alternative would be affected by somewhere between two to five of them (see Table 4.14-2). All of the alignment alternatives have a portion of their alignment within the right of way of a railroad (Southern Pacific Railroad) that has had recorded hazardous materials releases. The railroad property has completed cleanup, remediation and control activities as required by the state, but contamination likely remains.

The other hazardous material sites in Segment C have varied issues, but several involve hazardous materials or chemical releases to soils and groundwater, and the Oregon DEQ is involved. Alternatives

C1: Ash to I-5 and C3: Clinton to I-5 would encounter a manufacturing site that has contaminants in soils and shallow groundwater, and DEQ has called for further investigation and potential cleanup and remediation. This site could also involve further regulatory requirements if it is to be used by the project.

Operations and Maintenance (O&M) Facilities Options

Acquisitions associated with three of the four O&M facilities options being considered for the project would involve identified hazardous material sites (see Table 4.14-3). The Hunziker Facility option would acquire two priority sites. The Hunziker Facility would acquire a foundry that might have existing contamination issues complicated enough to cause cleanup and remediation to extend beyond project completion. The Branched 72nd Facility would acquire one priority hazardous material site. Similar to the foundry, this site could have existing contamination issues that are complicated enough to cause cleanup and remediation to extend beyond project completion. The Through 72nd Facility would not acquire any existing hazardous material sites.

Ongoing operations at the O&M facilities could result in long-term impacts from the use, storage and/or generation of hazardous materials such as fuels, cleaning solvents, paints and lubricants. Although state and federal rules regulate the use, storage and transport of these hazardous materials, there is still the potential over the long term for release of these materials. Generally, these risks are equivalent for all of the O&M facilities options considered.

Table 4.14-3. Priority Hazardous Materials Sites Impacting O&M Facilities Options

ID Number	Site Name	Address	Potentially Affected Options		
			Hunziker	Branched 72nd	Through 72nd
342	Warehouse, with underground storage tank	8100 SW Hunziker St.	●	N/A	N/A
352	Foundry	8200 SW Hunziker St.	●	N/A	N/A
380*	Manufacturing/Electronic/ Automotive, with soil and groundwater contamination	14100 SW 72nd Ave.	N/A	●	N/A

Notes: ID numbers correspond to site numbers assigned in Appendix B4.14.

N/A = Not Applicable.

*Also appears in Table 4.14-2.

4.14.3. Short-Term Impacts

All of the priority hazardous material sites within Segments A, B and C are discussed in the long-term impacts section above. The acquisition and associated cleanup are part of construction, but they are related to the long-term right of way requirements.

Short-term impacts from construction activities could occur as a result of accidental spills and leaks that could affect soils and infiltrate to groundwater, run off with stormwater or enter directly into surface waters. Construction activities such as demolition can expose workers, the public and the environment to hazardous materials, including lead or asbestos. TriMet requires that the handling of such materials during construction or demolition be done according to regulatory protocols, which minimizes these risks. During construction, and particularly during excavation, it is possible for contamination associated with hazardous materials or petroleum to become exposed.

4.14.4. Potential Mitigation Measures

The potential release of hazardous substances and petroleum hydrocarbons occurring from the operation and maintenance of the Southwest Corridor Light Rail Project would be mitigated through the applicable local, state or federal agency regulations or requirements, depending on the circumstances of each incident. Operating plans associated with project O&M facilities would minimize the potential for spills or accidental releases.

All of the properties being acquired for the project would be evaluated through an Environmental Site Assessment (ESA) to reduce the risk of encountering contaminated soils or groundwater during construction without controls already in place. These assessments would be completed before the acquisition of the property as part of the due diligence process, and would include a site inspection, a historical land review, interviews with knowledgeable parties, a survey for hazardous construction materials (i.e., lead and asbestos), and a review of available regulatory database records and files.

If the initial ESA process identifies environmental concerns or if properties being acquired previously have been identified as having releases of hazardous materials or existing contamination (through this evaluation), the property could be subject to a subsurface investigation to determine the existence of contamination, and if it exists, the nature and extent of contamination at the site.

Based on the ESA process, mitigation, handling and disposal plans for contaminated media and hazardous construction debris would be developed on a site-by-site basis in conjunction with the appropriate regulatory agencies.

In addition, hazardous substances and petroleum products used during construction, such as fuels, paints, solvents and other chemicals, would be managed and stored in accordance with the contractor's pollution control plan. The project would implement best management practices in order to reduce the risk of spills, leaks or other releases during construction activities. These best management practices could include:

- fueling, conducting maintenance and cleaning in areas contained by measures such as berms or other containment
- minimizing the production or generation of hazardous materials
- labeling and storing hazardous waste according to federal regulations
- locating hazardous waste storage away from storm drains or surface water
- recycling materials such as used motor oil and water-based paint as appropriate
- handling potential spills of hazardous materials in conformance with applicable Material Safety Data Sheets.

4.15. Utilities

This section reviews the potential long-term, short-term, indirect and cumulative effects on utilities of the light rail alternatives, based on conceptual engineering plans showing locations where the light rail alternatives could encounter a major utility.

4.15.1. Affected Environment

The study area for utilities is 20 feet from the edge of construction. Utilities that run parallel to or intersect with the study area will be identified. All along the light rail alternatives, there are overhead and underground utilities that are owned by public or private entities. These utilities include above- and below-ground facilities such as pipelines, cables and wires that provide water, power and communications services, and remove wastewater and stormwater throughout the study area. The study area for utilities consists of the area to be occupied or altered by the light rail alternatives, including any related improvements. Major utilities within the study area are summarized in Table 4.15-1 and are defined as the primary facilities needed to serve the area, such as large pipes that convey water or wastewater, high voltage transmission lines and primary communications facilities. Within the study area, primary arterial roads, such as SW Barbur Boulevard, are typically major utility corridors.

Table 4.15-1. Overhead and Underground Utilities in the Study Area

Owner	Overhead Utilities	Underground Utilities
Public Entities		
City of Portland	Communications (Bureau of Technology Services)	Water (Water Bureau) Stormwater and sanitary sewer facilities (Bureau of Environmental Services)
City of Tigard		Water, wastewater and stormwater
City of Tualatin		Water
Oregon Department of Transportation		Storm facilities, electrical facilities and fiber optic cable
Tualatin Valley Water District		Water
Clean Water Services (Washington County)		Stormwater and sanitary sewer
Private Entities		
Comcast	Communications	Communications
Frontier Communications	Communications	Communications
Northwest Natural Gas		Natural gas
Portland General Electric	Power	Power
CenturyLink	Communications	Communications

4.15.2. Long-Term Impacts

No-Build Alternative

The No-Build Alternative would not have long-term impacts on utility facilities. However, continued growth in the region, with or without the project, may result in some minor expansions and upgrades over time.

Light Rail Alternatives

The light rail alternatives are not anticipated to pose long-term impacts to utilities, because site-specific conflicts would have already been addressed by design and construction measures, including relocating utilities as appropriate. For underground utilities, there is the potential for stray electrical current to accelerate corrosion, but the project would be designed to include protective measures to avoid transferring current to the utilities. In addition, local utility providers may opt to pay TriMet to upgrade

utility facilities at a cost savings by using contractors who are already mobilized and equipped to perform the work.

The electric energy demands for the project could require upgrades to electrical transmission systems along the corridor, which could involve increasing the capacity of transmission lines, replacing poles or towers and improving electrical substations. Necessary improvements would be determined through consultation with the electrical utility providers, but they would usually involve upgrading existing transmission facilities rather than creating new facilities. More information on the impacts of changes in energy use is included in Section 4.13, Energy.

4.15.3. Short-Term Impacts

No-Build Alternative

Under the No-Build Alternative, no major projects are anticipated that would have short-term impacts on utility facilities.

Light Rail Alternatives

The light rail alternatives have construction that would conflict with existing utilities. This section highlights conflicts with utilities where the relocation of utilities or interruption of service is likely to affect larger service areas or create longer, more complex utility construction and relocation activities. Other, less complex utility conflicts are listed in Table B4.15-1 in Appendix B4.15.

Construction impacts to overhead utilities could occur if the alignment requires road widening and would impact existing power poles or towers. These impacts can involve relocation of the overhead lines and their poles or towers farther from the roadway, but in some cases the lines, poles or towers may need to be moved to adjacent streets. There would also be an impact to an overhead utility in locations where the project raises the grade of the ground or requires a structure that reduces the clearance the utility has for either light rail vehicles or other traffic passing underneath. The overhead utilities would also need to have enough clearance to avoid conflicting with the overhead power line system used for light rail.

Underground utility conflicts along the alignment could also be created where the light rail alternatives would need to lower the existing grade, which could expose or reduce the depth of cover for an underground utility, and require the utility to be moved to a deeper location. In some locations, this can have a ripple effect of impacts to other utilities, especially when several utilities cross each other underground.

Utility relocations can be large projects in themselves and often are conducted as an early phase of the construction of the light rail facility. Underground utilities that are in direct conflict with light rail tracks or structures are normally moved to allow them to be maintained or upgraded in the future without interrupting light rail service. Light rail drainage or stormwater features could also conflict with a utility and require its relocation. TriMet would employ standard design procedures and would closely coordinate with utilities to plan for and conduct a relocation. During final design and before construction, TriMet would conduct utility location surveys to identify and develop avoidance or relocation plans to address utility conflicts. TriMet would also employ standard construction procedures to minimize the potential for damage to utilities and unscheduled disruption to utility

service during construction. Short-term disruptions, typically less than a few hours to a day, may occur when service is switched from an existing utility facility to a relocated one. A short-term shutoff could also occur if a property's connection to a utility needs to be modified.

Most of the utility relocations would be fairly routine, meaning they would be localized, have disruptions of service to few users or have less potential for relocation out of the existing right of way. However, there are several locations where more complex utility relocations would be required, as discussed below. Appendix B4.15 lists the utility impacts by the individual alignment alternatives and the Marquam Hill connection options. The operations and maintenance (O&M) facilities would not impact major utilities; however, because they are large site developments, they would require utility connections. Station access improvements generally would not require utility relocations for sidewalk and bicycle improvements, because those types of improvements do not require full road reconstruction.

Segment A: Inner Portland

All of the Segment A alignment alternatives would have a high number of conflicts with utilities, because they have the majority of their alignments within primary arterials that have many utilities along or crossing them, both overhead and underground. In Segment A, the utilities relocation effort could extend the overall construction duration, because many utilities would need to be relocated.

All of the Segment A alignment alternatives would conflict with a Northwest Natural Gas district regulator station near the rebuilt SW Capitol Highway northbound on-ramp with SW Barbur Boulevard. The district regulator station handles gas distribution for much of the west side of Portland, and it connects to a larger high pressure regional gas transmission line. A relocation of a district regulator station would be more technically complicated than a typical local transmission line relocation, and an appropriate relocation site for the regulatory station would need to be found. The relocation could also involve temporary disruptions in service to a larger area, compared to a more localized line relocation.

All of the Segment A alignment alternatives would impact a Portland General Electric (PGE) substation on SW Naito Parkway near the intersection with SW Barbur Boulevard. A suitable relocation site would be needed, and a temporary disruption in power service to customers would be needed for power to switch over to the new substation.

For all of the Segment A alignment alternatives, impacts to PGE's transmission line that parallels SW Barbur Boulevard in Segment A would require additional right of way to relocate the aerial line. If sufficient right of way beside a widened SW Barbur Boulevard is not available, it could shift the relocation of the transmission line and poles into adjacent areas.

All of the Marquam Hill connection options would impact the 21-inch combined sewer main and two smaller combined sewer mains, a 12-inch and an 8-inch, providing service to the Oregon Health & Science University (OHSU) complex on Marquam Hill. The connection options would also impact the 12-inch water line Barbur Gibbs to Marquam Hill pump main, which is the main potable water source for the OHSU complex, and the Barbur Gibbs Pump Station. There is not a notable difference in impacts among any of the connection options.

Segment B: Outer Portland

There are several cell phone facilities along SW Barbur Boulevard that would require relocation. These facilities typically take more time to relocate than standard utilities, because they are often developed using an easement granted by another property owner. They are also located to physically provide coverage for a specific area, so a relocation site would need to provide customers with the same coverage.

As in Segment A, all of the Segment B alignment alternatives would impact PGE's transmission line running along the southbound side of SW Barbur Boulevard. One of the more complex conflict points is where the alternatives as well as the transmission line cross Interstate 5 (I-5). The elevated structure for Alternatives B2, B3 and B4 would have the most direct conflict with the transmission line, potentially requiring either a relocation or a notable increase in the elevation of this line. Alternatives B3 and B4 would conflict with the City of Portland's I-5 and SW 26th regional water quality facility.

Segment C: Tigard and Tualatin

The Segment C alignment alternatives would have very similar impacts on the number and types of utilities affected. All of the Segment C alignment alternatives have potential impacts to PGE's transmission line where it is parallel to the railroad for approximately a mile, and the transmission line may need to be relocated or raised. While there are other major utilities in the area, the conflicts would be more routine to resolve. This is largely because the alignment alternatives in Segment C are not following primary arterials where major utilities are located, and most of the conflicts are crossings, thus reducing the need for more complex relocations. As noted above, the O&M facilities would not impact utilities but would require new connections.

4.15.4. Potential Mitigation Measures

No significant long-term, indirect or cumulative impacts to utilities have been identified, and no mitigation is required.

For short-term impacts, all affected utility companies would be contacted during the preliminary engineering phase to help locate and map potentially affected utilities and to develop plans to coordinate either protection of the facilities within the construction area or relocation of impacted facilities. Proper coordination with utilities, advance communication to utility customers and the use of standard construction management techniques would minimize disturbance to system users and would also avoid damaging existing facilities that do not require relocation. Temporary utility impacts such as service disruption could occur during construction activities, but in general those impacts are short in duration, and advance communication about outages can minimize the inconvenience to customers. Service interruptions are often controlled by permits required by local jurisdictions.

Typically, new facilities such as poles, conduits or pipe are installed and then service is switched over, thereby minimizing any disruption of service. With these measures in place, no significant impacts to utilities are expected, and no additional mitigation measures would be required.

4.16. Public Services

This section reviews the impacts of the Southwest Corridor Light Rail Project to major public services. The impact analysis considers emergency service provision, which includes law enforcement, fire protection, rescue and emergency medical services, and hospitals. It also considers schools and school

transportation, postal service and solid waste services. The analysis focuses on whether the light rail alternatives would affect the service providers' ability to fulfill their missions to the community. It evaluates the long-term, short-term, indirect and cumulative impacts to the service providers' facilities, services and response routes, as well as the level of demand.

4.16.1. Affected Environment

There are many public services within the study area, which extends 0.5 mile from the light rail alternatives. Key public service facilities are shown in Figure 4.16-1, including police stations, fire stations, hospitals, schools and one post office. Impacts to existing transit service are discussed in Chapter 3 – Transportation Impacts and Mitigation.

Within the study area, three jurisdictions provide law enforcement: the Cities of Portland, Tualatin and Tigard. Fire protection, rescue and emergency medical services are provided by the City of Portland and Tualatin Valley Fire and Rescue. The City of Portland Police Bureau Central Precinct serves the portion of the study area within Portland. The Cities of Tigard and Tualatin each have police departments that provide law enforcement for their respective jurisdictions. The City of Tualatin also has an Intergovernmental Agreement to assist the City of Tigard when needed.

In addition to fire protection services, the fire departments within the jurisdictions listed above also provide hazard response and emergency medical services. Portland Fire and Rescue has four stations that serve the study area within Portland. The Tualatin Valley Fire and Rescue Command Center and Station 51 serve the portions of the study area within Washington County. Emergency medical transportation is a joint effort on the part of the Cities, Washington County and private ambulance companies, which include American Medical Services in Multnomah County and Metro West in Washington County. The northern portion of the study area is home to several hospitals and medical centers.

There are multiple public schools within the study area. The northern part of the study area is within the boundaries of the Portland School District and is served by five elementary schools, three middle schools and two high schools. The southern part of the study area is within Tigard-Tualatin School District boundaries and is served by one elementary school, one middle school and two high schools.

Within the study area, there is one U.S. Post Office facility, located in Tigard. Throughout the study area, local jurisdictions contract solid waste and recycling services to a number of private entities, although the services remain public. Solid waste and recycling collection services in the study area are provided by Arrow Sanitary, Heiberg Garbage Service, Waste Management Service, Pride Disposal and Republic Services. While the routes extend well beyond the study area, there are no solid waste and recycling collection and disposal facilities in the study area.

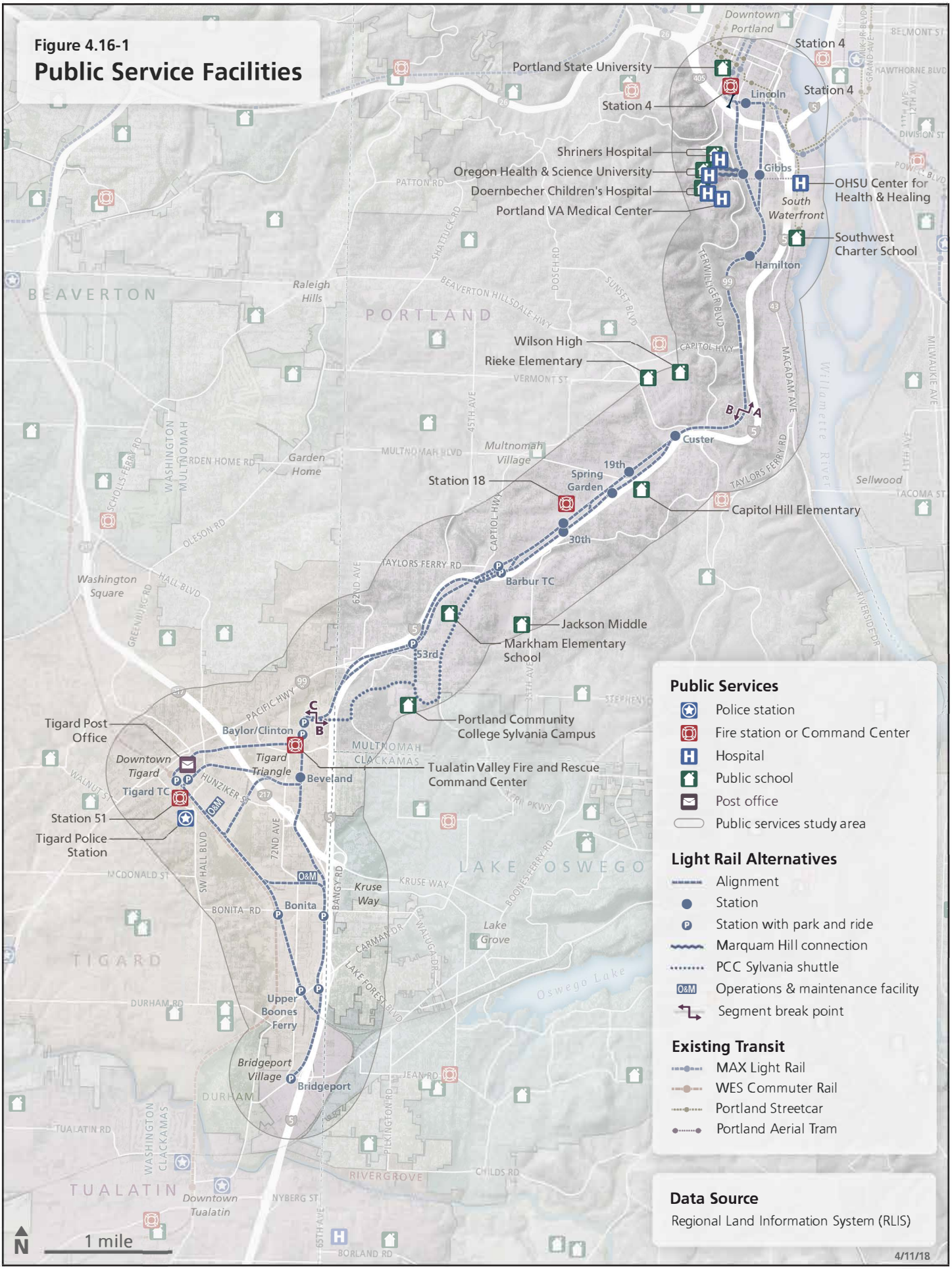


Figure 4.16-1
Public Service Facilities
Portland State University
Station 4
Station 4
Lincoln
Station 4
Shriners Hospital
Oregon Health & Science University
Doernbecher Children's Hospital
Portland VA Medical Center
Gibbs
OHSU Center for Health & Healing
South Waterfront
Southwest Charter School
Hamilton
Wilson High
Rieke Elementary
Custer
Station 18
19th
Spring Garden
Capitol Hill Elementary
30th
Barbur TC
Jackson Middle
Markham Elementary School
53rd
Portland Community College Sylvania Campus
Tigard Post Office
Baylor/Clinton
Downtown Tigard
Tigard Triangle
Beveland
Tualatin Valley Fire and Rescue Command Center
Tigard TC
Station 51
Tigard Police Station
Bonita
Kruse Way
Lake Grove
Upper Boones Ferry
Bridgeport Village
Bridgeport
Downtown Tualatin
Public Services
Police station
Fire station or Command Center
Hospital
Public school
Post office
Public services study area
Light Rail Alternatives
Alignment
Station
Station with park and ride
Marquam Hill connection
PCC Sylvania shuttle
Operations & maintenance facility
Segment break point
Existing Transit
MAX Light Rail
WES Commuter Rail
Portland Streetcar
Portland Aerial Tram
Data Source
Regional Land Information System (RLIS)
N
1 mile
4/11/18

4.16.2. Long-Term Impacts

No-Build Alternative

As the region and the communities in the study area grow, there will be increased demand for public services. Additional services and facilities will be needed to maintain adequate service levels. Individual public service providers regularly plan for this growth as part of their normal operations.

Transportation forecasts for the region also predict increased travel and worsening congestion on roadways. With the No-Build Alternative, future congestion could result in delays during peak hours, which could slow emergency response times compared to today. This topic is discussed further in Chapter 3 – Transportation Impacts and Mitigation.

Light Rail Alternatives

There are few differences in impacts to public services between the alignment alternatives. Therefore, the discussion of impacts below applies to all alignment alternatives unless otherwise noted.

Emergency Service Providers

No police or fire and rescue facilities within the City of Portland would need to be relocated for any of the alignment alternatives in Segments A and B. All of the alignment alternatives in these segments would alter the configuration of and conditions on roadways in the study area, as discussed in Chapter 3. These alterations would include modifications to fire and emergency medical services response routes. Along SW Barbur Boulevard, light rail would operate in the median for a large portion of all the alignment alternatives, with Alternative A1 having the largest section of operation in the median. This operation of light rail in the median would result in changes in access, circulation and response times for law enforcement, fire response and other emergency service providers.

The changes to roadways would include new and modified intersections and traffic signals; the addition of crossing gates in some locations; and new or modified structures in other locations. Portland Fire and Rescue relies on a pre-emption Opticam system maintained by the City of Portland Bureau of Transportation. Development of this system in the corridor is considered critical by Portland Fire and Rescue for safety and response times. In portions of the alignment where light rail would operate in the median, crossings of the median would be restricted for general traffic and could also be restricted for emergency vehicles. In addition, these modifications to emergency response routes, configurations and facility types will typically require additional training and new procedures for police, fire and emergency response personnel.

Neither the Tigard Police Department nor the Tualatin Police Department has facilities that would be directly impacted. As within the City of Portland, there would be gated intersections, new traffic signals, new median barriers and other obstacles associated with light rail along critical emergency response routes, such as SW Hall Boulevard, which could delay emergency vehicles.

A portion of property for the Tualatin Valley Fire and Rescue's Command Center and Station 51 would be acquired by all of the Segment C alignment alternatives (see Figure 4.16-1). The area to be acquired is currently vacant and unused; the center and station would not require relocation and would remain fully operational. Alternatives C3 and C4, which both operate on SW Clinton Street, would require more of the property than the other alternatives do.

Shriners Hospitals for Children, Oregon Health & Science University, Doernbecher Children's Hospital and the Veterans Affairs Portland Health Care System are within the study area on Marquam Hill, but their facilities would not be impacted. However, the Segment A alignment alternatives would affect emergency service response routes to the hospitals and could also alter response times along the roadways traversed by the light rail alternatives, including SW Naito Parkway and SW Barbur Boulevard. All options for the Marquam Hill connection are expected to improve access to the hospitals for staff, patients and visitors.

Schools and School Transportation

Alternative B1 would impact a small portion of the grounds of Markham Elementary School. See Section 4.7, Parks and Recreation Resources, for more information. The other alignment alternatives would not affect any school properties. Some bus routes for schools, such as Capitol Hill Elementary School or Markham Elementary School, and in Tigard along SW Hall Boulevard north of the First School Bus Facility, could be minimally affected by movement restrictions, gated crossings or other modifications required for the safe operation of light rail, but vehicle and walking routes would be maintained or improved. Station access improvement options would improve accessibility and safety by adding dedicated sidewalks, bikeways, pedestrian crossings and improved intersections, which would align with the goals of the Safe Routes to School program (Safe Routes). Safe Routes promotes walking and biking to school, and advocates for safer streets.

Postal Service and Solid Waste

Alternatives C3 and C4 would require relocation of the U.S. Post Office on SW Main Street in Tigard. None of the other alignment alternatives would impact postal service or solid waste facilities. Some routes to recycling and solid waste routes might need to be modified because of turn restrictions or other roadway alterations required for the project.

4.16.3. Short-Term Impacts

No-Build Alternative

The No-Build Alternative would not involve construction and would not have short-term impacts to public services.

Light Rail Alternatives

There are few differences in construction impacts to public services between the various alignment alternatives. Unless otherwise noted, the discussion below applies to all of the light rail alignment alternatives.

Emergency Service Providers

During construction in Segments A and B, street or lane closures on major roadways, such as on SW Barbur Boulevard and SW Naito Parkway, would impact law enforcement, fire protection, rescue and emergency medical service operations and emergency response routes, including routes to the hospitals on Marquam Hill. The Marquam Hill connection options would construct facilities to cross SW Terwilliger Boulevard, which would create short-term delays or lane closures for a section of this primary route to the medical centers, although emergency access would be maintained. Complete lane

closures of SW Barbur Boulevard would require alternative fire response plans, and limited access could require multi-unit responses.

Construction in Segment C within Tigard and Tualatin would also increase response times for the Tigard Police Department, Tualatin Police Department, and Tualatin Valley Fire and Rescue.

Schools and School Transportation

Alternative B1 includes partial acquisition of a small portion of the Markham Elementary School property, on the far east side of the baseball field. While this alignment alternative would require the removal of trees and vegetation, construction would be nearly 500 feet away from the nearest building of the school and at a different elevation, such that it is not expected to cause noise or other impacts at levels high enough to disrupt educational activities. No other Segment B alignment alternatives would impact school properties.

Bus routes in all school districts are often adjusted annually to meet changing student needs and population patterns. Coordination with the school districts before construction begins could minimize the impacts of street or lane closures in Portland, Tigard and Tualatin. Current maps available through the Safe Routes program indicate that walking or bicycling routes could be affected by construction.

Postal Service and Solid Waste

Short-term impacts would be the same for all of the alignment alternatives. Although minor adjustments may be needed on some postal routes, construction activities would allow mail delivery and collection services to continue. Solid waste collection would also continue. The light rail alternatives involve land clearing, the demolition of buildings and the removal of debris, which would increase demand for hauling and disposal services. However, on a regional scale, the increased demand would not be significant.

4.16.4. Potential Mitigation Measures

The long-term impacts that the project would have on the routes and operations of public services would be mitigated by planning and coordination with the service providers before the project begins operation. This planning and coordination would include facility design considerations that would support the training needed for public services staff, particularly police, fire and emergency services, so that they can safely and effectively respond to emergencies involving light rail. TriMet already has an existing fire, life and safety coordination program with the City of Portland, which would be expanded to include providers in Tigard and Tualatin as well.

To mitigate for the short-term street and lane closures that would occur throughout the study area during construction, TriMet would work closely with and communicate construction issues to the police departments, fire and emergency service providers, hospitals and ambulance services, schools, the U.S. Postal Service and solid waste collection services. TriMet's standard procedures for light rail construction require notice of closures well in advance and feature ongoing coordination with police, fire and emergency responders during construction planning as well as during construction.

A construction management plan would be developed with the public services providers. It would further define construction-period communications and coordination measures and techniques that would minimize impacts. A construction traffic management plan would also be developed for the

project. It would include traffic control measures such as bypasses, detours, signage and flaggers, which would be used to minimize and avoid delays for emergency responders and minimize impacts to all public services. These plans would be developed in coordination with the cities, school districts and other service providers.

Construction activities might require coordination for the pickup of solid waste or delivery of mail at individual addresses directly along the alignment.

4.17. Safety and Security

This section focuses on public safety considerations for the communities to be served by the project. It identifies direct, indirect or cumulative impacts to public safety that may occur during the project's construction or operation. Section 4.16, Public Services, evaluates impacts involving fire, police and emergency medical service providers, including hospitals. Chapter 3 – Transportation Impacts and Mitigation, considers safety in terms of vehicular, pedestrian, bicycle, freight and rail conflicts.

4.17.1. Affected Environment

The Southwest Corridor is within an urban area where violent crime incidents or other serious crimes are relatively rare. Most police calls in the study area, comprising lands within 0.5 mile of the light rail alternatives, involve property crimes and misdemeanor offences as well as public nuisances or other infractions (identified as "crimes against society").

For the current transit system, TriMet has a dedicated transit police division of assigned staff from local police agencies, operating out of four transit police precincts. The division works cooperatively with local law enforcement agencies, as well as fire and other emergency responders, to respond to incidents. TriMet also works with the federal Transportation Security Administration for specialized services and support. TriMet maintains security systems that include cameras, monitoring devices and communication systems that cover all rail transit centers, light rail stations, transit vehicles and elevators. In addition, contracted security personnel, TriMet operators, supervisors, customer service staff and maintenance workers also serve as visible deterrents to crime and are trained to identify and respond to security concerns. All incidents on the TriMet system are coordinated through the regional 9-1-1 system, allowing the closest available unit to serve as the first responders.

On TriMet's system, approximately one crime is reported per 387,000 rides, or less than one per day. Most crimes reported to the transit police are minor incidents and property crimes such as vandalism. TriMet employs a crime analyst to regularly review incident data, so that the transit police can adjust their safety and security strategies, including patrols, throughout the system.

Table 4.17-1 shows 2016 crime levels within 0.5 mile of each station proposed for the project. In Segment A, much of which is densely populated, property crimes are the most common offense. Segment B has lower rates of crime in all categories, but its station areas are also less densely populated than those in Segment A. Based on reported crime, Segment C has several areas that have higher levels of crime involving property as well as crimes against society, including the areas around the existing Tigard Transit Center and in the Tigard Triangle.

Table 4.17-1. Annual Crime Statistics, by Station Area (2016)

Station Area by Segment[1]	Crimes Against Persons[2]	Crimes Against Property[3]	Crimes Against Society[4]
Segment A: Inner Portland			
Gibbs Barbur	35	345	19
Gibbs Naito	35	359	18
Hamilton	18	205	2
Segment B: Outer Portland			
Custer	12	154	4
19th	9	139	4
Spring Garden	15	155	2
30th Barbur	14	135	2
30th I-5	13	123	1
BTC Barbur	10	131	3
BTC I-5	12	135	1
53rd Barbur	10	129	5
53rd I-5	10	131	5
Segment C: Tigard and Tualatin			
Baylor	43	279	60
Clinton	14	176	13
Beveland	15	176	14
TTC Ash	58	267	106
TTC Clinton	63	280	108
TTC Wall	66	282	110
Bonita I-5	4	80	7
Bonita RR	14	122	13
UBF I-5	5	99	11
UBF RR	4	61	9
Bridgeport	16	284	17

Sources: City of Portland; City of Tigard; City of Tualatin.

Note: BTC = Barbur Transit Center; RR = Railroad; TTC = Tigard Transit Center; UBF = Upper Boones Ferry.

[1] Incidents of crime during 2016 were collected for the area 0.5 mile around each station location.

[2] Crimes against persons include assault offenses, homicide, human trafficking, kidnapping/abduction, sex offenses, sex offenses non-forcible, child neglect, stalking, use of force and bias crime.

[3] Crimes against property include arson, bribery, burglary, counterfeiting/forgery, embezzlement, extortion/blackmail, fraud offenses, larceny offenses, stolen property offenses, motor vehicle break-ins or theft, robbery or vandalism.

[4] Crimes against society include pornography/obscene material, prostitution offenses, weapon law violations, drug/narcotic offenses and animal cruelty.

4.17.2. Long-Term Impacts

All of the light rail alternatives would feature the same safety and security techniques and systems that are applied throughout the regional transit system, which includes the MAX system. TriMet's transit police and contracted security staff patrols and supporting resources, technology, and safety and security systems would be expanded to address the additional facilities developed as part of the project. The agency would continue to apply its established transit rider security program that combines TriMet surveillance and enforcement with public safety resources from other jurisdictions and agencies in the corridor. TriMet would continue to coordinate with agencies that are part of

TriMet's system-wide fire, life and safety program; all of the agencies in the Southwest Corridor already participate in the program.

TriMet's system has other standard safety and security features that would be employed for the Southwest Corridor Light Rail Project. Security cameras are placed on all vehicles and facilities. This includes trains, buses, transit centers and station platforms. Transit police, fare inspection teams and security patrols would serve the new light rail line. TriMet also employs Crime Prevention through Environmental Design (CPTED), which is a multidisciplinary approach to designing public facilities to help deter criminal activity. One of the primary principles of CPTED is to maximize the visibility of a public facility and avoid creating blind or hidden areas. Open areas that are highly visible to other transit users as well as to transit staff, police and people in surrounding areas are more likely to deter criminals, because there is a greater likelihood that an offender will be detected and apprehended. This strategy combines active surveillance and enforcement by TriMet with what is often called "eyes on the street," or "natural surveillance," by which people perceive they are in a place where they can be seen by others.

Based on local data within the TriMet system, as well as on findings at the national level, the introduction of light rail would not cause more crime on a per capita basis. However, park and rides can increase property crimes, because large numbers of parked vehicles can be potential targets for criminals. See Appendix B4.17 for more detail on law enforcement agencies and transit-related crime.

Another safety factor is the response times for emergency personnel, which is discussed in Section 4.16, Public Services. Chapter 3 – Transportation Impacts and Mitigation, reports locations where localized congestion would increase on the roadways compared to the conditions without the project, which in turn could slow emergency response times.

The following sections discuss, by segment, where the proposed stations and facilities involve unique conditions that could affect safety and security.

No-Build Alternative

With the projected future growth in households, employment and transportation activity in the corridor, the number of reported crimes is likely to increase. TriMet's existing safety and security programs would continue on the routes and transit facilities serving the corridor. Based on past trends, the study area would continue to have relatively low incidences of crime.

Segment A: Inner Portland

Alternative A1: Barbur Alternative, A2-BH: Naito with Bridgehead Reconfiguration, and Alternative A2-LA: Naito with Limited Access

The Segment A alignment alternatives and their associated stations would not be in areas with high incidences of crime, particularly crimes against persons. The stations would be street-oriented stations along busy arterials, and would be in areas with high activity levels, good visibility and no unique safety concerns.

Marquam Hill Connection Options

All options for the Marquam Hill connection would have an east entrance near the station at SW Gibbs Street but off of SW Barbur Boulevard. The relative isolation and low visibility of the entrance, away from other active uses, could make it more difficult to provide a secure environment for patrons, particularly outside of daylight hours and in off-peak periods. Some patrons could perceive a lack of security and be reluctant to use the facilities.

Connections 1A, 1B and 1C have elevator and path systems connecting from SW Barbur Boulevard to SW Campus Drive or Oregon Health & Science University's (OHSU's) Kohler Pavilion. The paths traverse hillside areas that are wooded and would have low visibility to passersby on SW Terwilliger Parkway. The elevator, while equipped with surveillance cameras, would be difficult to secure due to its limited visibility from surrounding areas and its isolation. The isolated and confined environment of the paths and the elevators would also limit a patron's ability to avoid a potential safety threat if one were present. Connection 2: Full Tunnel would include a 453-foot-long tunnel extending from a portal off of SW Barbur Boulevard, and extending under SW Terwilliger Boulevard to an elevator and bridge connecting to the seventh floor of Kohler Pavilion. The long pedestrian tunnel leading to an elevator also would create safety and security concerns because of the confined spaces and isolation.

With Alternatives A2-BH and A2-LA, the closest station to the east entrance of all of the connection options would be at SW Naito Parkway and SW Gibbs Street, rather than nearby on SW Barbur Boulevard, thus increasing the isolation of these options.

Segment B: Outer Portland

None of the stations in Segment B would be in areas that currently experience high levels of crime.

Alternative B1: Barbur

The stations near SW Custer Street, SW 19th Street and SW 30th Street would be street-oriented along a busy arterial, offering good visibility from the street and from retail businesses and other developments. There would be no unique safety or security concerns.

The Barbur Transit Center's combined station, transit center, and park and ride adjacent to a busy arterial and near other businesses offers generally good visibility and fairly high activity levels, which would tend to deter criminal activity. However, the multiple structures on the site, including a large park and ride, could obscure some sight lines. Standard security features, such as the security cameras, surveillance and patrols, along with the presence of transit staff and patrons from connecting bus and paratransit activity at the transit center, would be deterrents for criminals.

The station at SW 53rd Avenue and its adjacent park and ride structure would be along a part of SW Barbur Boulevard where there are few adjacent businesses or other developments, thus reducing their visibility from nearby land uses. The station would be street-oriented in the median of SW Barbur Boulevard, which would offer good visibility of the station from the street, but the park and ride structure would be more isolated.

Alternative B2: I-5 Barbur Transit Center to 60th

The stations near SW Custer Street, SW 19th Street and SW 30th Street with this alternative would be the same as they are described for Alternative B1. With Alternative B2, the Barbur Transit Center Station would have a different layout, and its station platform would be less visible and would provide less security from areas on and near SW Barbur Boulevard than with Alternative B1. At the Barbur Transit Center Park and Ride, security issues would be similar to those of Alternative B1.

Alternative B3: I-5 26th to 60th

The Custer and 19th stations would be the same as described in Alternative B1. The 30th I-5 Station would be in a similar area to the Alternative B1 station, but the platform would have less visibility because it would be below grade and beside I-5. This would make the station relatively more isolated than the 30th Barbur Station. The Barbur Transit Center I-5 Station and the SW 53rd and SW Barbur Boulevard Station would be similar to Alternative B2.

Alternative B4: I-5 Custer to 60th

The safety issues for the Custer, 30th I-5, Barbur Transit Center I-5 and 53rd I-5 stations and the Barbur Transit Center and 53rd park and rides would be the same as those described for Alternative B3. The Spring Garden Station would have lower visibility than stations in other Segment B alignment alternatives because it would be below grade, beside I-5 and along a less active street with fewer adjacent developments than the station at SW 19th Avenue under the other Segment B alignment alternatives.

Portland Community College (PCC) Sylvania Campus (PCC-Sylvania) Shuttle Options

The Barbur Transit Center and Baylor Shuttle would have standard TriMet bus operations, and the same safety and security as any TriMet bus; therefore, it would not pose any unique safety concerns. Similarly, the 53rd Shuttle would operate along an improved SW 53rd Avenue between the station at SW 53rd Avenue and a stop on the PCC-Sylvania campus. Either the 53rd Shuttle would operate like a typical TriMet bus, with no unique safety concerns, or it could be a driverless system, which would require specialized security measures that will be addressed when more is known about the feasibility of this option. TriMet and PCC would coordinate on security procedures for the shuttle terminus, which would be in a less active part of the campus.

Segment C: Tigard and Tualatin

Segment C has several areas with comparatively higher levels of reported crime than other station areas along the alignment, but overall crime levels are low and crimes against persons remain very low. The primary areas with elevated levels of reported crime (which still average less than one per day and involve property crimes and crimes against society) are in the Tigard Triangle and near the existing transit center near downtown Tigard. Bridgeport Village also has a comparatively higher level of property crimes than many of the other potential station areas, which is not uncommon for major retail centers that have high numbers of parked vehicles.

Alternative C1: Ash to I-5

The Baylor Station would be built along SW 70th Avenue and would have an adjacent park and ride. The street-oriented station would offer good visibility, but the street is not heavily used and has vacant

properties nearby. The Beveland Station would be street-oriented, with good visibility and nearby developments, and no unique security concerns. The Tigard Transit Center Ash Station and a relocated transit center would involve a street-oriented station along a rebuilt public street, offering good visibility. The relocated transit center across SW Ash Street from the station would be active with patrons and transit staff and would have good visibility, but the station would be in an area with comparatively more reported crime. A multiuse path on the transit bridge crossing Highway 217 would be isolated from nearby uses for approximately 0.5 mile. Security may be a concern because of the length and isolation of the multiuse path.

The Bonita I-5 Station and the Upper Boones Ferry I-5 Station would be in areas with low levels of reported crimes, but the platforms would be somewhat isolated and less visible because of grade differences, less active nearby streets and fewer adjacent developments with views of the station. Each of these stations would have an adjacent park and ride that would also be relatively isolated from nearby uses.

The above-grade Bridgeport Station would have good visibility from nearby streets. The upper parking garage and pedestrian bridge would also have good visibility from multiple locations. The transit center could interrupt some sight lines, but the added activity of the transit center would be beneficial. No unique concerns are anticipated at this station.

Alternative C2: Ash to Railroad

The Baylor, Beveland, Tigard Transit Center Ash and Bridgeport stations, the multiuse path over Highway 217, and the Baylor, Tigard Transit Center and Bridgeport park and rides with Alternative C2 would be the same as those for Alternative C1. The elevated Bonita Railroad Station would not be very visible from nearby streets and developments, nor would its surface park and ride. The Upper Boones Ferry Railroad Station would be at grade, and nearby streets and existing buildings would have views of the station and its park and ride; therefore, no unique concerns are anticipated.

Alternative C3: Clinton to I-5

The Bonita I-5, Upper Boones Ferry I-5 and Bridgeport stations and all park and rides with Alternative C3 would be the same as those for Alternative C1. The street-oriented Clinton Station and the nearby parking garage would have similar conditions as Baylor Station (station with good street visibility but surrounding areas with vacant land) in Alternative C1. Site-specific safety and security measures would be considered at this station. The Tigard Transit Center Clinton Station would be street-oriented on a new public street, offering good visibility. A relocated transit center and the existing Westside Express Service (WES) Commuter Rail platform to the southwest would increase station area activity levels and visibility, which could create a deterrent to crime in this area that has more reported crime incidents than some of the other station locations.

Alternative C3 would also include a multiuse path on the transit bridge crossing Highway 217, but the bridge and path would be longer and in a different location than for Alternative C1. The multiuse path would be isolated from nearby uses for approximately 0.8 mile, but would include an elevator close to the midpoint of the path that would connect to ground level at SW Dartmouth Street. Security may be a concern because of the length and isolation of the multiuse path.

Alternative C4: Clinton to Railroad

The Clinton Station, the Tigard Transit Center Clinton Station and the multiuse path over Highway 217 would be the same as they are described for Alternative C3. The Bonita Railroad and Upper Boones Ferry Railroad stations would be the same as with Alternative C2. The Bridgeport Station would be the same as with Alternative C1.

Alternative C5: Ash and I-5 Branched

All facilities would be the same as those described for Alternative C1, except that Alternative C5 would also feature a multiuse path on the transit bridge crossing over Highway 217 between the Beveland and Bonita stations. This multiuse path would be isolated from nearby uses for approximately 0.1 mile, and may require elevator access on one or both ends of the bridge.

Alternative C6: Wall and I-5 Branched

Alternative C6 would have the same facilities as Alternative C5 along the branch between the Beveland and Bridgeport stations, but the branch between the Beveland and Tigard Transit Center Wall stations would follow a different route.

Alternative C6 would use a shorter bridge over Highway 217 that would include sidewalks, bicycle lanes, auto lanes and a center-running light rail trackway instead of only the light rail trackway and an adjacent multiuse path. This multimodal bridge would connect SW Beveland Street to SW Wall Street and SW Hunziker Street. The combination of modes would help make people walking and biking more visible, but the crossing would still be isolated from nearby uses for 0.25 mile.

The new Tigard Transit Center, light rail station and parking garage would be built parallel to the existing WES Commuter Rail platform, replacing the existing transit center, and there would be good visibility and sight lines for these facilities. No unique concerns are anticipated.

Operations and Maintenance (O&M) Facilities Options

The O&M facilities options would all have restricted access, and the general public would not be allowed without supervision. These facilities would have similar safety and security procedures as TriMet's existing O&M facilities, with no unusual considerations.

Station Access Improvement Options

Most of the station access improvement options would involve completing missing sidewalk, trail and bikeway facilities adjacent to existing local roadways, where visibility would be high; they involve no unusual safety concerns. In many cases, they would improve conditions for bicyclists and pedestrians by increasing activity levels in station areas and by improving visibility. The exceptions are the new pedestrian bridges over I-5 at SW Custer Street, SW Luradel Street and SW 53rd Avenue, which would place users in more isolated locations.

4.17.3. Short-Term Impacts

TriMet will work with the contractors and cities to minimize disruption to the transportation network. Unsecured construction areas could pose a threat to the traveling public if the plans, policies and procedures that are in place to protect the public are not followed.

Rerouting of traffic, pedestrians and bicycles might cause confusion and could increase the risk of incidents. Additionally, the high crime areas could pose a challenge for construction crews. Construction impacts to emergency responders are discussed in Section 4.16, Public Services.

4.17.4. Potential Mitigation Measures

For all facilities, final design and operations planning will consider best CPTED practices, including modified siting or layout concepts; the use of lighting, communications, electronic and security/police surveillance; and controlled entry. For unique facilities such as the Marquam Hill connection, the connection with the PCC-Sylvania shuttle, and for park and ride facilities, a combination of customized site-specific measures could be necessary, and would be developed in consultation with local agencies, emergency service providers, OHSU and PCC.

TriMet is committed to maintaining a safe and effective transit system. As the project continues into final design, TriMet would continue to develop and refine specific safety and security measures in consultation with the corridor jurisdictions by doing the following:

- Park and rides and station area design will consider site-specific measures to maximize security and discourage criminal activity.
- All Marquam Hill connection options will consider design features that provide enhanced visibility and lighting along with safety features to monitor potential criminal activity.
- Bicycle and pedestrian facilities will consider design features that enhance visibility and discourage criminal activity.
- During final design, TriMet would form a Project Safety and Security Committee comprising internal operations staff, staff from local jurisdictions, project design staff and maintenance staff. The committee will review CPTED approaches being applied to the project.
- TriMet would prepare a Safety and Security Management Plan addressing potential safety hazards and security vulnerabilities.
- TriMet would form a Fire, Life and Safety Committee for the light rail project composed of police, fire and safety personnel, and other emergency services providers in the corridor, to advise on design development and operations planning. This committee would review and advise on procedures, staff levels, and safety and security concerns.

4.18. Indirect and Cumulative Impacts

This section summarizes the indirect and cumulative impacts of the project. The impact analysis builds upon the long-term impacts and short term (construction) impacts discussions in Chapter 3 – Transportation Impacts and Mitigation, and other sections of this Chapter 4 – Environmental Impacts and Mitigation. This summary focuses on the areas where the analysis of indirect and cumulative effects among the environmental topics share common locations or characteristics, and where they share potential mitigation.

4.18.1. Analysis of Indirect Impacts

Indirect impacts are consequences that are related to the project but that may occur at a different time than the project itself, that may be more physically removed, or that may result from other actions occurring in response to the project. For the Southwest Corridor Light Rail Project, which is in a mostly developed urban area, the most reasonably foreseeable indirect consequences would involve the increased levels of activity that would occur at the new stations, including new trips and more dense developments around stations. These in turn would be expected to cause other changes in environmental conditions over time.

The Draft EIS's findings about direct impacts for Transportation (Chapter 3) and Land use (Section 4.2) provide much of the basis for the indirect effects analysis covered here. Both of these impact analyses inherently consider other actions because they combine existing conditions information with projections about what is expected to happen in the urban area in the future. The impact analyses of both incorporate future expectations about increases in populations and employment in the Portland area and in this corridor through 2035. The growth in population is expected to occur whether the light rail project is built or not.

The analyses that are based on transportation and the regional model include air quality, energy and noise and vibration. The remaining topics have the same study area as land use, with impact factors that are related to future development. Section 4.2, Land Use, provides more detail on the areas around stations that could be affected, including existing conditions in station areas. In addition, for the indirect impacts assessments described below, Appendix B4.18 Attachment 1 shows the individual station areas today, with more detailed mappings of their existing land use types, showing which areas are most likely to be influenced by the presence of a station.

As noted in Section 4.2 and in the land use analysis below, jurisdictions along the corridor have already adopted plans or zoning encouraging transit-oriented developments with a wider mix of allowed uses, including more multistory buildings, higher levels of square footage, and an increased variety of housing types. These plans and zoning also would make it more likely that the Southwest Corridor Light Rail Project would contribute to other changes in the corridor, potentially beyond the areas immediately surrounding stations. Based on zoning, the presence of the station and its transportation benefits, but also considering market conditions that may be in place in the future, would together encourage future development in many of the station areas. However, this does vary by location, by the interests of existing owners, by parcel size, and by the surrounding market conditions for any of the stations. After the selection of the Preferred Alternative, the Final EIS would include a more detailed analysis of the propensity of the surrounding land uses to experience change. Based on the experience of other light rail projects locally as well as nationally, while some station areas may appear more likely than others to experience change, market drivers may cause station areas to change even before the light rail project is developed; others might not change for decades.

4.18.2. Analysis of Cumulative Impacts

Other actions have already occurred in the corridor that have affected environmental conditions, including the urbanization of the Portland area and major infrastructure developments such as Interstate 5 (I-5), Interstate 205 (I-205) and the railroads. Other similar actions may occur in the future, both with or without the Southwest Corridor Light Rail Project. The effects of all of these actions

together are considered in the analysis of cumulative effects. Appendix B4.18 lists the future transportation projects that are planned for development in the corridor, along with land use plans and other developments that could affect transportation and environmental conditions.

4.18.3. Summary of Indirect and Cumulative Impacts

Table 4.18-1. Summary of Indirect and Cumulative Impacts *(multi-page table)*

Indirect Impacts	Cumulative Impacts
Transportation	
All of the light rail alternatives would support increased transit-oriented development, which in turn increases transportation activity levels in areas that are less developed today. These developments would increase trips in all modes of travel, including more transit, bicycle/pedestrian, freight and auto trips. However, these increases in development are already anticipated in local and regional land use plans and in accompanying zoning that is in place in station areas (see Land Use, below, for further discussion). Similarly, the increases in traffic are already accounted for in the long-range impact analysis, because travel forecasts show increases in trip making resulting from assumed growth in population, employment and related urban development. In addition, the impact analysis does not account for automobile trips avoided at the local level when drivers shift to transit for their trips. Throughout the corridor, all alternatives improve bicycle and pedestrian facilities, accommodating increased demand. There would be no additional long-term indirect effects. Some construction impacts could increase in areas where station area redevelopments occur at the same time as the project is being constructed. Given the mitigation already proposed for long-term impacts, no additional mitigation would be needed for long-term indirect impacts. For potential short-term construction impacts of other station area projects that might occur at the same time as the Southwest Corridor, TriMet would coordinate the light rail project construction activities and mitigation programs with the other projects.	As stated with in the indirect impacts analysis, regional growth and resulting localized changes in transportation demand, as well as changes due to other transportation projects, are already assumed in the forecasts used for the analysis of long-term impacts. Metro's regional travel demand model includes other planned transportation projects, and it accounts for land use plans that encourage focused growth and development in the corridor to meet future population and employment needs. Therefore, no additional long-term cumulative transportation impacts are anticipated. Shorter-term, cumulative construction impacts could still occur if other agencies' projects are constructed at the same time. No additional mitigation would be needed for long-term cumulative impacts. For potential short-term construction impacts, TriMet would coordinate construction activities and mitigation programs with other projects.
Acquisitions and Displacements	
There is the potential for additional indirect displacements if transit-oriented developments obtain additional land surrounding stations. These would typically be private transactions, unless TriMet or other agencies are involved as partners. Purchasers would pay market prices for properties, but relocation assistance for displaced tenants may not always be provided; it will depend on whether any public agencies are directly involved. Displacement and acquisition related to other development may be mitigated by ordinance (as in the city of Portland) or as a condition of approval for other projects. Cooperative multiagency programs could also provide assistance or additional relocation options for displaced parties. During final design and construction, TriMet and Metro would coordinate with local partners to develop station area redevelopment plans that include measures to minimize indirect impacts, including advancing programs to increase affordable housing supply in the corridor.	There are no sizable public projects currently planned in the project vicinity that would acquire properties and displace their current uses. Acquisitions and displacements from other public projects would be mitigated by their sponsors as required by applicable law. Ongoing development would be the other source of cumulative impacts. In many of the areas along the corridor, planned growth in population and jobs would spur increased development, and parties could be displaced. The mitigation described for indirect effects would avoid the potential for increased cumulative effects due to acquisitions or displacements.

Table 4.18-1. Summary of Indirect and Cumulative Impacts *(multi-page table)*

Indirect Impacts	Cumulative Impacts
Land Use	
Development or redevelopment in station areas would be made more attractive by the presence of stations. Developments could also be more likely where other transportation improvements are made, especially if zoning already allows a higher level of development, which is the case in much of the corridor. In Segment A, development effects would be higher under Alternatives A1 and A2-BH than for Alternative A2-LA. In Segment B, the alignments along SW Barbur Blvd. would be more supportive of redevelopment than alignments along I-5, primarily due to improved access to transit connections and stations, and more available land with land use designations that would support additional development. In Segment C, Alternatives C1, C2, C5 and C6 would each have two stations in the Tigard Triangle and, as a result, would support more redevelopment in the Tigard Triangle and in downtown Tigard than Alternatives C3 and C4, each of which would only have one station. South to Tualatin, the remaining stations would have relatively low levels of land use change because of the limited amount of underdeveloped lands nearby, and because I-5, railroads and topography limit development potential. Redevelopment to higher levels is already included in the local land use planning and zoning that are considered in the long-term impacts analysis. While the project may change the pace of redevelopment, it would not result in additional indirect land use impacts that are not already considered as part of the long-term impacts analysis. The mitigation proposed for acquisitions and displacements would avoid the need for additional mitigation for indirect land use effects.	Due to long-term population and employment growth, and as called for in local agency plans and enabled by zoning that allows developments with taller buildings and more square footage than exist today, existing land uses would change in and beyond the project corridor. Other planned transportation infrastructure and associated improvements would also support additional development and land use change in and beyond the project corridor. However, these changes to existing land uses due to transportation investments and new developments would be consistent with local and regional planning goals, even if they do alter existing land use patterns. The mitigation proposed for acquisitions and displacements would avoid the need for additional mitigation for cumulative land use effects.
Economics	
Potential redevelopments in station areas and along the corridor, as described in this table under Land Use, would have net beneficial indirect economic impacts, because they would attract new businesses and employment, and would increase tax revenues and property values. However, existing businesses and their associated jobs may need to relocate if underlying properties redevelop. This need to relocate could result in additional business closures or job loss for some parties, although overall economic activity levels would increase. No additional long-term impact mitigation would be needed beyond that already identified for the project's long-term impacts and for the indirect effects of acquisitions and displacements. For potential short-term construction impacts due to other projects, TriMet would coordinate its construction mitigation program with the other agencies.	Overall increases in local and regional population and employment, taken with land use plans and zoning designed to manage growth, could increase economic activity and property values near and beyond the corridor. These increases in economic activity and property values would be considered a net benefit and could be experienced along all project segments; however, they are expected to be greater in Segments B and C, where there is a greater supply of under-developed lands. Other agencies may construct transportation projects in the corridor. If multiple projects are constructed at the same time as the Southwest Corridor Light Rail Project, there could be reduced short-term business activity levels if customers are discouraged by real or perceived inconveniences during construction. The same mitigation approach described for indirect effects also would avoid potential cumulative effects.

Table 4.18-1. Summary of Indirect and Cumulative Impacts *(multi-page table)*

Indirect Impacts	Cumulative Impacts
Communities	
Indirect impacts to communities could occur as a result of station area developments described above under Acquisitions and Displacements, Land Use and Economics. Some additional residents and businesses could be displaced by redevelopment or by increasing rents and property taxes. These changes to existing communities could disrupt social ties and impact neighborhood cohesion in areas near the stations. However, under any alignment alternative, neighborhood quality of life would generally indirectly benefit from the project through improved access to transit and other multimodal transportation improvements. The increased supply and range of housing types that could be developed could also offset these impacts. No additional cumulative or indirect impact mitigation would be needed beyond the indirect impacts mitigation proposed for transportation, acquisitions and displacements, and economics.	A potential effect could be reduced neighborhood cohesion due to turnover of residents and businesses as station areas and the greater surrounding areas redevelop consistent with local plans, particularly along SW Barbur Blvd. and in downtown Tigard. Improved neighborhood cohesion and quality of life could result from improved walking, biking and transit access; the addition of parks, open spaces and other gathering places; and the increased supply of a range of housing types that could occur along the corridor. No additional cumulative or indirect impact mitigation would be needed beyond the indirect and cumulative impacts mitigation proposed for transportation, acquisitions and displacements, and economics.
Visual Quality	
Greater levels of development around station areas could intensify visual change by increasing the extent of urban development. This would occur primarily where described under land use, but the visual impacts would be low because the majority of stations are in commercial or industrial areas where viewers are less visually sensitive. No additional mitigation would be needed.	Increased development due to urban growth, along with other transportation projects, could increase the project's impacts and intensify the existing trend of visual change. These visual changes would be highest in areas where the land use plans anticipate the greatest level of growth, specifically in the Tigard Triangle and South Portland landscape units. However, the other transportation projects are smaller in scale than the Southwest Corridor Light Rail Project, and applicable local agency land use plans also include planning guidelines for developments in order to reduce negative impacts. No additional mitigation would be needed.
Historic and Archaeological Resources	
Greater levels of development around station areas could introduce new visual elements as well as redevelopment pressures, which could result in a loss of historic or archaeological resources or impacts to their character-defining features. In inner Portland, these changes could affect the South Portland Historic District as well as individual properties. As mitigation, TriMet would partner with the other corridor jurisdictions and the State Historic Preservation Office to develop a cooperative plan for avoiding or mitigating the loss of historic or archaeological resources due to indirect effects.	Increased development and other transportation projects could affect additional historic properties and archaeological resources. These effects would be similar in nature to those described for indirect effects. The mitigation identified for indirect impacts would also help reduce cumulative impacts.
Geology, Soils and Hydrogeology	
No indirect effects were identified for geology, soils and hydrogeology. Station area developments would be built to meet applicable codes and standards, and would be restricted in areas with higher levels of geologic risk (such as steep slopes). No mitigation would be needed.	Similar to indirect effects, with other projects and developments being built to meet applicable codes and standards, the potential for unmitigated cumulative effects would be avoided. No mitigation would be needed.

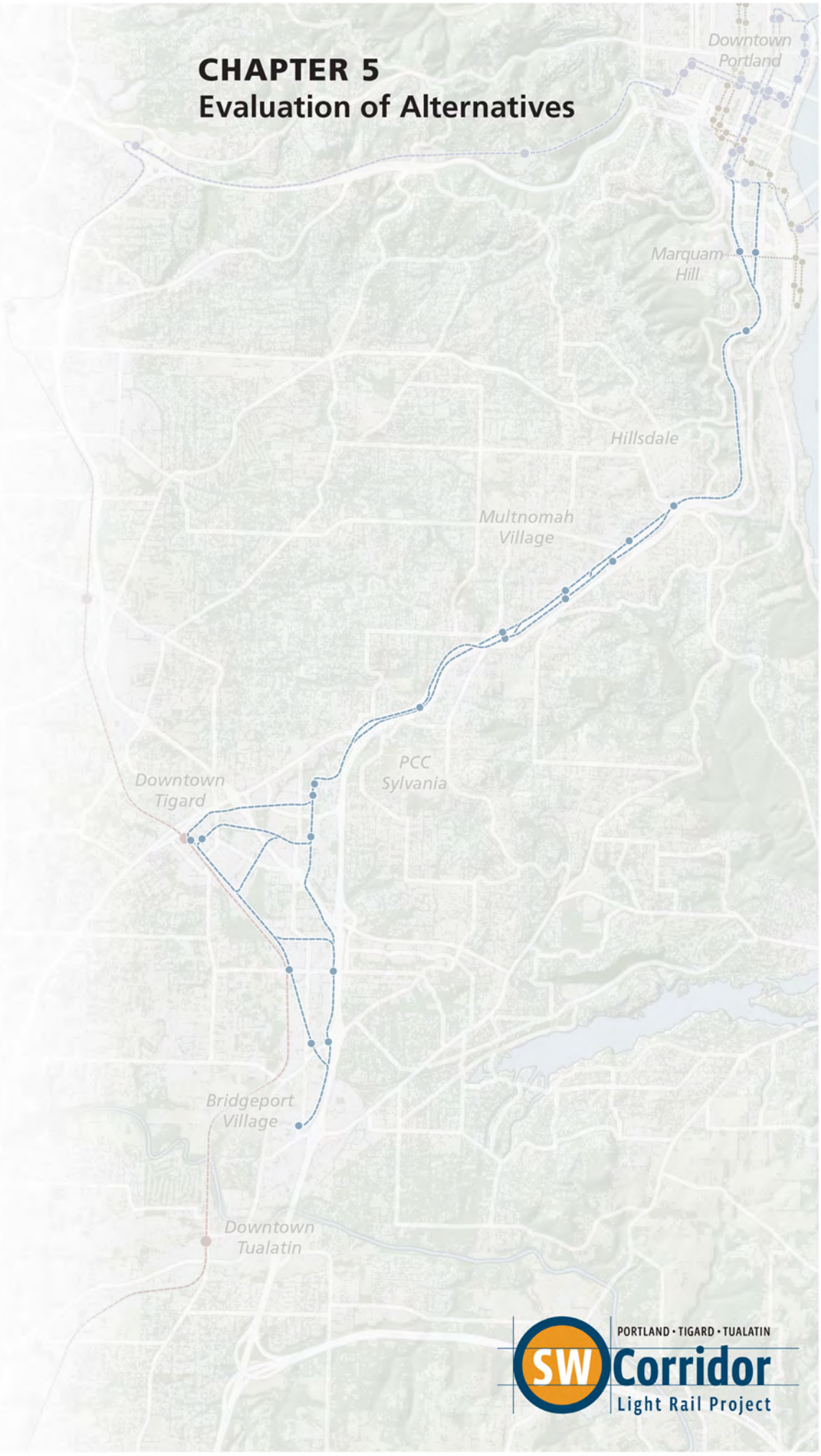
Table 4.18-1. Summary of Indirect and Cumulative Impacts *(multi-page table)*

Indirect Impacts	Cumulative Impacts
Ecosystems	
The majority of the corridor is already developed, and station area transit-oriented developments would have limited effects on ecosystems. There would be indirect beneficial effects to ecosystems from improved stormwater treatment associated with the project. No indirect adverse effects to biological species were identified. No additional mitigation would be needed.	No cumulative ecosystem impacts were identified. Developments, as well as other transportation projects, would generally not adversely affect ecosystem resources, because they are proposed in areas that are largely urbanized. Further, other projects or land use actions would be subject to regulatory review and/or permitting, which would trigger measures to avoid, minimize or mitigate impacts on ecosystem resources, including streams and wetlands. Such processes would also result in compensatory mitigation for any unavoidable impacts to streams or stream buffers, wetlands or wetland buffers. No additional mitigation would be needed.
Water Resources	
Potential station area developments would be in areas that are already largely developed. New development and redevelopment projects would upgrade stormwater treatment to current standards, resulting in beneficial indirect effects to stormwater quality. No additional mitigation would be needed.	Other development or transportation projects would comply with current stormwater management regulations and would improve water quality. No additional developments or other transportation projects are anticipated within floodplains or floodways. No additional mitigation would be needed.
Noise and Vibration	
No long-term impacts are expected due to the largely mixed-use nature of future station area developments that would be allowed by existing zoning. In addition, larger buildings in station areas and along the project corridor could provide additional shielding from existing traffic noise sources such as I-5 or SW Barbur Blvd. Further, additional noise due to increased transportation activity is already accounted for in the long-term impacts analysis. The construction of station area redevelopments could create additional construction-period noise or vibration, but impacts would be limited by the controlling codes, ordinances and permits of local jurisdictions. No additional mitigation is needed beyond the measures already identified for long-term and construction-period effects.	Other developments developed in accordance with local land use plans or other transportation projects could result in higher noise levels. Any new transportation projects would be expected to consider mitigation for their own noise or vibration impacts. The project, by mitigating its severe noise impacts, would not contribute to increased cumulative impacts. No additional mitigation would be needed beyond the measures already identified for long-term and construction-period effects.
Air Quality and Greenhouse Gases	
The long-term air quality impacts analysis is based on the transportation analysis and already takes into account effects from station area developments and related growth in transportation activity levels. No additional mitigation would be needed.	The air quality analysis is cumulative in nature and shows that cumulative air pollutant and greenhouse gas emissions from regional transportation sources will decrease in the future with the project, compared to the No-Build Alternative. No additional mitigation would be needed.
Energy	
Energy demand for future transportation conditions already considers transportation related to future developments in station areas. Increases in energy demand for the developments around stations themselves would be insignificant relative to the energy demand for the metropolitan area overall. No mitigation would be needed.	Cumulative energy demand would increase but is not anticipated to outpace the capacity of energy providers, who plan long-term operations and capital improvements to meet future demand. No mitigation would be needed.
Hazardous Materials	
Development and redevelopment around light rail stations has the potential to result in the demolition of structures that contain hazardous materials or the disturbance of subsurface contaminants in the soil and groundwater. These activities would be subject to regulatory requirements for the treatment of contaminated sites, and no adverse indirect impacts are expected. No additional mitigation would be needed.	Cumulative growth and projects, including transportation and development projects, would be subject to regulatory requirements for the treatment of contaminated sites. No adverse effects are expected, and associated cleanup and treatment of hazardous materials would be considered a cumulative benefit. No additional mitigation would be needed.

Table 4.18-1. Summary of Indirect and Cumulative Impacts *(multi-page table)*

Indirect Impacts	Cumulative Impacts
Utilities and Public Services	
Higher demand for utilities or public services is already expected under local land use plans, although it might occur earlier or more rapidly if light rail is present. Redevelopment in station areas and surrounding communities would require providers to manage their facilities and services to meet increased demand, but this would not be considered an adverse effect. No additional mitigation would be needed.	The impacts of other transportation projects to utilities or public services would be avoided, because each of the other projects would be expected to mitigate its individual impacts. Continued development due to urban growth could require utility upgrades and increased levels of public services, which utilities and service providers routinely plan and implement to meet future demand. No additional mitigation would be needed.
Safety and Security	
Indirect safety and security impacts would be limited, because current design practices and standards for developments incorporate safety principles, and additional public activity in more developed areas tends to improve public safety and security. Conditions would be similar to those described under long-term impacts. No additional mitigation would be needed.	Similar to what is described for indirect effects, cumulative effects with other transportation projects and local and regional growth and development are anticipated to improve public safety and security, and would be similar to those described under long-term impacts. No additional mitigation would be needed.

CHAPTER 5
Evaluation of Alternatives



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5. EVALUATION OF ALTERNATIVES

This chapter evaluates how well the Southwest Corridor Light Rail Project alternatives meet the Purpose and Need statement (see Chapter 1), comparing the environmental, transportation and cost differences among the Draft Environmental Impact Statement (EIS) alternatives.

Section		Page
5.1	Ability to Meet Purpose and Need	5-1
5.2	Initial Route Proposal	5-9
5.3	Finance Plan	5-12

Section 5.1 evaluates how well the Draft EIS alternatives address the Purpose and Need. Section 5.2 discusses the initial route proposal, including the factors shaping it, and how its performance would compare to the other light rail alternatives. Section 5.3 discusses cost and financing issues.

5.1. Ability to Meet Purpose and Need

Provide light rail transit service that is cost-effective to build and operate with limited local resources

All alternatives have similar ridership levels and travel time savings, which are key parts of how cost-effectiveness for a transportation project is measured. As they all achieve similar increases in transit use, their resulting cost-effectiveness would primarily reflect differences in the capital costs needed to build a particular segment and the ongoing operating and maintenance (O&M) costs. Table 5.1-1 shows the estimated range of capital and O&M costs for different configurations of the project, compared to the initial route proposal with design refinements. Table 5.1-2 shows the capital cost differences between alignment alternatives.

Table 5.1-1. Estimated Project Capital and Operating Costs

	Total Capital Cost Range[1]	Annual O&M Cost[2]
Draft EIS Alternatives		
Through Route	$3,270 to $3,590 million	$22 million
Branched Route	$3,390 to $3,630 million	$30 million
Tigard Transit Center MOS	$2,920 to $3,160 million	$19 million
Bridgeport MOS	$2,970 to $3,170 million	$22 million
Initial Route Proposal (with design refinements)		
Full corridor	$2,640 to $2,860 million	$22 million
MOS	$2,170 to $2,410 million	$19 million

Note: MOS = minimum operable segment; O&M = operating and maintenance.

[1] Capital costs are in year-of-expenditure (2024) dollars and include finance costs.

[2] Operating costs assume 2035 service frequencies.

Table 5.1-2. Capital Cost Differences Between Alignment Alternatives

Alignment Alternative	Capital Cost Difference[1] *Compared to lowest cost*
Segment A: Inner Portland	
A1: Barbur	lowest cost
A2-BH: Naito Bridgehead	+$140 million
A2-LA: Naito Limited Access	+$160 million
Segment B: Outer Portland	
B1: Barbur	+$40 million
B2: I-5 Barbur TC-60th	+$30 million
B3: I-5 26th-60th	lowest cost
B4: I-5 Custer-60th	lowest cost
Segment C: Tigard and Tualatin	
C1: Ash-I-5	+$60 million
C2: Ash-RR	lowest cost
C3: Clinton-I-5	+$120 million
C4: Clinton-RR	+$60 million
C5: Ash-I-5 Branched	+$20 million
C6: Wall-I-5 Branched	+$60 million

[1] Costs are in year of expenditure (2024) dollars and include finance costs.

The project would require additional sources of revenue. Other sources of funding, including federal funds, dedicated local funds or potentially private funds, would be needed. Federal funds for high capacity transit projects such as the Southwest Corridor Light Rail Project are awarded on a nationally competitive basis, with projects typically needing a 50 percent or higher local match to qualify for major federal funding grants. Federal funding eligibility is based on factors such as transportation benefits, environmental benefits, land use benefits and economic benefits. An important part of the evaluation is the project's cost-effectiveness, measuring projected ridership against annualized capital and operating costs. Alternatives that have lower costs and still maintain good travel times, accessible stations and lower impacts would be most cost-effective. See Section 5.3 for further information on the project's finance plans, which provide further analysis of the region's financial ability to build and operate the Southwest Corridor Light Rail Project.

Serve existing transit demand and significant projected growth in ridership resulting from increases in population and employment in the corridor

To meet the projected growth in demand for transit trips in the corridor, the light rail alternatives connecting the full corridor offer higher capacity transit service than the No-Build Alternative. All of the alignment alternatives serve the same major population and employment centers along the corridor. Some of the alignment alternatives are closer than others to certain employment and residential areas, but they all have similar 30 percent to 40 percent increases in transit ridership levels compared to the No-Build Alternative.

In Segment A, Alternative A1 would provide a station closest to the OHSU Marquam Hill campus and the VA Portland Health Care System hospital, with the fastest access to a Marquam Hill connection up to this major employment and medical services complex. The two other alignment alternatives on SW Naito Parkway have stations that are about two additional blocks from the connection made by

Alternative A1, but they would still be within walking distance of the connection. The Segment B alignment alternatives all have similar stations and alignments, with equal abilities to meet transit demand, although alignments adjacent to Interstate 5 (I-5) (Alternatives B2, B3 and B4) have more stations that are an additional block or more away from most nearby land uses, compared to Alternative B1 on SW Barbur Boulevard. The Segment C alignment alternatives offer the most variations among the alternatives, but all serve downtown Tigard and Bridgeport Village, two of the larger sources for additional future transit ridership. In Segment C, alignment alternatives that are along I-5 south of Tigard (Alternatives C1, C3, C5 and C6) have stations that are closer to employment areas in Lake Oswego than do the alignment alternatives that are along the railroad (Alternatives C2 and C4).

Improve transit service reliability, frequency and travel times, and provide connections to existing and future transit networks including Westside Express Service (WES) Commuter Rail

Compared to the No-Build Alternative, all of the light rail alternatives in Segments A and B offer improvements in reliability, frequency and travel times. The different alignment alternatives offer similar functional connections to existing and future transit connections, which would increase overall transit use in the corridor. In Segment C, the alignment alternatives also would make the same transit network connections, including a station serving downtown Tigard and WES Commuter Rail, but frequency and travel times would vary depending on a rider's desired destination. Alternatives C5 and C6, which have a Branched Route, would require riders traveling to or from the Bridgeport Station or other stations on the Bridgeport branch to transfer to the Tigard branch to access the WES station, Tigard Transit Center or downtown Tigard. The Segment C alignment alternatives that have a Through Route (Alternatives C1 to C4) have more frequent and direct service to downtown Tigard and the Bridgeport Station, compared to the branched alternatives, which have every other train going to one of the two destinations. On the other hand, the branched alternatives (Alternatives C5 and C6) require more frequent trains to be able to branch, which results in more frequent service to the Tigard Triangle as well as for Segments A and B, particularly during off-peak periods.

Support adopted regional and local plans including the *2040 Growth Concept*, the *Barbur Concept Plan,* the *Tigard Triangle Strategic Plan* and the *Tigard Downtown Vision* to accommodate projected significant growth in population and employment

All of the light rail alternatives support the projected growth in population and employment in the Southwest Corridor, consistent with the *2040 Growth Concept*, because they all provide stations serving targeted growth areas. All of the alternatives by segment also support the respective local plans, but there are differences in station locations and alignment specifics that vary with some elements of the plans. In Segment A, Alternatives A2-BH and A2-LA, are more supportive of the *Barbur Concept Plan* than Alternative A1, because the plan prioritizes SW Naito Parkway over SW Barbur Boulevard for redevelopment and high capacity transit station locations. Changes to SW Naito Parkway envisioned in the plan, including reconfiguration of Ross Island Bridge ramps, would be made by Alternative A2. These features could be added as an option for Alternative A1, but it would increase that alternative's impacts and costs.

In Segment B, Alternatives B2, B3 and B4 have some sections and stations along I-5 rather than along SW Barbur Boulevard. That makes them less supportive of Portland's *Barbur Concept Plan* than Alternative B1, which follows SW Barbur Boulevard, primarily because the plan proposed using SW

Barbur Boulevard only. However, the other alignment alternatives in Segment B include stations serving the same areas, and they make other multimodal improvements to SW Barbur Boulevard, consistent with the *Barbur Concept Plan*. In Segment C, the alignment alternatives all support the *Tigard Triangle Strategic Plan* and the *Tigard Downtown Vision*. There are differences in locations among the alignments and the stations, but all of the alignment alternatives have the capacity to serve anticipated growth in population and employment.

Complete and enhance multimodal transportation networks to provide safe, convenient and secure access to transit and adjacent land uses AND

Advance transportation projects that increase active transportation and encourage physical activity

The alignment alternatives in each segment incorporate multimodal improvements to the facilities they are rebuilding as part of light rail development, including SW Barbur Boulevard or SW Naito Parkway in Segment A, and on streets and pathways connecting to the light rail and its stations. In several areas, including at Marquam Hill, along SW Barbur Boulevard, along SW Naito Parkway, at Portland Community College (PCC) Sylvania campus, in the Tigard Triangle and in downtown Tigard, the light rail alternatives make new multimodal connections. These new connections help overcome barriers between neighborhoods and regional transit services. However, they also affect total project costs.

In Segments A and B, alignment alternatives that rebuild much of SW Barbur Boulevard to incorporate missing or substandard sidewalks, bicycle facilities, and intersection and pedestrian crossings would improve multimodal safety and access along one of the region's most heavily populated corridors. Alternatives A1 and B1 would improve the longest stretches of SW Barbur Boulevard, and the other alignment alternatives in these segments would improve shorter sections. In Segment C, the primary areas of improvement would be in the Tigard Triangle, where new multimodal connections would be completed, and existing roadways would be rebuilt with sidewalks and bicycle facilities. The alignment alternatives vary in terms of where in the Tigard Triangle these facilities would be placed, but they all make similar scale multimodal improvements.

The regional connections offered by light rail would enhance the mobility and active lifestyle benefits of better local facilities for biking and walking, because they allow a wider range of trips and destinations than the local facilities alone would. The additional set of station access improvement options would further extend these benefits; these options are available to all alignment alternatives in each segment.

Provide travel options that reduce overall transportation costs

Any combination of the alignment alternatives comprising a full-corridor light rail project would help reduce vehicle miles traveled in the region, primarily by offering a viable alternative to travel by automobile or by bus on congested local streets. The reduction in travel by personal vehicle equates to reduced transportation costs, and the reduced hours spent in congestion by buses and their passengers helps reduce personal costs as well as overall transit operational costs. The alignment alternatives are all equal in this regard, not including their differences in capital and operating costs, which are discussed separately in this evaluation.

Improve multimodal access to existing jobs, housing and educational opportunities, and foster opportunities for commercial development and a range of housing types adjacent to transit

The light rail project would perform better than the No-Build Alternative in improving multimodal access and fostering development adjacent to transit. All of the alignment alternatives in each segment would make major multimodal access improvements to existing and planned employment, housing and education centers along the corridor. They all would foster a direct connection from the southwest communities to downtown Portland and the regional Metropolitan Area Express (MAX) light rail system, including all of the jobs, housing and educational centers served by the regional light rail network. Extending light rail to the southwest would improve corridor and regional connections to OHSU, the VA Portland hospital and PCC-Sylvania. Light rail would serve the growing urban center anticipated in the Tigard Triangle, as well as at Bridgeport Village. Much of the corridor today, beyond downtown Portland, has large amounts of land dedicated to surface parking. Light rail would allow people to reach the region's centers and growth areas without needing to drive and park, thus reducing the proportion of land needed for parking. The light rail alternatives effectively support local and regional plans that call for more compact forms of development in areas that can be well-served by transit, including developments that could offer a range of housing types.

By segment, there are differences in how the location of a given alignment alternative and its stations might serve the areas around it and support plans for growth. However, given the proximity of the different alignment alternatives (usually within a block of each other), the differences in location generally involve trade-offs between which part of a neighborhood would be closest to the station, rather than differences in which neighborhood or community is served. All would allow improved access to major regional destinations.

For instance, Alternative A1 on SW Barbur Boulevard would be closest to OHSU and the VA Hospital on Marquam Hill, and it would improve access along a section along SW Barbur Boulevard that has numerous multifamily residential properties. Alternative A2-BH, on the other hand, improves access and mobility along SW Naito Parkway and its adjacent neighborhoods, but the connection to Marquam Hill could still be made within a few more blocks. Its station would be more in the heart of walkable single-family areas as well as multifamily residences, and it would be located closer to the growing Southwest Waterfront area.

Alternatives B1 and B2, which are along SW Barbur Boulevard for the longest in Segment B, would provide improvements and stations serving neighborhoods on both sides of the major arterial, while Alternatives B3 and B4 require crossing SW Barbur Boulevard to reach alignments adjacent to I-5.

In Segment C, the location of the alignments as well as the route configuration are factors. The Through Route offers the most frequent trips to downtown Tigard, and the Branched Route offers the fastest trips to Tualatin. The Clinton or Ash alignments offer different sets of choices as well for subareas of the Tigard Triangle. The existing Ash alignments all create new multimodal facilities and stations serving the centers of the Tigard Triangle and downtown Tigard, but they would also create higher impacts to existing housing, businesses and other developments than the Clinton alignments.

Ensure benefits and impacts that promote community equity AND

Advance transportation projects that are sensitive to the environment, improve water and air quality, and help achieve the sustainability goals and measures in applicable state, regional and local plans

To address these two elements of the Purpose and Need statement, the evaluation considers the range of environmental impacts considered in this Draft EIS, noting areas where the light rail alternatives have notable differences in their impacts. The benefits of the light rail alternatives are similar, however, in that the station locations and the other multimodal improvements would be available to the same communities along the corridor. People closest to the light rail line would have the easiest access to the mobility benefits offered by light rail. In addition, measures to improve safety, provide multimodal connections, improve water quality or reduce noise would also provide benefits to those people along the corridor at the same or higher levels than others in the corridor communities. Table 5.1-3 summarizes primary areas of impacts for the alignment alternatives by segment and for the full corridor, where impacts can be totaled. Where the differences in impacts between the alignment alternatives and the need for mitigation are notable, the table shows more detail by alternative. Otherwise, it shows the general effects for all alternatives. Environmental topics for which there are no clear differences and no effects requiring mitigation are not detailed in the table (Land Use, Air Quality, Energy, Utilities and Public Services).

Table 5.1-3. Summary of Transportation and Environmental Effects *(multi-page table)*

Environmental Discipline	Impacts and Benefits
Transportation • Transit • Streets • Bicycle and Pedestrian • Parking • Freight • Safety	• Compared to the No-Build Alternative, the light rail alternatives would notably improve transit reliability and frequency • Light rail offers up to 9-minute faster in-vehicle transit travel times on full-corridor transit trips than the No-Build Alternative • Light rail would carry up to 41,600 daily light rail riders by year 2035, and the full-corridor project covers up to 8 percent more total transit riders (on bus and rail) than No-Build • There would be increased vehicular, bicycle and pedestrian activity around transit stations and park and rides • Local and arterial intersections with congestion or queues below standards would have mitigation available to return to No-Build conditions or better • Impacts to local freight access to individual properties could create out-of-direction travel and increase travel times • Construction could temporarily reduce highway and local roadway capacity, increase truck traffic, involve sidewalk and road closures or detours, and affect access and travel times for transit
Residential acquisitions and displacements	• A full-corridor project would acquire and displace 78 to 293 residential units • Segment A alternatives would affect 41 to 125 residential units, with A2-LA having the highest impacts and A1 the least • Segment B alternatives would affect 32 to 78 residential units, with B4 having the highest impacts and B1 the least • Segment C alternatives would affect 5 to 85 residential units, with C1/C2 and C5 having the highest impacts and C3/C4 and C6 the least

Table 5.1-3. Summary of Transportation and Environmental Effects *(multi-page table)*

Environmental Discipline	Impacts and Benefits
Economics (Business Displacements)	• A full-corridor project would have acquisitions affecting 106 to 156 businesses or institutions and 961 to 1,990 employees • Segment A alternatives would have acquisitions affecting 15 to 23 businesses and 108 to 371 employees, with A2-BH and A2-LA having the highest impacts and A1 the least • Segment B alternatives would affect 54 to 66 businesses and 469 to 565 employees, with B1 affecting the fewest businesses, B2 affecting the fewest employees, and the other alignment alternatives at the higher end of the impact range • Segment C alternatives would affect 31 to 55 businesses and 323 to 839 employees; C5 would affect the most businesses, and C3 the most employees • Temporary construction impacts would involve increased traffic congestion and reroutes, noise, vibration, dust, and changes to business access and visibility
Communities	• In all segments, clusters of residential and business displacements could disrupt individual social ties and indirectly cause property values to increase through redevelopment around stations, which could affect low-income populations • In Segment A, all alternatives would affect parking for a church, but replacement parking could be provided as mitigation • In Segment C, Alternatives C1, C2 and C5 would displace a community lodge and businesses providing counseling and a medical clinic • Alternatives C3 and C4 would displace the Tigard U.S. Post Office • Alternatives C3 and C6 would displace a medical clinic • Alternatives C1, C2 and C5 (SW Ash Ave. alignments) would displace a cluster of multifamily residential buildings in the Downtown Tigard neighborhood along SW Hall Blvd. and SW Ash Ave.; the relocation of several blocks of residents would alter the current character and social interactions in this neighborhood. Improved transportation infrastructure and services for all modes could benefit area residents, businesses and patrons
Visual Quality	• Segment A alternatives would have moderate visual impacts overall, but there would be areas with higher impacts due to building and vegetation removal, such as near Marquam Hill, along SW Barbur Blvd. in The Woods, and in areas with historic properties • Segment B alternatives would have moderate visual impacts overall • Segment C alternatives would have high impacts in the Tigard Triangle and downtown Tigard due to prominent new structures, vegetation removal and removal of buildings in areas with nearby residences; Alternatives C1, C2 and C5 would have the most locations with high visual impacts
Historic and Archaeological Resources	• A full-corridor project would have a presumed adverse effect due to full parcel acquisitions of 7 to 21 historic properties • Segment A alternatives would involve full parcel acquisitions on 5 to 15 historic properties, with A2-LA having the most • All Segment A alternatives would have impacts to two historic trestle bridges • Segment B alternatives would involve 2 to 5 historic properties, with B1 having the most • All of the alignment alternatives could encounter potential archaeological sites
Parks and Recreation Resources	• A1 would remove vegetation bordering Duniway Park and Lair Hill Park • A2-BH and A2-LA would affect strips of land bordering Water and Gibbs Community Garden and Front and Curry Community Garden • All Segment A alternatives would remove vegetation and trees along the Terwilliger Parkway/Open Space along SW Barbur Blvd. and for the Marquam Hill connection, and in George Himes Natural Area Park • All Segment B alternatives would remove vegetation and trees bordering Fulton Park between the community garden and the street
Geology, Soils and Hydrogeology	• All alternatives are in a seismically active region that requires engineering measures to address the risk of damage from earthquakes • All alternatives cross areas that require measures to reduce slope instability risks
Ecosystems Resources	• A full-corridor project would involve between 1.3 and 1.6 acres of permanent wetland impacts • Tree removal in Segments A and B would affect some protected areas such as stream crossings; there would be less than 0.1 acre of permanent wetland impacts in each segment

Table 5.1-3. Summary of Transportation and Environmental Effects *(multi-page table)*

Environmental Discipline	Impacts and Benefits
	• Several stream and wetland crossings by alignment alternatives in Segment C; permanent wetland impacts would range from 0.4 acre to 1.6 acres, with C3 and C4 (Clinton) having the most
Water Resources	• There would be increased pollution-generating and non-pollution-generating impervious surfaces for all alternatives • There would be floodplain impacts for all alternatives in Segment C except C6 • Hunziker O&M facility is located in the floodplain
Noise and Vibration	• There are noise and vibration-sensitive properties, including residences, that would be impacted in all three segments • More frequent trains are needed for the Branched Configuration, creating higher noise and vibration impacts • Segment A would have up to 353 moderate noise impacts, up to 8 severe noise impacts and up to 76 vibration impacts • Segment B would have up to 147 moderate noise impacts, one severe noise impact, and up to 29 vibration impacts • Segment C would have up to 72 moderate noise impacts, up to 15 severe noise impacts, and up to 21 vibration impacts • TriMet would mitigate impacts to be below federal severe impact thresholds for all alternatives
Hazardous Materials	• A full-corridor project would acquire 5 to 8 parcels with higher risk for remaining hazardous materials for the alignment, and an O&M facility could involve 2 additional parcels; resulting cleanup would be an environmental benefit • All Segment B alternatives would acquire up to 3 parcels with higher risk for remaining hazardous materials • Segment C alternatives would acquire 2 to 5 parcels with higher risk for remaining hazardous materials, with C5 having the least
Safety and Security	• Car prowls could occur with new or expanded park and rides • Some station locations in Segment C would be in areas that currently experience property and nuisance crimes, particularly in downtown Tigard
Land Use, Air Quality, Energy, Utilities, Public Services	• No adverse long-term impacts

A full-corridor alternative adds the effects by segment, including for the O&M facility, for an overall total for the project. Transportation effects, particularly the effects that span the full corridor or are regional in nature, such as increased transit ridership and reduced vehicle trips and miles traveled, are greatest for a full-corridor alternative. These regional transportation effects are generally positive.

The totals for impacts related to the conversion of land ("project footprint impacts" corresponding to property-related impacts and impacts to natural resources) are at their maximum levels with a full-corridor alternative.

The minimum operable segment (MOS) options would initially have lower total "project footprint" impacts, because a section of the project would no longer be built. However, if and when the remaining part of the project is built, the total impacts would be the same as the full project. The MOS options could either avoid or defer the impacts of converting some of the existing land uses for use by the transportation project. However, the MOS options would also have less frequent trains than a full-corridor alternative, which reduces noise and vibration impacts.

A shorter project involving lower train frequencies and fewer stations would still bring transportation benefits, but these benefits would be reduced (about 9,200 fewer daily light rail trips than a

full-corridor alternative). Other benefits such as improvements in air quality would be lower, and a shorter project would have reduced consistency with regional plans for land use and the transportation system.

5.2. Initial Route Proposal

This Draft EIS identifies a draft Preferred Alternative, known as the initial route proposal, to give the public and federal, state and local agencies, and tribal governments an opportunity to comment on a full-length light rail alternative. After the close of public comments on the Draft EIS, comments on the initial route proposal will inform the selection of the Preferred Alternative to study in the Final EIS (see Section 1.5, Next Steps, for more information).

Overview of Initial Route Proposal

Table 5.2-1 shows the alignment alternatives, design refinements and additional project elements that are included in the initial route proposal. The initial route proposal is a 12-mile through-routed light rail line with 13 stations, a Marquam Hill connection, a PCC-Sylvania shuttle and an O&M facility. The initial route proposal includes up to seven park and rides with a likely range of 2,000 to 3,650 spaces. The initial route proposal would use 32 light rail vehicles operating as two-car train sets (16 sets) at headways of 7 to 15 minutes in 2035, depending on location and time of day. If there is insufficient funding to construct the entire light rail line, the MOS for the initial route proposal would terminate in downtown Tigard.

Table 5.2-1. Initial Route Proposal Overview

Segment	Alignment Alternatives and Design Refinements[1]	Additional Project Elements
Segment A	Alternative A1: Barbur Refinement 1: Barbur Woods East-Side Running	Marquam Hill connection[2]
Segment B	Alternative B2: I-5 Barbur TC to 60th Refinement 2: Taylors Ferry I-5 Overcrossing Refinement 4: Barbur Undercrossing	PCC-Sylvania shuttle[2]
Segment C	Alternative C2: Ash to Railroad Refinement 5: Elmhurst Refinement 6: Tigard Transit Center Station East of Hall	Hunziker O&M facility

Note: O&M = operations and maintenance; PCC = Portland Community College; TC = Transit Center.

[1] The design refinements have not been analyzed at the same level of detail as the alignment alternatives in this Draft EIS. Design refinements would be incorporated into the Preferred Alternative in the Final EIS. Refinement 3, I-5 Undercrossing, was not selected because it was less promising than Refinement 4, Barbur Undercrossing, which covers the same area.

[2] The design for the Marquam Hill connection and the PCC-Sylvania shuttle route will be selected prior to the Final EIS through a public process that will involve the institutions, neighborhoods and appropriate resource agencies.

The light rail project will include a set of station access improvements that will be selected prior to the Final EIS. The Portland region will also seek to fund and construct the Bridgehead Reconfiguration separate from the light rail project if Alternative A1 is included in the Preferred Alternative.

Reasoning for Initial Route Proposal Selection

The initial route proposal was developed by project partner staff considering information from the Draft EIS analysis and public outreach. Table 5.2-2 compares the trade-offs between the initial route proposal, the base Draft EIS alignment alternatives that are included in the initial route proposal without design refinements, and the other alignment alternatives studied in this Draft EIS. See

Table 5.1-3 for a description of adverse impacts that could occur with the initial route proposal (not accounting for design refinements).

Alignment Alternatives

The primary factors that informed the selection of each alignment alternative in the initial route proposal were:

- **Alternative A1, Barbur,** would provide a shorter connection to Marquam Hill, have a faster travel time, and result in fewer property impacts compared to Alternatives A2-BH and A2-LA. The land use and transportation benefits of the Bridgehead Reconfiguration that would be included in Alternative A2-BH could be accomplished with a separate regional effort to fund and construct the Bridgehead Reconfiguration.

- **Alternative B2, I-5 Barbur Transit Center to 60th,** would offer more accessible and visible station locations, include more streetscape and safety improvements on SW Barbur Boulevard, result in fewer residential displacements, and better support the Barbur Concept Plan compared to Alternatives B3 and B4. Alternative B2 would avoid the complex reconstruction of the existing bridge over I-5 at Crossroads that would be necessary with Alternative B1.

- **Alternative C2, Ash to Railroad,** would be a Through Route, which would be more cost-effective to operate and would provide better Tigard-Tualatin connectivity and better transit service in Downtown Tigard compared to a Branched Route (Alternatives C5 and C6). The Ash alignment of Alternative C2 would provide an additional station in the Tigard Triangle, result in higher ridership, better support the Tigard Triangle Strategic Plan, and avoid a critical traffic impact compared to the Clinton Alignment (Alternatives C3 and C4). The railroad alignment of Alternative C2 would have a faster travel time and result in fewer impacts to businesses and employees than the I-5 alignment (Alternatives C1 and C3).

Design Refinements

The following design refinements in the initial route proposal were developed to improve the performance of the alignment alternatives while minimizing the environmental impacts described below:

- **Refinement 1, Barbur Woods East-Side Running**, would move the alignment to run along the east side of SW Barbur Boulevard for about a mile in The Woods, largely on aerial structure(s). The refinement would avoid replacing the Newbury and Vermont trestle bridges, which are potentially eligible historic structures. The refinement would also help reduce construction impacts to traffic on a facility that is one of the primary routes to and from downtown Portland. The refinement also carries potential cost and constructability advantages.

- **Refinement 2, Taylors Ferry I-5 Crossing,** would shift the light rail alignment to follow SW Taylors Ferry Road at the Barbur Transit Center and cross over I-5 just 5west of the Crossroads intersection. This refinement would reduce construction impacts on I-5 by providing a shorter light rail structure, reduce visual impacts, and offer cost and constructability advantages.

Table 5.2-2. Comparison of Initial Route Proposal to Other Alignment Alternatives

	Initial Route Proposal[1]	Base Draft EIS IRP Designs	Change from Base Draft EIS IRP Designs to Other Alignment Alternatives									
			Segment A		Segment B			Segment C				
	Alts. A1, B2, C2 with Refs. 1, 2, 4, 5, 6	*Alts. A1, B2, C2 (no refinements)*	*Alt. A2-BH*	*Alt. A2-LA*	*Alt. B1*	*Alt. B3*	*Alt. B4*	*Alt. C1*	*Alt. C3*	*Alt. C4*	*Alt. C5*	*Alt. C6*
Transit travel time												
PSU-Tigard TC	24 to 25 min	26min 10sec	+1m	+1m	-1m	+30s	-50s	Similar	-1m10s	-1m10s	Similar	+1m50s
PSU-Bridgeport	30 to 31 min	32min 30sec	+1m	+1m	-1m	+30s	-50s	+30s	-50s	-1m20s	**-3m30s**	**-3m30s**
Ridership												
Line riders	43,000 to 44,000	41,200	+300	+300	Similar	Similar	Similar	-600	-600	-800	**+1,600**	+900
New transit trips	19,000 to 20,000	17,500	**-900**	**-900**	Similar	Similar	Similar	-400	-400	-500	+800	+600
Displacements[2]												
Residential units	80 to 100	163	+12	**+84**	Similar	+3	+46	Similar	**-80**	**-80**	Similar	**-78**
Businesses	100 to 120	121	+5	+8	-7	+5	+1	+4	-9	-13	+18	+8
Employees	1,200 to 1,700	1,016	+160	+123	+31	+96	+27	**+458**	**+563**	+105	+192	+222
Cost[3]												
O&M (annual)	$22 M	$22 M	Similar	Similar	Similar	Similar	Similar	Similar	Similar	Similar	**+$8 M**	**+$8M**
Capital (YOE - 2024)	$2,600 to $2,800 M	$3,300 M	**+$130 M**	**+$160 M**	+$10 M	-$30 M	-$30 M	+$70 M	**+$120 M**	+$60 M	+$30 M	+$60 M
Other												
Additional trade-offs			Longer walk to Marquam Hill Land use and transp. benefits of Bridgehead Reconfig. Better supports Barbur Concept Plan	Longer walk to Marquam Hill Naito reinforced as a barrier	Adds complex reconstruct. of Crossroads bridge Better supports Barbur Concept Plan	Less supportive of Barbur Concept Plan	Less supportive of Barbur Concept Plan		Critical traffic impact at SW Hall Blvd. near Pacific Hwy. Less supportive of Tigard Triangle Strategic Plan	Critical traffic impact at SW Hall Blvd. near Pacific Hwy. Less supportive of Tigard Triangle Strategic Plan	Less frequent service to downtown Tigard	Less frequent service to downtown Tigard No impact to wetlands

Note: BTC = Barbur Transit Center; IRP = initial route proposal; M = million; O&M = operating and maintenance; TC = Transit Center; YOE = year of expenditure.

Cells are shaded to indicate how other alignment alternatives compare to the base Draft EIS IRP designs for each factor:

Worse			Similar			Better

[1] Numbers are approximate and subject to change because the design refinements have not been analyzed at the same level of detail as the alignment alternatives in the Draft EIS. Some of the design refinements would also be compatible with other alignment alternatives not included in the initial route proposal, but the change in impacts and benefits would differ.

[2] Numbers include the Hunziker O&M facility and a Marquam Hill connection. Connection 1A is assumed for the purpose of comparison (Connections 1B and 1C would result in the same displacements, and Connection 2 would result in fewer displacements).

[3] Reflects costs displayed in Table 5.1-2

- **Refinement 3, I-5 Undercrossing,** was not selected for the initial route proposal because it was less promising than Refinement 4, Barbur Undercrossing, and would cover the same area.

- **Refinement 4, Barbur Undercrossing,** would use a shorter aerial crossing over I-5 paired with an undercrossing below SW Barbur Boulevard, which would reduce visual impacts and construction-period traffic impacts on I-5. This concept would also shift the Baylor Station and park and ride to SW 68th Avenue just south of Pacific Highway, which would provide improved station spacing and increased ridership.

- **Refinement 5, Elmhurst,** would shift the alignment and station from SW Beveland Street slightly to the north, on SW Elmhurst Street. This refinement would reduce impacts to businesses on SW Beveland Street and would result in faster transit travel times and increased ridership.

- **Refinement 6, Hunziker,** would shift the alignment from SW Ash Avenue to southeast of SW Hall Boulevard. This refinement would avoid residential displacements along SW Hall Boulevard and SW Ash Avenue and reduce traffic impacts by avoiding at-grade auto crossings of SW Hall Boulevard.

Additional Project Elements

The design for the Marquam Hill connection and the PCC-Sylvania shuttle route will be selected prior to the Final EIS through a public process that will involve the institutions, neighborhoods and appropriate resource agencies. The Hunziker Facility was selected for an O&M facility in the initial route proposal because the 72nd Facility is incompatible with Alternative C2.

5.3. Finance Plan

The estimated capital and operating costs affect to some degree how the light rail alternatives could be funded. This section describes the preliminary funding concepts to illustrate potential differences presented by the alternatives. A detailed finance plan for the Preferred Alternative will be prepared for the Final EIS.

Capital Funding

The capital costs of developing and constructing the project are expected to be paid with a federal New Starts grant, a potential regional funding measure, and a combination of state, regional and local funding sources, as described below:

- **FTA Section 5309 Capital Investment Grant (New Starts funds).** The Federal Transit Administration's (FTA's) Capital Investment Grant (CIG) program funds high capacity transit projects, such as light rail, on a competitive basis. Currently Congress annually authorizes about $2.3 billion for this program; demand for these funds exceeds the amount authorized. Large fixed-guideway projects, such as the Southwest Corridor Light Rail Project, are funded under the New Starts category of the CIG program. Of the eight New Starts projects with grant awards in fiscal year 2019, half are in the $1.0 billion to $1.25 billion range; the other half are lower. Historically, there have been few grant awards in excess of $1.25 billion. To qualify for New Starts funds, a project must proceed through a multi-step process that includes periodic evaluation and ratings by FTA of the project's benefits, cost-effectiveness and finance plan. A project must be rated "medium" by FTA to be eligible for New Starts funds, but higher rated projects are more likely to be recommended for

funding. A key factor in these ratings is the proposed share of New Starts funding. The maximum New Starts funding share is limited by law to 60 percent of the project's capital cost, although very few projects nationally have achieved that level. To evaluate the potential competitive rating from FTA, the project partners have assumed that a maximum 50 percent share of New Starts funds for the least expensive Southwest Corridor alternatives, with a declining percentage share for the higher cost alternatives. Projects must complete the National Environmental Policy Act process and preliminary engineering before they can formally apply for the New Starts program.

- **Regional Funding Measure.** Subject to the approval of the voters in their district, either TriMet or Metro could issue general obligation bonds or other regional funding mechanisms to pay capital costs for the Southwest Corridor Light Rail Project. If approved by their voters, either district could levy a property tax on all taxable properties within its boundaries to meet debt service for the bonds. Because there is only a small difference in the assessed value of the districts, the tax rate would be similar for a TriMet or a Metro bond of the same size. General obligation bonds are exempt from property tax limitations or other tax increase restrictions under Oregon law. Portland region voters have previously approved such bonds for the Westside LRT Project ($125 million) and the South-North LRT Project ($475 million).

- **Other Local, Regional and State Funding.** Metro has already committed a portion of the region's federal formula grant program to fund project development and engineering for the Southwest Corridor Light Rail Project. TriMet has provided funding for all of its previous light rail projects, generally using its payroll tax revenues to repay revenue bonds for the projects, and currently has financial capacity to contribute funding for the Southwest Corridor Light Rail Project without any tax increase or levy. The state legislature could authorize lottery bonds for the project, as it has for other high capacity transit projects in the Portland region, including the Westside LRT Project ($125 million), South-North LRT Project ($375 million), and Milwaukie LRT Project ($250 million). The state legislature could also authorize general obligation bonds under Article XI-Q of the state constitution for portions of the Southwest Corridor Light Rail Project that will be owned by the state. The Oregon Department of Transportation has also historically contributed to light rail projects, using formula federal funds or, for eligible portions of the project, state highway funds. Cities and counties have also historically contributed to light rail projects within their boundaries. General funds, local improvement districts, system development charges, parking enterprise revenues and gas tax revenues have been used. Local governments have also made in-kind donations in the form of donated right of way and staff time. If the project is included in an urban renewal plan, tax increment funds could be used to pay project costs incurred within the urban renewal district. Finally, private funding sources are also being encouraged at the national level, although such arrangements still require a project that can generate adequate revenues or create other values that would be attractive to private investors.

- **Revenues Used to Repay Capitalized Interest.** FTA requires the capital cost of the project to include the financing costs paid during the construction period on borrowings used to fund the local share (e.g., the general obligation bond). FTA allows the local revenues used to repay these borrowings (e.g., property tax revenues used to repay general obligation bonds) to count toward the local share of project costs.

While work on securing local funding contributions is planned during the preparation of the Final EIS, financial plan concepts were developed to illustrate general differences among the alternatives

addressed in this Draft EIS. Table 5.4-1 shows illustrative finance plan concepts for the project, including the total cost ranges of the Draft EIS alternatives, the full-corridor initial route proposal and the initial route proposal MOS. While the amount of the New Starts funds required by the current range of Draft EIS alternatives is comparatively high ($1.31 billion to $1.45 billion), reflecting an assumed New Starts share that is lower than assumed for the initial route proposal in order to remain nationally competitive with other projects. Consequently, a cumulative contribution of $1.50 billion to $1.68 billion from state, local and regional sources, including the regional funding measure, would be required. Revenues used to pay capitalized interest costs on borrowings for these state, local and regional contributions make up the remainder of the finance plan.

Because the initial route proposal would be less expensive than the Draft EIS alternatives, the assumed amount of New Starts funds ($1.25 billion) reflects an assumed higher percentage share than for the Draft EIS alternatives. Given their lower cost and higher New Starts share, the full-corridor initial route proposal and initial route proposal MOS would require a cumulative contribution of $0.85 billion to $1.29 billion from state, local and regional sources, including the regional funding measure. Capitalized interest payments on the associated borrowings are also considered in the finance plan.

For all of the light rail alternatives, if the region assembles lower levels of local and state funding, a higher regional funding measure amount could be used to offset the deficit. Conversely, the amount of the regional funding measure could be reduced if greater amounts of local and state funding are committed than shown.

Table 5.4-1. Illustrative Finance Plans

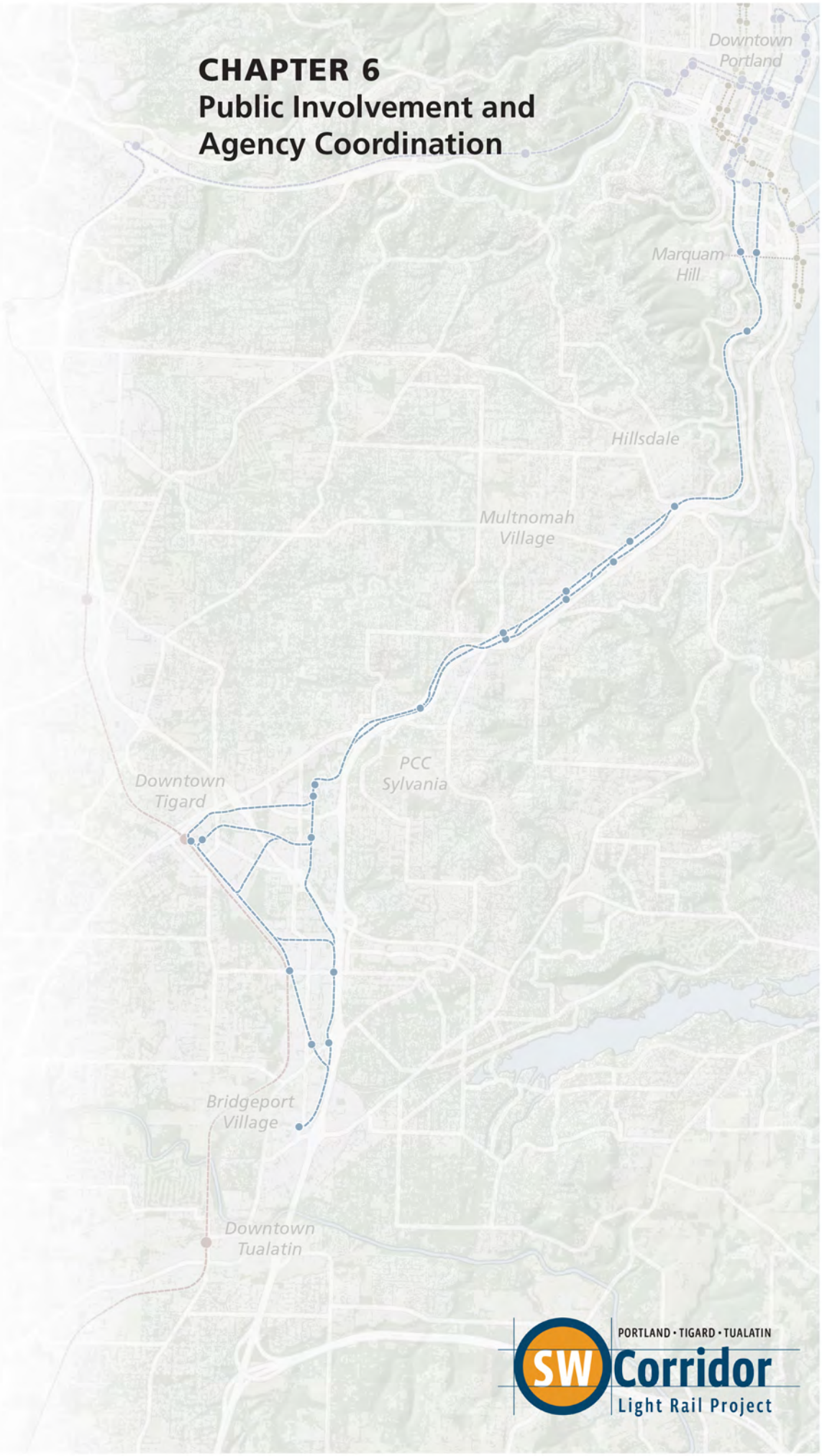
Revenue Source	Draft EIS Alternatives: Full Corridor *(in millions)*	Initial Route Proposal: Full Corridor *(in millions)*	Initial Route Proposal: MOS *(in millions)*
New Starts funds	$1,310 to $1,450	$1,250	$1,090 to $1,210
Regional funding measure	$1,200 to $1,300	$850 to $990	$650 to $710
Other local, state or regional funds	$300 to $380	$250 to $300	$200 to $250
Revenues to pay capitalized interest	$460 to $500	$290 to $320	$230 to $240
Total revenue	**$3,270 to $3,630**	**$2,640 to $2,860**	**$2,170 to $2,410**

Note: Amounts are in year-of-expenditure (2024) dollars. MOS = minimum operable segment.

Operations and Maintenance Funding

TriMet would provide the O&M funding for operating the Southwest Corridor Light Rail Project and its feeder bus system; no new operating funding would be required. Like virtually all other transit districts, TriMet was forced to undertake a series of cost reductions in 2010 to balance costs with the reduced tax revenues resulting from the recession. Since then, TriMet has taken several major steps that have placed it on solid financial footing for the long term. TriMet completed a multiyear union labor contract that significantly reduced the growth in medical benefit costs. TriMet also completed a series of payroll and self-employed tax rate increases that began in 2004, started a new series of payroll and self-employment tax rate increases in 2016 that will be phased in over a ten-year period and secured legislative approval for a new major tax source that begins in 2019. The additional revenues from these sources are dedicated to new and expanded bus service, innovative community/job connector service and light rail service.

CHAPTER 6
Public Involvement and Agency Coordination



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6. PUBLIC INVOLVEMENT AND AGENCY COORDINATION

Section		Page
6.1	Project Outreach History	6-1
6.2	Community Participation	6-4
6.3	Agency Coordination	6-5

Metro and TriMet have been conducting public outreach since 2012 providing opportunities for public input on early decision-making for the Southwest Corridor. In addition, a formal scoping period for the EIS review process occurred from September 2, 2016, to October 3, 2016. Metro and TriMet continue to provide ongoing opportunities for public engagement for the Southwest Corridor Light Rail Project. Metro, TriMet and the FTA have an *Agency Final Coordination Plan* for the project which identifies agency roles in project development, including for public outreach. This chapter summarizes the project's public, agency and tribal coordination during the Draft EIS.

6.1. Project Outreach History

Since 2012, the Southwest Corridor project has engaged the community and its partners in a planning process to improve life in the Southwest Corridor. Engagement involved large and small community focus groups, briefings, forums, workshops and public meetings. Online engagement tools such as surveys and interactive maps have allowed for increased participation, while a partnership with local organizations and service providers has expanded the project's reach to more diverse audiences.

The project's outreach efforts have been guided by engagement objectives and outcomes listed below.

6.1.1. Public Engagement Objectives

The public engagement objectives of the project are to:

- provide relevant information to the public about upcoming project deliberations
- generate public feedback and ideas, and ensure that feedback is presented to decision-makers
- communicate with stakeholders in a way that generates understanding and enthusiasm for the project
- build on existing relationships with engaged members of the public and build new relationships with members of the public whose perspectives have been underrepresented to date
- demonstrate how decision-makers are receiving and considering community input when deliberating decisions.

6.1.2. Public Engagement Desired Outcomes

The desired outcomes of the public engagement effort for the project are:

- input on key issues and trade-offs specific to each key community in the corridor
- summary of stakeholder perspectives on high capacity transit (HCT) alignment choices
- input on desired benefits that Southwest Corridor Plan investments can bring to communities in the region
- elevated voices of champions for the project

- public stakeholders who feel they have access to project details, technical staff and decision-makers
- decision-makers who understand and consider public input in their decision-making.

6.1.3. Early Public Involvement Efforts

Several phases of project outreach were conducted between 2012 and 2014, prior to the Notice of Intent to begin the EIS. Table 6.1-1 summarizes the outreach activities during this time period. The main purpose of this outreach was to develop the Southwest Corridor Shared Investment Strategy. The purpose of the plan was to form a complete vision for the corridor from Southwest Portland to Tigard, Tualatin and Sherwood that would include HCT, bicycle and pedestrian improvements, and an equitable development and housing strategy.

Table 6.1-1 summarizes the early public involvement efforts between 2012 and 2014.

Table 6.1-1. Public Involvement 2012–2014 *(multi-page table)*

Project Phase and Time Frame	Purpose	Outreach Activities	Feedback
Initial Refinement - 2012 to 2013	• Determine the scope, evaluation framework and goals for the overall *Southwest Corridor Plan* • Kicking off the planning effort, informing the public about the background and proposed elements of the plan • Asking residents what they value about their communities	• An online, virtual open house • An open house • A walking tour • Booths at community events • An online survey • Website • Email notices • Mailed information	• Protect existing neighborhoods • Create local destinations that add to sense of community • Improve access to parks and natural areas • Provide transportation choices • Increase efficiency of SW Barbur Blvd./Pacific Hwy. (99W) • Lower traffic impacts on adjacent neighborhoods
Shared Investment Strategy - 2013	• Identify a list of potential projects based on public input • Identify the benefits and trade-offs of different types of investments	• Interactive website called "Shape Southwest" • Open houses, town halls, economic forums and community planning forums • Booths at community events • Community group briefings • An online questionnaire • Paper-version questionnaire (in English, Spanish and Vietnamese) • Email notices	• Strong support for HCT in the Southwest Corridor • Interest in better local transit service and more transit connections • Desire for quicker transit trips • Concerns about congestion and time spent in traffic • Feasibility is important (cost, funding potential and support) • More healthy and prosperous communities for all

Table 6.1-1. Public Involvement 2012–2014 *(multi-page table)*

Project Phase and Time Frame	Purpose	Outreach Activities	Feedback
Focused Refinement 2013 to 2014	• Define and select the most promising HCT alignment, terminus and mode (light rail or bus rapid transit) options • Collect input from the public regarding the different transit design options under consideration • Gather public feedback about potential HCT station areas and multimodal projects along the transit design options under consideration • Make a recommendation to the Steering Committee	• Open houses and public meetings/forums • Website • Discussion groups • Community group briefings • Booths at community events • Online surveys • Online metro news stories • Social media postings • Email notices	• Strong support for HCT in the Southwest Corridor including fast, reliable travel times, high ridership and access to key places • Interest in better local transit service and more transit connections • Desire for quicker transit trips • Potential to address future needs • Concerns about congestion and time spent in traffic • Feasibility is important (cost, funding potential and support) • Healthier and more prosperous communities for all

Note: HCT = high capacity transit.

The public outreach described above informed the Southwest Corridor Steering Committee decision-making from 2014 to 2016. The Steering Committee is made up of elected officials from seven cities (Portland, Tigard, Tualatin, Sherwood, Beaverton, King City and Durham), Washington County, and Metro, and representatives from TriMet and the Oregon Department of Transportation.

The Steering Committee led the decision-making process on:

- options for the Marquam Hill Connection
- consideration of a tunnel serving the Portland Community College (PCC) Sylvania campus
- preferred mode—bus rapid transit or light rail
- alternatives to be considered in the Draft EIS

Each major decision was informed by a public comment period that included public forums, open houses, online surveys and solicitation of public testimony at the Steering Committee's public meetings.

6.1.4. NEPA Public Outreach

A formal scoping comment period for the Southwest Corridor Light Rail Project was held from September 2, 2016, to October 3, 2016, as part of the project's NEPA draft environmental review process*. The Scoping Summary Report* summarizes the agency, tribe and public comments that Metro and FTA received, and describes how Metro and FTA advertised the notice of intent and engaged the public and agencies during the scoping period. A variety of outreach efforts were used to encourage the involvement of residents and businesses in the Southwest Corridor during the scoping comment period, including:

- two public online surveys
- five briefings at neighborhood association meetings

- agency and tribal scoping meeting
- email notices
- online Metro News stories
- public scoping meeting.

A total of 1,620 comments were received during the scoping comment period, including surveys, emails and letters from the general public, agencies and organizations.

6.2. Community Participation During NEPA

Below is a description of some of the public participation methods employed during the development of the Draft EIS:

- **The Community Advisory Committee** was created and populated by the Southwest Corridor Steering Committee in December 2016, based on guidance from project partner staff.
- **Briefing books** were released at different times throughout the NEPA process to provide detailed information about each alignment alternative.
- **A project mailing/newsletter** that included a summary of the proposed light rail project was mailed to over 10,500 mailing addresses within approximately 1,200 feet of a proposed alignment (including residential and business tenants), and also to an additional 900 property owners.
- **Public forums**, or general public meetings, were held to allow for public input, sharing of information and general project awareness.
- **Briefings with business and neighborhood associations** included visits that provided project updates and the opportunity for questions and input.
- **Ongoing public awareness events**, including community group presentations and tabling events, were held to provide an opportunity for project partner staff to share general information on the project and answer questions.
- **Individual meetings with potentially impacted property owners and door-to-door visits** allowed project partner staff to meet with property owners, upon their request, to show them potential alignments and discuss possible impacts on their properties. Door-to-door visits expanded project awareness and relationship building in business areas along the corridor.
- **Website and social media efforts** included the development of a public website that has been a public resource for information about the project. In addition, Metro sends monthly project email updates to a list of about 2,000 interested individuals.
- **Outreach to comply with federal environmental justice guidelines** (more details about environmental justice outreach are in Appendix C, Environmental Justice Compliance) included developing partnerships with organizations that have established relationships with low-income and minority populations in the corridor to help conduct targeted outreach to these populations.

6.3. Agency Coordination

The *Agency Coordination Plan* describes how the lead agencies will engage with participating tribes and agencies during the environmental review process and identifies tribal and agency roles and responsibilities. FTA and Metro invited 35 agencies and jurisdictions to participate in an agency scoping meeting for the Southwest Corridor Light Rail Project, on September 20, 2016. Seven agencies participated in person at this meeting. Other participants attended the meeting by phone.

Table 6.3-1 lists all federal, state and local agencies and tribes invited to participate based on the natural, cultural and socioeconomic resources in the project area, or because of other agency jurisdiction and expertise. See the *Agency Coordination Plan* for more details about how these agencies participated in the NEPA process.

Table 6.3-1. Agencies and Tribes Invited to Participate in the NEPA Process *(multi-page table)*

Tribe, Agency or Organization	Status	Related Regulation
Confederated Tribes of the Grand Ronde Community of Oregon	Participating Tribe / Consulting Tribe	National Environmental Policy Act / Section 106 of the National Historic Preservation Act
Confederated Tribes of Siletz Indians of Oregon	Participating Tribe / Consulting Tribe	NEPA / Section 106
Confederated Tribes of the Warm Springs Reservation of Oregon	Participating Tribe / Consulting Tribe	NEPA / Section 106
Cowlitz Indian Tribe	Consulting Tribe	Section 106
Federal Highway Administration	Cooperating Agency	NEPA
Federal Railroad Administration	Participating Agency	NEPA
National Park Service	Participating Agency	NEPA
NOAA Fisheries	Participating Agency	NEPA
US Army Corps of Engineers	Participating Agency	NEPA
US Environmental Protection Agency	Participating Agency	NEPA
US Fish and Wildlife Service	Participating Agency	NEPA
Oregon Department of Energy	Did not respond to invitation	N/A
Oregon Department of Environmental Quality	Declined	N/A
Oregon Department of Fish and Wildlife	Did not respond to invitation	N/A
Oregon Department of Geology and Mineral Industries	Did not respond to invitation	N/A
Oregon Department of Land Conservation and Development	Did not respond to invitation	N/A
Oregon Department of State Lands	Did not respond to invitation	N/A
Oregon Department of Transportation	Participating Agency	NEPA
Oregon Parks and Recreation	Did not respond to invitation	N/A
Oregon State Historic Preservation Office	Participating Agency	NEPA
Clackamas County	Participating Agency	NEPA
Multnomah County	Declined (NEPA) / Did not respond (Sec 106)	N/A
Washington County	Participating Agency / Did not respond (Sec 106)	NEPA
City of Beaverton	Did not respond to invitation	N/A
City of Durham	Did not respond to invitation	N/A
City of King City	Did not respond to invitation	N/A
City of Lake Oswego	Participating Agency	NEPA
City of Portland	Participating Agency / Consulting Party	NEPA / Section 106

Table 6.3-1. Agencies and Tribes Invited to Participate in the NEPA Process *(multi-page table)*

Tribe, Agency or Organization	Status	Related Regulation
City of Rivergrove	Did not respond to invitation	N/A
City of Sherwood	Did not respond to invitation	N/A
City of Tigard	Participating Agency / Consulting Party	NEPA / Section 106
City of Tualatin	Participating Agency / Did not respond (Sec 106)	NEPA
Clean Water Services	Participating Agency	NEPA
Tualatin Hills Park & Recreation District	Did not respond to invitation	N/A
Tualatin Valley Fire & Rescue	Declined	N/A
Tualatin Valley Water District	Participating Agency	NEPA
Clean Water Services	Participating Agency	NEPA
West Multnomah Soil & Water Conservation District	Participating Agency	NEPA
Restore Oregon	Consulting Party	Section 106

After the ROD is published, TriMet will need to obtain several agency approvals for project construction. The approving agencies are a cooperating or participating agency during the NEPA process (see Table 6.3.1) previously, but these agencies will also have formal permit or review roles over topic areas that are listed in Table 6.3.2 below.

Table 6.3-2. Potential Federal, State and Local Agency Approvals *(multi-page table)*

Agency	Topic
Federal	
U.S. Department of Defense, Army Corps of Engineers	Wetlands, Hydrology/Water Quality
U.S. Department of Transportation, Federal Highway Administration and Federal Transit Administration	FHWA - Freeway and Highway Access, FTA - Hydrology/Water Quality, Wetlands, Traffic, Air Quality, Right-of-Way, Displacements/ Relocations, Highway Improvement Plans, Noise and Vibration, and Capital Cost Estimates
U.S. Department of Transportation, Federal Railroad Administration	Right-of-Way, Traffic, Transit, Safety and Security
U.S. Department of Homeland Security, Federal Emergency Management Agency	Hydrology/Water Quality
U.S. Department of Homeland Security, Transportation Security Administration	Safety and Security
U.S. Department of the Interior, Park Service	Parklands Resources
Advisory Council on Historic Preservation	Historic/Cultural Resources
U.S. Environmental Protection Agency	Wetlands, Air Quality, Hazardous Materials, and Ecosystems, Water Quality/Sole Source Aquifer
U.S. Department of the Interior, Fish and Wildlife Service	Threatened and Endangered Species, Essential Fish Habitat,
U.S Department of Commerce, National Oceanic and Atmospheric Administration (NOAA) Fisheries	Threatened and Endangered Species, Essential Fish Habitat, Least Environmentally Practicable Alternative

Table 6.3-2. Potential Federal, State and Local Agency Approvals *(multi-page table)*

State of Oregon	
Department of State Lands	Hydrology/Water Quality and Wetlands and state property use
Department of Fish and Wildlife	Wetlands, Threatened and Endangered Species, Fish Passage and Wildlife
Department of Environmental Quality	Hydrology/Water Quality, Construction impacts (stormwater) Wetlands, Air Quality, Energy, Hazardous Materials, and Noise and Vibration
Department of Transportation	Right of Way, Review of Design and Construction, Freeway Access
State Historic Preservation Office	Historic and Archaeological Resources
Local	
City of Portland, City of Tigard, City of Tualatin	Wetlands, Hydrology/Water Quality, Fish and Wildlife, Land Use and Economic Development, Historic Resources, Displacements/ Relocations, Transportation Plans and Traffic, Noise and Vibration, Visual Resources, Historic and Archaeological Resources, Neighborhoods, and Hazardous Materials, safety standards
Clean Water Services	Wetlands, Hydrology/Water Quality, Fish and Wildlife
Metro	Land Use, Transportation
Tualatin Valley Water District	Water Quality
Tualatin Valley Fire and Rescue	Safety Standards