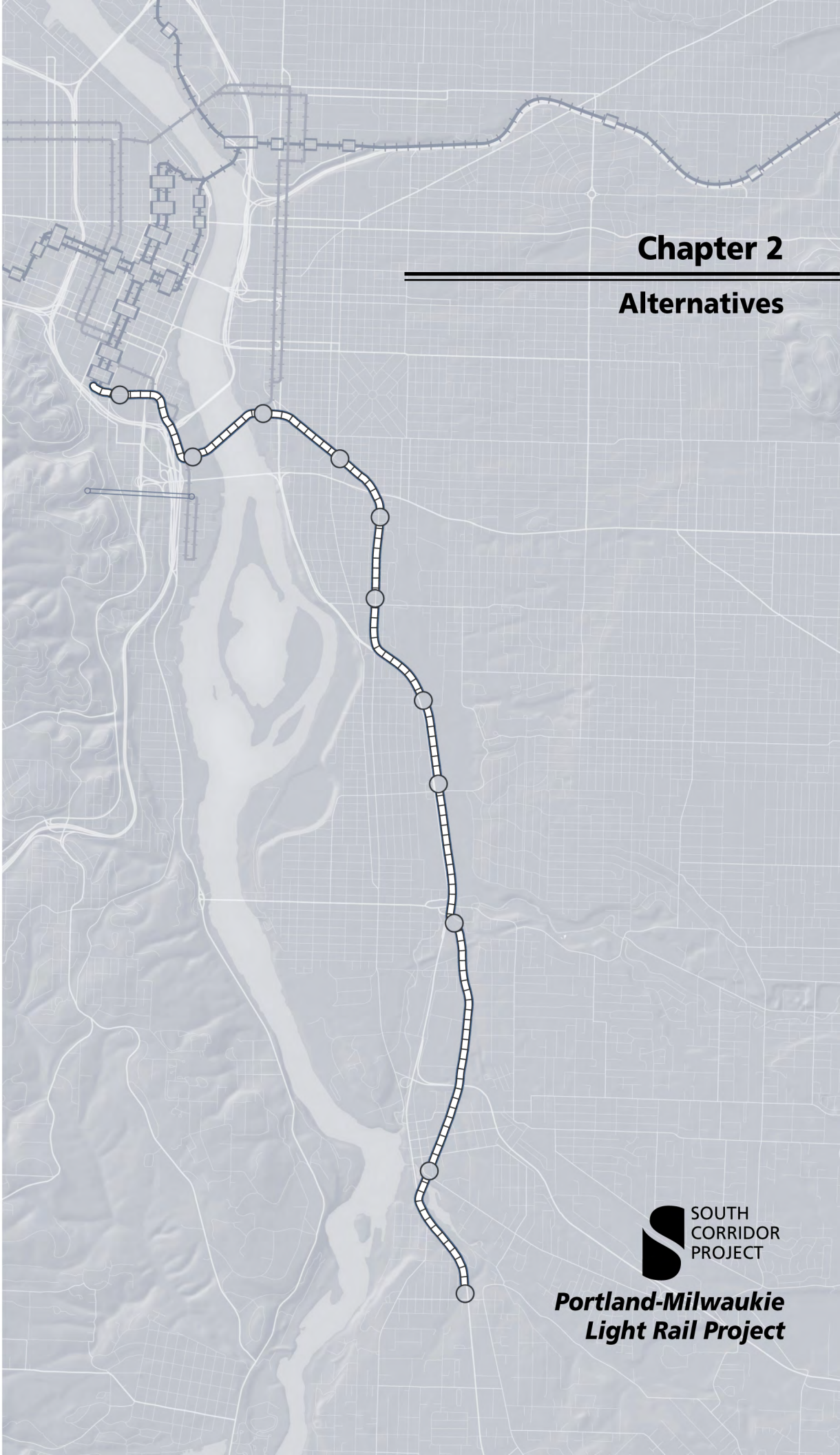


Chapter 2

Alternatives

SOUTH CORRIDOR PROJECT

Portland-Milwaukie Light Rail Project

2. ALTERNATIVES

CHAPTER CONTENTS

The Portland-Milwaukie Light Rail Project Final Environmental Impact Statement (FEIS) is being prepared under the National Environmental Policy Act (NEPA), which requires disclosing the environmental impacts and proposed mitigation for projects with federal funding or that involve other federal actions or approvals. The Federal Transit Administration (FTA), Metro, and the Tri-County Metropolitan Transportation District of Oregon (TriMet) are considering a 7.3-mile extension of light rail for the South Corridor between downtown Portland and north Clackamas County that would include federal as well as local funds. FTA is the federal lead agency under NEPA.

This FEIS considers a Locally Preferred Alternative (LPA) for a light rail project that would connect downtown Portland to the City of Milwaukie and north Clackamas County, and compares the light rail project to a No-Build Alternative. When the LPA was adopted in 2008, it included a recommendation for a Minimum Operable Segment (MOS) if funding could not be secured to construct the full-length LPA alignment to SE Park Avenue. In this FEIS, the MOS is evaluated as an option. Prior to making the decision on the MOS, the timing and priority for the future SE Lake Road to SE Park Avenue alignment would be addressed. The SE Lake Road to SE Park Avenue alignment will remain a regional transit priority until constructed. For this reason, the FEIS also evaluates a lower cost LPA phasing option that allows the project to be completed to SE Park Avenue by deferring some features of the LPA.

In addition, streetcar-related tracks and roadway facilities that are associated with, but not funded by, the project are included in this FEIS. These related projects are not necessary for the Portland-Milwaukie Light Rail Project, but the light rail project has some features that support the development and operation of these related facilities.

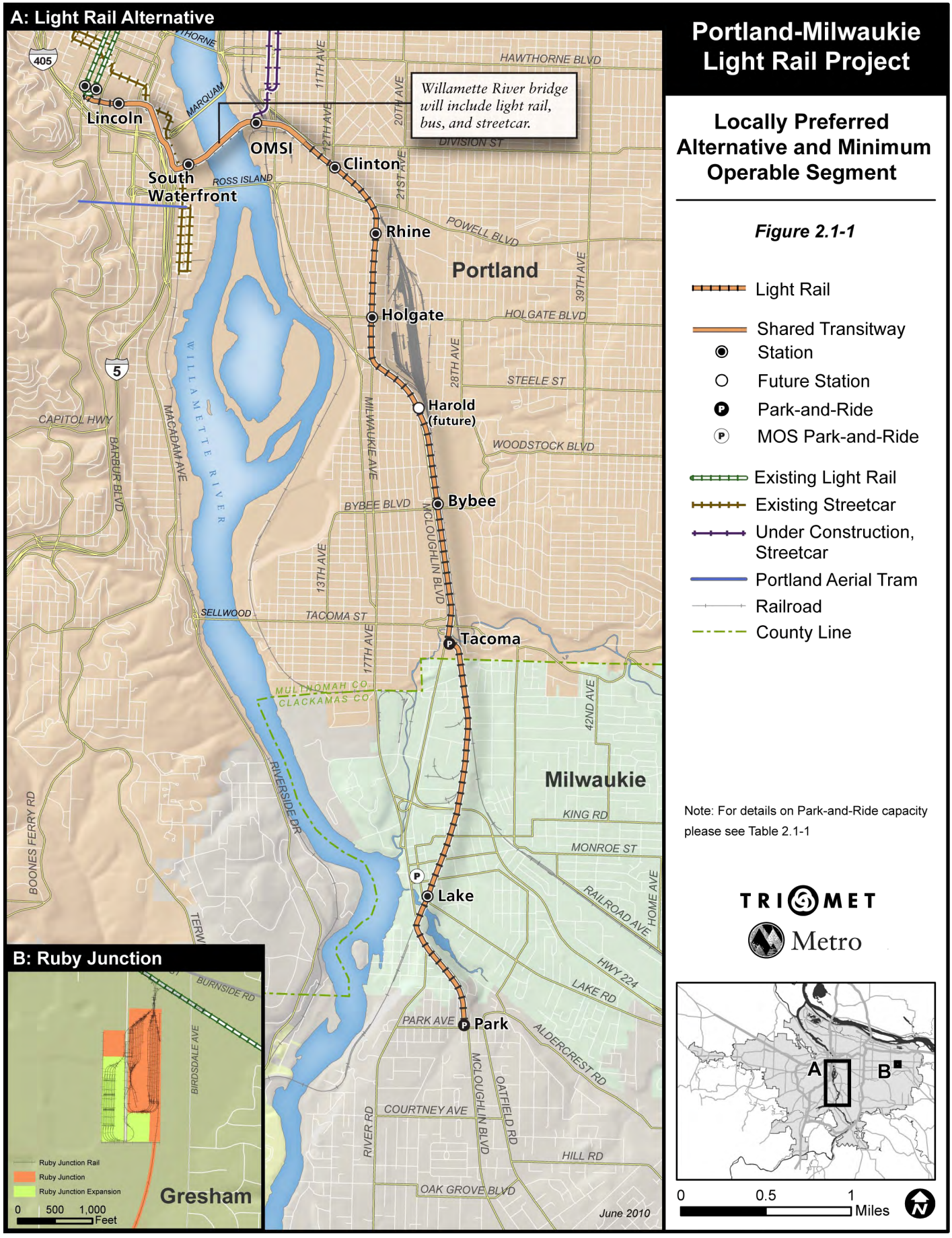
This chapter describes the light rail project, provides cost estimates and reviews decisions that led to the selection of the LPA to Park Avenue and MOS to Lake Road for the project. Section 2.1 provides a description of the alternatives evaluated for this FEIS. This description is based on preliminary engineering information developed by TriMet. Section 2.2 includes capital costs and operating and maintenance costs for light rail. Section 2.3 describes the process that led to the selection of LPA for this project. It focuses on the analysis undertaken and results of the *Portland-Milwaukie Supplemental Draft Environmental Impact Statement* (SDEIS). Appendix L, Background on Alternatives Development, provides additional detail on the modes and alignments evaluated in the corridor prior to the *Portland-Milwaukie SDEIS*.

2.1 DEFINITION OF ALTERNATIVES

The alternatives considered in this FEIS were developed through a NEPA environmental process that began in 1993 for the South/North Corridor Project, which produced a Draft Environmental Impact Statement (DEIS) in 1998. Since then, several other studies and supporting NEPA documents have helped shape the South Corridor alternatives, including the *South Corridor Project SDEIS* (2002), the *Downtown Amendment to the South Corridor Project SDEIS* (2003), and the *South Corridor FEIS* (2004). Most recently, the *Portland-Milwaukie Light Rail Project SDEIS* (2008) focused specifically on a set of light rail alternatives that serve the South Corridor between downtown Portland, the City of Milwaukie, and northern Clackamas County.

This FEIS examines the impacts and benefits of the following:

- **No-Build Alternative** representing future conditions without the Portland-Milwaukie Light Rail Project. The No-Build Alternative represents both a possible outcome of this FEIS process and a reference point to gauge the benefits, costs, and impacts of the LPA to Park Avenue and the MOS to Lake Road. Characteristics of these alternatives are summarized in Table 2.1-1 and described below. The **No-Build Alternative** is required under NEPA.
- **Locally Preferred Alternative (LPA) to Park Avenue** from the Downtown Portland Transit Mall to SE Park Avenue in north Clackamas County, including approximately 7.3 miles of light rail, ten stations (plus a previously deferred station on the Portland Transit Mall and a future station), two park-and-rides, and a new bridge across the Willamette River.
- **Locally Preferred Alternative (LPA) Phasing Option** There is a lower cost phasing option for the LPA to Park Avenue (the LPA Phasing Option) that describes how some elements of the LPA could be deferred or modified in the project's initial construction and operation. Figure 2.1-1 shows the LPA alignment and the location of stations and park-and-rides. For further detail see Section 2.1.1.1 for the LPA to Park Avenue, and Section 2.1.1.2 for the LPA Phasing Option.
- **Minimum Operable Segment (MOS) to Lake Road,** an option to terminate at SE Lake Road in downtown Milwaukie, with 6.5 miles of light rail plus five shelters and one station deferred from the Portland Mall Transit Project at SW Jackson Street. The MOS alignment is the same as the LPA alignment between the Downtown Portland Transit Mall and SE Lake Road, but would add a park-and-ride facility associated with the Lake Road Station and increase park-and-ride capacity at the Tacoma Station. For further detail see Section 2.1.1.3.
- **Related Bridge Area Transportation Facilities** including streetcar and local roadway improvements in the vicinity of the new Willamette River bridge. Streetcar improvements would connect the Portland Streetcar currently operating in South Waterfront to the Portland Streetcar Loop Project now under construction on the east side of the Willamette River. SW Moody Avenue and SE Water Avenue would be reconstructed to accommodate light rail and streetcar to maximize the transportation benefits of the light rail project and to allow it to be built and operated consistent with local development plans. Streetcar stations would be located in South Waterfront and near OMSI. The Related Bridge Area Transportation Facilities are not assumed to be funded as a part of the Portland-Milwaukie Light Rail Project. For further detail see Section 2.1.1.6.



Portland-Milwaukie Light Rail Project

Locally Preferred Alternative and Minimum Operable Segment

Figure 2.1-1

- Light Rail
- Shared Transitway
- Station
- Future Station
- Park-and-Ride
- MOS Park-and-Ride
- Existing Light Rail
- Existing Streetcar
- Under Construction, Streetcar
- Portland Aerial Tram
- Railroad
- County Line

Note: For details on Park-and-Ride capacity please see Table 2.1-1

TRIMET

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0 0.5 1 Miles

- **Ruby Junction Maintenance Facility. The** Portland-Milwaukie Light Rail Project would also require expanding the existing Ruby Junction Facility in Gresham to store and service the additional light rail vehicles and support the maintenance activities associated with the project.

Table 2.1-1
Summary of Transit and Roadway Improvements/Modifications

	Transit	Roadway
No-Build	Existing transit services and facilities, plus: • Some increases in route frequency and/or run times to avoid peak overloads and/or to maintain schedule reliability. • Incremental increases in service hours and vehicle procurement, consistent with available revenue sources and consistent with the Regional Transportation Plan (RTP) 2025 financially constrained transit network. • A new #30 Johnson Creek bus route that would connect the Clackamas Transit Center and downtown Milwaukie on SE Johnson Creek Boulevard. • A 100-space shared park-and-ride at Clackamas Community College. • Minor changes in transit operations and routing in the South Corridor. • Expansion of TriMet's Powell Garage facility to accommodate at least 50 additional buses.	Road improvements included in the 2004 Regional Transportation Plan (RTP) financially constrained highway network. See Appendix B of the *Detailed Definition of Alternatives Report* (Metro 2007) for a detailed listing of the planned roadway projects within the Portland-Milwaukie Light Rail Project area.
LPA to Park Ave.[1]	All transit improvements included within the No-Build Alternative, plus: • A double-tracked light rail between downtown Portland and Milwaukie, terminating at SE Park Avenue, generally parallel to and east of SE McLoughlin Boulevard, with 10 light rail stations, and 20 additional light rail vehicles (17 to 20 vehicles with the phasing option). • Adjustments to the bus routing to eliminate or modify bus routes that would duplicate light rail service and adjustment of routes to connect to light rail stations or transit centers. • An 800-space park-and-ride structure at SE Tacoma Street (with as few as 320 spaces on a surface lot with the phasing option). • A 600-space park-and-ride structure at SE Park Avenue (or a structure with as few as 355 spaces with the phasing option.) • Elevated structures and track over SW Harbor Dr., the Willamette River, SE Powell Blvd., SE Harold St., Crystal Springs Creek, SE Tacoma St. ramps, Johnson Creek, the Tillamook Branch line, SE Lake Road, Kellogg Lake, and SE McLoughlin Blvd. • A new Willamette River bridge that will accommodate light rail, buses, bicycles, pedestrians, and a future streetcar. • Access to the new Willamette River bridge and transitway for bus lines 9, 17, and 19, allowing rerouting of buses from congested streets. • Expansion of the Ruby Junction Maintenance Facility to accommodate 17 to 20 additional light rail vehicles (a smaller expansion size if phasing is used). • New and consolidated control center for light rail transit (LRT) operations located at TriMet's Center Street facility.	The following road improvements and modifications in addition to those in the 2004 RTP financially constrained highway network: • Modifications to segments of roadways along SW Lincoln Street; SW Harbor Drive; SW Moody Avenue between SW River Parkway and SW Gibbs Street and SE Water Avenue from the north side of the OMSI parking lot to SE Caruthers; and SE 8th, SE 9th, and SE 17th avenues in Portland. • Reconfiguration of access to SE McLoughlin Boulevard at the Tacoma Station. • Reconfigurations that would close SE Adams Street and SE Sparrow Street to through traffic.

Table 2.1-1
Summary of Transit and Roadway Improvements/Modifications

	Transit	Roadway
MOS to Lake Rd.	All improvements included with the LPA except: • Light rail would terminate in Milwaukie at SE Lake Rd., with no structure from SE Lake Rd. to SE McLoughlin Blvd. and would include 16 additional light rail vehicles. • A 1,000-space park-and-ride facility at SE Tacoma St. and a 275-space facility at SE Lake Rd. There would be no park-and-ride at SE Park Ave. • Expansion of the Ruby Junction Maintenance Facility to accommodate 16 additional light rail vehicles.	Improvements and modifications included in the LPA, except SE Sparrow Street would not be closed.
Related Bridge Area Facilities	• New double track for the Portland Streetcar in South Waterfront, realigned to remain within median of SW Moody Ave. • Realigned streetcar tracks and station at OMSI connecting to shared transitway,	Reconstruction of SW Moody Ave. between SW River Parkway and SW Gibbs St. and realignment of SE Water Ave.

[1] Includes features that could be phased or modified by LPA Phasing Option. The elements that would be potentially affected by the LPA Phasing Option are described in Section 2.1.1.2.

2.1.1 Portland-Milwaukie Light Rail Project Description

This section describes the major features of the LPA to Park Avenue and the MOS to Lake Road including the alignment, a new Willamette River bridge, station and park-and-ride locations, and other facilities that are associated with the project. This section also describes the project's construction plans. The No-Build Alternative is described at the end of the section.

2.1.1.1 Locally Preferred Alternative (LPA) to Park Avenue

This section describes the LPA to Park Avenue alignment from the Downtown Portland Transit Mall to a terminus station at SE Park Avenue in Clackamas County. The alignment would be double track, at grade unless otherwise noted.

Downtown Portland Transit Mall to the Willamette River Bridge

This section of the alignment is shown in Figure 2.1-2. The alignment would connect with the MAX light rail on the Downtown Portland Transit Mall near Portland State University. From the connection with the Downtown Portland Transit Mall at SW Jackson Street on SW 5th Avenue southbound and SW 6th Avenue northbound, the alignment would turn east and cross SW 5th Avenue, SW Grant Street, and SW 4th Avenue at grade, and continue east on SW Lincoln Street.

SW Lincoln Street would be rebuilt with light rail tracks in a center median, with a station located between the SW 2nd Avenue and SW 3rd Avenue pedestrian walkways and a left-turn pocket from SW Lincoln Street to SW 1st Avenue. The north side of SW Lincoln Street, which is uphill, would have a bike lane; the south side lane, which is downhill, would have a shared vehicle and bicycle lane. SW Lincoln Street would be extended one block west of SW 1st Avenue, creating a new intersection at SW Naito Parkway. This one-block extension would be exclusively for use by light rail trains, buses, pedestrians, and bicycles.

Three bus lines, #9 Powell, #17 Holgate, and #19 Woodstock, would be rerouted to operate on a shared transitway, accessing the transitway via SW Lincoln Street at SW Naito Parkway. After crossing SW Naito Parkway at grade, the LPA to Park Avenue alignment would be an exclusive transitway for use by light rail vehicles and buses.

The shared transitway would cross on structures over SW Harrison Street and SW Harbor Drive, turn southward, and remain on structures to travel under the I-405 ramp structure and over SW Sheridan Street. It would continue south along the west side of SW Moody Avenue into the South Waterfront District on up to 14 feet of retained fill. At the intersection of SW Moody Avenue and SW Porter Street, the alignment would turn toward the river and cross the Portland Streetcar tracks and SW Moody Avenue at grade.

Facilities to provide additional transit connections to and from the bridge are also being considered in conjunction with the light rail project. These include streetcar connections and modifications to the local street system. These facilities are discussed in more detail in Section 2.1.1.6, Related Bridge Area Transportation Facilities, below. As a part of the Related Bridge Area Transportation Facilities, two sets of streetcar tracks would replace an existing single-track section of SW Moody Avenue between SW River Parkway and SW Gibbs Street, and SW Moody Avenue would be reconstructed. This project was awarded a Transportation Investment Generating Economic Recovery (TIGER) grant, and would be implemented independent of the light rail project. The streetcar would access the transitway just to the east of where the light rail alignment turns toward the river.

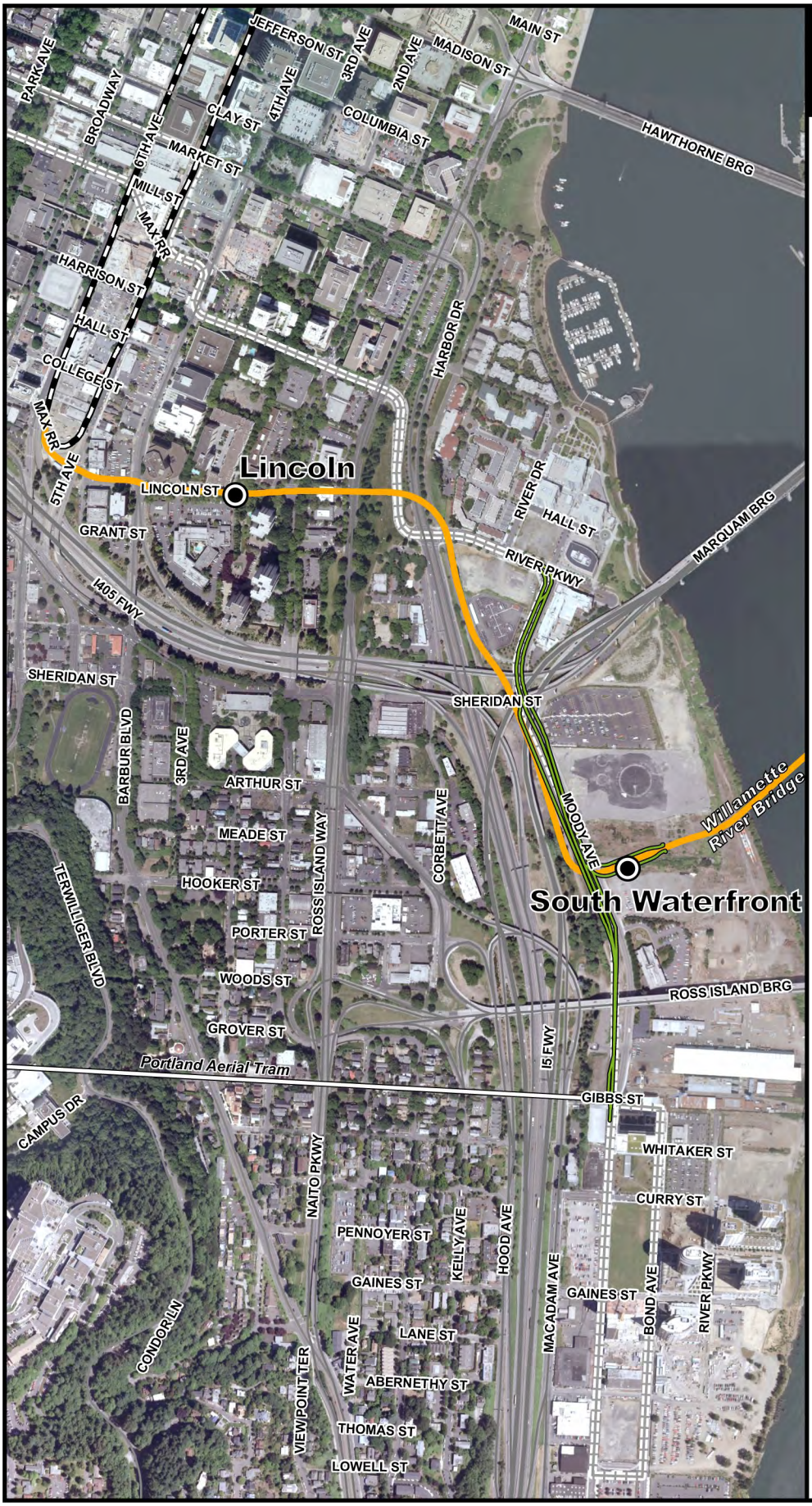
A South Waterfront transit station would be located between SW Moody Avenue and the planned location of SW Bond Street. This station would be coordinated with a planned Oregon University Systems Life Science building that is under development. The station would feature separate platforms for light rail and bus stops with streetcar platforms located nearby on SW Moody Avenue.

Leaving the station, the light rail alignment would begin to climb as it approaches the new bridge crossing the Willamette River. The alignment would cross the planned SW Bond Street on retained fill, and then be elevated on structure to cross over the proposed future Willamette River Greenway Trail on the west bank.

Willamette River Bridge

The Willamette River bridge would be a cable-stayed structure that would accommodate light rail trains, streetcars, buses, pedestrians, bicycles, and emergency vehicles. Buses, light rail trains, and streetcars would share a set of paved tracks in the center of the bridge. Both sides of the bridge would have 14-foot multi-use paths that would be separated from the transit vehicles and tracks by barriers.

The alignment for the Willamette River bridge is shown in Figure 2.1-3, and Figure 2.1-4 shows typical section, plan, and elevation design drawings. Photographic simulations of the bridge are shown in Appendix D, and preliminary engineering drawings of the bridge are shown in Appendix H.



Portland-Milwaukie Light Rail Project

Downtown Portland Transit Mall to the Willamette River Bridge

Figure 2.1-2

- Light Rail Alternative
- Station
- Existing MAX
- Existing Streetcar
- Proposed Streetcar

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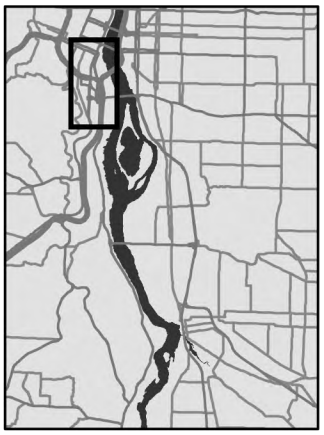

0 500 1,000 Feet

March 2010

Portland-Milwaukie Light Rail Project

Willamette River Bridge

Figure 2.1-3

- Light Rail Alternative
- Station
- Existing Streetcar
- Under Construction Streetcar
- Proposed Streetcar

Metro

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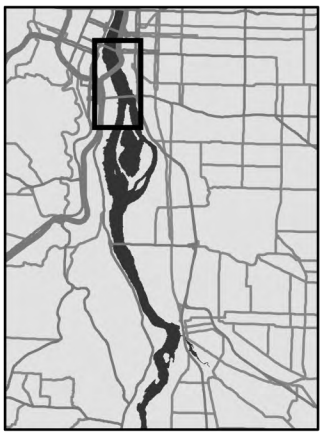
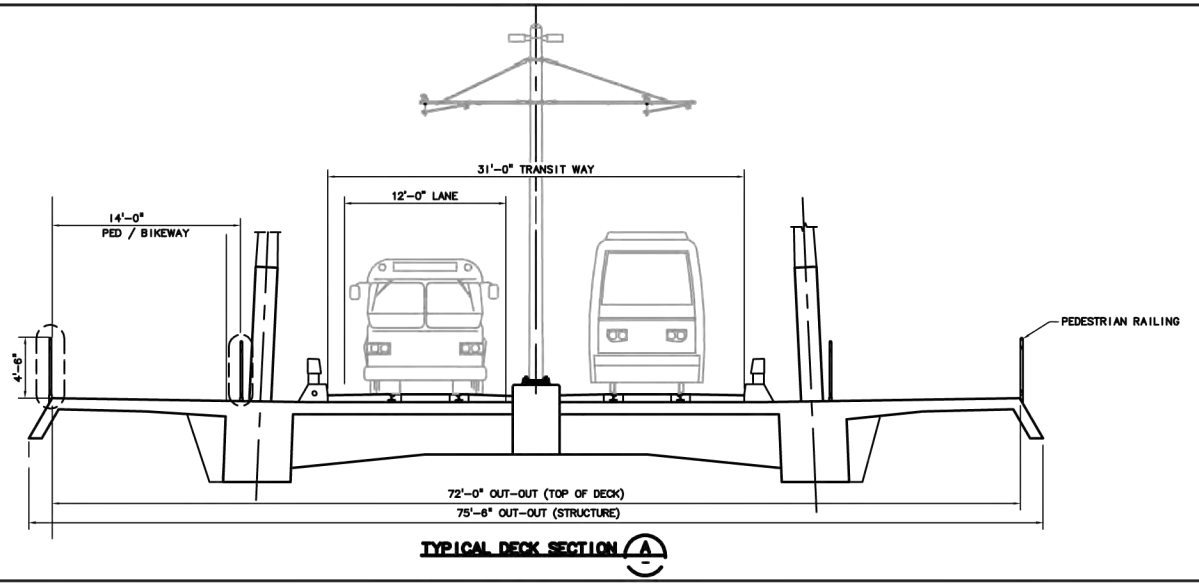
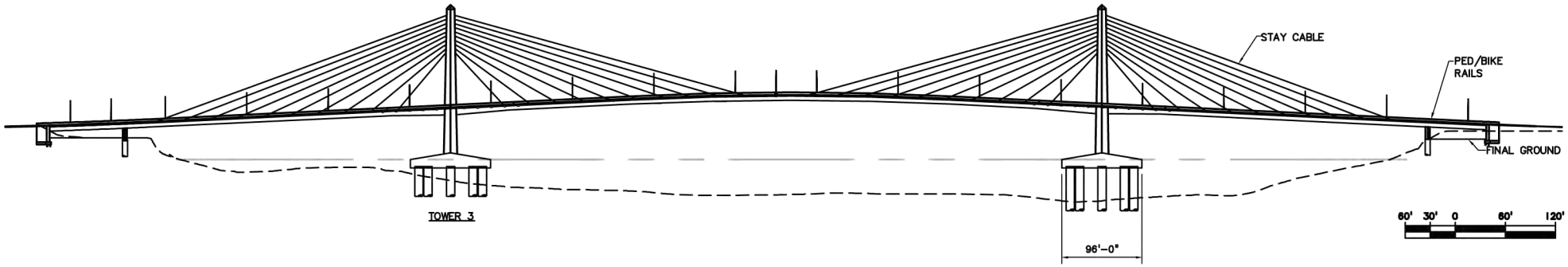
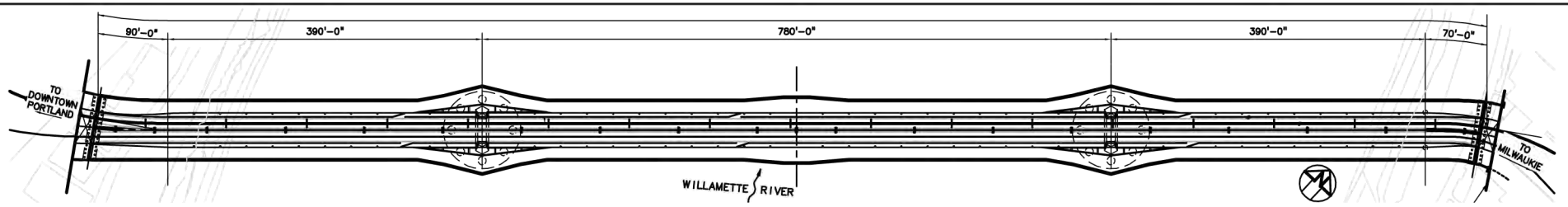


0 500 1,000 Feet

February 2010







Portland-Milwaukie Light Rail Project *Figure 2.1-4*

Willamette River Bridge Design

(Not to Scale)

Refer to Figure H-16 for LPA Phasing Option Bridge Design

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Metro

September 2010

The Portland-Milwaukie Light Rail Project would construct the switches and elements necessary to allow the streetcar to operate on the bridge, although with a phasing option for the LPA, some of these elements could be deferred until other connecting streetcar improvements are in place. Additional elements that would be required in order to allow the streetcar to access the bridge are described in more detail in Section 2.1.1.6, Related Bridge Area Transportation Facilities, and are shown in Figure 2.1-9.

The bridge would have two towers, both approximately 180 feet high, connected to cables extending down to the bridge deck. Each of the towers would be anchored in foundations provided by concrete-capped pier structures in the water. Each of the capped pier structures would be approximately 96 feet in diameter and about 20 feet thick, and would be supported by a set of up to nine 10-foot-diameter drilled shafts that would be anchored in bedrock below the river bottom. The bridge would be approximately 1,720 feet long from abutment to abutment. In addition, up to eighteen 24-inch-diameter steel pipe piles may be needed near the east pier, upstream of the bridge, to assist commercial passenger boat operations in maneuvering vessels to and from an existing dock.

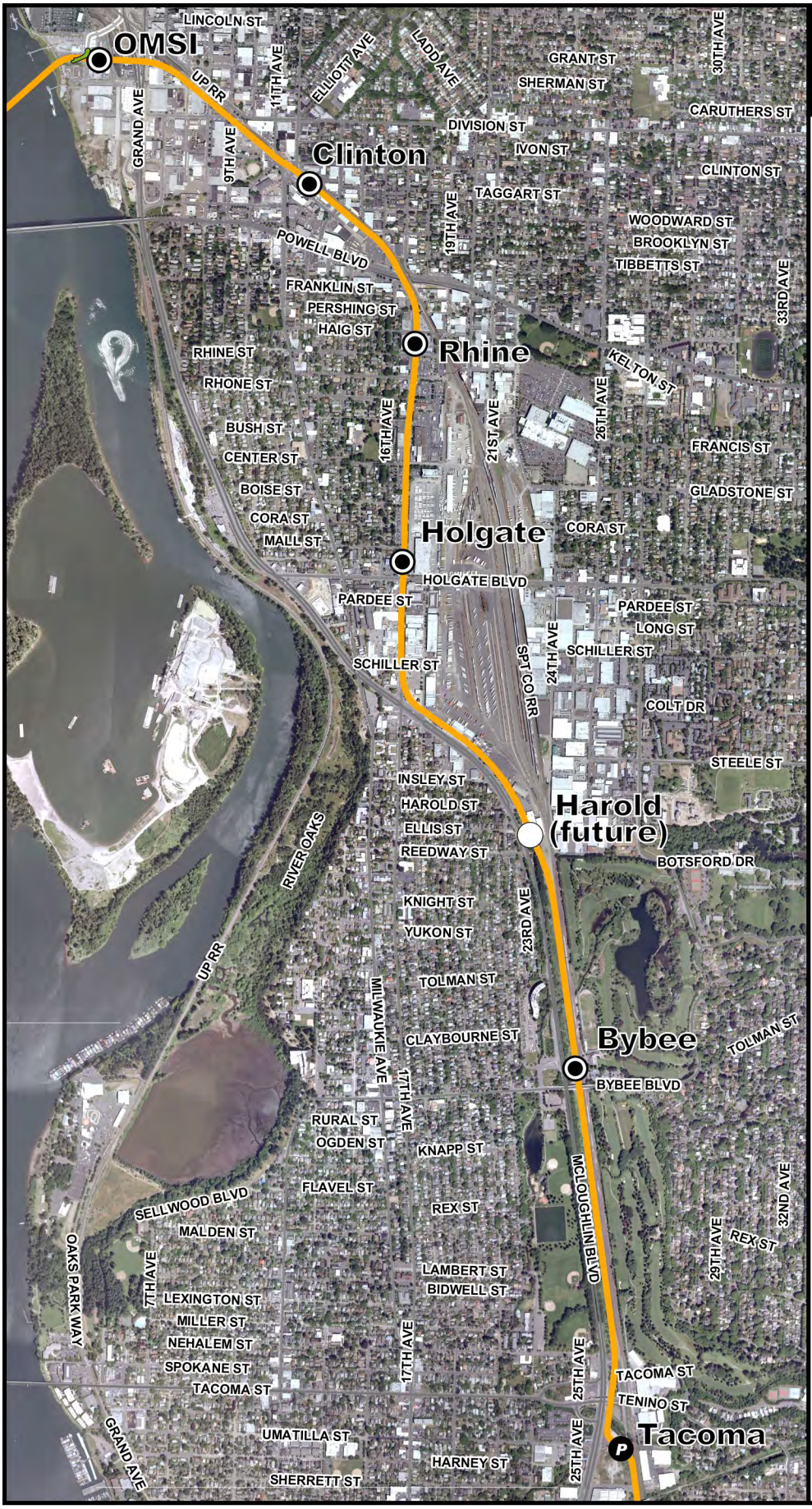
The bridge would also have two landside piers, one on each side of the river, located above ordinary high water but below top of bank. The west bank abutment is anticipated to be approximately 100 feet west of the existing mapped top of bank. The east bank abutment is anticipated to be approximately 62 feet east of the existing top of bank. Abutments and retaining walls would be placed to allow clearance for the Willamette River Greenway Trail on the east bank and a planned trail on the west bank.

The new bridge is being designed to provide 77.52 feet of vertical clearance for navigation as measured from the Columbia River Datum for approximately 150 feet in the middle of the center span of the bridge. The bridge's 180-foot towers are approximately 780 feet apart. Measuring from their capped piers near water level, there would be approximately 694 feet of waterway between them.

The bridge design was developed considering a range of factors, including river navigation, landside transportation, land use, environmental impacts, costs, and visual and aesthetic appeal. The project's assessment of navigational needs was based on extensive study of Willamette River navigational conditions and needs, including a river user survey, climate change analysis, bridge and landside design implications for various heights, the navigational channel, and information about existing bridge clearances upstream and downstream. Analysis of the navigational effects of the new bridge options is provided in Chapter 4, Transportation, and in Appendix O, Navigation Report. The climate change analysis (*Willamette River Stage and the Effect of Global Climate Change*, Parametrix, January 27, 2010) is summarized in Section O.5.7 of Appendix O, Navigation. See Section 2.3.2.2, Selection of Willamette River Bridge Type, for more information on the development of the bridge design.

Oregon Museum of Science and Industry (OMSI) to SE Tacoma Street

The alignment between OMSI and SE Tacoma Street is shown in Figure 2.1-5. On the east side of the river, the bridge would transition onto retained fill near the former SE Sherman Street alignment. The bridge abutment is approximately one block south of the Oregon Museum of



Portland-Milwaukie Light Rail Project

OMSI to SE Tacoma Street

Figure 2.1-5

- Light Rail Alternative
- Station
- Future Station
- Park-and-Ride
- Proposed Streetcar

Metro

TRIMET

February 2010

Science and Industry (OMSI) and immediately north of the Portland Opera building. A station would be located east of OMSI and would have shared platforms for buses and light rail vehicles. Streetcars would turn north, leaving the transitway west of the station that would serve light rail and buses. A streetcar station would be located at OMSI just to the north of the shared transitway.

Several related street improvements as well as facilities for connecting the streetcar to the Willamette River bridge are planned in the area between OMSI and SE Martin Luther King Jr. Boulevard. These improvements are discussed in more detail in Section 2.1.1.6, Related Bridge Area Transportation Facilities, and shown in Figure 2.1-9.

The alignment for the shared transitway would proceed east and cross the Oregon Pacific Railroad (OPR) line at grade. The OPR switching yard, which the light rail tracks would otherwise cross, would be relocated to the north of its existing location. The new location of the switching yard had previously been identified as the future location for the home of the Oregon Rail Heritage Foundation museum and storage for three steam locomotives. The Oregon Rail Heritage Foundation has now, with project assistance, identified a potential new location south and east of the OPR switching yard.

The alignment would pass under the SE Martin Luther King Jr. Boulevard viaduct. The light rail tracks would run adjacent to and south and west of the Union Pacific Railroad (UPRR) tracks between SE 7th Avenue and SE Powell Boulevard (US 26). An existing railroad spur, the Darigold Spur, would be closed.

Three at-grade street crossings of the UPRR tracks would be consolidated into one crossing of the UPRR and light rail tracks. The consolidated crossing would occur at a realigned SE 8th Avenue. SE Division Place and SE 9th Avenue would also be realigned to provide access to the consolidated crossing. The reconfigured intersections would have sidewalks and a combination of medians and crossing gates. A future multi-use path could be constructed along the alignment from SE Division Place and SE 9th Avenue to SE Clinton Street at SE 11th Avenue, but would not be constructed as a part of the Portland-Milwaukie Light Rail Project.

A station would be located on SE Gideon Street southwest of the SE 12th Avenue and SE Clinton Street intersection. To improve station access and traffic operations, several modifications to the surrounding street and pedestrian and bicycles network would occur in the station area. The at-grade UPRR and light rail crossings at SE 11th and SE 12th avenues would be modified to include crossing gates, signals, and sidewalks. The SE Clinton Street crossing of the UPRR tracks would be closed, with traffic rerouted to SE 11th and SE 12th avenues. Intersections at SE Clinton Street and SE 12th Avenue and at SE 11th Avenue, SE Milwaukie Avenue/SE 12th Avenue, and SE Gideon Street would be signalized and provided with crosswalks and sidewalks connecting to the station, improving walk and bike access and will be designed to meet American with Disabilities Act (ADA) requirements.

In addition, a pedestrian overcrossing of the UPRR tracks currently located west of SE 16th Avenue and SE Brooklyn Street would be removed. A new pedestrian overcrossing that would include ramps meeting ADA requirements would be constructed from SE 14th Avenue over the

UPRR to the Clinton Station. Under the LPA Phasing Option, the construction of this overpass would be deferred, but the project will still be designed to meet ADA requirements and includes the other station area access improvements described above.

Where the alignment crosses SE Powell Boulevard at SE 17th Avenue, the existing overcrossing of SE Powell Boulevard would be replaced with a wider structure adjacent to the existing UPRR bridge. This would also require reconstruction of on-ramps and off-ramps to and from SE Powell Boulevard. Motor vehicles, bicycles, and pedestrians would be accommodated on the rebuilt SE Powell Boulevard overcrossing with separate travel lanes.

After crossing SE Powell Boulevard, the light rail alignment would transition to the center of SE 17th Avenue and continue to run in the center of SE 17th Avenue to south of SE Schiller Street from just north of SE McLoughlin Boulevard (OR 99E). A center platform station would be located north of the SE 17th Avenue and SE Rhine Street intersection. The existing pedestrian overpass of the UPRR tracks at SE Lafayette Street would be replaced with a reconfigured overcrossing to better facilitate connections between the neighborhoods and the station at SE Rhine Street. As with all the project facilities, the new overcrossing would meet ADA requirements. Under the LPA Phasing Option, the construction of this overpass would be initially deferred, and the existing bridge would remain, although it does not currently meet ADA standards.

Along SE 17th Avenue, the addition of light rail would require modifications at most intersections and a widening of the SE 17th Avenue right-of-way improving bicycle and pedestrian facilities and providing ADA-compliant access. Signalized intersections with crosswalks would be provided for the crossings of light rail and SE 17th Avenue at SE Rhine Street, SE Center Street, SE Holgate Boulevard, and SE Schiller Street. A traffic signal would also be located at the TriMet bus parking access on SE 17th Avenue. Other side streets and driveways along SE 17th Avenue would be restricted to right-in, right-out movements only. An island station would be located in a median of SE 17th Avenue, just north of SE Holgate Boulevard.

South of SE Schiller Street, immediately north of SE McLoughlin Boulevard, the alignment leaves SE 17th Avenue, moving to the east where it would run east of SE McLoughlin Boulevard. The intersection of SE McLoughlin Boulevard and SE 17th Avenue would also be improved, including the addition of a pedestrian crosswalk and pedestrian islands.

The light rail follows the east side of SE McLoughlin Boulevard, and a grade-separated crossing would be constructed over SE Harold Street to provide freight access to SE McLoughlin Boulevard from the Brooklyn Yards. The design accommodates a future station at SE Harold Street, which would be elevated. Construction and operation of the station is not included in the Portland-Milwaukie Light Rail Project, and the phasing option defers construction of some of the station structural facilities. Between SE Harold Street and SE Tacoma Street, the light rail track center line would be located 50 feet west of the UPRR track center line and to the east of SE McLoughlin Boulevard.

A bridge would be constructed for the light rail tracks to cross over Crystal Springs Creek, which is currently in a culvert that continues under the UPRR tracks. Constructing the bridge over the culvert would allow the culvert to be removed in the future.

North of SE Bybee Boulevard, near the Eastmoreland Golf Course, a station with stairs and elevators would connect to the Bybee Bridge. The Bybee Bridge would be expanded to the north and the south and restriped to provide bus pullouts and bus stops on each side. Under the LPA Phasing Option, the expansion on the south side of the bridge and the elevator on the south side potentially would be deferred. The stairs on the south side would provide access to the south side of the station and bus station located at SE 27th Avenue.

As the light rail line proceeds south, the tracks would rise on fill and be on structure over the northbound SE McLoughlin Boulevard ramp that provides access to and from SE Tacoma Street. It would then cross under SE Tacoma Street, cross Johnson Creek on a new structure, and then turn slightly to the east. A station and park-and-ride would be located south of Johnson Creek.

SE Tacoma Street to SE Lake Road

Figure 2.1-6 shows the alignment from SE Tacoma Street to SE Lake Road. The Tacoma Station would be located south of SE Tacoma Street and Johnson Creek, between SE McLoughlin Boulevard and the UPRR main line tracks. The station platform would be toward the north side of the station site. The station would include an 800-space parking facility, which is reduced from the 1,000-space facility originally identified when the LPA was adopted. However, to help the project remain cost-effective, the capacity of the park-and-ride was reduced during preliminary engineering. Similarly, the LPA Phasing Option reduces costs by deferring the construction of the parking garage and providing a 320-space surface park-and-ride facility at the Tacoma Station. See Section 2.1.1.4, Stations and Park-and-Rides, for more information on the park-and-ride capacities. Access to the park-and-ride would be from SE Tacoma Street, and there would be right-in, right-out only access from SE McLoughlin Boulevard. Pedestrian and bicycle access from the south would be via the Springwater Corridor Trail; access from the north would be via the SE Tacoma Street bridge. Sidewalks connecting to the SE Tacoma Street bridge would be added to an existing access ramp and bridge over Johnson Creek that serves the Tacoma Station site. A new pathway would be constructed that would connect to the Springwater Corridor Trail to the south of the site. The Tacoma Station would also be designed to accommodate potential storefront retail opportunities on nearby properties or potentially in the parking structure. South of the station, the light rail line would cross under the existing Springwater Corridor Trail bridge over the UPRR tracks, requiring excavation around the existing west bridge abutment. Then the light rail line would rise on retained fill and cross over the Tillamook Branch line railroad tracks on an elevated structure. The alignment would return to grade north of SE Mailwell Drive, which would be crossed at grade. The Tillamook Branch line and the Anderson spur would be realigned to accommodate the required 25-foot track offset from freight sidings and the Tillamook main line. A minor realignment of SE 26th Avenue would also be required. The light rail tracks would cross under Highway 224.

From near the undercrossing of Highway 224, the light rail alignment would run at grade along the east side of the rail right-of-way, separated by a 25-foot offset from the Tillamook Branch line tracks. As a condition of using the UPRR right-of-way in this area, UPRR requires the light rail project to have a 6-foot safety wall that would continue in sections through downtown Milwaukie to SE Lake Road. To maintain safe sight distance near street intersections, the safety walls would end 250 feet from each location where light rail crosses existing streets.

Portland-Milwaukie Light Rail Project

SE Tacoma Street to SE Lake Road

Figure 2.1-6

Light Rail Alternative

Park-and-Ride

MOS Park-and-Ride

Metro

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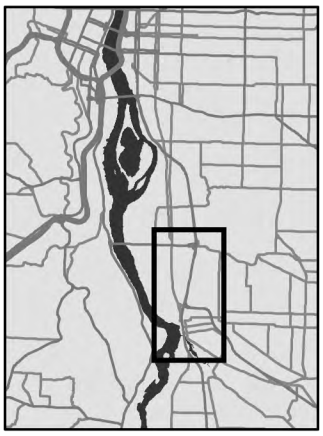

0 500 1,000 Feet

June 2010

The project would modify intersections at SE Mailwell Drive, SE Harrison, SE Monroe, SE Washington, and SE Adams streets, SE 21st Avenue, and SE Lake Road, providing new sidewalks, installing crossing gates, and adding in-street vehicle detectors within the crossings as an additional safety measure. Fences would also be provided between the light rail alignment and adjacent properties, and some sections require new retaining walls. SE Adams Street would be closed to through vehicle traffic to the west at SE 21st Avenue and redesigned for pedestrian and bicycle connections.

A station in downtown Milwaukie would be located at SE Lake Road and SE 21st Avenue. The station would include improved pedestrian facilities, passenger drop-off, as well as nearby bus stops designed for access by individuals with impaired mobility. The City of Milwaukie is planning transit-oriented development (TOD) adjacent to the station at SE Lake Road. TODs typically mix residential, retail, office, open space, and public uses in a way that maximizes the benefits of the improved access provided by the public transportation investment. Additional discussion of TOD opportunities in this and other station areas is provided in Section 3.2, Land Use and Economy.

SE Lake Road to SE Park Avenue

Figure 2.1-7 shows the alignment from SE Lake Road to SE Park Avenue. The tracks would cross over SE Lake Road and Kellogg Lake on a new bridge along the east side of the existing freight rail trestle within the railroad right-of-way. The bridge would be constructed to allow the City of Milwaukie to construct a multi-use path beneath the bridge deck that would provide a connection from the area south of Kellogg Lake to the Lake Road Station and downtown Milwaukie in the future. The path would not be constructed as a part of the Portland-Milwaukie Light Rail Project.

The alignment would cross over SE McLoughlin Boulevard to run along the west side of the roadway, and would continue on an elevated structure to cross over SE 23rd Avenue, SE Bluebird Street, and SE River Road. SE Sparrow Street would be closed at SE McLoughlin Boulevard. The alignment would be on a retained fill structure from just south of SE River Road to approximately 200 feet north of SE Sparrow Street.

Along the west side of SE McLoughlin Boulevard, the light rail project would use a portion of an old streetcar right-of-way that was purchased by Metro and the North Clackamas Parks and Recreation District for the development of the Trolley Trail, a six-mile regional multi-use path that is to extend from downtown Milwaukie to Gladstone and is expected to begin construction in 2010. Light rail would operate between the trail and SE McLoughlin Boulevard. As the light rail and the trail approach SE Park Avenue, light rail leaves the Trolley Tail alignment to stay along SE McLoughlin Boulevard, while the trail continues to follow the old streetcar right-of-way to the west and continues south to Gladstone. Design coordination between the two projects will continue.

Portland-Milwaukie Light Rail Project

SE Lake Road to SE Park Avenue

Figure 2.1-7

Light Rail Alternative

Park-and-Ride

MOS Park-and-Ride

Metro

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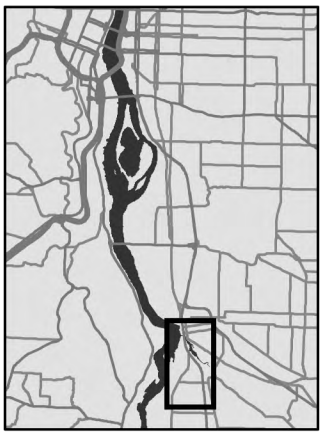


0 500 1,000 Feet

September 2010

The tracks would terminate at a station on the north side of SE Park Avenue, and a 600-space park-and-ride structure would be located south of SE Park Avenue. The capacity of the park-and-ride has been reduced since the adoption of the LPA, which had identified a 1,000-space structure. The LPA Phasing Option potentially would defer the construction of some levels of the parking garage, but would provide for 355 parking spaces. See Section 2.1.1.4, Stations and Park-and-Rides, for more information on the park-and-ride capacities. The project includes reconstructed sidewalks and improved street crossings leading to the station along SE Park Avenue and SE McLoughlin Boulevard, providing improved pedestrian, bicycle, and ADA access. The project would modify the intersection at SE Park Avenue and SE McLoughlin Boulevard and provide a new signalized intersection at SE Park Avenue and SE 27th Avenue that would be designed to provide for the crossing of the Trolley Trail. Vehicular access to and from the park-and-ride would be provided on SE 27th Avenue. Right-in and right-out only access would be provided to and from southbound SE McLoughlin Boulevard. The parking structure would include a pedestrian overpass over SE Park Avenue connecting the station to the park-and-ride (although with the LPA Phasing Option this structure would not be included, as described below).

2.1.1.2 LPA Phasing Option

TriMet and its partners have also developed a lower cost phasing option for the LPA to Park Avenue, which would reduce initial capital and operating costs for the LPA to Park Avenue alignment while maintaining a high level of project benefits for light rail service that extends to SE Park Avenue. The LPA Phasing Option reduces costs by deferring some investments and applying lower cost design approaches to several facilities and system features. It also assumes additional local funding sources. The phasing option is included in the FEIS to disclose how these modifications to various project features would affect the environmental effects and mitigation of the project. Many of the cost-saving elements were identified through "value engineering" reviews conducted as part of the preliminary engineering for the LPA to Park Avenue, and are typical of refinements for major capital projects entering final design. As the project continues into final design, some of these cost-saving measures may not be needed if other cost savings or funding is available.

The primary modifications that the phasing option features compared to the LPA to Park Avenue are:

- The Tacoma Station and Park-and-Ride would feature a 320-space surface parking facility, deferring an 800-space multi-floor parking structure;
- The Park Avenue Station and Park-and-Ride would feature a 355-space parking structure, deferring the full 600-space structure identified in the LPA to Park Avenue, and a pedestrian bridge between the structure and the station would not be constructed;
- The development of a new pedestrian overcrossing of the UPRR at the Clinton Station would be deferred (an existing pedestrian bridge at SE 16th Avenue/SE Brooklyn Street would still need to be removed);

- A new pedestrian overcrossing at the Rhine Station would be deferred (an existing pedestrian bridge at SE Lafayette Street would remain in place);
- The initial fleet requirements needed would be phased to include 17 to 20 new LRT vehicles, compared to the full 20 vehicles assumed in the LPA to Park Avenue;
- The bicycle and pedestrian pathways over the Willamette River bridge would retain 14-foot minimum widths, but extra widening near the towers and at a mid-bridge belvedere would be eliminated;
- The Willamette River bridge would eliminate some aesthetic design elements currently assumed in the LPA to Park Avenue, including eliminating the specification for white-pigmented concrete for the towers, and eliminating an aesthetic design treatment at the tower pier caps;
- At the Bybee Station, the phasing option would defer widening of the Bybee Bridge for the more southern of two bus pullouts, and would defer the elevator on the south side of the structure; a bus pullout and elevator would remain on the north side, as well as stairways on both the north and south sides;
- A potential new signal at SE Johnson Creek Boulevard/SE 42nd Street and related traffic-calming features would not be included;
- Streetcar switches on the transitway leading to the Willamette River bridge would be deferred;
- At the Lake Road Station in downtown Milwaukie, the side platform of a center-and-side platform station would be deferred;
- At the site of the future Harold Station, a narrower elevated structure would be developed.

The LPA Phasing Option also includes other cost reduction measures that would not affect the analysis of environmental effects. These include not building system features such as switch heaters and overhead wire ice-caps, and deferring a contribution to a system-wide electronic fare system replacement previously assumed to coincide with the Portland-Milwaukie Light Rail Project. Other items being considered are reducing the Art Program funding by 10 percent, and reducing the initial supply of bike parking by 20 percent.

The LPA Phasing Option differs from the LPA by eliminating or deferring the elements of the LPA noted above in order to reduce the project cost. TriMet is seeking additional funding for the project to proceed with the LPA, but may need to implement some of the cost-reduction elements identified in the LPA Phasing Option. In this Final EIS, TriMet, Metro and FTA fully evaluate the environmental and community impacts of all of these elements as part of the LPA, and also consider the impacts of their deletion from the project as part of the LPA Phasing Option. If after the environmental Record of Decision has been issued by FTA, TriMet's financial plan requires additional deferral or elimination of project elements not identified in the ROD, TriMet, Metro and FTA will follow the environmental procedures defined in 23 CFR Part 771.129, and

FTA may issue an amended ROD to identify the modified elements and any additional commitments to mitigate environmental and community impacts for such amended project.

2.1.1.3 Minimum Operable Segment (MOS) to Lake Road

The MOS to Lake Road would be the same as the LPA to Park Avenue except that it would have a southern terminus at SE Lake Road, and would not cross Kellogg Lake or SE McLoughlin Boulevard. A downtown Milwaukie station would be located at SE Lake Road, similar to the LPA to Park Avenue, but there would be a third track at the terminus. The MOS to Lake Road would include a park-and-ride with 275 parking spaces located north of Kellogg Lake between SE Washington Street and SE McLoughlin Boulevard. The capacity of the Tacoma Park-and-Ride would increase to accommodate up to 1,000 spaces. The MOS to Lake Road would allow the project to be developed in phases if there is not sufficient funding to fully extend the project to SE Park Avenue. The MOS would be designed to accommodate a future extension to the south.

2.1.1.4 Stations and Park-and-Rides

Stations would be approximately 200 to 250 feet long and could have either one center platform between the tracks or two platforms with one on each side of the tracks. The single center platforms would be approximately 15 to 20 feet wide. With platforms on each side, each platform would be approximately 12 to 15 feet wide. The platforms would allow for level boarding of the light rail cars to provide accessibility for individuals with impaired mobility. Major elements that would be incorporated on the platform include shelters, ticket machines, lighting, furniture, and fencing and railings. All stations will be designed to meet ADA requirements, including accessible connections to the local street network and sidewalks.

No stations would be elevated except for a future station at SE Harold Street. The Bybee Station would be below the Bybee Bridge.

The LPA to Park Avenue would include park-and-ride structures at the Tacoma and Park Avenue stations. The Tacoma Park-and-Ride would include 800 spaces, and the Park Avenue Park-and-Ride would include 600 spaces, although a phased approach for the LPA identifies smaller initial capacities for the park-and-rides. This reflects the results of transportation analysis conducted during preliminary engineering, which identified the predicted mode of access for stations throughout the line, and found high levels of ridership would still remain even if lower supplies of parking were provided. Much of the area served by the project has access to the line without relying on park-and-ride lots. The transportation analysis found that potential riders would also take transit, walk, or bike to reach the light rail line. In response, the maximum capacity of these park-and-rides has been reduced since the adoption of the LPA, which originally identified 1,000 spaces for both of these structures. The reduction in the capacity of the park-and-rides would reduce traffic, property impacts, and costs while still maintaining strong ridership and cost-effectiveness.

If the project is not able to identify the resources to extend the project to SE Park Avenue, the MOS to Lake Road provides an option for constructing the project with 1,000 parking spaces at the Tacoma Park-and-Ride and 275 spaces at a Lake Road Park-and-Ride. The capacity at the Tacoma Park-and-Ride for the MOS to Lake Road has been reduced to 1,000 spaces from the 1,250 spaces identified when the MOS was originally defined in 2008.

2.1.1.5 Ruby Junction Maintenance Facility

The LPA to Park Avenue would require an additional 20 light rail vehicles (compared to 17 to 20 new vehicles assumed for the LPA Phasing Option); and the MOS to Lake Road would require 16 vehicles. In addition, the proposed Columbia River Crossing Project is currently considering a proposal to extend the Yellow Line to Vancouver, Washington, which would also require additional light rail vehicles. Therefore, both projects are preparing FEIS documents that evaluate expanding the existing TriMet Ruby Junction Operations and Maintenance Facility on NW Eleven Mile Avenue in Gresham. This expansion would require enlarging the existing maintenance facility site and adding new structures and storage tracks. The expanded facility would encompass property to the west and south of the existing facility, and a portion of NW Eleven Mile Avenue would be vacated to the street's southern terminus. The existing operations control center at Ruby Junction would be relocated to TriMet's Center Street offices on SE 17th Avenue in Portland. Figure 2.1-8 shows the location of the maintenance facility, and Appendix H provides preliminary engineering drawings of the proposed expansion. A phased option for expanding the Ruby Junction Facility has also been developed to expand the facility in several steps as system capacity increases. The initial phase would expand the facility to the west of NW Eleven Mile Avenue but defer the development of some track, internal roadway, parking facilities, and other structures. NW Eleven Mile Avenue would remain open, with two at-grade gated rail crossings of the street to allow light rail cars to move to and from the main yard to car wash and storage tracks in the expanded yard area to the west.

2.1.1.6 Related Bridge Area Transportation Facilities

This section provides additional detail on future or separately funded projects, including streetcar improvements, as well as several other transportation improvements related to the light rail project. Related Bridge Area Transportation Facilities are shown in Figure 2.1-9. These elements would complement the Portland-Milwaukie Light Rail Project, but they are not required for the light rail project to be implemented. In several cases, the projects could be developed by TriMet in partnership with local agencies, and they may include the use of federal funds. The environmental impacts of these projects are disclosed in this FEIS.

Related Bridge Area Transportation Facilities include streetcar connections to the bridge and roadway reconstruction and on both the sides of the Willamette River. These transportation facilities include the following elements, which are described below:

- Portland Streetcar
- SW Moody Avenue
- SE Water Avenue

The Portland Streetcar element would connect the Portland Streetcar line currently operating in South Waterfront to the Portland Streetcar Loop Project now under construction on the east side of the Willamette River. The loop project, which extends streetcar from Northwest Portland to the east side of the Willamette River and south to OMSI, published a NEPA Environmental Assessment in February 2008 and received a Finding of No Significant Impact from the FTA in July 2008. Construction began in 2009 for the project.

The extension of streetcar over the new Willamette River bridge along with the light rail project is consistent with long-range plans for the streetcar system, which called for another crossing of the Willamette River at the southern end of downtown Portland. The streetcar connection project would construct additional trackway in South Waterfront and use the new Willamette River bridge to complete an urban circulator loop. Two sets of streetcar tracks would replace the existing single-track section between SW River Parkway and SW Gibbs Street to provide separate inbound and outbound tracks. Stations for streetcar would be located in South Waterfront on the west side and at OMSI on the east side of the river. On the west side, the streetcar station would be located on SW Moody Avenue north of the light rail alignment. It would access the transitway south of the streetcar station and would pass through the light rail station. On the east side, streetcars would turn north and leave the transitway west of the OMSI light rail station. A streetcar station would be located at OMSI north of the transitway.

Additional facilities would complete the connections needed for streetcars to travel to and from the shared transitway on the new Willamette River bridge. These facilities would include the five additional streetcars, trackway, and switches to connect streetcar and light rail tracks from the bridge to the Eastside and South Waterfront streetcar sections. All streetcars using the shared transitway would need to be equipped with Automatic Train Stop (ATS) technology and associated systems that are being developed for the new bridge. Figure 2.1-9 shows the streetcar trackway and roadway reconfigurations associated with the Related Bridge Area Transportation Facilities.

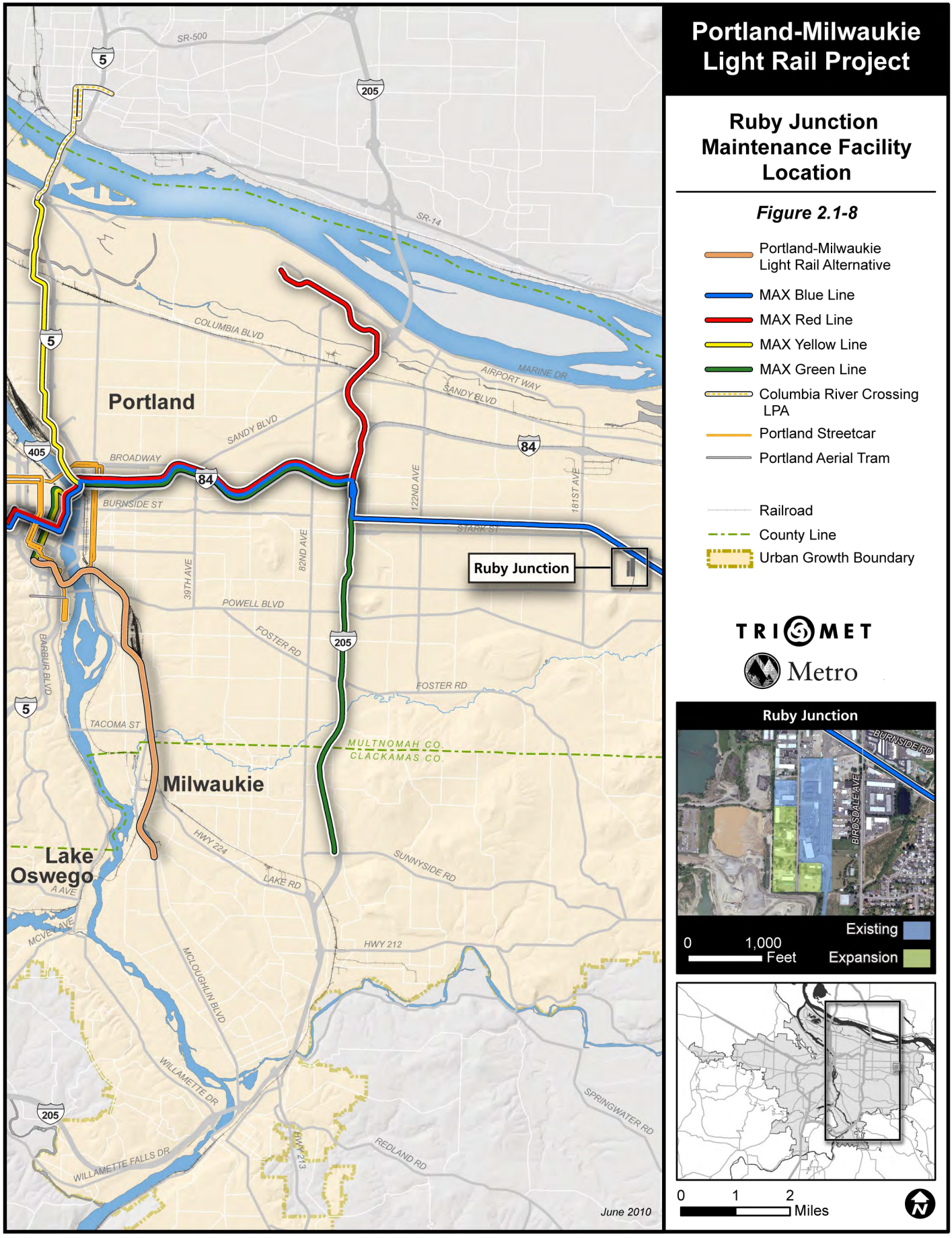
A streetcar maintenance facility is located in northwest Portland under I-405 at NW Northrup Street between NW 15th and NW 16th avenues. This facility is being expanded as a part of the Portland Streetcar Loop Project currently under construction. The new configuration will include storage adequate for the 26-car fleet planned for 2030 service levels. Additional information on fleet size and service levels is available in the Streetcar Service section of 2.1.1.9, Transit Operating Plans.

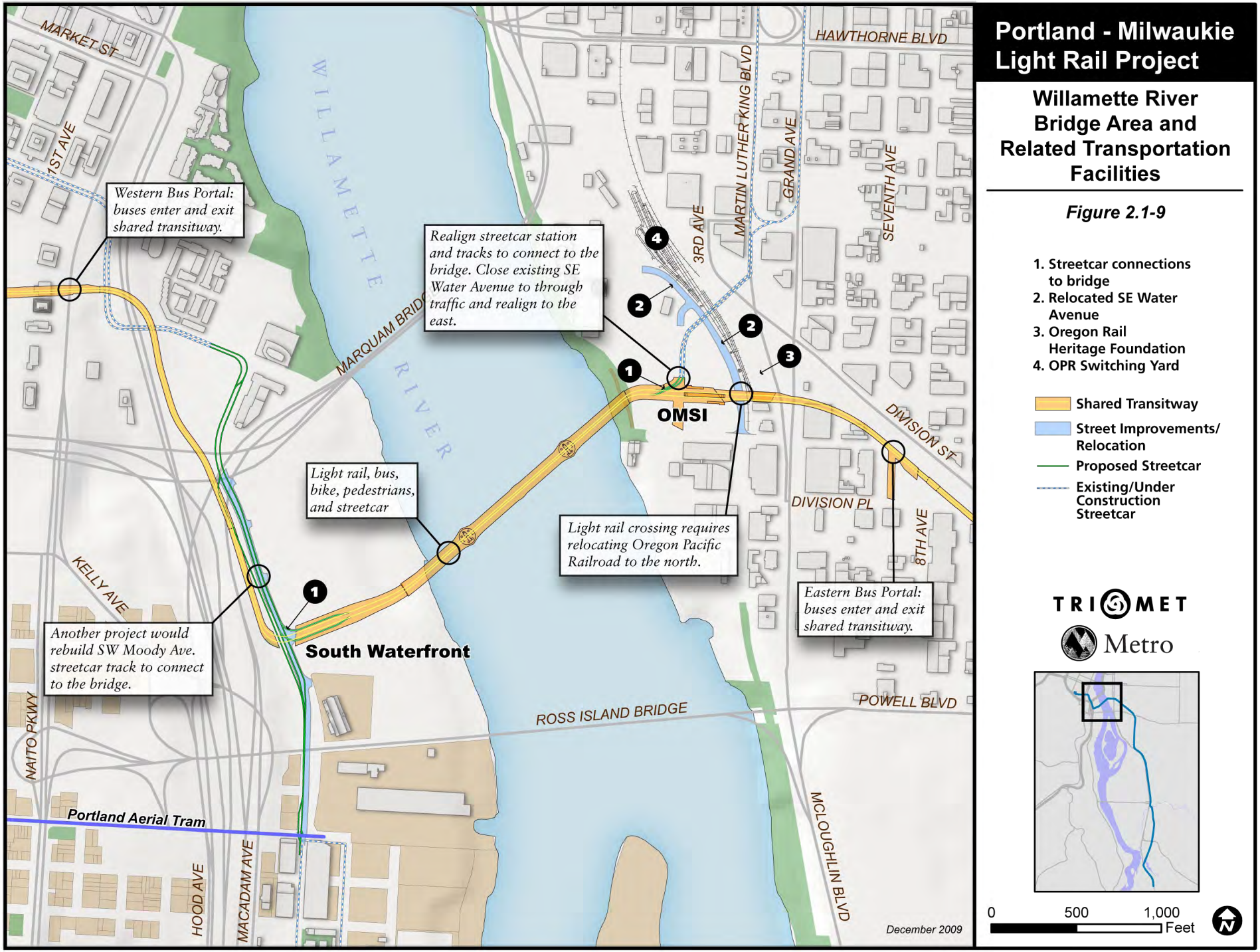
SW Moody Avenue

SW Moody Avenue from SW River Parkway to SW Gibbs Street would be reconstructed to accommodate the double track for streetcar and to raise the grade of the street to match the grade of the light rail track and transitway. Reconstruction would include three traffic lanes with northbound and southbound streetcar tracks and pedestrian and bicycle facilities. The grades of SW Moody Avenue and SW Porter Street would be constructed with 14 feet of fill to allow for redevelopment of brownfields in the South Waterfront area. Street improvements are consistent with the City of Portland's South Waterfront North District Street Plan for a new street network in the area of the South Waterfront light rail station.

SE Water Avenue

The roadway function of SE Water Avenue would be relocated to the east from SE Caruthers Street northward to match the existing alignment of SE 4th Avenue south of SE Caruthers Street. On the north, the relocated alignment would reconnect with the current alignment northwest of OMSI, approximately 500 feet north of the SE Lincoln Street right-of-way. SE Water Avenue is currently in a temporary alignment slightly west of the proposed location because of a sewer construction project. The existing SE Water Avenue would be converted to a bicycle and pedestrian facility. Figure 2.1-9 shows the relocated SE Water Avenue.


Portland-Milwaukie Light Rail Project
Ruby Junction Maintenance Facility Location
Figure 2.1-8
Portland-Milwaukie Light Rail Alternative
MAX Blue Line
MAX Red Line
MAX Yellow Line
MAX Green Line
Columbia River Crossing LPA
Portland Streetcar
Portland Aerial Tram
Railroad
County Line
Urban Growth Boundary
TRIMET
Metro
Ruby Junction
BURNSIDE RD
BIRDSDALE AVE
Existing
Expansion
0
1,000
Feet
0
1
2
Miles
Portland
Milwaukie
Lake Oswego
Ruby Junction
SR-500
SR-14
COLUMBIA BLVD
MARINE DR
AIRPORT WAY
SANDY BLVD
BROADWAY
BURNSIDE ST
STARK ST
122ND AVE
181ST AVE
82ND AVE
39TH AVE
POWELL BLVD
FOSTER RD
TACOMA ST
MULTNOMAH CO.
CLACKAMAS CO.
HWY 224
LAKE RD
SUNNYSIDE RD
HWY 212
MCLOUGHLIN BLVD
WILLAMETTE DR
WILLAMETTE FALLS DR
HWY 213
REDLAND RD
SPRINGWATER RD
BARBUR BLVD
A AVE
MCVEY AVE
5
205
84
405
June 2010


Portland - Milwaukie Light Rail Project
Willamette River Bridge Area and Related Transportation Facilities
Figure 2.1-9
1. Streetcar connections to bridge
2. Relocated SE Water Avenue
3. Oregon Rail Heritage Foundation
4. OPR Switching Yard
Shared Transitway
Street Improvements/ Relocation
Proposed Streetcar
Existing/Under Construction Streetcar
TRIMET
Metro
Western Bus Portal: buses enter and exit shared transitway.
Realign streetcar station and tracks to connect to the bridge. Close existing SE Water Avenue to through traffic and realign to the east.
Light rail, bus, bike, pedestrians, and streetcar
Light rail crossing requires relocating Oregon Pacific Railroad to the north.
Eastern Bus Portal: buses enter and exit shared transitway.
Another project would rebuild SW Moody Ave. streetcar track to connect to the bridge.
South Waterfront
OMSI
WILLAMETTE RIVER
MARKET ST
1ST AVE
MARQUAM BRIDGE
HAWTHORNE BLVD
MARTIN LUTHER KING BLVD
GRAND AVE
3RD AVE
SEVENTH AVE
DIVISION ST
DIVISION PL
8TH AVE
KELLY AVE
ROSS ISLAND BRIDGE
POWELL BLVD
NAITO PKWY
Portland Aerial Tram
HOOD AVE
MACADAM AVE
MCLOUGHLIN BLVD
December 2009
0
500
1,000
Feet

2.1.1.7 Other Light Rail Facilities

The operation of the light rail project with either the LPA to Park Avenue or the MOS to Lake Road also involves a number of other facilities and system features, which are described in this section.

Crossover tracks and switches to allow trains to safely pass from one set of tracks to the other during track maintenance, to bypass a stalled train, or to turn in the opposite direction, are currently assumed to be:

- Between SW 4th and SW 5th avenues
- North of the South Waterfront Station along SW Moody Avenue
- North of the Bybee Station, north and south of the Crystal Springs Creek bridge
- Near SE Hanna Harvester Drive

Storage tracks, which are used to hold trains and allow trains to switch directions, would be located between Clinton Station and SE Powell Boulevard and at the terminus station north of SE Park Avenue with the LPA to Park Avenue, or at the Lake Road Station with the MOS to Lake Road. A pocket track, between the main tracks, would be located between the Clinton Station and SE Powell Boulevard. There would be a third track for storage at either the Park Avenue or Lake Road station. These storage tracks include switches to and from the main tracks and allow trains to be moved off of the main tracks. Disabled trains can use storage tracks to move off the main tracks to maintain service, and the tracks can also hold trains that may be needed to serve special events or other operational needs.

The light rail system would be electrically powered using an overhead catenary (contact wire), supported on poles. The power to the catenary is fed from electrical traction power substations. Substations are usually located adjacent to the right-of-way near stations. Substations would be located:

- West of SW Moody Avenue north of the South Waterfront Station
- East of the SE Martin Luther King Jr. Boulevard viaduct
- South of the Clinton Station platform
- Northeast of the Rhine Station on SE Haig Street
- West of the Bybee Station
- East of the Tacoma Park-and-Ride
- In downtown Milwaukie between SE Monroe Street and SE Washington Street
- Southeast of SE Washington Street and SE 21st Avenue
- West of the Park Avenue Station

In addition, upgraded transmission lines may be needed to feed to the power substations, which could result in the replacement or relocation of nearby power lines and poles.

Signal and communication facilities would generally be located adjacent to substation locations, including:

- North of the Lincoln Station between the sidewalk and the multifamily dwelling north of the station
- On SW Moody Avenue to the west of the South Waterfront Station
- East of the SE Martin Luther King Jr. Boulevard viaduct
- South of the Bybee Station platform
- East of the Tacoma Park-and-Ride
- West of the Park Avenue Station

Retaining walls are commonly, but not always, associated with overcrossing structures and would be located:

- From SW Naito Parkway to the abutment of the SW Harbor Drive structure over SW Harrison Street
- From the SW Harbor Drive structure abutment south of SW Sheridan Street south to the Willamette River bridge
- From the east Willamette River bridge abutment to near the existing SE Water Avenue alignment
- On the east side of the Willamette River, extending from under the bridge approximately 200 feet to the north and 160 feet to the south
- Along SE Powell Boulevard
- North and south of the SE Harold Street overcrossing structure
- North and south of the Spring Creek structure
- North of the SE Tacoma Street ramp structure
- North and south of the Johnson Creek structure
- North and south of the elevated structure over the Tillamook Branch line
- Under Highway 224
- From Highway 224 to just south of SE Monroe Street
- Between SE Washington Street and the Kellogg Lake overcrossing structure at SE Lake Road
- From south of the SE McLoughlin Boulevard overcrossing structure, including a section along the Trolley Trail
- From SE Sparrow Street to approximately one-half mile north of the Park Avenue Station

Where the alignment is within 25 feet of the UPRR tracks, safety walls would be located between the light rail and UPRR tracks. Safety walls would be located:

- From approximately 250 feet south of SE Mailwell Drive to approximately 250 feet north of SE Harrison Street

- From approximately 250 feet south of SE Harrison Street to approximately 250 feet north of SE Monroe Street

The existing operations control center at the Ruby Junction Facility would be relocated to TriMet's Center Street offices on SE 17th Avenue in Portland.

2.1.1.8 Stormwater Management

Stormwater facilities would be constructed to meet the City of Portland's stormwater management requirements, including areas outside of the city's jurisdiction. The City of Portland's approach to stormwater management emphasizes the use of vegetated surface facilities to treat and infiltrate stormwater on-site. The requirements, which are described in the City's Stormwater Management Manual, are based on a stormwater hierarchy. The higher categories include on-site filtration; lower categories include off-site discharge. The highest technically feasible category must be used.

The project would use tie and ballast track where feasible and allowed by the local jurisdictions to minimize the amount of impervious areas. Stormwater treatment would be required from SW Jackson Street to SE 8th Avenue and from the SE Powell Boulevard overpass along SE 17th Avenue to SE McLoughlin Boulevard. From SE 17th Avenue and SE McLoughlin Boulevard to SE Park Avenue, the alignment would be tie and ballast except for the structures at Crystal Springs Creek, Johnson Creek, and the elevated structures over the Tillamook Branch rail line, Kellogg Lake, and SE McLoughlin Boulevard. The project would also result in new impervious areas at stations and park-and-rides, which would be treated.

Larger water quality features are planned for the following locations:

- An infiltration basin southwest of the South Waterfront Station
- An infiltration swale along the south side of the trackway from east of "new" SE Water Avenue to SE 7th Avenue
- Vegetated infiltration basins in the vicinity of the rebuilt consolidated intersection at SE 8th Avenue and SE Division Place
- Vegetated infiltration basins at the intersection of SE Milwaukie, SE 11th, and SE 12th avenues
- An infiltration planter adjacent to the Clinton Station and along SE Gideon Street
- A vegetated infiltration basin at the intersection of SE 17th Avenue and SE McLoughlin Boulevard
- A stormwater planter north of structure over SE Tacoma Street ramps, west of the trackway
- Four stormwater planters adjacent to or near the Tacoma Station and Park-and-Ride
- Stormwater planters along SE Harrison Street west of the trackway
- A stormwater planter north of and adjacent to or within the current SE Lake Road right-of-way
- A stormwater planter south of the SE McLoughlin Boulevard structure
- Stormwater planters near the Park Avenue Station and Park-and-Ride structure

Stormwater collection pipes will be mounted to the elevated structures at the Willamette River, the SE Tacoma Street ramps, between the Springwater Corridor Trail and SE Mailwell Drive, Kellogg Lake, and SE McLoughlin Boulevard. Stormwater from all structures will be collected and treated.

2.1.1.9 Transit Operating Plans

This section describes other transit service in the Portland-Milwaukie Project Corridor and on the Willamette River bridge. Operations for bus, streetcar, and light rail would affect or be affected by the project, mainly by enhancing connections. Some bus service would be modified to provide service to the new light rail stations. These transit connections are components of the transportation analysis and are described in Chapter 4. This section describes other key considerations concerning transit operations.

Light Rail Service

Light rail service between downtown Portland and the southern terminus station would operate weekdays between approximately 4:30 a.m. and 1:30 a.m., with headways (the frequency of service) of 7.5 minutes in the peak periods from 6:00 a.m. to 9:00 a.m. and 3:00 p.m. to 6:00 p.m., and approximately 15 minutes in the off-peak periods in 2030. Opening year operations during the peak periods would have headways of 10 minutes and off-peak headways of 15 minutes. Some weekend or late-night service could be less frequent than 15 minutes. The travel times from SE Park Avenue to PSU are shown in Table 2.1-2. With the LPA Phasing Option, which would potentially reduce park-and-ride capacity at SE Tacoma Street and SE Park Avenue, the frequency of trains during the peak period could be reduced from 7.5-minute service to 8.6-minute service. Off-peak service would be unaffected by the phasing option.

Table 2.1-2
Travel Times

Section Location (station to station)	Travel Time (in minutes, including stops)
Park Avenue to Lake Road	1.53
Lake Road to Tacoma	3.05
Tacoma to Bybee	2.03
Bybee to Holgate	2.68
Holgate to Rhine	1.57
Rhine to Clinton	1.83
Clinton to OMSI	1.48
OMSI to South Waterfront	2.1
South Waterfront to Lincoln	2.7
Lincoln to Jackson	1.15
Total - Park Avenue to Jackson	20.12

Source: TriMet 2010.

The service would connect with other light rail lines, as well as with buses on the Downtown Portland Transit Mall. The service would also connect with the Portland Streetcar Loop at South Waterfront and OMSI. From the south, trains would travel through downtown Portland and turn

back at Union Station, or would continue north on the Yellow Line to the Portland Metropolitan Exposition Center.

The light rail would operate at the speed limit while traveling in streets or in urban areas at grade. Speeds up to 55 miles per hour could be achieved where the track is grade-separated, with slower speeds at curves and elevation changes, in congested locations, and near schools.

Streetcar Service

A streetcar connection on the Willamette River bridge would complete an extension of the existing Portland Streetcar and create an urban circulator loop serving the urban core on the east and west sides of the Willamette River. The Portland Streetcar Loop Project from northwest Portland to OMSI is currently under construction, but the Willamette River bridge connection would not be completed as a part of that project. Elements that would facilitate completion of the streetcar project would be included in the Portland-Milwaukie Light Rail Project, and this FEIS documents the impacts of operating streetcars on the Willamette River bridge. (The LPA Phasing Option would not install streetcar track crossovers in anticipation of the future completion of the Portland Streetcar urban circulator loop.) With the completion of the Portland Streetcar Loop Project to OMSI in 2012, the Portland Streetcar fleet size will increase from 11 to 17 vehicles, and service will be provided 18 hours per day, with 12- to 14-minute headways (the frequency of service). In 2015, with completion of the Willamette River bridge connection, the fleet size would increase to 22 vehicles. In 2030, the fleet size would increase to 26 vehicles, and service would be provided 18 hours per day, with 10-minute headways.

Portland-Milwaukie Corridor Bus Transit Service

The bus service on SE McLoughlin Boulevard north of Milwaukie, which is currently provided by lines #31 Estacada, #32 Oatfield, #33 McLoughlin, #41 Tacoma, and #99X McLoughlin Express, would be restructured to provide better coverage in the area and would no longer provide service north of Milwaukie. The line #32 Oatfield would terminate in Milwaukie, and line #99X McLoughlin Express would terminate at SE Milport Street. Line #31 Estacada would continue to run from Milwaukie, alternating between Damascus and Estacada, and would extend south from Milwaukie to Clackamas Community College to provide service currently provided by line #33 McLoughlin. Line #33 McLoughlin would be restructured to provide service between Milwaukie and Clackamas Community College. Headways on some corridor routes would be adjusted to meet estimated demand. Buses would likely serve all the light rail station locations.

Lines #70 12th Avenue and #75 Lombard/39th currently terminate at the Milwaukie Transit Center. These lines would continue to terminate in downtown Milwaukie, and a layover location would be identified during final design.

Shared Transitway Operations

The shared transitway across the new Willamette River bridge would allow joint operations of light rail, buses, and streetcars. It would be the first transitway in the country to operate with all three modes. However, similar “joint operations” transit systems are in place for the new Green Line along the Downtown Portland Transit Mall and in Seattle’s downtown transit tunnel. The transitway would be constructed with an automated control system. These systems will also be

designed to control all transit traffic if there is a disruption in service, such as a stopped transit vehicle or other incident in the transitway.

Buses that currently travel between southeast and southwest Portland on the Ross Island Bridge would use the new bridge to improve travel time and reliability. Lines #9 Powell, #17 Holgate, and #19 Woodstock would be modified to use the new Willamette River bridge instead of the Ross Island Bridge.

From the Downtown Portland Transit Mall, outbound buses would use SW 5th Avenue and SW Grant Street to SW Lincoln Street and access the transitway at SW Lincoln Street and SW Naito Parkway. Outbound buses would exit the transitway at SE 7th Avenue and SE Caruthers Street, travel in a mixed traffic lane on SE Division Place between SE 7th and SE 9th avenues, then use the dedicated transitway between SE 9th Avenue and SE Milwaukie Boulevard, and then merge onto SE Milwaukie Boulevard. Buses using the transitway inbound to the Downtown Portland Transit Mall would travel north from SE Powell Boulevard on SE 9th Avenue, turn left on SE Division Place, and then north to access the transitway at SE 7th Avenue and SE Caruthers Street. Inbound buses would exit the transitway at SW Naito Parkway and SW Lincoln Street. Except for a short segment between SW Naito Parkway and SW 1st Avenue, they would travel in mixed traffic lanes west on SW Lincoln Street, north on SW 4th Avenue, and north on SW Hall Street to access the Downtown Portland Transit Mall. Separate bus pullouts would be provided along the transitway at the South Waterfront and OMSI light rail stations.

Table 2.1-3 shows the frequency of transit service by mode that is planned on the new bridge in 2030.

Table 2.1-3
Number of Willamette River Bridge Crossings per Hour in Peak Direction in 2030

Mode	During Peak	During Off-Peak
Light rail[1]	8	4
Streetcar[2]	6	4
Bus[3]	33	12

[1] With the LPA Phasing Option, peak period peak direction crossings would be 7 per hour; off peak would be the same as the LPA to Park Avenue.

[2] Streetcar service for the Portland Streetcar Loop would require five additional vehicles to provide a central city circulator that would connect east and west sides of the Portland Central City. Additional improvements necessary to complete the Portland Streetcar Loop Project are not included in the Portland-Milwaukie Light Rail Project.

[3] Bus service provided by #9 Powell, #17 Holgate, and #19 Woodstock.

At the South Waterfront and OMSI stations, station platforms would serve buses on the inside and light rail vehicles on the outside. At the South Waterfront Station, streetcars would travel through the station in the bus lanes, but would not stop. Streetcar stops would be provided on SW Moody Avenue. At the OMSI Station, streetcars would exit and enter the shared transitway west of the light rail station and would not travel through the station. A streetcar station would be located to the northwest of the OMSI Station at the former SE Water Avenue location.

Light Rail Early Operations

The light rail from the Downtown Portland Transit Mall to the South Waterfront Station may be opened for operation before the Willamette River bridge has completed construction and testing. TriMet is considering operating light rail between PSU and the South Waterfront Station early to provide service to the proposed Oregon University System Life Science building that is planned adjacent to the station. The Oregon University System may share in the expense of building the station. Operations could begin in early 2015. Early operations to the South Waterfront could be conducted without changes to the project LPA to Park Avenue or the MOS to Lake Road. These early light rail operations are expected to be less than nine months in duration, and would likely be without streetcar or bus operations across the bridge. Therefore, their effects would be the same or less than those stated in Chapters 3 and 4 for the full LPA operations.

2.1.1.10 Light Rail Construction

This section describes construction of the Portland-Milwaukie Light Rail Project and the expected effects of construction. The environmental and social effects are summarized at the end of this section and discussed in more detail as they relate to each section topic in Chapter 3, Environmental Analysis and Consequences; traffic and transit construction impacts and mitigation are discussed in Chapter 4, Transportation.

This description is generally based on the preliminary engineering information. Construction practices and approaches will continue to be refined during final engineering stages. Specific construction plans would be developed during final design to establish the limits for the various construction phases and construction contracts. Final refinement of construction plans would continue into construction procurement selection and negotiations, in order to finalize the requirements to ensure appropriate mitigation of construction impacts. Where possible, construction activities would be coordinated with other capital improvement projects, including projects carried out by the local jurisdictions or a potential Columbia River Crossing Project, to help minimize construction impacts. In addition, extensive involvement of local jurisdictions starting in preliminary engineering and continuing through construction would help ensure coordination to resolve issues, and would seek to reduce inspection and approval times.

Construction Activities

The major construction activities include:

- Delivery of materials and equipment
- Demolition (buildings, pavement and structures, other obstructions)
- Relocation and possible disruption of utilities, including fiber optic, gas, sewer, water, and communication
- Clearing and grubbing
- Fill and excavation and grading
- Elevated track structure construction and reconstruction
- Retaining wall construction
- Pile driving or drilling

- Concrete casting
- Roadway construction, including roadway crossings and traffic detours
- Trackway construction
- Roadway construction
- At-grade station construction
- Parking garage and maintenance facility construction
- Construction of signal communications buildings and substations
- Construction activity in or near waterways and wetlands
- Temporary in-water work elements, including work bridges, cofferdams, and barges
- Subterranean soil stabilization
- Possible relocation of underwater utilities
- Landscaping and replanting

Construction Approach and Sequence

The project would use two contracting methods and construction would be divided among several contracts. Construction of the Willamette River bridge and the park-and-ride structures is planned to be accomplished through separate design-build contracts. Design-build construction was successfully used for TriMet's Red Line that opened for revenue service in September 2001, on a section of the Yellow Line that opened for service in May 2004, and on the I-205 portion of the Green Line that opened September 2009.

TriMet intends to divide the remainder of the project into two or three contract packages for two or three sections and use a construction management/general contractor (CMGC) approach. The CMGC contracts would likely be Segments A, C, and D, shown in the TriMet's preliminary engineering drawings. Segments C and D might be combined. The CMGC contracting method allows the contractor to provide pre-construction design and costing input during the final engineering phase of the project.

The earliest steps in the construction process would include setting up staging sites and relocation of multiple utilities (water, sewer, stormwater, electrical, and communications). A combination of private and public utilities and TriMet contractors would perform this utility relocation work. The trackway would be prepared by developing drainage, preparing subgrade, adding ballast, and then laying tracks. The stations and park-and-ride structures would be constructed. The overhead catenary would be constructed by adding foundations and poles along the alignment, span wires, and electrical catenary. Signals and communication equipment required for the train operations would be added along the alignment and at small buildings located along the alignment. The final stages of construction include addition of station finishes, art and signage, and landscaping. Following completion of the construction, TriMet would extensively test the line prior to opening it for passenger service.

Construction Duration and Timing

Construction is planned to begin in summer 2011 and extend through summer of 2015. With the LPA Phasing Option or the MOS to Lake, the initial construction would also occur during this time period, with other deferred facilities or features developed in later phases depending on the availability of funding and other factors. Although overall project construction is assumed to require four years, the major activities usually occur over about a two-year period. In order to minimize disruption to businesses and residences, construction that would affect access would be planned, staged, and completed in a manner that would minimize disruption. The duration of heavy civil construction in front of any particular property would typically not exceed six to twelve months, with some exceptions possible. For instance, complex structures such as the Willamette River bridge would take longer to construct. All in-water work necessary for constructing bridges over water would be restricted to the approved in-water work time periods. For additional information on bridge construction see the Willamette River Bridge section below; Chapter 3, Environmental Analysis and Consequences; Section 3.8, Ecosystems; and the *Biological Assessment: Portland-Milwaukie Light Rail Project* (Metro 2010).

Construction Staging Areas and Temporary Easements

TriMet is expected to need temporary construction easements (TCEs) for most properties that immediately abut the project footprint to complete construction, and additional areas would be required for construction staging. Staging areas are needed in advance of all construction work, but the need and proximity vary depending on the feature being constructed, available space, presence of sensitive areas, schedule restrictions, and contractor desires. Bridges and other elevated structures would be staged adjacent to or very near their construction site. Other types of staging and materials storage are more flexible in location.

Project staging areas would be used to stockpile, load, and haul excavated and demolished materials; receive and stockpile materials and equipment; assemble and, in limited cases, fabricate project elements; stage prefabricated elements prior to erection/assembly; and locate construction field administration offices and, possibly, construction worker parking. Staging areas in South Waterfront would include a temporary roadway at SW Bond Avenue. Appendix G, Properties Affected by Acquisitions includes a list of properties where TCEs could be negotiated and maps of potential staging sites. Staging areas would be selected from these potential sites during final design and construction.

Construction Traffic

Construction traffic and localized transportation modifications will be needed to accommodate activities including construction operations, truck hauling, and construction staging, and can alter existing traffic and circulation patterns, add volume to specific locations, and often require localized reduction of traffic capacity to allow construction to occur. See Chapter 4, Transportation and the *Traffic Impacts Results Report* (Metro 2010) for details about specific locations.

Construction-related truck traffic would be greatest at the locations generating the highest amounts of excavation and spoils and delivery of materials, such as the Willamette River bridge, parking structures, and other elevated structures.

Demolition and Utility Work

The initial phase of construction work would involve demolition/clearing and rerouting of utilities. In some areas it would be necessary to demolish existing buildings or structures before starting construction of light rail facilities. Demolition would involve implementing stormwater erosion control measures, tearing down buildings and structures, removing debris, and containing and disposing of hazardous materials. Materials from demolition would be recycled if possible. Demolished structures could potentially contain asbestos material, lead paint, or other regulated materials.

Public and private utilities, both underground and aerial, would be relocated as required. There may also be underground storage tanks associated with some structures and excavations for utilities, thus increasing the risk of potential soil contamination. Both demolition and utility work can also generate noise and dust, and truck traffic associated with debris removal. Three utility lines, including a 36-inch water line that is approximately 45 feet from the east pier location of the proposed Willamette River bridge, are located near the bridge alignment toward the east bank of the Willamette River. These lines would be protected or, if deemed necessary, relocated.

At-Grade Light Rail Construction

Open track segments of the route, consisting of at-grade tracks, would require clearing and grading, and shallow excavations. Clearing may include demolition and/or removal of pavement, vegetation, and other surface features, and implementation of an erosion, sediment, and stormwater control plan. During the grading phase, the contractors would install culverts or other permanent drainage structures and below-grade light rail infrastructure. This process may require temporary steel plates in the roadway and temporary lane closures. Where in-street track would be within existing or expanded street right-of-way, grading would generally minimal, but extensive reconstruction of streets, sidewalks, and other existing facilities may occur.

Shallow, near-surface excavations would be required to construct the subgrade and track and station platform slabs for at-grade segments. Overhead catenary support poles would be placed in the street or on the sidewalks, before the overhead catenary system would be installed above the trackway. This work in streets, including street reconstruction, can disrupt traffic.

Some at-grade light rail construction would require retaining walls. Retained fill areas would be created by constructing new retaining walls and filling behind them. This increases the quantity of excavation and the duration of construction in an area. The locations of retaining walls are listed in Section 2.1.1.7, Other Light Rail Facilities.

Safety walls would be constructed in Milwaukie in locations where the alignment is within 25 feet of the UPRR tracks. The construction could require earthmoving equipment for site preparation and pile driving.

Parking Structures

A park-and-ride structure would be constructed at the Tacoma Station. With the LPA to Park Avenue, a park-and-ride structure would be constructed south of SE Park Avenue west of SE McLoughlin Boulevard. With the MOS to Lake Road, a park-and-ride structure would be

constructed north of Kellogg Lake between SE Washington Street and SE McLoughlin Boulevard.

Construction activities at the park-and-ride structures would begin with mobilization of the contractor, including temporary work trailers and electrical and communication services. Environmental protection for erosion and temporary water quality control would be installed prior to clearing and grubbing the site. Ground preparation and pile driving to support the foundations for the parking structure would then occur. The amount, depth, and type of ground preparation and pile driving will be determined by geotechnical analysis and structural calculations. Contractors would install reinforcing steel cages and mats, construct concrete forms, and pour concrete for the structural support piers. The ramps and garage decks would use cast in place concrete methods. Final water quality facilities and other utilities would be installed. The final stages would be the development of finishes, including railings, lighting, installation of elevator(s), and landscaping and site finish work.

This construction would generate concentrated construction material delivery traffic that may impact local traffic and that may generate episodic noise during excavation, and foundation and structure construction. Chapter 4, Transportation provides additional information on construction-related traffic impacts.

Elevated Light Rail Construction

Elevated structures would be built over other land and over water. Elevated structures would be constructed at the following locations:

- SW Harbor Drive
- Willamette River
- SE Powell Boulevard at SE 17th Avenue
- SE Harold Street
- Crystal Springs Creek
- SE Tacoma Street ramps
- Johnson Creek
- Between the Springwater Corridor Trail and SE Mailwell Drive in the North Milwaukie Industrial Area

With the LPA to Park Avenue, elevated structures would also be constructed over SE Lake Road, Kellogg Lake, and SE McLoughlin Boulevard to SE River Road.

The structures over water are discussed separately below. Construction activities related to structures over land would include the following general activities:

- Contractor mobilization including preparation for construction trailers and development of material staging and storage areas
- Placement of environmental protection for erosion and stormwater control
- Site preparation including clearing and grubbing

- Relocation of site utilities
- Installation of driven piles and/or drilled shafts to support bridge piers—the depth, amount and type of piles or drilled shafts necessary will depend on the geotechnical investigation and structural analysis
- Placement of embankment material for retained earth structures and bridge approaches
- Installation of reinforcing steel cages and mats, construction of concrete forms, and placement of concrete for bridge piers
- Bridge superstructure construction using cast-in-place concrete or precast concrete methods
- Development of permanent water quality facilities
- Placement of track, drainage, and railing and overhead electrical systems
- Landscaping and finish work

The construction of elevated trackways over existing streets may impact traffic because of temporary road closures. The new SE Powell Boulevard overcrossing would require deconstruction of the existing SE 17th Avenue structure over SE Powell Boulevard.

Clearing and grading activities, along with demolition of other structures for newly acquired right-of-way, would likely be greater where the elevated trackway transitions to at-grade track.

Elevated trackways would be constructed of combinations of steel and reinforced concrete. Construction would begin with preparation to build foundations with shallow spread footings, deep driven or augured piles, or drilled shafts. Noise and vibration can result from foundation installation. Once foundations are in place, concrete columns and crossbeams would be constructed. Superstructures would be built of steel, cast-in-place concrete, or precast concrete. If steel and/or precast concrete is used, it can be transported to the site and lifted onto the substructure from the street. If cast-in-place concrete is used, then temporary structures would be required to support the superstructure until the cast concrete has gained enough strength (during curing) to support itself.

No stations would be constructed on structure. However, a future station at SE Harold Street would be built on an elevated structure, and the South Waterfront Station would be built on fill to a height of approximately 14 feet above the current grade.

The alignment crosses creeks and small streams that will be crossed on structure, which are described in more detail below. For additional details on construction methods of stream crossings, see the *Biological Assessment: Portland-Milwaukie Light Rail Project* (Metro 2010). Construction of the Willamette River bridge is discussed in detail below.

Willamette River Bridge

Bridge construction is anticipated to take approximately 36 to 42 months. In-water construction would be staged to occur during the Willamette River in-water work window from July 1 to October 31. Construction work could occur at any time of the day and would be required to meet the City of Portland noise ordinance requirements, which can apply to time outside of normal working hours. If night work is required, the work areas would be illuminated.

Barges and temporary work bridges would be used to construct the Willamette River bridge. A work bridge would be constructed from each bank to the in-water pier locations. On the west bank, the work bridge would be designed to avoid a planned hazardous material cap that is to be constructed by Zidell Companies as part of Remedial Action Objectives for hazardous materials present on the site. The east pier and temporary work bridge are located near a 36-inch City of Portland water line. The project would be designed and constructed to avoid damage to the water line and other underwater utilities. Scour protection materials would be placed around the pier and utility lines to prevent damage from hydraulic scour.

Each of the temporary bridges would include up to 138 (134 in-water) steel pipe piles. The piles would be driven either from barges or from the bank, and would be driven initially by vibratory methods into the cemented gravel layer, estimated to be 60 to 80 feet below the mud line of the river. Once the gravel layer is reached, piles would be struck with an impact hammer 30 to 50 times. Hydroacoustic attenuation methods would be used during impact driving. Installation of each temporary work bridge pile would take between one-quarter to one full work day, but no more than 12 hours of impact pile driving activity would occur per day.

For barge-mounted equipment, anchors or temporary piles (spuds) would be required to keep the barge in its desired position. Placement and removal of spuds could occur year-round.

The in-water piers would be constructed within fully contained sand islands using cofferdams. Cofferdams for the in-water piers would be constructed of steel sheet pile and placed in an approximately 100-foot-diameter circular pattern. Individual sheets would be installed using vibratory methods. Once the cofferdam is in place, the water level would be lowered by pumping, using best management practices to avoid harming fish. Pumped water would be disposed of in accordance with applicable permits and regulations. Sand would be pumped or dumped into the cofferdam to create a sand island for pier construction. Sand would be obtained from a permitted source, and would meet Sediment Evaluation Framework standards for in-water placement.

It is anticipated that the equipment used to install the drilled shafts would be mounted on one or more barges around the perimeter of the sand island, and drilling operations are expected to be performed outside of the in-water work windows. Drilled shaft steel casings would be installed via oscillatory (non-vibratory) or vibratory methods approximately to the depth of the Troutdale Formation, which is approximately 100 feet below the mud line. Drilled shafts would be installed to approximately 40 feet into the Troutdale Formation. Installation of each 10-foot-diameter drilled shaft will require approximately one week to vibrate or oscillate the temporary steel casings to the depth required and to construct each of the concrete shaft foundations.

The anticipated bridge construction sequence for the bridge is as follows. The bridge will be constructed through a design-build approach, which provides contractors the ability to propose other methods and sequences that would remain consistent with the findings of this FEIS, including its assessment of impacts and mitigation commitments, as well as other regulations and permits required of the project.

Stage 1 – Drive the piles for and construct work bridges concurrently from each bank to the in-water tower locations. Place rock for scour protection, construct cofferdams, perform fish removal, and fill with sand, gravel, and cobbles. Construct drilled shaft foundations and

reinforced concrete pile cap for each tower. Remove sand within cofferdam, allow water to fill volume, and remove cofferdams.

Stage 2 – Construct drilled shaft foundation and pile caps. Construct reinforced concrete tower for first tower.

Stage 3 – Attach first stay cable to either side of the tower and stress to predetermined load.

Stage 4 – Attach stay cable and construct deck in segments with form travelers (mobile forms) starting from the tower using a "balanced cantilever" approach.

Stage 5 – Cast center-span segment and end diaphragm, remove form travelers, and stress outer cables.

Stage 6 – Construct second tower and repeat balanced cantilever deck construction.

Stage 7 – Connect center-span traveler to both deck cantilevers and construct deck closure pour at mid-span. Drill shafts, and construct concrete columns and caps for landside piers. Drive abutment piles, form and pour abutments. Construct falsework for end spans. Form and pour end spans. Construct barriers, install rail, and pour concrete around rail. Remove work bridges and sand islands and dispose of sand. Install lighting and LRT systems.

The west bank of the river is composed of soft to medium density silty sands that have the potential to liquefy and lose strength during the design earthquake (1000-year). To minimize the potential damage, ground improvements are anticipated to be required. Stone columns or deep soil mixing may be necessary, and ground surface may be disturbed up to a maximum 240-foot-wide by 150-foot-long upland area to the west of the landside pier. With these ground improvements, the hazardous soils anticipated within the upper 10 feet would either be removed entirely in the case of stone columns, or be cemented in place with the deep soil mixing method.

Crystal Springs Creek and Johnson Creek Bridges

The bridge crossing Crystal Springs Creek would be a single-span structure with precast-prestressed (PCPS) concrete on cast-in-place abutments with a driven pile foundation. Construction will use typical cast-in-place concrete practices, with reinforcement and formwork. The bridge would completely span Crystal Springs Creek; no element of the structure will be within the 20-foot active waterway channel.

The bridge over Johnson Creek would be a single-span steel through girder structure with PCPS floorbeams on cast-in-place abutments founded on driven piles. It is anticipated that ground strengthening would be required for the abutment on the north side of Johnson Creek in an area approximately 100 feet wide and extending 100 feet north. The bridge will completely span Johnson Creek. In addition to the new bridge structure over Johnson Creek, there is an existing bridge that would provide access to the new Tacoma Park-and-Ride structure that would be modified slightly to accommodate a sidewalk for pedestrian access. Construction of the sidewalk modification is anticipated to include a minimal extension of the existing abutment on which a new primary superstructure element (PCPS structural elements) will be placed.

There will be approximately 30 piles driven for each of these two bridges, 15 for each abutment. Piles will be driven using a diesel impact hammer mounted on a crane. Operations will meet

noise requirements as required by local jurisdictions. Each pile will take approximately 12 continuous hours to complete, and all pile installations are anticipated to be complete within 30 days. Pile driving would be subject to City of Portland noise regulations, but may occur at any time of the day and at any time of the year, unless in-water work becomes necessary. No in-water work is anticipated at Crystal Springs Creek or Johnson Creek. If work is scheduled to occur at night, mobile light plants would be required.

Primary access to the sites would be within the trackway. Staging areas will be located either on the trackway or to the east of the trackway in the vicinity of Crystal Springs Creek. Access to the north bridge abutment at Johnson Creek is proposed to be from the existing access driveway into the site and set back 25 feet from the top of bank. Access to the south bridge abutment is proposed to be from the Tacoma Park-and-Ride site. Staging will be located outside of the area designated as a conservation zone under the City of Portland Environmental Zone.

Kellogg Lake

The Kellogg Lake bridge would be a box girder structure with multiple spans. The box girders, pier foundations, and abutments will be cast-in-place and founded on drilled shafts and driven piles. Additionally, structural provision for a future pedestrian path under the bridge would be included. It is anticipated that the truss for this path will be installed by the City of Milwaukie.

One H-pier consisting of two 6-foot-diameter columns will be constructed in the Kellogg Lake bed, with the remainder of the piers above ordinary high water. Two temporary 8-foot-diameter steel casings will be driven into the creek bed with a crane-mounted vibratory hammer or oscillator. The drilled shafts for the H-pier will be excavated to the scheduled elevation. Then, reinforcing cages will be placed into the excavation and the shaft will be filled with concrete. Upon completion of the shafts above the water surface, the temporary steel casings will be removed.

Additional in-water work includes installation of approximately 60 steel pipe pilings for support of a temporary work bridge extending from each bank. These temporary work bridges would provide access to the in-water H-pier and all bridge construction operations. Each temporary steel pipe piling will be installed using a vibratory hammer. When the pile can no longer be driven using vibratory methods, a diesel hammer would be used to proof each pile. The total driving duration for each pile is estimated to be one to four hours. The temporary piles will be extracted using a vibratory hammer when the bridge is complete.

Landside bridge supports include two H-piers consisting of two 6-foot-diameter drilled shafts for the piers and abutments. For the piers, some amount of excavation may be required. The shafts will be drilled to the scheduled depth, and temporary 8-foot-diameter steel casings will be driven with a crane-mounted vibratory hammer or oscillator. All landside piers and the cross beam associated with the in-water H-pier will be located above ordinary high water. The H-pier shafts and cross beams will be formed, reinforced, and filled with concrete. The pile driver for the steel piles for the landside abutments will be a crane-mounted, diesel-powered impact hammer, and will have a maximum noise level of 120 dBA. Next, the abutment walls and bearing seats will be formed, reinforcement installed, and the concrete for the abutment walls and bearing seat placed. The forms will be stripped, the bearings placed, and the abutment will be ready for installation of the superstructure.

Once the abutments and piers are constructed, prefabricated structural members will be placed on pier caps and abutments with the use of cranes. The prefabricated structural members will be constructed offsite and delivered to the construction site on trucks. Scaffolding and formwork will be utilized to construct the superstructure of the bridge. The temporary formwork and scaffolding will be removed once the superstructure is complete.

In addition to the light rail bridge, a multi-use bridge is proposed to be attached underneath the light rail bridge superstructure. Construction of the approximately 240-foot pedestrian structure would include the installation of ADA-compliant approach ramps on both the north and south banks, attached to concrete substructure supports that would support the main pedestrian superstructure. The anticipated superstructure could consist of a prefabricated 14-foot-wide steel truss with a concrete walking surface. The truss would be fabricated offsite and delivered to the construction site on trucks.

Ruby Junction Maintenance Facility

Construction activities associated with the expansion of the Ruby Junction Facility would include utility relocation, removal of buildings, building construction or rebuilding, some minor grading, and roadway and trackway construction. Demolition would involve implementing stormwater erosion control measures, tearing down buildings and structures, removing debris, and containing and disposing of hazardous materials. Demolished structures may potentially contain asbestos material, lead paint, or other regulated material. Demolition will generate noise and dust, and truck traffic.

2.1.2 No-Build Alternative

The No-Build Alternative represents transportation and environmental conditions with no light rail connection between Portland and north Clackamas County. The No-Build Alternative is required by NEPA and provides a reference point to gauge the benefits, costs, and impacts of the LPA to Park Avenue and the MOS to Lake Road. The No-Build Alternative includes assumptions about future growth in population and employment in the region and in the project corridor through the year 2030. Projected population and employment growth through the year 2030 is discussed in Chapter 1, Purpose and Need.

The No-Build Alternative also includes the regional transportation system with the committed transportation investments that would occur with or without the Portland-Milwaukie Light Rail Project. Transportation components of the No-Build Alternative are summarized in Table 2.1-1.

The No-Build Alternative transportation system improvements are projects in the corridor that are currently planned and for which a source of funding has been identified. They are listed in the “financially constrained” project list of the 2004 Regional Transportation Plan (RTP), which is the transportation plan adopted for the region in 2007, when the current EIS analysis was re-initiated. The highway and road projects in the No-Build Alternative would also be included in the Portland-Milwaukie Light Rail Project.

The No-Build Alternative would not involve construction activities for light rail or any other specific project, but does assume that other RTP projects will be constructed over time. See Chapter 4 for additional information on the No-Build Alternative.

2.2 COST ESTIMATES

This section provides capital cost estimates and operations and maintenance (O&M) cost estimates for the Portland-Milwaukie Light Rail Project. This chapter uses 2010 dollars. These costs do not include inflation or financing. Chapter 5, Evaluation of Alternatives, provides estimates in year-of-expenditure (YOE) dollars, which include financing costs. Cost estimate details are shown below.

2.2.1 Capital Cost Estimates

The 2010 capital cost estimate (not including finance charges) for the Portland-Milwaukie Light Rail Project is $1.15 billion for the LPA to Park Avenue, $1.12 billion for the LPA Phasing Option and $1.04 billion for the MOS to Lake Road (Table 2.2-1). These estimates include the full cost of capital improvements for the service levels and operating requirements needed to meet the projected 2030 demand for the light rail project. Cost estimates for elements necessary to provide access to the Willamette River bridge for light rail and buses are included in the project cost estimates. The estimated cost for the additional facilities described in Section 2.1.1.6, Related Bridge Area Transportation Facilities, are still being developed by the City of Portland, but initial estimates have ranged from $60 million to $80 million, depending on sequencing and other elements. These are not included in the project costs. Costs do not reflect cost reductions because fewer buses would be necessary with the light rail project compared to the No-Build Alternative.

Table 2.2-1
Light Rail Project Capital Cost Estimates (in millions of 2010 dollars)

	LPA to Park Ave.	LPA Phasing Option	MOS to Lake Rd
Insurance, Special Condition	$49.6	$49.3	$44.3
Utilities/street construction	$76.5	$76.8	$69.6
Track Grade, Structures, Installation	$274.1	$270.2	$247.7
Stations/Park and Rides	$50.1	$34.8	$48.6
System	$69.9	$69.1	$64.9
Operations/Maintenance Facility	$8.1	$5.1	$7.8
Right-of-Way [3]	$204.0	$203.6	$196.8
Vehicles [1]	$87.1	$77.3	$69.9
Professional Services	$173.5	$166.3	$154.8
Unallocated Contingency	$161.0	$159.6	$139.3
Sub-Total (2010 Dollars)	$1,153.9	$1,112.1	$1,043.7
Escalation to Year-of-Expenditure on Sub-Total	$120.6	$116.2	$111.1
Finance Charges[2]	$273.4	$262.1	$226.4
Total in Year-of-Expenditure Dollars	$1,547.9	$1,490.4	$1,381.2

Source: TriMet 2010; numbers may not add due to rounding.

[1] LPA to Park Avenue cost incorporates 20 vehicles; LPA Phasing Option incorporates 18 vehicles, and MOS to Lake Road cost incorporates16 vehicles.

[2] Includes interest payments for interim borrowing and net finance costs during the construction period on bonds issued to provide local match. Finance costs are based on assumption that annual appropriations of New Start funds for the project would not exceed $100 million in any one year. Finance costs and, therefore, total project costs would change if assumption regarding annual appropriation levels change during Final Design.

[3] Includes Land and right-of-way purchased plus value of land and right-of-way donated to project.

Capital cost estimates are based on 30 percent engineering drawings and are provided by TriMet. The estimates are for 2030 service levels with a fleet size of 20 additional light rail vehicles for the LPA to Park Avenue and 16 for the MOS to Lake Road.

The opening year fleet would require fewer light rail vehicles and would have lower capital costs than in 2030. Costs that correspond to an opening day funding scenario are presented in Chapter 5, Financial Analysis and Evaluation of Alternatives. The opening day costs in YOE dollars would form the basis of a project funding plan and would constitute the basis for developing federal funding requests and local match requirements.

2.2.2 Operations and Maintenance Cost Estimates

The LPA to Park Avenue would increase transit services and annual transit system O&M expenditures in 2030 over the No-Build Alternative by approximately $8.89 million, the LPA Phasing Option by $8.54 million, and the MOS to Lake Road would increase annual O&M expenditures by approximately $7.49 million. The O&M cost estimates are based on the transit system described in Section 2.1, Definition of Alternatives. All O&M cost estimates are for 2030 service levels in 2010 dollars.

Table 2.2-2 provides a summary of the annual O&M cost estimates for the LPA to Park Avenue and the MOS to Lake Road, with separate estimates for bus and light rail.

Table 2.2-2
Annual Operating and Maintenance Cost Estimates for Year 2030 Service Levels
In Millions of (2010) Dollars

	No-Build	LPA to Park Ave	LPA Phasing Option	MOS to Lake Rd
Light Rail Project O&M Costs[1]	$0.00	$9.01	$8.66	$7.62
Corridor Bus O&M Costs[2]	$28.73	$28.60	$28.60	$28.60
Total Corridor O&M Costs	$28.73	$37.61	$37.26	$36.22
Difference from No-Build	NA	$8.89	$8.54	$7.49

Source: TriMet and Metro 2010.

[1] Portland-Milwaukie Light Rail Project O&M costs

[2] O&M costs of buses serving the Portland-Milwaukie corridor.

2.3 BACKGROUND ON ALTERNATIVES CONSIDERED

The Portland-Milwaukie Light Rail Project builds on the following key environmental and planning efforts for high capacity transit in the South Corridor:

- 1993 South/North Alternatives Analysis (1993 South/North AA)
- South/North Major Investment Study Final Report (1995 South/North MIS)
- 1998 South/North Corridor Project Draft Environmental Impact Statement (1998 South/North DEIS)

- 2000 South Corridor Transportation Alternatives Study (2000 SCTAS)
- 2002 South Corridor Supplemental Draft Environmental Impact Statement (2002 South Corridor SDEIS)
- 2003 Downtown Amendment to the South Corridor Project Supplemental Draft Environmental Impact Statement (2003 Downtown Amendment)

The selection of the LPA in 2008 was based on the alternatives and options studied in the *Portland-Milwaukie Light Rail Project SDEIS* process initiated in 2007. The alternatives studied in the SDEIS were based on:

- The LPA adopted in 2003 at the completion of the *South Corridor SDEIS*
- The 2003 Downtown Amendment to the South Corridor SDEIS

Additional information on the 2003 LPA selection process and recommendations is available in Appendix L, Background on Alternatives Development, and the *South Corridor Project Locally Preferred Alternative Report* (Metro 2003). The project development process is illustrated in Figure 2.3-1.

2.3.1 The Portland-Milwaukie Refinement Study

In preparation for the *Portland-Milwaukie Light Rail Project SDEIS*, Metro and TriMet conducted a Refinement Study. The purpose of the Refinement Study was to ensure that all reasonable alternatives were considered in the *Portland-Milwaukie SDEIS*, and to finalize those alternatives for study. Areas identified for study focused on the areas shown Figure 2.3-2:

- Willamette River crossing alignment
- North Milwaukie Industrial Area alignment
- Southern terminus location

The other areas of focus included:

- Willamette River bridge type
- Station locations and park-and-ride locations and capacity

This section provides an overview of the options considered and eliminated. See Appendix L, Background on Alternatives Development and the *Portland-Milwaukie Refinement Report* (Metro 2007) for additional information on the options, evaluation, selection process, and recommendations on the options evaluated in the *Portland-Milwaukie SDEIS*.

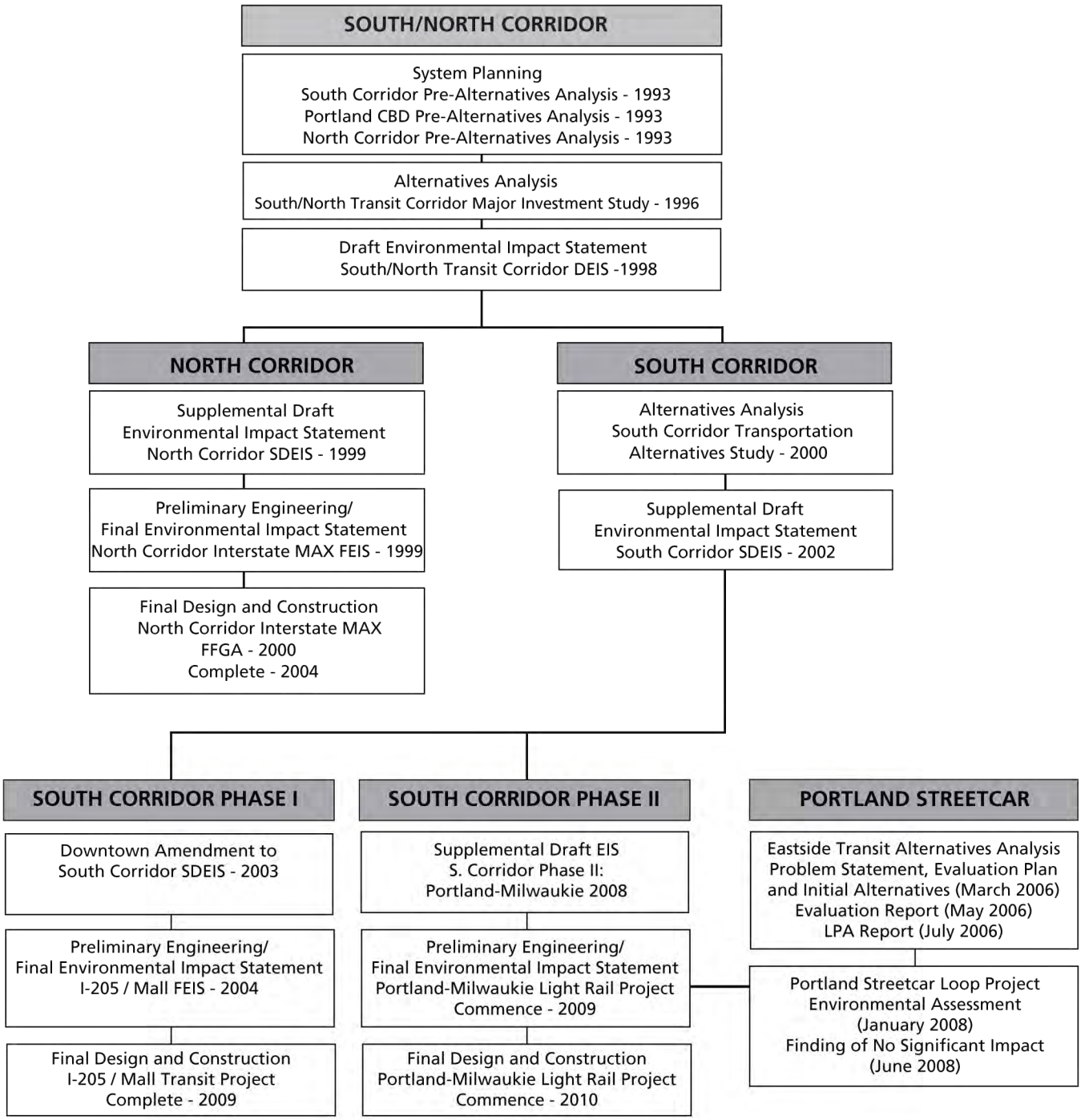
A potential alignment on SE Division Place was subsequently eliminated because it:

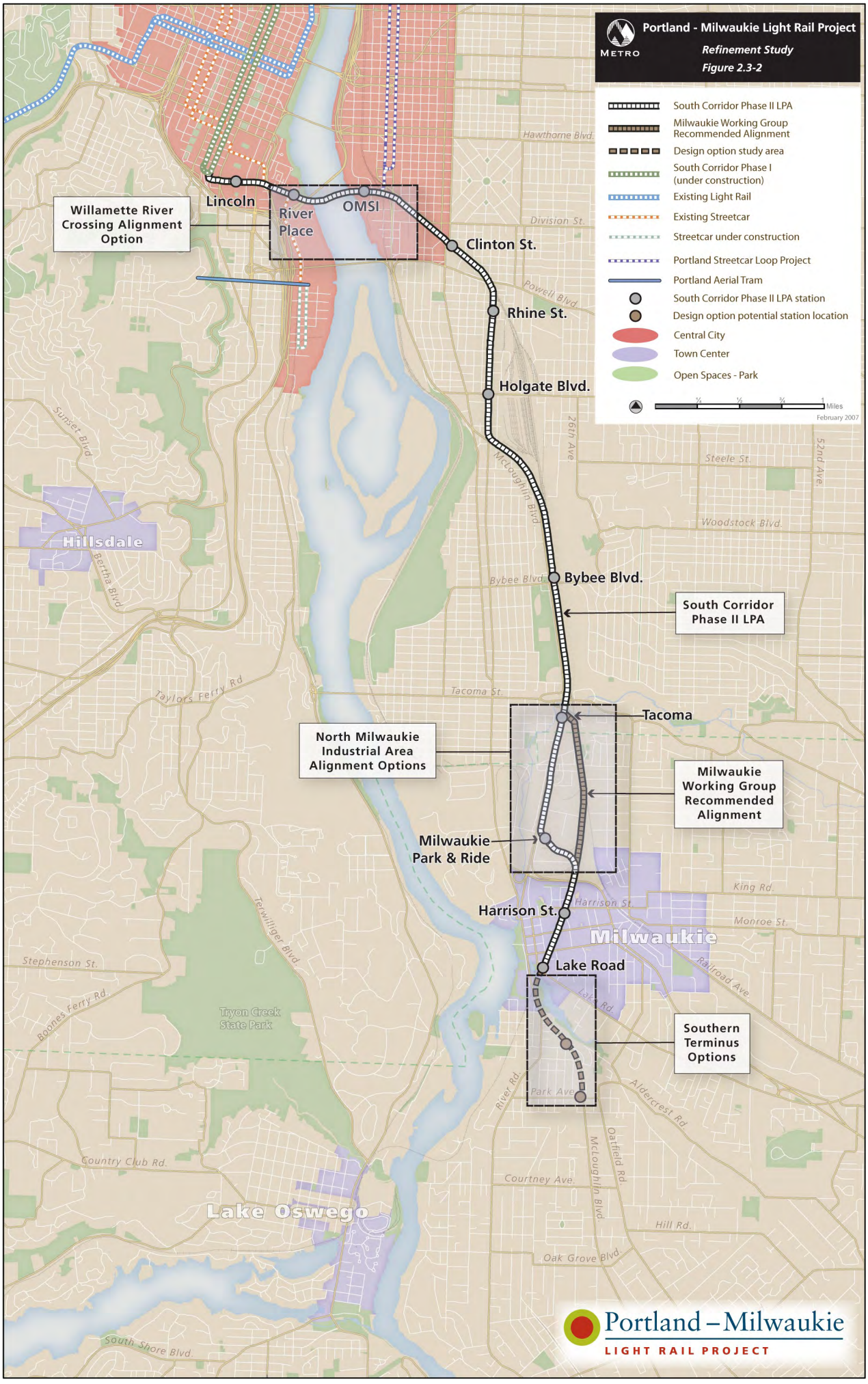
- Had many more traffic and property impacts in the Central Eastside Industrial District (CEID) than other alignments being studied
- Would not serve OMSI as well as other options

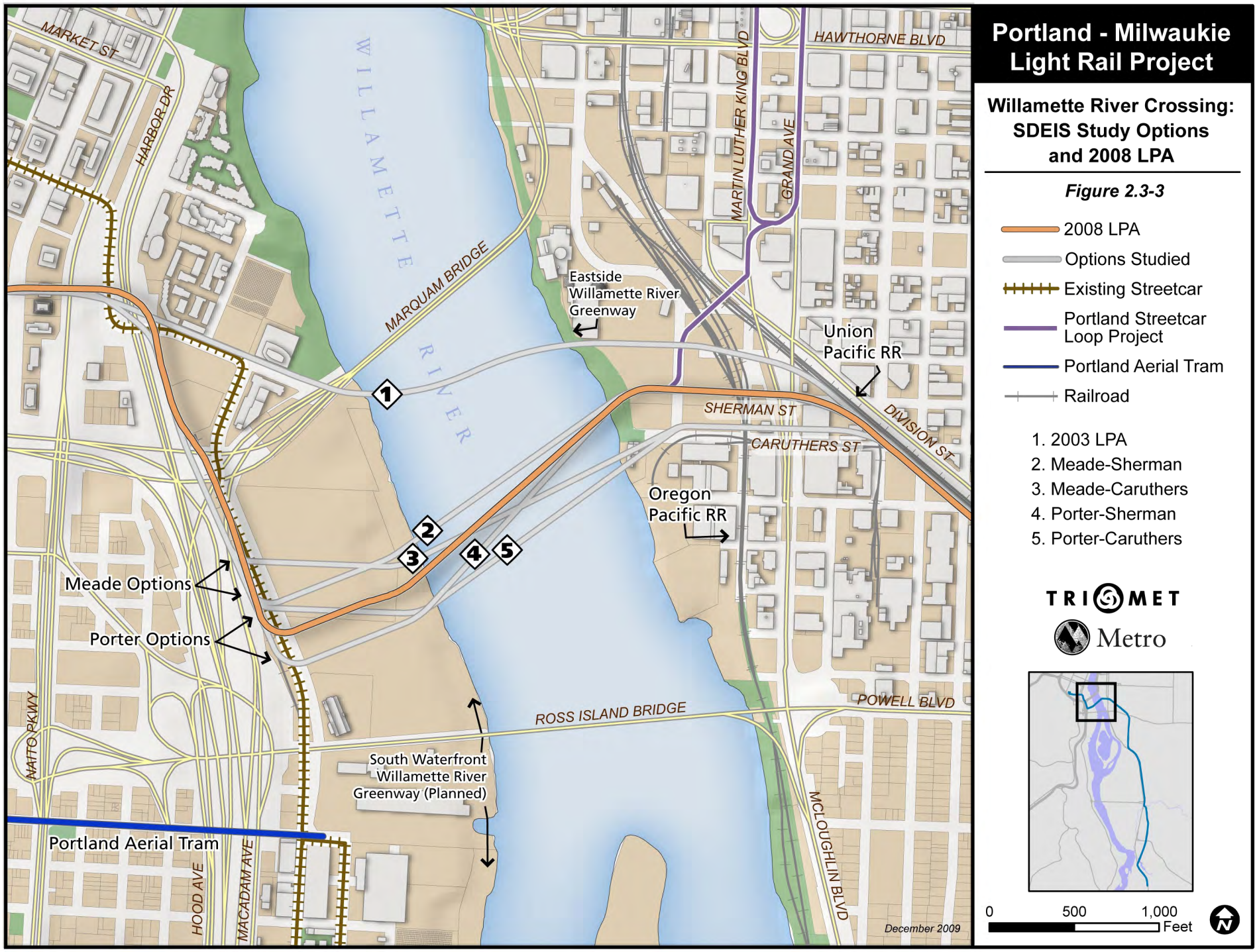
The SE Division Place alignment is therefore not a reasonable alternative to meet the project purpose and need statements to:

- Optimize the transportation system

Figure 2.3-1: South/North Corridor and Portland Streetcar Loop Development Processes




Portland - Milwaukie Light Rail Project
Refinement Study
Figure 2.3-2
METRO
South Corridor Phase II LPA
Milwaukie Working Group Recommended Alignment
Design option study area
South Corridor Phase I (under construction)
Existing Light Rail
Existing Streetcar
Streetcar under construction
Portland Streetcar Loop Project
Portland Aerial Tram
South Corridor Phase II LPA station
Design option potential station location
Central City
Town Center
Open Spaces - Park
Miles
February 2007
Willamette River Crossing Alignment Option
Lincoln
River Place
OMSI
Clinton St.
Rhine St.
Holgate Blvd.
Bybee Blvd.
South Corridor Phase II LPA
Tacoma
North Milwaukie Industrial Area Alignment Options
Milwaukie Working Group Recommended Alignment
Milwaukie Park & Ride
Harrison St.
Lake Road
Southern Terminus Options
Hillsdale
Milwaukie
Lake Oswego
Tryon Creek State Park
Hawthorne Blvd.
Division St.
Powell Blvd.
Sunset Blvd.
Bertha Blvd.
26th Ave.
McLoughlin Blvd.
Steele St.
52nd Ave.
Woodstock Blvd.
Bybee Blvd.
Taylors Ferry Rd.
Tacoma St.
King Rd.
Harrison St.
Monroe St.
Railroad Ave.
Lake Rd.
Terwilliger Blvd.
Stephenson St.
Boones Ferry Rd.
River Rd.
Park Ave.
Aldercrest Rd.
Oatfield Rd.
Country Club Rd.
Courtney Ave.
Hill Rd.
Oak Grove Blvd.
South Shore Blvd.
Portland – Milwaukie
LIGHT RAIL PROJECT


Portland - Milwaukie Light Rail Project
Willamette River Crossing: SDEIS Study Options and 2008 LPA
Figure 2.3-3
2008 LPA
Options Studied
Existing Streetcar
Portland Streetcar Loop Project
Portland Aerial Tram
Railroad
1. 2003 LPA
2. Meade-Sherman
3. Meade-Caruthers
4. Porter-Sherman
5. Porter-Caruthers
TRIMET
Metro
0
500
1,000
Feet
December 2009
WILLAMETTE RIVER
MARKET ST
HARBOR DR
MARQUAM BRIDGE
HAWTHORNE BLVD
MARTIN LUTHER KING BLVD
GRAND AVE
Eastside Willamette River Greenway
Union Pacific RR
SHERMAN ST
CARUTHERS ST
DIVISION ST
Oregon Pacific RR
Meade Options
Porter Options
NAITO PKWY
ROSS ISLAND BRIDGE
POWELL BLVD
South Waterfront Willamette River Greenway (Planned)
Portland Aerial Tram
HOOD AVE
MACADAM AVE
MCLOUGHLIN BLVD

- Be environmentally sensitive
- Support land use goals
- Reflect community values

The following Willamette River crossing options, shown in Figure 2.3-3, were brought forward for study in the *Portland-Milwaukie SDEIS* based on recommendations of the Willamette River Partnership, a committee comprising representatives of affected property owners and agencies:

- 2003 LPA
- Meade-Sherman
- Porter-Caruthers
- Meade-Caruthers
- Porter-Sherman

2.3.1.1 Willamette River Crossing Alignments Considered and Eliminated

The LPA adopted in 2003 included the Caruthers Willamette River crossing between RiverPlace and OMSI, which had last been evaluated in 1998. In order to respond to the significant growth that had taken place in the South Waterfront District since 1998, several options between the Marquam Bridge and the Ross Island Bridge were developed and evaluated to identify the options that would be most promising in terms of meeting the project purpose and need, goals and objectives, and criteria and measures.

The Ross Island Bridge alignment was eliminated due to the following issues:

- Potentially significant impact to the historic Ross Island Bridge
- Lack of service to the CEID and OMSI
- Substantial property impacts on the east side
- Elevated station in South Waterfront District
- High cost

The Ross Island Bridge alignment is therefore not a reasonable alternative to meet the project purpose and need statements to:

- Be environmentally sensitive
- Support land use goals
- Be fiscally responsive

An alignment along SW Naito Parkway was eliminated due to the following issues:

- Longest alignment
- Longest travel time
- Very significant infrastructure cost
- Significant property impacts

- Elevated station in South Waterfront District
- Poor streetcar connections
- Lack of service to RiverPlace

The SW Naito Parkway alignment is therefore not a reasonable alternative to meet the project purpose and need statements to:

- Optimize the transportation system
- Be environmentally sensitive
- Be fiscally responsive
- Support land use goals
- Reflect community values

2.3.1.2 North Milwaukie Industrial Area Alternatives Considered and Eliminated

Two alignment options in the North Milwaukie Industrial Area were included in the Refinement Study, neither of which was eliminated during the study. The Southgate Crossover alignment was the 2003 LPA. It was evaluated in the Refinement Study and recommended for study in the *Portland-Milwaukie SDEIS* with a 600-space park-and-ride at the Southgate Theater site.

Following the adoption of the 2003 LPA, the Transit Working Group, a committee convened by the City of Milwaukie, recommended that the Tillamook Branch line option be reconsidered. However, their recommendation included a park-and-ride on a site south of Kellogg Lake, which the City of Milwaukie later learned was not available for use as a park-and-ride. Since the park-and-ride recommended at Kellogg Lake was not available, and the Tillamook Branch line precluded a park-and-ride at Southgate, additional opportunities for park-and-ride locations were sought.

2.3.1.3 North Milwaukie Industrial Area Alternatives Recommended for Further Study

The alignment options in the North Milwaukie Industrial Area recommended for further study in the *Portland-Milwaukie SDEIS* were:

- The 2003 LPA (Southgate Crossover) alignment with a park-and-ride
- The (Milwaukie Transit Working Group) Tillamook Branch line alignment without a park-and-ride

2.3.1.4 Southern Terminus Alternatives Considered and Rejected

The terminus for the 2003 LPA was at SE Lake Road, north of Kellogg Lake. The terminus identified for the Tillamook Branch line was not available. In order to provide additional park-and-ride opportunities, an alignment south of downtown Milwaukie along SE McLoughlin Boulevard to SE Park Avenue was considered as an extension to both the 2003 LPA and the Tillamook Branch line alignment. A variety of potential park-and-ride and station locations with various capacities were reviewed for each of these alignments. Park-and-ride options reviewed included locations at SE Sparrow Street and SE Park Avenue.

During the refinement phase, the following problems were identified with the SE Sparrow Street park-and-ride:

- Limited parking capacity
- Traffic impacts
- Inconsistency with the surrounding (residential) zoning
- Local opposition

The park-and-ride at SE Sparrow Street is therefore not a reasonable alternative in terms of meeting the project purpose statements to:

- Optimize the transportation system
- Support local land use goals
- Reflect community values

During the refinement phase, additional alignments through downtown Milwaukie were reviewed at the request of the community. Public workshops and hearings were held in Milwaukie in the summer of 2007. The results of the process are documented in *Portland-Milwaukie Light Rail Project Downtown Milwaukie Alignments Review* (Metro 2007) and *Portland-Milwaukie Light Rail Project Downtown Milwaukie Workshop Summary SE Main Street/SE 21st Avenue* (Metro 2007).

Alignments along SE McLoughlin Boulevard and SE Main Street were developed and evaluated first. The alignments were found to have the following issues based on the project purpose and need, goals and objectives, and criteria:

- Conflicts with Milwaukie's Downtown and Riverfront Framework Plan, which includes an enhanced connection between downtown and Riverfront Park; the alignments would have required substantial impacts to the small park and further separated it from the downtown
- Numerous significant traffic impacts to SE McLoughlin Boulevard
- Costs associated with acquisitions and reconstruction of SE McLoughlin Boulevard in this area

The alignments along SE McLoughlin Boulevard and SE Main Street are therefore not reasonable alternatives in terms of meeting the project purpose statements to:

- Support land use goals and reflect community values
- Optimize the transportation system
- Be environmentally sensitive
- Be fiscally responsive

Alignments through downtown Milwaukie along SE Main Street and SE 21st Avenue were evaluated next. The Portland-Milwaukie Light Rail Project Steering Committee decided not to carry the alignments forward because of the following issues:

- Displacement of downtown businesses

- Loss of over 100 parking spaces
- Conflicts with Milwaukie's Downtown and Riverfront Framework Plan vision for a revitalized retail and mixed-use development along SE Main Street
- Downtown traffic impacts, including the addition of seven new signals and left-turn restrictions
- Reduced light rail reliability
- Additional cost due to highway overpass and downtown street reconstruction

The alignments through downtown Milwaukie along SE Main Street and SE 21st Avenue therefore were not reasonable alternatives in terms of meeting the project purpose statements to:

- Support land use goals and reflect community values
- Optimize the transportation system
- Be fiscally responsive

In addition, in response to testimony during the Refinement Study, the project considered terminus points north of downtown Milwaukie at SE Tacoma Street and in the North Milwaukie Industrial Area. Terminus points north of Highway 224 were eliminated because these options would:

- Require a transfer to reach the town center, which has the greatest concentration of households and jobs
- Not support the region's 2040 Growth Concept, which calls for connecting regional and town centers with high quality transit service
- Not address the demand for service to points south and east of the area
- Significantly degrade the transit service, adding time and uncertainty, and deter potential riders

A permanent terminus north of downtown Milwaukie is therefore not a reasonable alternative to meet the project purpose and need statements to:

- Support land use goals
- Optimize the transportation system

The 2003 LPA included a station at SE Harrison Street in Milwaukie. During the refinement phase, community members raised several issues concerning that location, so several other possible locations were proposed. Station location options in Milwaukie that were reviewed included SE Harrison Street, SE Monroe Street, and SE Lake Road, and south of Milwaukie at SE Bluebird Street, SE Sparrow Street, and SE Park Avenue.

2.3.1.5 Southern Terminus Area Alternatives Recommended for Further Study

The alignment options recommended for further study in the *Portland-Milwaukie SDEIS* were:

- 2003 LPA with a station at SE Harrison Street, and a station and 275-space park-and-ride at SE Lake Road

- 2003 LPA with extension to SE Park Avenue, stations at SE Washington Street and SE Bluebird Street, and a station and 1,000-space park-and-ride at SE Park Avenue
- Tillamook Branch line alignment with a station at SE Monroe Street, a station and 275-space park-and-ride at SE Lake Road, and a 1,000-space park-and-ride at SE Park Avenue

2.3.2 The Portland-Milwaukie Light Rail Project SDEIS

The sections below describe the options studied in the *Portland-Milwaukie SDEIS*. The purpose of the *Portland-Milwaukie SDEIS* was to identify the alternative and options that best met the purpose and need, goals and objectives, and criteria and measures for the project in order to select the LPA. See Appendix L and the *Portland-Milwaukie SDEIS* for additional background on project development.

The alignment options selected for study in the SDEIS included:

- **2003 LPA** from the Downtown Portland Transit Mall to SE Lake Road in Milwaukie with a new bridge across the Willamette River and an alignment along SE McLoughlin Boulevard and SE Main Street in the North Milwaukie Industrial Area
- **Willamette River crossing options** from the South Waterfront District to southeast Portland, with four location options in addition to the 2003 LPA river crossing
- **Extension to SE Park Avenue**, an alignment terminus option that would extend light rail approximately 0.84 mile from SE Lake Road to SE Park Avenue and possibly add two stations and provide additional park-and-ride capacity at SE Park Avenue
- **Tillamook Branch Line**, an alignment option between SE Tacoma Street and Highway 224 that would transition to an alignment along the existing Tillamook Branch Railroad at the Tacoma Station and include the extension to SE Park Avenue

Figure 2.3-3 (shown previously) and Figures 2.3-4 and 2.3-5 (on the following pages) show the options studied in the SDEIS. For a detailed description of the options, see the *Portland-Milwaukie SDEIS*.

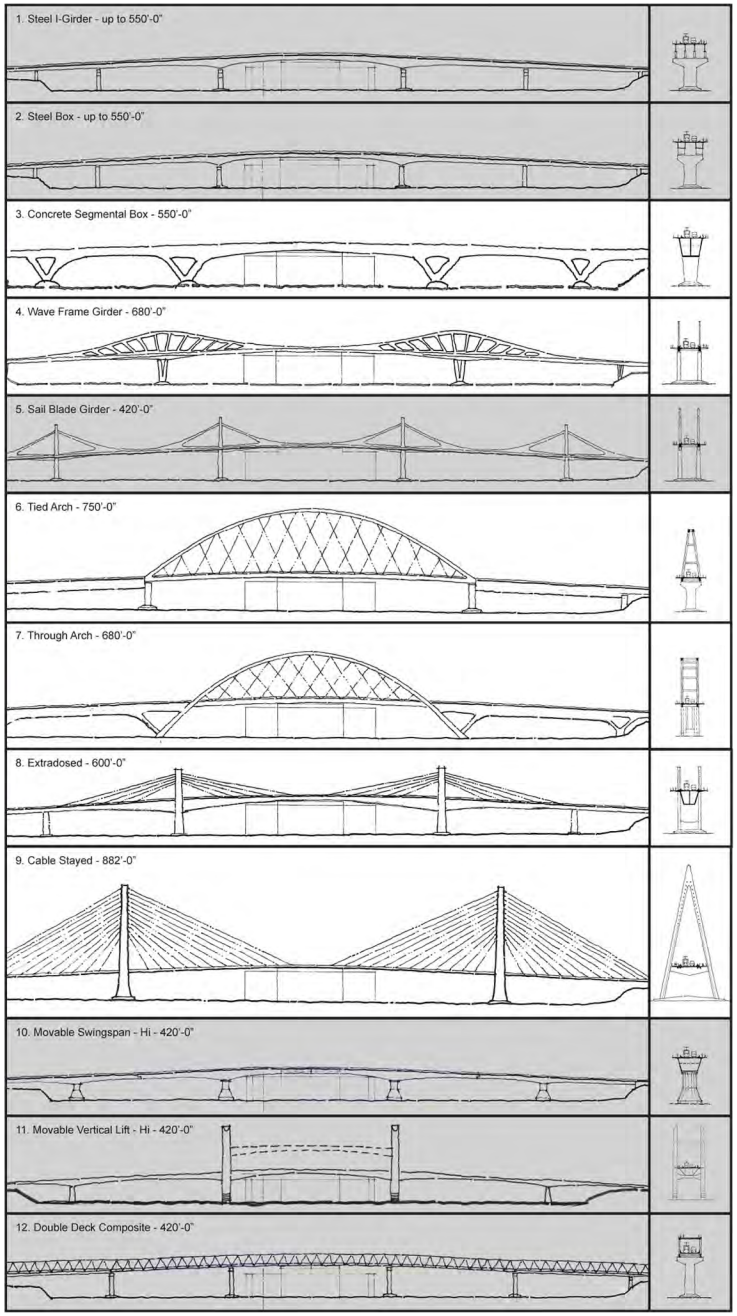
Other localized options that were studied included:

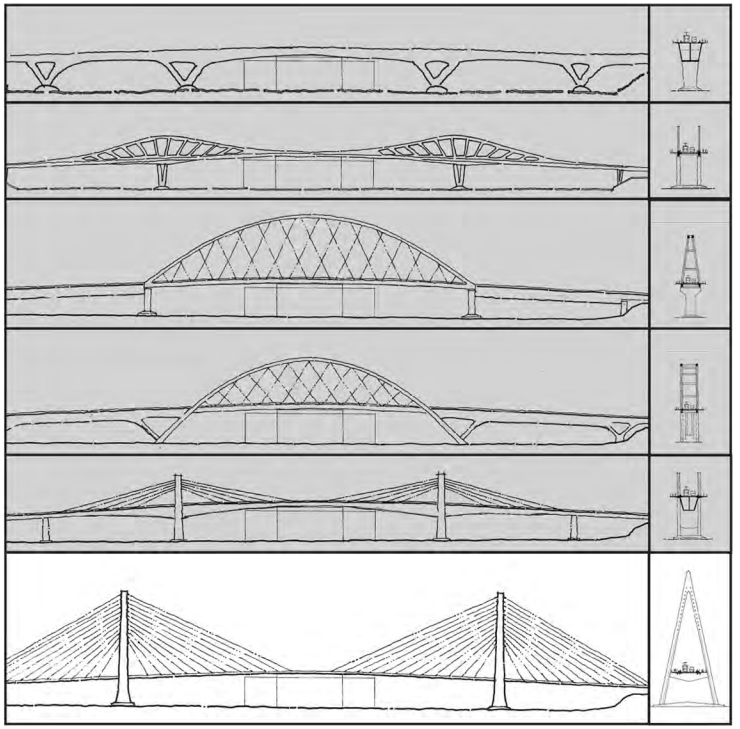
- An additional station on the elevated structure over SW Harbor Drive
- An additional station in southeast Portland at SE Harold Street
- Station options in downtown Milwaukie, in addition to the station at SE Harrison Street that was identified in the 2003 LPA
- Bridge options that would accommodate bus and Portland Streetcar access
- Bridge type and height
- Options for elevated or at-grade crossings of the OPR line and SE McLoughlin Boulevard east of the Willamette River

The detailed results of this analysis are documented in Chapter 3, Environmental Analysis and Consequences, and Chapter 4, Transportation of the Portland-Milwaukie SDEIS. For the most comprehensive information, also see the results reports prepared for each area of study. The 2003 LPA represented the baseline for the Portland-Milwaukie SDEIS and provided a point of

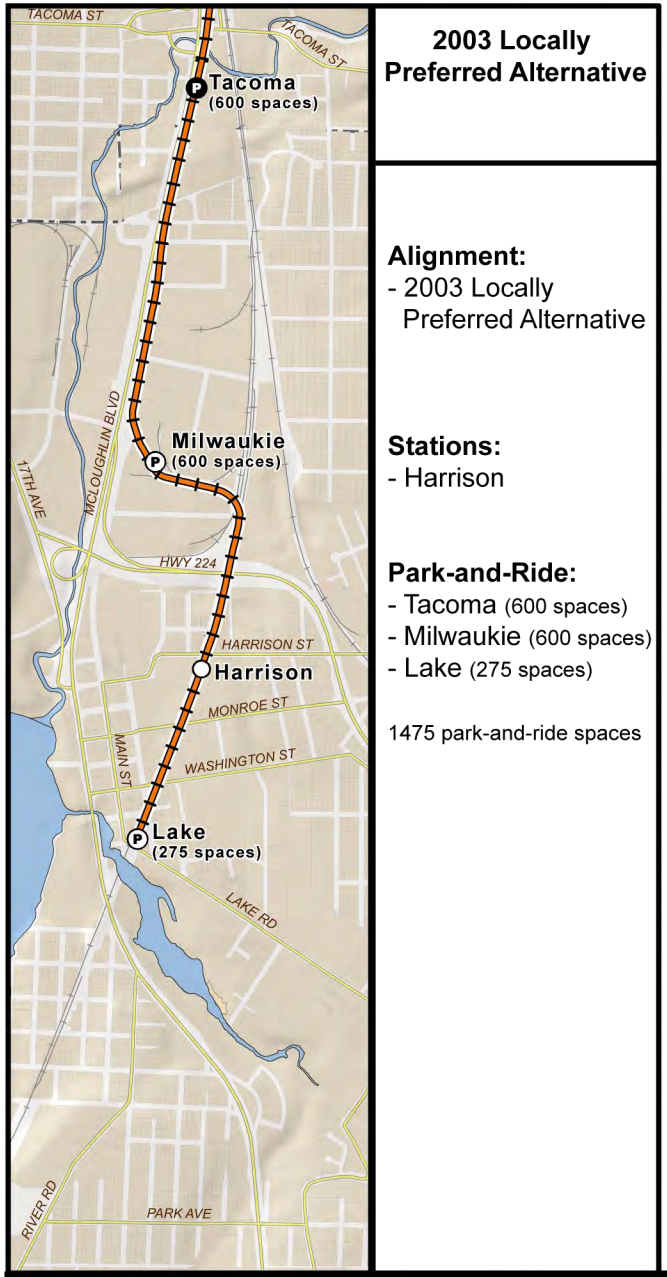
Figure 2.3-4 Bridge Type Narrowing and Selection

Working Group Recommendations:





✓ = recommended to move forward



2003 Locally Preferred Alternative

Alignment:
- 2003 Locally Preferred Alternative

Stations:
- Harrison

Park-and-Ride:
- Tacoma (600 spaces)
- Milwaukie (600 spaces)
- Lake (275 spaces)

1475 park-and-ride spaces

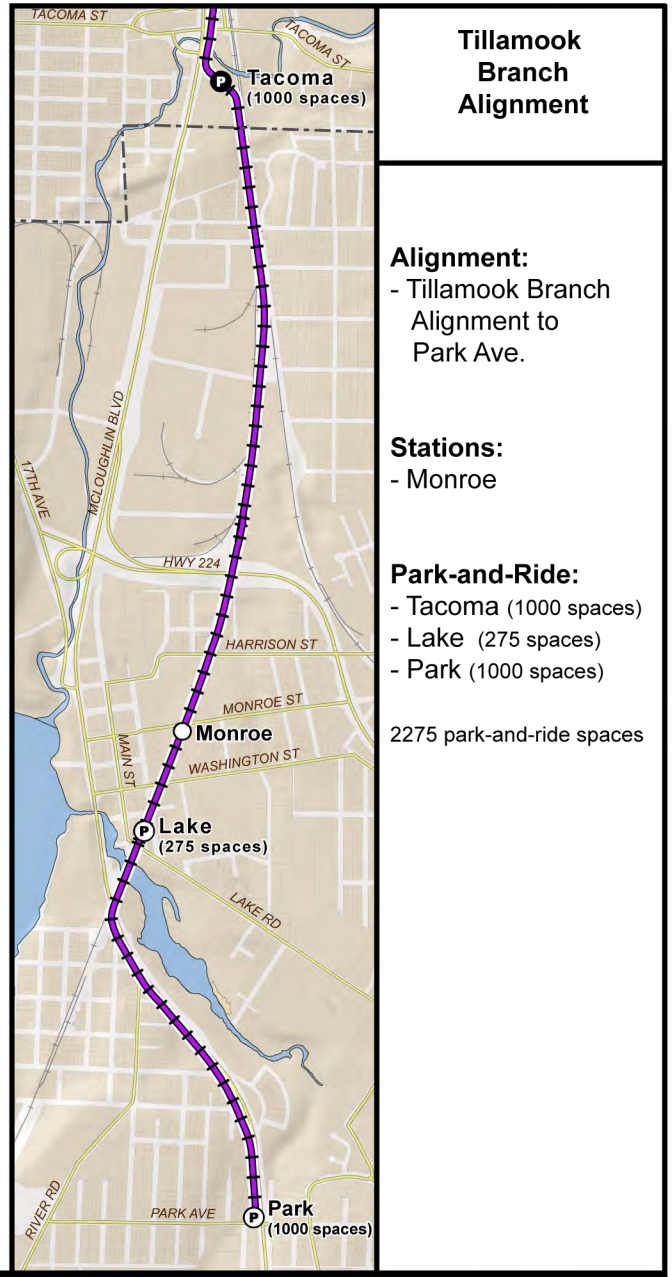
Locally Preferred Alternative with extension to Park Avenue

Alignment:
- Locally Preferred Alternative with extension to Park Ave.

Stations:
- Washington
- Bluebird

Park-and-Ride:
- Tacoma (1000 spaces)
- Milwaukie (600 spaces)
- Park (1000 spaces)

2600 park-and-ride spaces



Tillamook Branch Alignment

Alignment:
- Tillamook Branch Alignment to Park Ave.

Stations:
- Monroe

Park-and-Ride:
- Tacoma (1000 spaces)
- Lake (275 spaces)
- Park (1000 spaces)

2275 park-and-ride spaces

Portland-Milwaukie Light Rail Project ***Figure 2.3-5***

SDEIS Study Options: Tacoma to Project Terminus

Light Rail Alternative
Station
Station Option
Park-and-Ride
Park-and-Ride Option
Railroad
County Line

0 0.25 0.5 Miles

N

June 2010

comparison for the options described below and the decision on the Portland-Milwaukie Light Rail Project 2008 LPA. The 2003 LPA studied in the *Portland-Milwaukie SDEIS* included approximately 6.4 miles of light rail, 11 stations, and a new bridge across the Willamette River. The route would begin near PSU, where it would connect with the recently completed Downtown Portland Transit Mall light rail, and end in downtown Milwaukie at SE Lake Road.

2.3.2.1 Selection of Willamette River Crossing Alignment Option

During the SDEIS process, the City of Portland convened the Willamette River Partnership, a committee of local property owners, river users, businesses, and agencies in the vicinity of the proposed bridge crossings. The committee was charged with coordinating private development plans and investments with City of Portland utility, street, streetcar, and park improvements and the light rail project. The committee recommended a refined Porter-Sherman crossing. The refined Porter-Sherman alignment is parallel to, and between, the Meade-Sherman and Porter-Sherman options on the west side of the river and is similar to them on the east side.

Compared to the 2003 LPA river crossing, the refined Porter-Sherman alignment would:

- Serve almost 3,000 more residents and more than 4,000 additional employees
- Add 1,200 to 1,400 light rail trips a day between downtown Portland and Milwaukie or Oak Grove
- Reduce total transit travel time to South Waterfront by five minutes
- Have fewer noise impacts and impact one less park
- Be more likely to serve as a catalyst for development in the area
- Provide substantial travel time benefits for buses, with over 13,000 riders gaining benefits
- Provide an additional transit connection across the Willamette River for 2,500 streetcar riders daily

Therefore, the refined Porter-Sherman alignment better met the purpose and need for the project because it would:

- Optimize the transportation system
- Support land use goals
- Be environmentally sensitive
- Reflect community values
- Maintain livability in the region

The refined Porter-Sherman crossing also would have several additional advantages not shared by the other options that would serve South Waterfront. It would:

- Avoid the greater impacts to eastside industrial business required by the Meade-Caruthers or Porter-Caruthers options
- Be compatible with the OHSU and OMSI master plans

- Be more compatible with the South Waterfront Willamette River Greenway plans for natural habitat area between SW Porter Street and the Marquam Bridge
- Offer a short walk connection to the Portland Aerial Tram, which provides access to more than 10,000 jobs on Marquam Hill

The refined Porter-Sherman crossing better met the purpose and need because it would:

- Optimize the transportation system
- Support land use goals
- Be environmentally sensitive
- Maintain livability in the metropolitan region
- Reflect community values

2.3.2.2 Selection of Willamette River Bridge Type

Willamette River bridge types identified for study in the SDEIS included cable-stayed, concrete segmental, and cable-stayed through-truss hybrid bridge types. During the SDEIS, bridge concept designs were developed to explore the range of impacts of the most likely bridge types for the alignment options. Since the adoption of the 2008 LPA, more details on the design have been developed through the efforts of the Willamette River Bridge Advisory Committee (WRBAC). These efforts are described following discussion of the bridge type options studied in the SDEIS.

The designs studied in the SDEIS included deck widths that ranged from 58 to 66 feet depending on the location of the bridge and the bridge type, and included a 13-foot lane in each direction shared by light rail and streetcar, and two 12-foot bicycle/pedestrian lanes. Buses were included on all options, and the 2003 LPA was studied with and without buses. The SDEIS studied both a 65-foot and a 72-foot vertical navigational clearance. Each bridge type was studied with the vertical clearance most appropriate to it, in order to represent the range of likely impacts. The navigational needs were assessed through a river user survey, which is discussed in Chapter 4 (Section 4.3.4, Navigational Impacts). The United States Coast Guard will ultimately decide the navigational clearance requirements based on that assessment.

At the time the 2008 LPA was adopted, several issues related to the bridge height and type were identified. Given the multi-use purpose of the bridge, its location, and its vital importance to the Portland-Milwaukie Light Rail Project, the project asked a committee of design, transportation, business, and community leaders to study all bridge types and recommend types appropriate for the context and the budget. The WRBAC, a volunteer citizen committee under the leadership of former Portland Mayor Vera Katz, was formed to advise project partners on bridge type selection.

The WRBAC agreed on the selection criteria and considered cost, risk, navigation, fundamental performance, architecture, urban context, greenways, environmental sustainability, bridge operations, other technical considerations, and opportunities, including which bridge types are best at treating stormwater, supporting wildlife and fish habitat, and incorporating alternative energy. The committee initially eliminated bridge types that would not meet the navigation needs of current users with plans to operate at their current locations for the long term. Steel girder, steel box, sail blade girder, moveable swing span, moveable vertical lift, and double deck

composite bridge types were eliminated because they would not provide the horizontal navigational clearance or would not meet other selection criteria, including cost, constructability, number and location of piers, and navigation requirements.

As a result, bridge types that met the selection criteria and remained under consideration included:

- Concrete segmental
- Tied arch
- Through arch
- Two-pier cable-stayed
- Four-pier cable-stayed
- Wave frame

The concrete segmental bridge type was subsequently eliminated due to the higher cost required to meet the minimum span. The committee further evaluated the remaining five bridge types and, because of risks associated with cost, geotechnical issues, navigation, and construction scheduling, selected the wave frame and two variations of the cable-stayed bridge type to carry forward. Cost estimates showed that the wave frame bridge type had a substantially higher estimated cost than the cable-stayed bridge type. Committee members considered the wave frame cost estimates and project risk and recommended a cable-stayed bridge type for the project.

The cable-stayed bridge type was selected over other types because:

- It is efficient at spanning long distances, which allowed the number of piers in the water to be reduced, and increased navigational clearance.
- Fewer in-water piers would reduce the long-term environmental impact of the structure.
- The cantilevered construction process used would reduce environmental impact during construction.
- In comparison with steel girder bridge types, less steel would be required.
- It can be designed with thinner decks than other bridge types, allowing a more transparent structure on the city skyline and a greater vertical navigation clearance.

Therefore, the cable-stayed bridge type better met the purpose and need to:

- Be environmentally sensitive
- Reflect community values
- Maintain livability in the metropolitan region
- Be fiscally responsive
- Optimize the transportation system

Additional information about the bridge study process is available in *Portland-Milwaukie Light Rail Project Willamette River Bridge Type Selection Process* (TriMet 2009). Reports, agendas,

presentations, and meeting summaries from the WRBAC meetings are available at: trimet.org/pm/library/bridge.htm.

2.3.2.3 Selection of the North Milwaukie Industrial Area Alignment and Southern Terminus

Alignment options studied in this section were developed based on the recommendations of a Transit Working Group established by the City of Milwaukie following the adoption of the LPA in 2003 and the Refinement Study. The options studied in the *Portland-Milwaukie SDEIS* included alignments in the North Milwaukie Industrial Area south of SE Tacoma Street in the city of Portland and north of Highway 224 in the city of Milwaukie, and terminus options at SE Lake Road in Milwaukie and SE Park Avenue in the Oak Grove neighborhood. There were also options for station and park-and-ride locations. Additional information on the development of these options is available in Appendix L.

The 2003 LPA alignment would follow SE McLoughlin Boulevard and SE Main Street in the North Milwaukie Industrial Area, and cross over to the Tillamook Branch line north of Highway 224. It would run along the east side of the rail line through downtown Milwaukie and terminate at a station with a park-and-ride at SE Lake Road.

The 2003 LPA with Extension to SE Park Avenue would be identical to the 2003 LPA except, rather than terminating at SE Lake Road, it would continue south and cross over SE Lake Road and Kellogg Lake alongside the east side the existing freight rail trestle. It would cross SE McLoughlin Boulevard, SE River Road, and SE 22nd Avenue. Options included an elevated structure and an at-grade crossing over SE McLoughlin Boulevard. After the crossing, the alignment would run on the west side of SE McLoughlin Boulevard and terminate north of SE Park Avenue.

The Tillamook Branch line alignment would turn to the southeast at the Tacoma Station. South of the station, it would cross under the Springwater Corridor multi-use path, then rise to cross over the Tillamook Branch line tracks and remain on an elevated structure until descending to cross under Highway 224. It would run along the east side of the rail line through downtown Milwaukie. This option would also extend to SE Park Avenue and had the same options as the 2003 LPA with Extension to SE Park Avenue to cross SE McLoughlin Boulevard either at or above grade.

Many comments received during the SDEIS public comment period advocated for the SE Park Avenue terminus. They cited access for Clackamas County residents and downtown Milwaukie livability issues as the primary reasons. A number of comments opposed the SE Park Avenue terminus also, citing livability issues and a perceived increase in criminal activity.

In July 2008, the Metro Council adopted the LPA with a Tillamook Branch line alignment, including the extension to SE Park Avenue, and a Minimum Operable Segment with a terminus at SE Lake Road, as shown in Figure 2.1-1.

Compared to the 2003 LPA or the 2003 LPA to SE Park Avenue, the Tillamook Branch line alignment was adopted as the LPA in 2008 because it would:

- Require fewer impacts to traffic and freight access for businesses in the North Milwaukie Industrial Area
- Result in fewer acquisitions and displacements of North Milwaukie Industrial Area businesses
- Reduce light rail travel time by one minute along the length of the segment
- Cost approximately $39 million less to construct than the 2003 LPA alignment
- Avoid adverse impacts to a historic property (ODOT building and grounds on SE McLoughlin Boulevard)
- Have support of the businesses in the North Milwaukie Industrial Area and would be similar to the Milwaukie Transit Working Group recommendation
- Avoid traffic impacts at SE Ochoco and SE Milport streets

The Tillamook Branch line alignment was selected because it best met the purpose and need requirements to:

- Optimize the transportation system
- Support land use goals
- Be environmentally sensitive
- Be fiscally responsive
- Maintain livability in the metropolitan region
- Reflect community values

2.3.2.4 Selection of Station Locations and Park-and-Ride Facilities

The station locations considered in the *Portland-Milwaukie SDEIS* were based on the 2003 LPA, findings of the 2007 Refinement Study, and recommendations of the Willamette River Partnership and the Steering Committee. Station locations studied included:

- Lincoln
- Harbor Drive
- RiverPlace
- South Waterfront (with several site options)
- OMSI (with several site options)
- Clinton
- Rhine
- Holgate
- Harold
- Bybee
- Tacoma
- Milwaukie (the former Southgate site)
- Harrison
- Monroe
- Washington
- Lake Road
- Bluebird
- Park Avenue

Based on Citizen Advisory Committee and Steering Committee recommendations, the Metro Council adopted station locations at:

- SW Lincoln Street
- South Waterfront
- OMSI
- SE Clinton Street
- SE Rhine Street
- SE Holgate Boulevard
- SE Bybee Boulevard
- SE Tacoma Street
- SE Lake Road
- SE Park Avenue

In addition, Portland Streetcar stations would be located in South Waterfront and near OMSI.

The Harbor Drive Station was combined with the Lincoln Station. The LPA adopted in 2008 included a combined station at SW Lincoln Street and SW Harbor Drive. Metro Council directed the project to reexamine the Lincoln and Harbor stations and identify a single station location that would optimize ridership, be fiscally responsible, and serve the RiverPlace and the South Auditorium areas. During preliminary engineering, project staff reviewed the station location and determined that a station location at SW Lincoln Street and SW 4th Avenue would best meet project goals and objectives. Reasons for the decision to consolidate stations included:

- The location best supports PSU's development plans and the development planned by the City of Portland in the South Auditorium District
- The location is within walking distance to RiverPlace, and would have streetcar access that will serve OHSU, OMSI, and downtown
- The SW Harbor Drive Station would require an elevated station at substantially more cost than other options
- The SW Harbor Drive station boardings were estimated to be among the lowest of any station, with 70 percent estimated to be transfers, and reduced overall ridership because of trip delay

A future station is planned at SE Harold Street. Many comments received during the SDEIS public comment period advocated for including the Harold Station in the built project. The Citizens Advisory Committee also included the Harold Station in their recommendation to the Steering Committee. A few comments expressed a preference for no station at SE Harold Street.

The 2008 LPA recommendation directed staff to consider the Harold Station as a future station, and to coordinate with the City of Portland to evaluate ridership, cost-effectiveness, alternative funding sources, land use, zoning, infrastructure, and bus routing options that would support a future Harold Station. Reasons for this decision included:

- Current land uses and zoning do not adequately support a Harold Station at this time. A Harold Station would benefit by having a multi-use bridge over the railroad tracks at SE Reedway Street to connect to the Reed Neighborhood and Reed College. The cost of the bridge is estimated at $6 million to $8 million.
- There would be low ridership (1,400 boardings per day even with a pedestrian bridge that would provide access to neighborhoods to the east) compared with other stations.
- Most of the station area is within one-half mile of either the Bybee Station or the Holgate Station.
- Most riders could be served by the existing #19 Woodstock bus route or other routes that will benefit from using the new Willamette River bridge, which will increase reliability and decrease bus travel times.
- 19,000 daily light rail riders traveling through the station would experience a 30- to 60-second delay, thereby reducing the cost-effectiveness of the light rail project.

In the City of Milwaukie, stations at SE Harrison Street, SE Monroe Street, SE Washington Street, and SE Lake Road were studied in the SDEIS. Reasons for recommending one station at SE Lake Road included:

- The station location is the closest of the four stations studied to SE Main Street, the retail spine of downtown Milwaukie
- The station location encourages the greatest possible use of SE Main Street, helping to activate the entire length of the street with pedestrian activity compared with the other station alternatives in downtown Milwaukie
- The station location provides downtown Milwaukie with the anchor that Milwaukie's Downtown Plan suggests is necessary for strengthening SE Main Street
- The station location will be highly convenient to Milwaukie High School
- The station location has community support and was recommended by the Milwaukie City Council

The adopted LPA did not recommend a station location at SE Bluebird Street in Clackamas County. Reasons for not recommending a SE Bluebird Street station included:

- The station would need to be elevated, and station construction costs and visual impacts would be substantially greater than for at-grade stations
- The light rail ridership would be significantly lower than other stations along the light rail line (the SE Bluebird Street station is estimated to have had only about 1,400 boardings and alightings daily, compared to the station median of 2,748)
- The potential for substantially increasing ridership by increasing the density and intensity of land use is very limited because of existing zoning and land uses
- There are existing commercial uses that would have to be acquired and displaced at the site

The adopted LPA recommended park-and-ride locations at SE Tacoma Street and SE Park Avenue. The SE Lake Road park-and-ride facility was not recommended to be included in the LPA to Park Avenue. It is included in the MOS to Lake Road, which is discussed below. Many

comments received during the SDEIS public comment period expressed a desire for no park-and-ride at SE Lake Road. They cited concerns about livability issues, negative impacts to downtown and traffic, and a perceived increase in criminal activity.

2.3.2.5 Minimum Operable Segment (MOS) Option

In July 2008, Metro Council also identified an MOS terminating at SE Lake Road. This would be pursued only if sufficient funds to construct the preferred alignment with a terminus at SE Park Avenue cannot be identified. The preferred alternative would remain a SE Park Avenue terminus. In order to accommodate the demand for a park-and-ride, a park-and-ride would be necessary with the terminus at SE Lake Road, and the parking capacity at the Tacoma Park-and-Ride would increase. The Lake Road Park-and-Ride structure would accommodate up to 275 spaces.

2.4 NEXT STEPS

The analysis and preparation of this FEIS represents one of the concluding steps in the planning and environmental review phase of the development of the Portland-Milwaukie Light Rail Project before the project moves on to final design and construction. This section outlines other major steps in the project timeline, as shown in Table 2.4-1.

Table 2.4-1.
Portland-Milwaukie Light Rail Project Timeline

Preliminary Engineering	*March 2009 – Summer 2010*
Final Environmental Impact Statement	*Spring 2009 – Fall 2010*
Record of Decision	*Fall 2010*
Final Design	*Winter 2010 – Winter 2012*
Utility Relocation	*Spring 2011 – Spring 2013*
Willamette River Bridge Construction	*Early 2011 – Fall 2014*
Bridge In-Water Work	*Summer 2011 – Fall 2014*
Light Rail Construction	*Summer 2011 – May 2015*
Systems Installation and Testing	*Summer 2013 – Spring 2015*
Operations Training and Simulated Service	*Summer 2015*
Service Begins	*Fall 2015*

2.4.1 Federal Record of Decision

Following the release of the FEIS, the FTA is expected to issue a Record of Decision documenting its findings on the environmental effects and mitigation commitments for the project, including whether the project has satisfied the requirements of all applicable federal regulations. These include meeting the requirements of the Endangered Species Act, requiring consultation and approval with the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service, which must occur before publication of the FEIS. The U.S. Coast Guard and the U.S. Army Corps of Engineers and State of Oregon and City of Portland

must also provide approvals for the Willamette River bridge prior to its construction. Chapter 6 provides a list of the permits and approvals that would be required. With the Record of Decision, the project would be eligible for FTA's approval to enter final design, and can begin other activities such as right-of-way acquisition, permitting, and some limited construction activities.

2.4.2 Final Design and Full Funding Grant Agreement

The final design phase completes the engineering and construction planning for the project, including documentation of all construction details. During this phase all project permits are obtained and right-of-way is acquired. A list of project permits is available in Chapter 6.

The Full Funding Grant Agreement (FFGA) is a grant agreement that the FTA uses for making a major investment in a new fixed guideway system, such as light rail. In exchange for the FTA's commitment to provide federal funds over a multiyear construction schedule, TriMet would commit to completing the light rail project on time, within budget, and in compliance with all applicable federal requirements, and to bear any cost increases that might occur subsequent to award and execution of the FFGA.

An FFGA benefits both parties to the agreement in that it defines the project scope, establishes a firm date for project completion, provides a mechanism for designating funds for future years, leads to the development of accurate cost estimates, and permits the use of state and local funding for early project activities without jeopardizing future federal funding for those activities.

2.4.3 Construction, Testing, and Operations

Construction is expected to take four years. The construction start depends on the funding scenario. After construction is completed, system testing will occur to ensure safe and reliable operations before opening for revenue service as early as 2015.