Description of Alternatives

Multnomah County | Earthquake Ready Burnside Bridge Project

Portland, OR

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Earthquake Ready Burnside Bridge Description of Alternatives

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Acronyms, Initialisms, and Abbreviations

ac	acre
ADA	Americans with Disabilities Act
CFRP	carbon fiber–reinforced polymer
CSZ	Cascadia Subduction Zone
EIS	environmental impact statement
EQRB	Earthquake Ready Burnside Bridge
I-5	Interstate 5
I-84	Interstate 84
ODOT	Oregon Department of Transportation
OHW	ordinary high water
ROW	right-of-way
TCE	temporary construction easement
UPRR	Union Pacific Railroad
USCG	U.S. Coast Guard

1 Introduction

1.1 Project Location and Context

Please see the project location and context information in any one of the technical reports (Multnomah County 2021). See Figure 1.

1.2 Bridge History

The original Burnside Bridge was built in 1892. It was later replaced with the current bridge in 1926 in response to a growing population and the increasing use of motor vehicles. The bridge was the first Willamette River bridge in Portland to be designed with the help of an architect. It was originally designed by Hedrick and Kremer with the final design completed by Gustav Lindenthal. The drawbridge opening mechanism (bascule[1]) was designed by Joseph Strauss who also designed the Golden Gate suspension bridge.

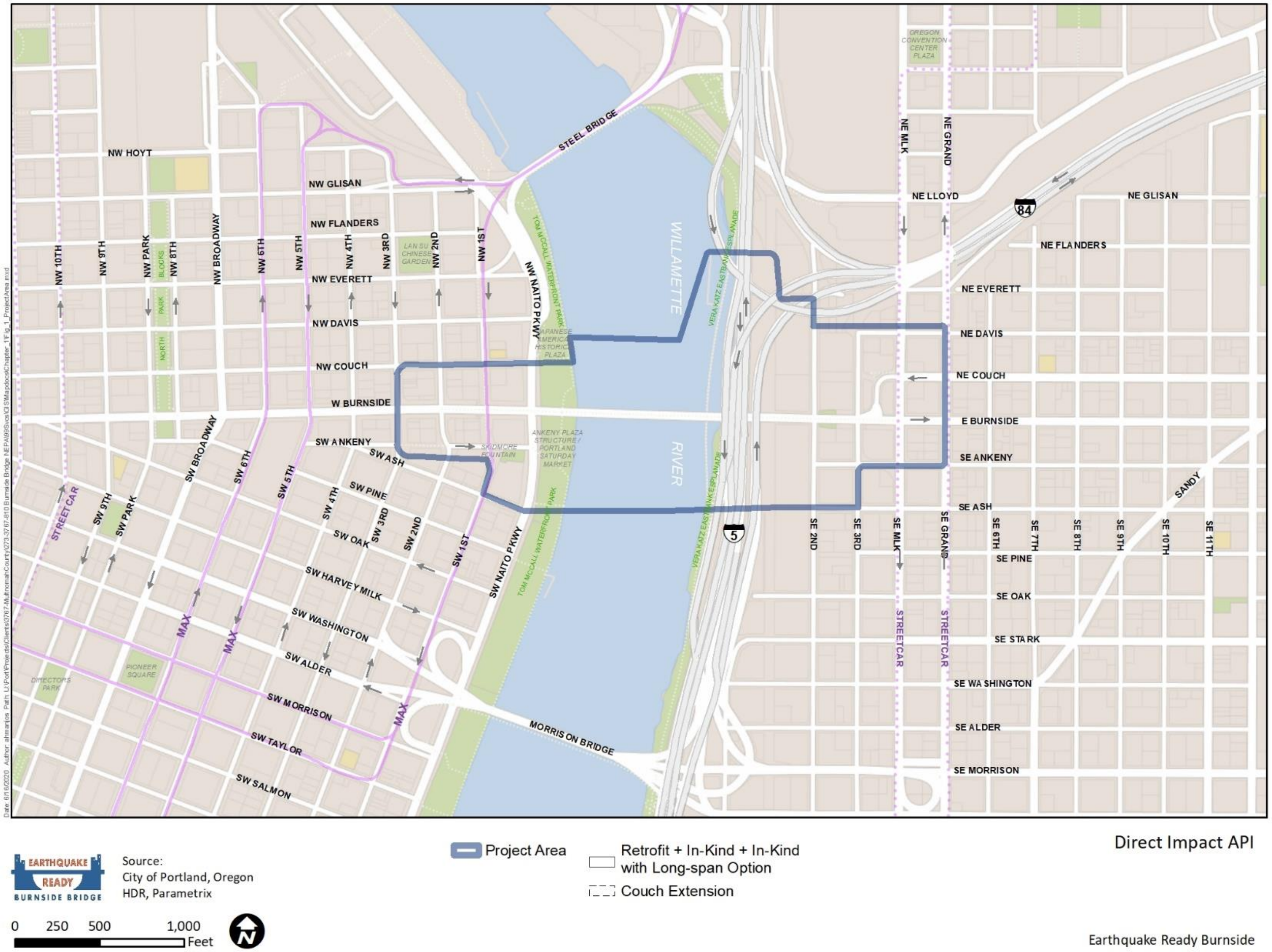
The bridge initially supported six lanes of traffic, but in 1995 the City of Portland requested bike lanes to be installed on the bridge; one traffic lane was converted into two bike lanes. The bridge now has five lanes dedicated to traffic, with two westbound lanes and three eastbound lanes; the outer eastbound lane is reserved for transit only. There are sidewalks on both sides of the bridge.

The bridge has only had minor modifications since it was constructed. Electric streetcar service over the bridge ended in the late 1940s, lighting and traffic control devices were updated in the 1950s, automobile traffic gates were installed in 1971, and the bascule pier fenders on the upstream side were replaced in 1983. Multiple deck resurfacing projects and expansion joint repairs have been conducted over the years.

Most recently, Multnomah County (County) conducted the Burnside Bridge Maintenance Project between 2017 and 2019, which included improvements and repairs to the main bridge span and approaches, as well as mechanical and electrical repairs related to drawbridge operation. These repairs are anticipated to provide another 15 to 20 years of service life for the existing structure.

[1] Bascule – A bridge with one or two leaves which rotate from a horizontal to a near-vertical position, providing unlimited vertical clearance above.

Figure 1. Project Area and Area of Potential Impact



Source: City of Portland, HDR, Parametrix

1.3 Chapter Organization and Alternatives Nomenclature

This chapter describes the Alternatives evaluated in the Draft Environmental Impact Statement (EIS), first describing their operations and design, followed by construction assumptions.

There are two groups of Alternatives: the No-Build Alternative and the Build Alternatives. Among the Build Alternatives there is an Enhanced Seismic Retrofit Alternative and four Replacement Alternatives. There are two primary options for managing traffic during construction (with and without a temporary bridge), and there are three modal options for the temporary bridge. Nomenclature for the Alternatives/options is listed below:

- No-Build Alternative
- Build Alternatives:
    - Enhanced Seismic Retrofit Alternative (Retrofit Alternative)
    - Replacement Alternative with Short-span Approach (Short-span Alternative)
    - Replacement Alternative with Long-span Approach (Long-span Alternative)
    - Replacement Alternative with Couch Extension (Couch Extension)
- Construction Traffic Management Options
    - Temporary Detour Bridge Option (Temporary Bridge) includes three modal options:
        - Temporary Bridge: All modes
        - Temporary Bridge: Transit, Bicycles and Pedestrians only
        - Temporary Bridge: Bicycles and Pedestrians only
    - Without Temporary Detour Bridge Option (No Temporary Bridge)

Other design resources include the detailed design and engineering reports and the design criteria on the Multnomah County EQRB website.[2]

2 No-Build Alternative

The No-Build Alternative assumes that all other programmed and planned projects move forward, but that the Burnside Bridge—lacking a major retrofit or replacement—would remain seismically vulnerable. Because the Earthquake Ready Burnside Bridge (EQRB) Project (Project) is intended to serve two very different future conditions, before as well as after the next Cascadia Subduction Zone (CSZ) earthquake, the No-Build Alternative is similarly defined in two scenarios:

- No-Build prior to the next major earthquake
- No-Build after the next major earthquake

[2] https://multco.us/earthquake-ready-burnside-bridge/design-technical-reports

The future projects assumed within the No-Build Alternative are the same in both scenarios. The difference is that in the first scenario, the focus of the analysis is on daily operations, whereas the second scenario analyzes how a seismically vulnerable Burnside Bridge would affect emergency response and recovery after the next CSZ earthquake. The following outlines the fundamental assumptions behind the two No-Build Alternative scenarios.

2.1 No-Build Pre-Earthquake

Both scenarios of the No-Build Alternative include future projects and land use changes that are anticipated in adopted transportation and land use plans. Both also anticipate population and employment growth consistent with regional forecasts, and other documented, major trends, such as a changing climate. The No-Build transportation network is based on the existing network plus changes included in the Regional Transportation Plan (Metro 2018) and the Central City in Motion Plan (City of Portland n.d.). Specific projects are described in the EQRB Transportation Technical Report (Multnomah County 2021i). Future land use is based on relevant City of Portland land use plans and development trends (see the EQRB Land Use Technical Report [Multnomah County 2021g]). Future population and employment are based on Metro forecasts. Future climate assumptions are based on the best available projections and estimates (see the EQRB Climate Change Technical Report [Multnomah County 2021c]). Note that while the Build Alternatives of the Burnside Bridge discussed in Section 1.3 are being designed with considerations of a future streetcar running across the bridge, within the No-Build scenario, no such improvement would be completed within the 2045 future year considered in the EQRB Transportation Technical Report (Multnomah County 2021i).

2.1.1 Lane Assignments

The Burnside Bridge lane assignments for the No-Build Alternative are based on currently adopted plans, which include an eastbound transit-only lane, consistent with the Enhanced Transit Corridors Plan. Some stakeholders and local agency staff have also expressed interest in studying the potential for a future westbound transit-only lane on Burnside Street (which could include the segment on the Burnside Bridge). There is no such project in an adopted plan, nor have there been the studies and outreach to fully understand how it would perform and where or what it would be. Therefore, it is not part of the No-Build assumptions. The cross section evaluated for No-Build conditions is based on presently adopted plans. Because the City owns and manages Burnside Street, including the segments adjacent to the Burnside Bridge, the City could modify lane allocations at any time in the future. To address this future uncertainty, and to support the region’s goal of improving transit service, the County is coordinating with the City of Portland and TriMet on a separate study that evaluates how the Burnside Bridge might accommodate a future westbound transit-only lane, should the City adopt such a proposal in the future.

Details of the conditions and impacts of the No-Build Alternative are described in Chapter 3 of the Draft EIS, Affected Environment and Environmental Consequences (Multnomah County 2021).

2.2 No-Build Post-Earthquake

Any day, without warning, a magnitude 8+ CSZ earthquake could strike and forcefully shake the region for several minutes. Such an earthquake would render every existing Willamette River crossing in downtown Portland unusable. All other infrastructure not built to CSZ seismic standards would also be devastated or substantially damaged.

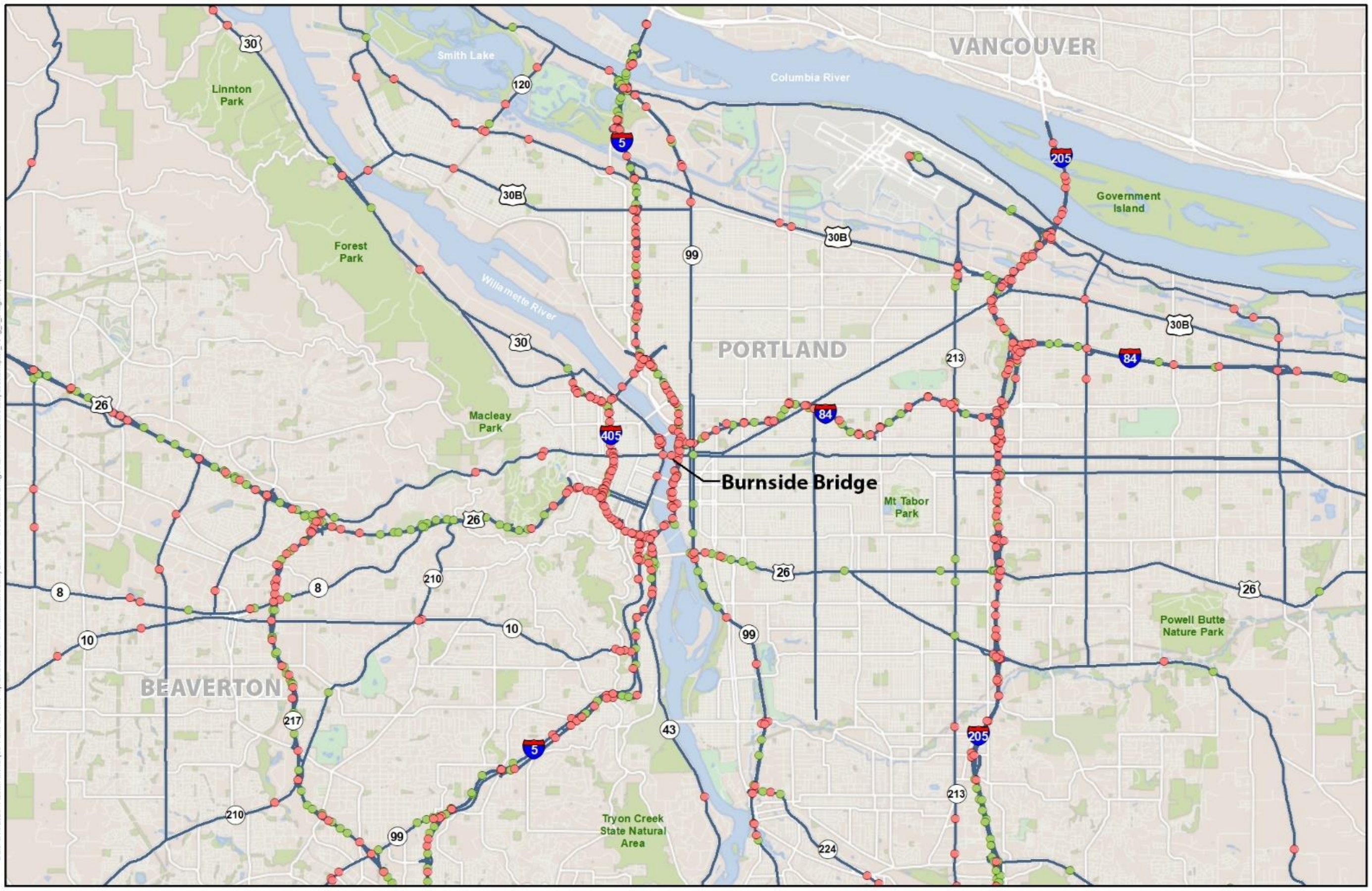
This includes most of the Interstate 5 (I-5), Interstate 84 (I-84), Interstate 405 (I-405) and other highway viaducts, as well as bridges and overpasses on other roadways (see Figure 2), as well as buildings, airports, marine ports, transmission lines, water systems, and other utilities not built to such standards. Landslides and rivers clogged with debris are also expected. Widespread regional damage from the Oregon Coast to the Cascade Range is anticipated with all of the Alternatives.

The particular effect of the next major earthquake that would be unique to the No-Build Alternative is the collapse of the existing Burnside Bridge, thus leaving the region without any viable way to cross the Willamette River, possibly for months. A visual simulation of a likely scenario for the Burnside Bridge failure is shown in Figure 3 (also see the simulation video at https://multco.us/earthquake-ready-burnside-bridge/project-videos). Under the west end of the bridge, concrete columns containing very little steel reinforcement would fail early. Weak unstable soil would cause permanent shifting and cracking of the shoreline pier.[3] The pier would sink and rotate causing the truss to collapse. Fixed spans would become unseated and fall into the water, creating a barrier to river traffic. Weak soils and inadequate foundations would cause settlement and damage to the river piers. The earthquake would break the locks that connect the spans together, allowing the draw spans to lift and shake independently. The internal support holding the draw span would fracture, and the span would fall into the pier. The movable-span truss members would break and fall into the river and block ship passage. Columns would be torn apart and collapse sideways. Soils under the east approach would liquefy after shaking, accelerating the collapse of support columns.

The bridge would collapse onto Naito Parkway, TriMet MAX Red and Blue Lines, SW 1st Avenue, and Tom McCall Waterfront Park. Bridge debris would obstruct all modes of transportation, blocking over one billion dollars in transportation infrastructure that relies on the bridge. The collapsed bridge would block the main river channel creating an obstacle for the river traffic that would be needed to deliver goods or people after the earthquake (other bridges would also collapse and create further navigation and travel obstacles both in the river and on land). The collapsed bridge would sever and block the Eastbank Esplanade, I-5, I-84, the Union Pacific Railroad (UPRR) mainline tracks, and SE 1st, SE 2nd, and SE 3rd Avenues. With other bridges out of service, Portland would be divided by the Willamette River, leaving tens of thousands stranded. Emergency responders would be unable to cross the river to aid victims, fight fires, address other emergencies or facilitate evacuation.

[3] Pier – A substructure unit made up of two or more column or column-like members connected at their top-most ends by a cap, strut, or other member holding them in their correct positions. Interchangeable with the term *bent*.

Figure 2. Seismically Vulnerable Bridges on Emergency Transportation Routes



Source:
City of Portland, Oregon
HDR, Parametrix

0 1 2 4 Miles

Regional Emergency Transportation Routes

Bridge Collapse Potential on Emergency Transportation Routes:

- Significant to Moderate (1994 and Prior)
- Low to Very Low (1995 to Present)

Structure Collapse Potential

Earthquake Ready Burnside

Figure 3. Simulation of Existing Burnside Bridge After a CSZ Earthquake

Source: Multnomah County

The No-Build Alternative would also result in higher immediate casualties to people on and under the bridge. There are no permanent residences beneath the bridge, but at any given time, dozens to hundreds of people work, shop, recreate, commute, or shelter on and beneath the bridge including at the Saturday Market, the Burnside Skatepark, the Vera Katz Eastside Esplanade, Waterfront Park, multiple businesses, as well as in cars, trucks, buses, trains, on foot, and on a bicycle.

Long-term recovery would be hampered for months due to the lack of a usable bridge to support clearing and removing debris, transporting fuel and materials, and reconstructing power, water, and sewer facilities, as well as other infrastructure necessary to allow jobs, school, commerce, government, and daily activities to return to normal. Significant delay in recovery would adversely affect the region for years.

Other details of the conditions and impacts of the No-Build Alternative post-earthquake, including transportation operations and emergency response and recovery, are described in Chapter 3 of the Draft EIS, Affected Environment and Environmental Consequences (Multnomah County 2021).

3 Build Alternatives – Common Elements of Operations and Design

During early feasibility studies conducted for the Project, over 100 alternatives were considered, including tunnels, ferries, and other bridge configurations. From those studies, four Build Alternatives have been advanced for further evaluation in the Draft EIS:

- The Enhanced Seismic Retrofit Alternative would retrofit the existing bridge, replacing major components required to meet seismic design criteria.
- Three Replacement Alternatives are identical on the extreme east and west sides of the bridge, but have different span configurations for the main river spans and approaches.

For all Build Alternatives, there are also options for managing traffic during construction. This is addressed in detail in Section 7.3.

3.1 Daily Operations (Pre-Earthquake)

This section provides a brief discussion of the assumptions related to operations, bridge use, and seismic design criteria that are common to all four Build Alternatives.

Under normal operations, all Build Alternatives would provide access across the bridge for the same transportation modes that presently use the bridge, including motor vehicles, bus transit, and pedestrians and other active transportation types such as bicycles, skateboards, and scooters. Additionally, all Build Alternatives are being designed to accommodate potential streetcar service on the Burnside Bridge in the event that service is expanded in the future as first identified in Portland’s Streetcar System Concept Plan adopted in 2009.

Surface transportation modes that presently pass under the bridge would be accommodated under all Build Alternatives. Freight and passenger rail and interstate highway traffic pass under the eastern bridge approach spans, and local roads with associated pedestrian and active transportation facilities pass under both sides of the bridge. As under existing conditions, park and recreation features would connect under the bridge on both sides, and new access to these features from the bridge itself may be included in the design.

All Build Alternatives would also continue to permit commercial, recreational, and government water vessels to navigate under or past the bridge using a lift or bascule(s) to accommodate taller marine vessels. The U.S. Coast Guard (USCG) requires that all current water vehicle traffic be safely accommodated with a bridge replacement, which for the Burnside Bridge results in a water crossing span with at least a 147-foot vertical clearance (when raised) above ordinary high water (OHW) and 205-foot-wide horizontal clearance.

3.2 Seismic Resiliency Standards

The primary purpose of the Project is to build a seismically resilient Burnside Street lifeline crossing over the Willamette River that would remain fully operational and accessible for vehicles and other modes of transportation following a major CSZ earthquake. The Burnside Bridge would also provide a reliable crossing for emergency response, evacuation, and economic recovery after a 1,000-year earthquake event. Additionally, the bridge would provide a long-term safe crossing with low maintenance needs. The relevant seismic design criteria that are the basis of the four Build Alternatives can be found in the EQRB Seismic Design Criteria Report (Multnomah County 2021h).

The bridge would be designed for a minimum 100-year design life and would meet all current and applicable city, county, state, and national design and safety standards. The bridge would also be designed to accommodate heavier loads, including streetcar vehicles, emergency vehicles, and heavier freight or emergency hauling needs.

3.2.1 Structure Offset and Separating from Existing Buildings

Presently, buildings and elevated highway infrastructure are very close to the bridge spans, bridge approaches, and piers, and there is likelihood of them knocking into each other during a major seismic event. In some cases, these structure and bridge elements are loosely connected with only a 1-inch gap between structures. All Build Alternatives would be designed and constructed to provide clearance between the bridge and adjacent buildings to allow independent movement during a seismic event. The process of separating the buildings from the bridge is not expected to cause physical damage to the buildings.

3.3 Earthquake Recovery Scenario

All of the Build Alternatives are being designed so that the bridge can be immediately used for emergency response after a CSZ earthquake of up to magnitude 9.0. It is anticipated that the other Willamette River bridges in downtown Portland will be heavily damaged or inaccessible such that a seismically resilient Burnside Bridge would be the only usable crossing for months. Because of this, the bridge would serve as a crucial link for emergency vehicles and for community members trying to get home to loved ones. In addition to the initial earthquake, aftershocks will likely occur in the hours and days following the initial event, further damaging the already compromised infrastructure. Additional debris clearing and inspections may be required after each aftershock.

Use of the bridge will likely change with time as the emergency response progresses and transitions into recovery operations. In the event of a CSZ earthquake, given the widespread damage expected, emergency management and county personnel may not be able to access the bridge immediately after the earthquake. A seismically resilient bridge would eventually be accessible to anybody trying to cross the river to evacuate the downtown area after debris is cleared and the bridge's structural integrity is confirmed. Once emergency personnel have arrived onsite, use of the bridge will likely be managed by local emergency management and law enforcement personnel. The initial response will likely be to quickly clear a pathway through any crashed vehicles and fallen debris from adjacent buildings, in order to allow emergency vehicles to pass. This would be followed by complete clearance to open all lanes. This could be accomplished with nearby trucks and equipment owned by emergency responders or by other city bureaus and the state.

It is anticipated that, after initial clearing, the bridge traffic will first include emergency responders engaging in rescue and continued debris clearing operations, followed by vehicles hauling emergency supplies such as water, food, fuel, and materials/equipment and personnel needed to make emergency repairs on critical utilities and facilities. Private cars will likely have difficulty reaching the bridge due to ground transportation damage such as fallen debris, damaged utilities, and roadway and bridge/overpass damage. Pedestrian and bicycle use may be a common mode of travel for citizens immediately following the earthquake.

After the initial debris clearing and rescue operations (approximately 2 weeks), the bridge may be prioritized for emergency responders, for vehicles evacuating refugees, for trucks removing debris that is blocking roads or posing additional hazards, as well as for emergency maintenance. It is likely that federal agency and military trucks, heavy equipment and personnel would be transported to the region in this time frame. A major CSZ earthquake is expected to cause heavy damage and long-term closure of I-5, I-84, and I-405, freight rail, and MAX light rail and Portland Streetcar service. Depending on the magnitude of the seismic event and damage, private vehicle use in the region may continue to be limited for weeks due to damaged roadways, limited supplies of fuel, widespread closure of businesses, and temporary population reduction due to evacuation.

In the months following a CSZ event, as emergency response gives way to long-term recovery efforts, the Burnside Bridge may continue to provide the only crossing for movement of materials and personnel engaged in recovery and reconstruction of infrastructure, institutions, and other necessary facilities. Because the breadth of infrastructure damage and human casualties is uncertain, the breadth and duration of recovery from the next earthquake is uncertain. However, research shows that seismically resilient transportation infrastructure, such as the proposed Build

Alternatives, can benefit the long-term ability of a region to recover economically and socially after a major disaster.

3.4 Other Elements Common to All Build Alternatives

The following elements would be included in all Build Alternatives:

- Lighting – Lighting styles have not been determined at this level of design; however, lighting would be provided under any Build Alternative that would meet local standards for illumination of eastbound and westbound roadways, and pedestrian and bicycle lanes. Lighting under publicly accessible portions of the bridge approaches would also be installed consistent with local standards for public spaces, roads, and parks, as applicable.
- Stormwater Capture – Presently, not all stormwater runoff from road surfaces is captured, with some runoff from the center of the bridge flowing directly into the river. Under all Build Alternatives, stormwater would be captured from roadways and sidewalks and would be routed to the city's stormwater treatment facilities.
- Improved access to the Eastbank Esplanade – Under all Build Alternatives, the current stairwell from the south side of the eastern bridge approach to the Eastbank Esplanade would be replaced with an Americans with Disabilities Act (ADA)-compliant facility, likely a ramp and stairwell combination. Access from the north side of the approach to the Esplanade is not proposed under any Build Alternative.
- Improved access to the Skidmore Fountain MAX Station – Under all Build Alternatives, the current stairwell from the south side of the western bridge approach to the Skidmore Fountain MAX Station would be replaced with an ADA-compliant facility, likely a ramp and stairwell combination. The existing stairway on the north side of the bridge would be reconstructed as is.

4 Enhanced Seismic Retrofit Alternative – Operations and Design

4.1 General Information

The Burnside Bridge is nearing 100 years of age, and while the bridge has been maintained and upgraded several times, substantial portions are either past their usable lifespan and/or seismically vulnerable and need to be heavily retrofitted or replaced. These retrofitted and replaced elements would be visually similar to the existing bridge elements such that the bridge would not appear to be substantially changed after construction. Table 4.1-1 describes which of the major bridge elements under this Alternative would be replaced or retrofitted for seismic safety.

Table 4.1-1. Enhanced Seismic Retrofit Alternative – Elements Replaced vs. Retrofitted

Bridge Element	Materials	Disposition
Bridge deck	Concrete and asphalt	Replaced.
Fixed steel trusses – east and west side	Steel	Retrofit. Some truss bracing and individual beams would be replaced or reinforced.
Support bents – west approach	Reinforced concrete	Replaced, likely with larger but fewer bents. Addition of soil mitigation to mitigate liquefiable-soil-induced settlement and lateral spreading.
Support bents and spans – east approach between river and I-84 ramps	Reinforced concrete or steel beam	Replaced.
Support bents and spans – between I-84 ramp and east end of bridge	Reinforced concrete or steel beam	Replaced. Addition of soil mitigation to mitigate liquefiable-soil-induced settlement and lateral spreading.
Bascule leaves	Steel, machinery, concrete counterweight	Retrofit, with multiple individual pieces replaced (or replaced in its entirety).
Bascule trunnions	Steel	Replaced.
Operator towers	Concrete, wood, tile	Removed or seismically stabilized.
Pier 1 – Waterfront Park	Reinforced and unreinforced concrete above timber piles[4]	Major retrofit with deep foundation work and replacement of multiple concrete sections.
Pier 2 – west-side bascule	Unreinforced concrete caps[5] over timber piles	Major retrofit and reinforced above water level, new deep foundation installed below river level to extend to stable soil.
Pier 3 – east-side bascule	Unreinforced concrete caps over timber piles	Major retrofit and reinforced above water level, new deep foundation installed below river level to extend to stable soil.
Pier 4 – between NE 2nd and 3rd Ave	Reinforced and unreinforced concrete above timber piles	Major retrofit with deep foundation work and replacement of multiple concrete sections.
Pedestrian stairs – west	Steel and concrete	Replaced with stairs and an ADA-compliant ramp to MAX station (south side) and stairs (north side).
Pedestrian stairs – east	Steel and concrete	Replaced with new stairs and an ADA-compliant ramp to the Eastbank Esplanade (south side only).

[4] Pile – A shaft-like linear structure which carries loads through weak layers of soil to those layers which are capable of supporting such loads.

[5] Cap – The topmost portion of a pier or bent, which serves to distribute the loads upon the columns or piles and hold them in their proper positions.

Figure 4 shows a plan and aerial view of the Retrofit Alternative. (For detailed plan sheets see Appendix C of the EQRB Enhanced Seismic Retrofit Technical Report [Multnomah County 2021f]).

Figure 5 is a profile view of the Retrofit Alternative showing which elements would be retrofitted and which would be replaced.

4.1.1 River Pier and Bent Locations and Size

The location and general visual appearance above water of the two piers in the river (Piers 2 and 3) would not change under this Alternative, although the piers would undergo a major retrofit to meet current seismic standards. Under water, the piers would be encased in concrete. For all four main bridge piers (1 through 4), multiple deep reinforced concrete foundation columns would be constructed, extending below existing landforms and the riverbed to reach the seismically more stable Upper and Lower Troutdale geologic formations.

In addition to the 4 main piers, there are 34 bents[6] on land that support the current bridge,19 on the west side of the river and 15 on the east side. There is an abutment[7] on each end that connects the bridge to Burnside Street and which functions as a ramp to the lower surface streets.

Under this Alternative, these bents and abutments would be retrofitted to meet current seismic standards. On the east side of the river, three replacement spans would be constructed over the freeway ramps and lanes, and over the UPRR tracks. Proposed bent and pier locations under this Alternative are shown in aerial and plan views in Figure 6 and Figure 7. (For detailed plan sheets see Appendix C of the EQRB Enhanced Seismic Retrofit Technical Report [Multnomah County 2021f].)

4.1.2 Other Features of this Alternative

- Width of travelway – The existing deck width at the center of bridge is 86 feet; it gradually widens to approximately 110 feet on each side of the bridge where it connects to surface streets. Under this Alternative, the bridge width would not change. Cross sections for the travelway are shown in Figure 8.
- Operation of bascules – The existing bridge bascule span can only open to approximately 55 degrees from horizontal because of restrictions from previous repair work. One of the objectives of the Retrofit Alternative is to restore the bascule span leaf opening angle to the original design angle of 73 degrees.
- Vehicular, pedestrian, ADA, and active transportation access – This Alternative would provide the same modal connections at each end of the bridge as presently exist on the Burnside Bridge. In addition, the existing stairs from the south side of the

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[6] Bent – A substructure unit made up of two or more column or column-like members connected at their top-most ends by a cap, strut, or other member holding them in their correct positions. Interchangeable with the term *pier*.

[7] Abutment – Support elements at the ends of a bridge, which absorb many of the forces placed up on the bridge and act as retaining walls that prevent the earth under the bridge approaches from moving.

east approach to the Eastbank Esplanade would be replaced with an ADA-compliant ramp connection, as well as stairs, and near the west end, the existing stairs that connect the south side of the bridge to 1st Avenue would be replaced with stairs and an ADA-compliant ramp connection. The stairs on the north side to 1st Avenue would be reconstructed. See Figure 9.

Figure 4. Enhanced Seismic Retrofit – Aerial View

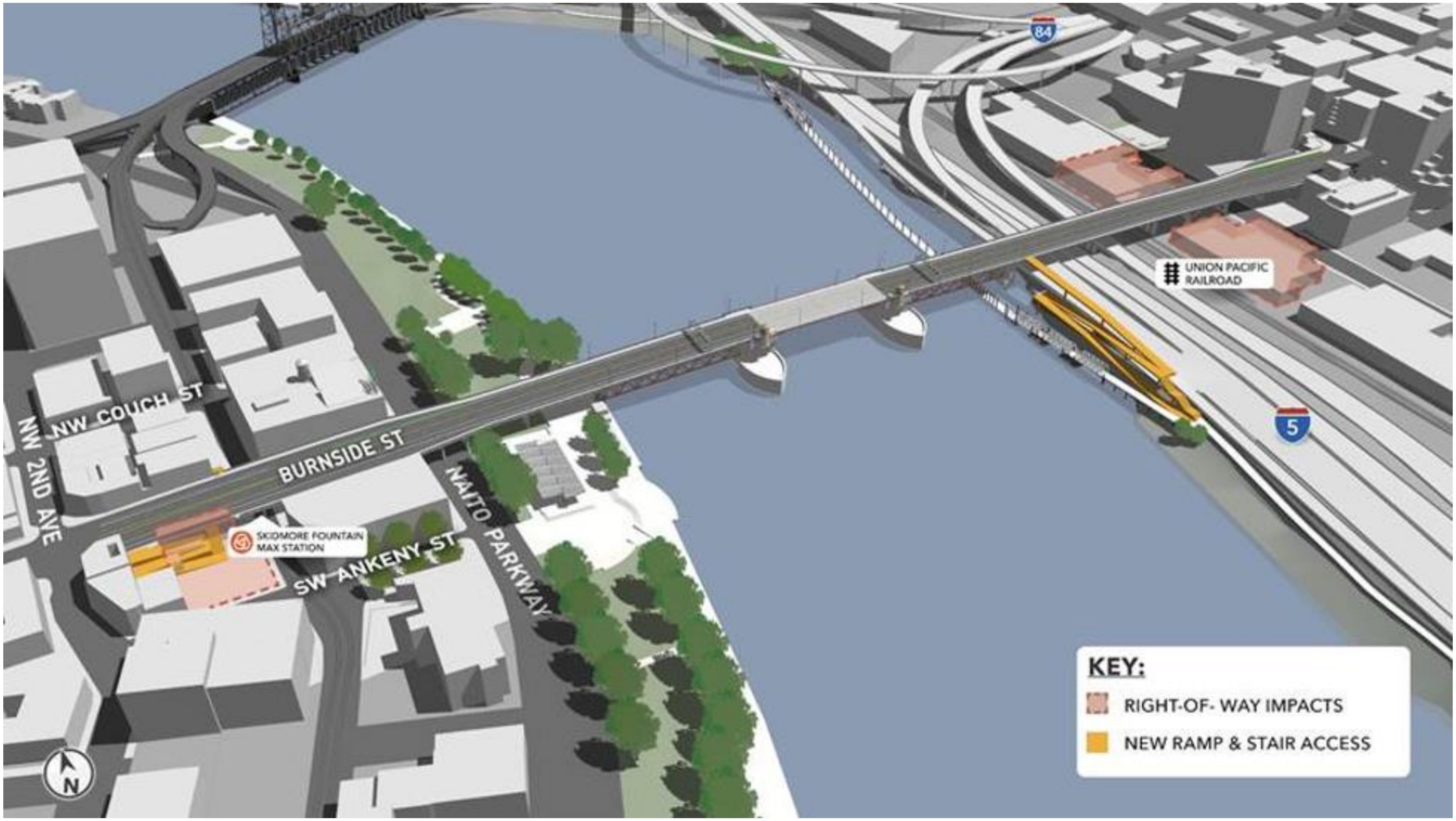


Figure 5. Enhanced Seismic Retrofit – Portions Retrofit and Replaced

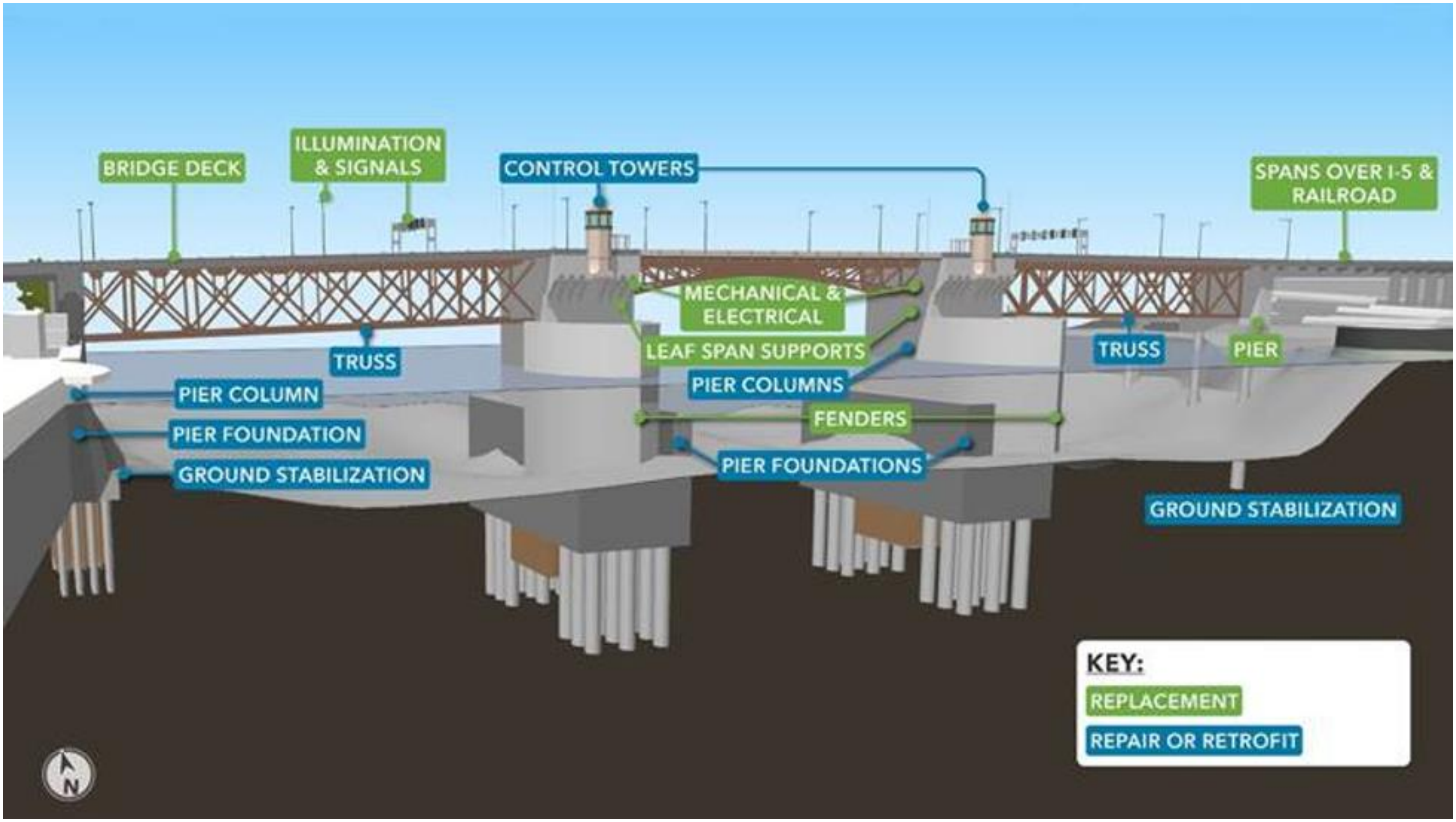


Figure 6. Enhanced Seismic Retrofit – Pier and Bent Locations, Aerial View

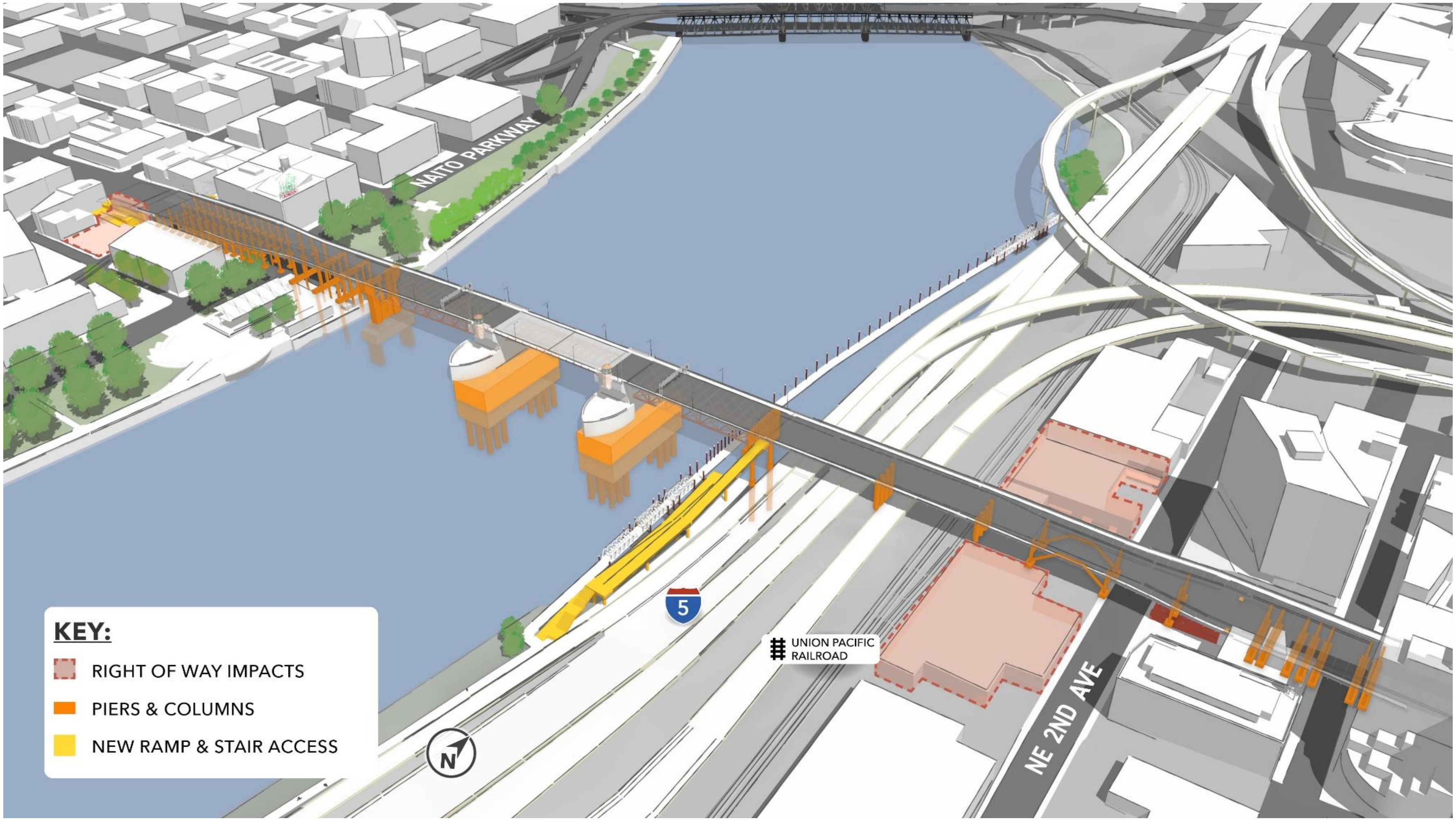


Figure 7. Enhanced Seismic Retrofit – Pier and Bent Locations, Plan View

Figure 8. Enhanced Seismic Retrofit – Cross Sections

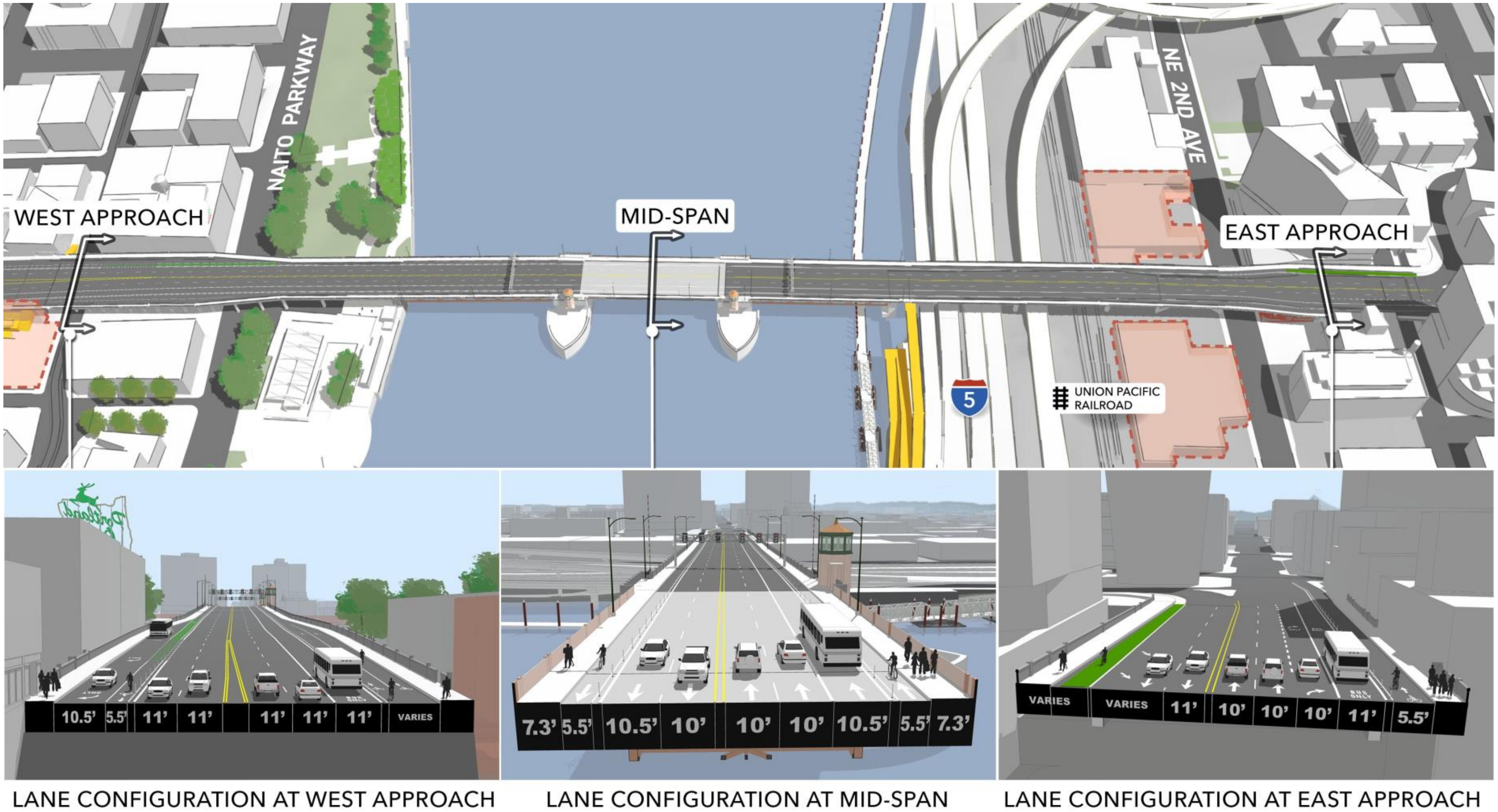
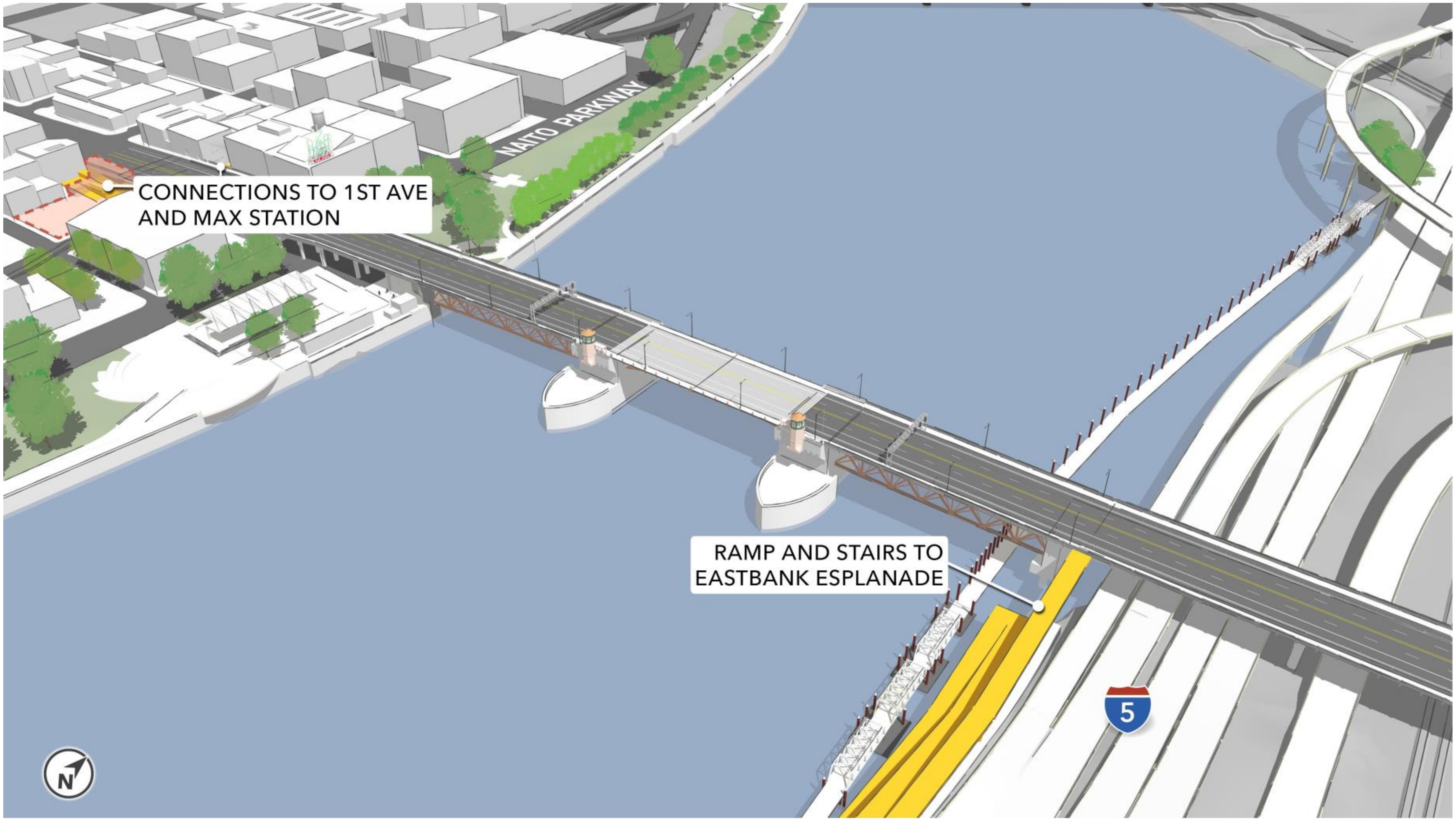


Figure 9. Enhanced Seismic Retrofit Modal Connections



5 Replacement Alternatives

5.1 Introduction

Prior studies and outreach were conducted from 2016 to 2018 to determine feasible alternatives for a replacement bridge. This process resulted in the three Replacement Alternatives under consideration that would completely remove and replace the existing Burnside Bridge. These Replacement Alternatives would measure approximately 2,330 feet in total length and consist of three separate bridge segments: the west approach spans, the east approach spans, and a movable center span system that would be constructed over the primary navigation channel.

As part of the process of refining alternatives during the feasibility studies, multiple span configurations were considered. As a baseline for the design, bridge substructures and foundations were kept out of the existing roads and railways, and the vertical profile was set to maintain the vertical clearance envelopes while maintaining sidewalk access to connected buildings on the west approach. Attempts were made to balance the span lengths of the structure, while maintaining reasonable distances between intermediate supports. The three Replacement Alternatives that were recommended for further study in the EIS are briefly described below:

- Replacement Alternative with Short-span Approach – This would construct a new bridge to replace the existing structure on the existing alignment. The design includes a movable bridge span over the primary navigation channel and fixed bridge spans for the east and west approaches. The bridge generally consists of structural members below the riding surface and has span lengths comparable to the existing Burnside Bridge spans.
- Replacement Alternative with Long-span Approach – This would construct a new bridge to replace the existing structure on the existing alignment. The design includes a movable bridge span over the primary navigation channel and long-span fixed bridge spans for the east and west approaches. For the long-span members, the bridge consists of structural members above the riding surface and has span lengths longer than the existing Burnside Bridge spans.
- Replacement Alternative with Couch Extension – This design consists of the same west approach and movable center span as the for the Short- and Long-span Alternatives, but on the east approach it extends NE Couch Street approximately 1,100 feet westward on structure over all roads and buildings west of Martin Luther King, Jr. Boulevard before curving south to reconnect with the main Burnside Bridge over the water.

Movable-span systems consisting of vertical lift and bascule span types are under consideration; however, the type of movable-span system will not be determined until after selection of the Preferred Alternative. Figure 10 shows examples of several potential types of movable-span options.

Figure 10. Replacement Bridge – Potential Movable-Span Types

Single-Leaf Bascule Bridge

Vertical Lift (lowered position)

Double-Leaf Bascule Bridge

Vertical Lift (raised position)

5.2 Replacement Alternative with Short-Span and Long-Span Approaches

These Alternatives replace the existing bridge with a bridge with the same connection to W Burnside from the west approach and only slightly modified connections to NE Couch Street and E Burnside from the east approach.

Figure 11 and Figure 12 show aerial and profile views of the proposed layouts for both the bascule and vertical lift options for these Alternatives.

5.2.1 Approach Span Alternatives

Both short-span and long-span approaches are being evaluated. Under the Long-span Alternative, large segments of the east and west approaches would be supported by above-deck superstructure, thus eliminating piers, bents, and deep foundation and soil improvement work in those sections. Common long-span bridge types include tied-arch and cable-stayed bridges. For the east approach, the height of the superstructure above the bridge deck could range from about 140 feet for a tied-arch bridge and up to about 250 feet or more for a cable-stayed bridge.

On the west side, the Long-span Alternative would include a clear span extending from the movable span in the river (western river bent) approximately 450 feet to the east side of Naito Parkway. On the east side, the Long-span Alternative would clear-span from the movable span in the river (eastern river bent) across the floating Eastbank Esplanade path, I-5 and I-84 connector ramps, and the UPRR right-of-way to just west of 2nd Avenue, a distance of approximately 740 feet.

Compared to the Short-span Alternative, the Long-span Alternative would:

- Eliminate a pier/bent in Waterfront Park
- Eliminate an in-water pier/bent near the eastern shoreline

Eliminate two sets of upland bents on the east side, west of 2nd Avenue

Figure 11. Replacement Alternative with Short-Span Approach – Aerial View

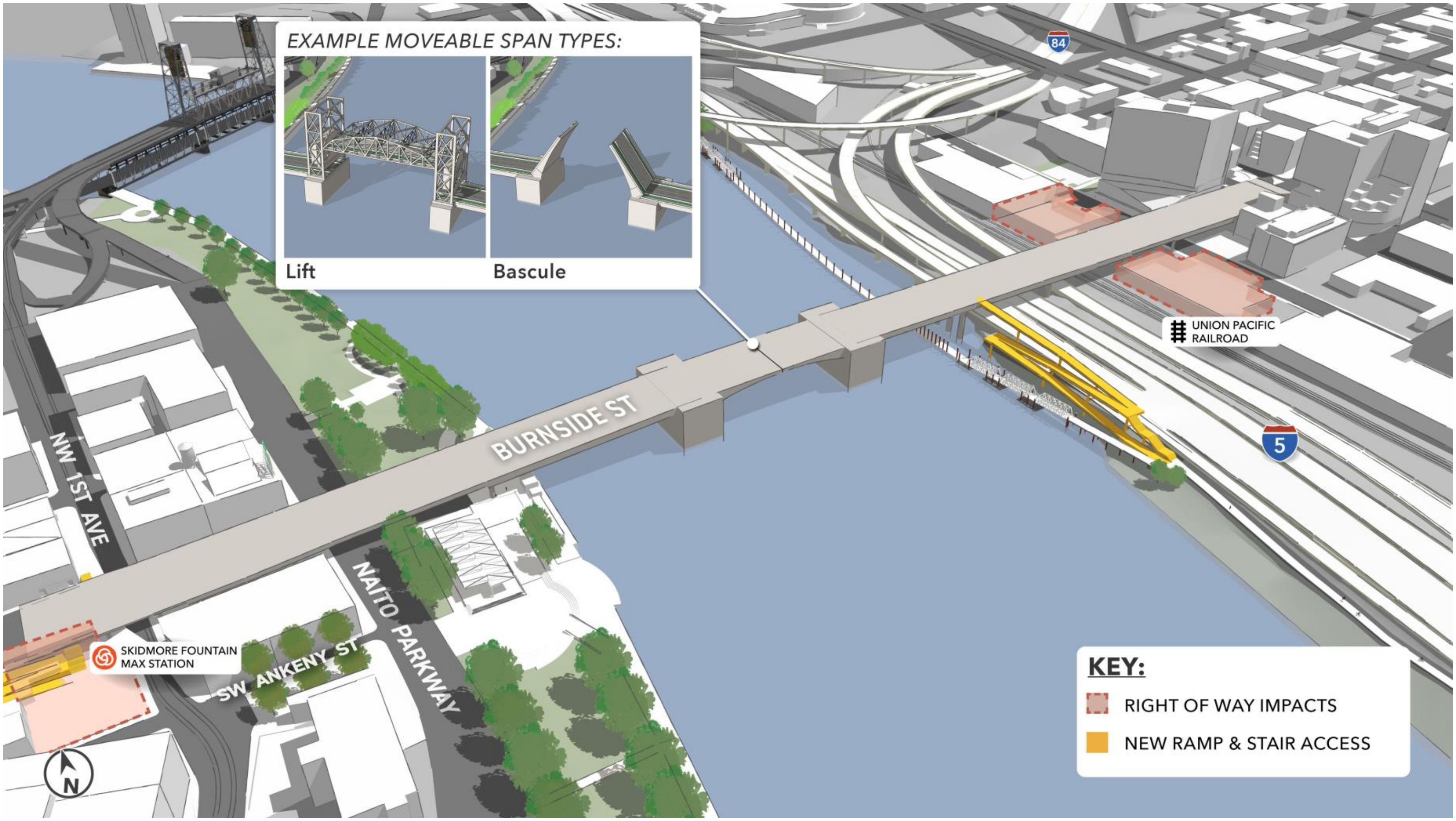


Figure 12. Replacement Alternative with Short-Span Approach – Profile View

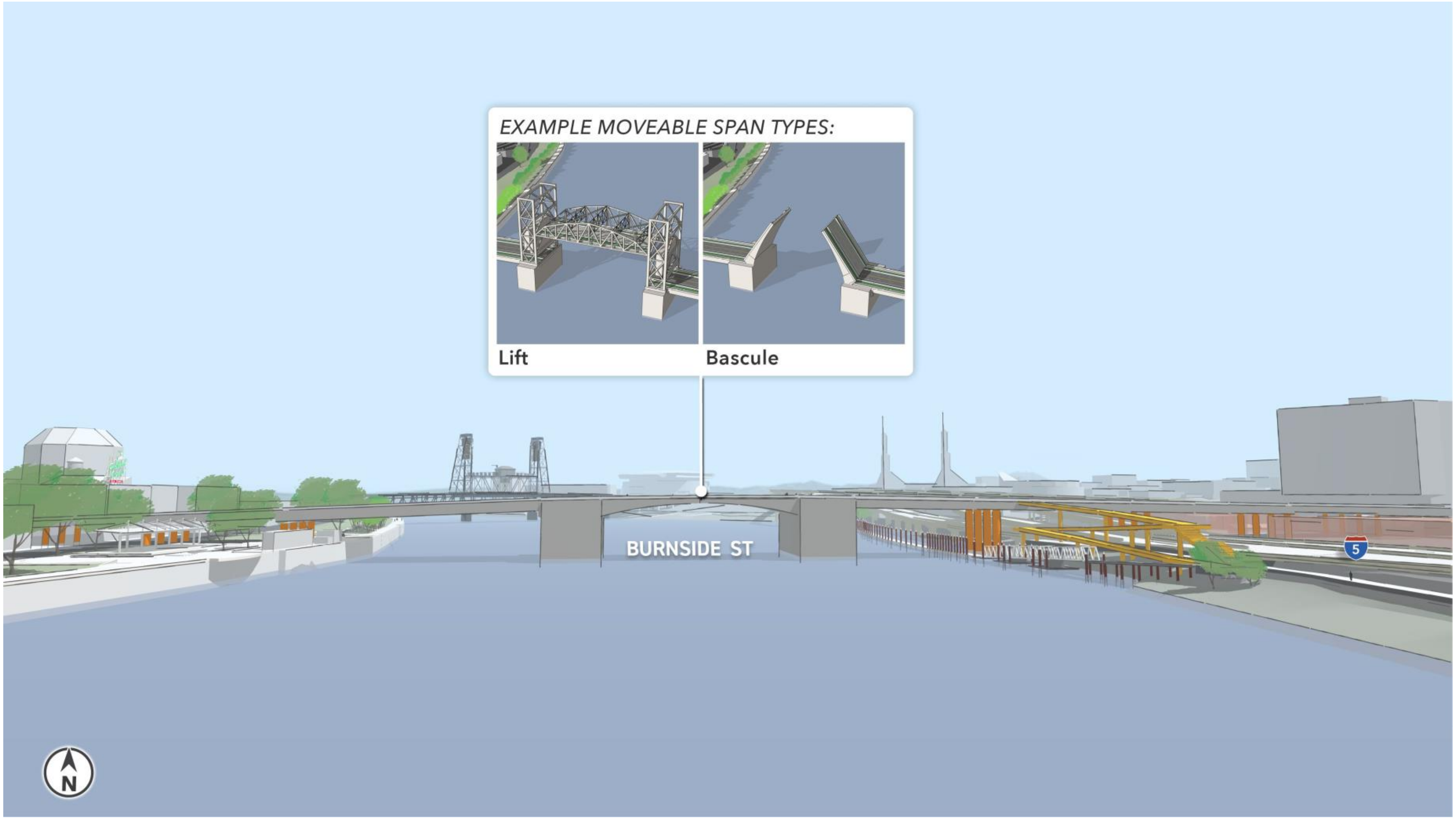


Figure 13 and Figure 14 show aerial and profile views of potential bascule and vertical lift configurations of the Long-span Alternative assuming the superstructure would be a tied-arch span.

Figure 15, Figure 16, and Figure 17 show the proposed locations of bents and bridge span sections associated with the Short-span Alternative for the bascule and vertical lift configurations. Figure 18, Figure 19, and Figure 20 show the proposed location of bents and bridge span sections associated with the Long-span Alternative for the bascule and vertical lift configurations (see Appendix B of the EQRB Bridge Replacement Technical Report [Multnomah County 2021b]).

5.2.2 West Approach Spans and Bent Locations

For the Short-span Alternative (Figure 15, Figure 16, and Figure 17), the west approach encompasses six spans, 1 to 6, as shown in Table 5.2-1. The Long-span Alternative would combine Spans 5 and 6 into a single clear span, as shown in Table 5.2-2 and Figure 18, Figure 19, and Figure 20.

Table 5.2-1. Short-Span Alternative West Approach – Feasible Span Lengths and Structure Types (TBD during Type Selection)

Span Number	Feasible Span Length (feet)	Feasible Structure Type
1	70	Prestressed concrete voided slab
2	44	Prestressed concrete voided slab
3	126	Prestressed concrete girder
4	126	Prestressed concrete girder
5	150	Steel plate girder
6	295	Steel plate girder

TBD = To be determined.

Table 5.2-2. Long-Span Alternative West Approach – Feasible Span Lengths and Structure Types (TBD during Type Selection)

Span Number	Feasible Span Length (feet)	Feasible Structure Type
1	70	Prestressed concrete voided slab
2	44	Prestressed concrete voided slab
3	126	Prestressed concrete girder
4	122	Prestressed concrete girder
5	450	Steel tied-arch

TBD = To be determined.

Figure 13. Replacement Alternative with Long-Span Approach – Aerial View

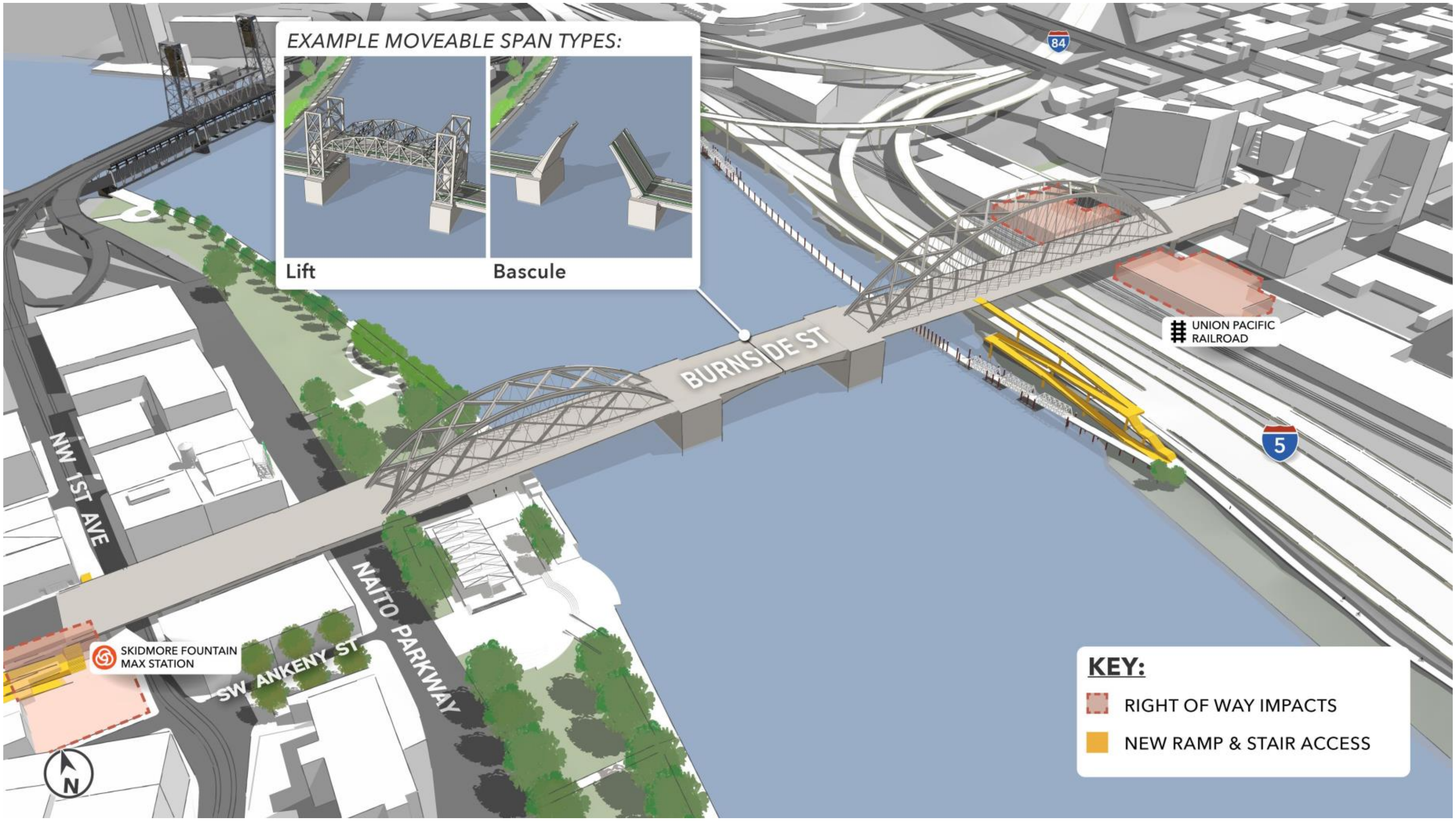


Figure 14. Replacement Alternative with Long-Span Approach – Profile View

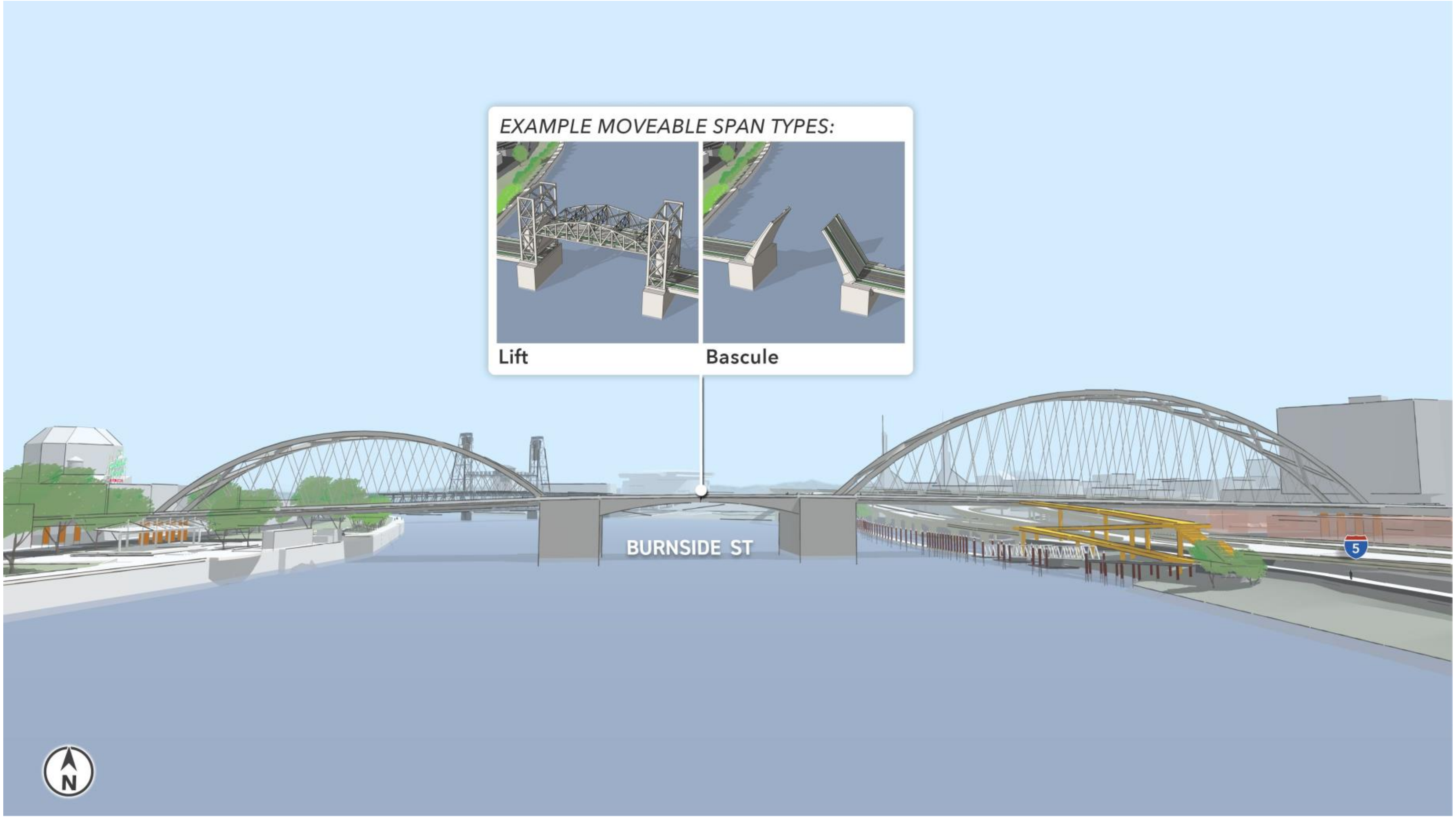


Figure 15. Replacement Alternative with Short-Span Approach – Profile (Bascule)

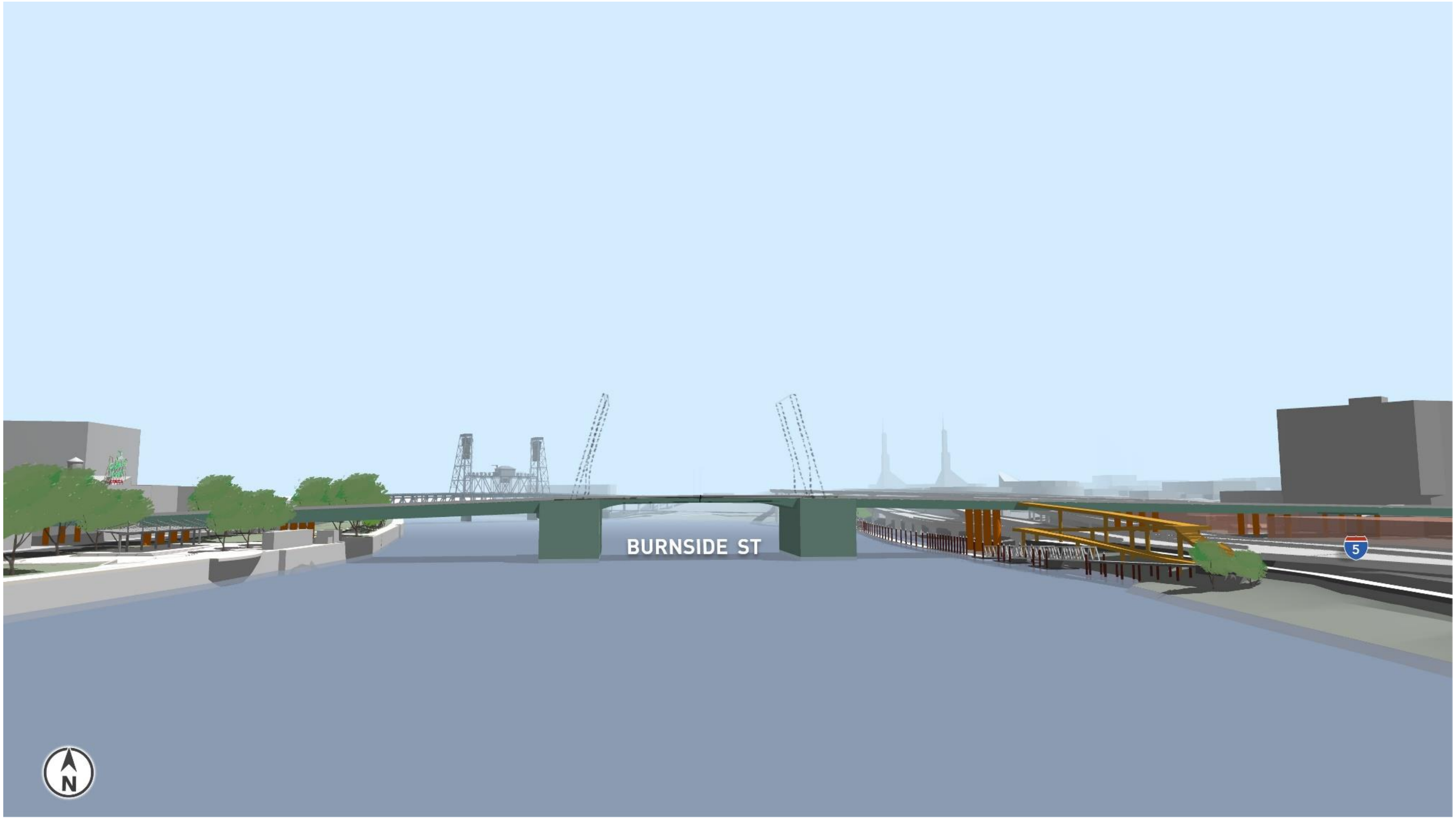


Figure 16. Replacement Alternative with Short-Span Approach – Profile (Lift)

Figure 17. Replacement Alternative with Short-Span Approach – Bent Locations

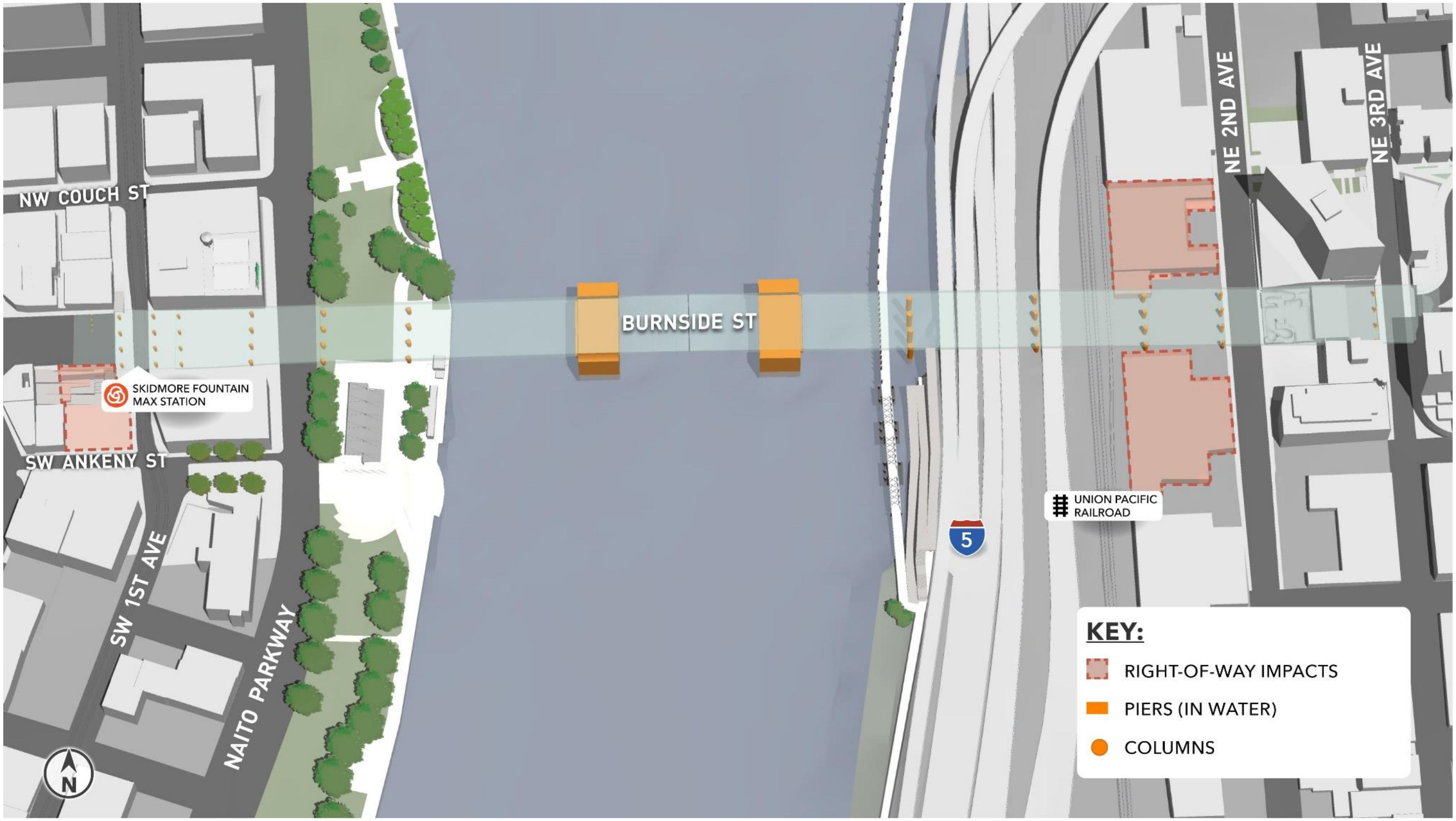
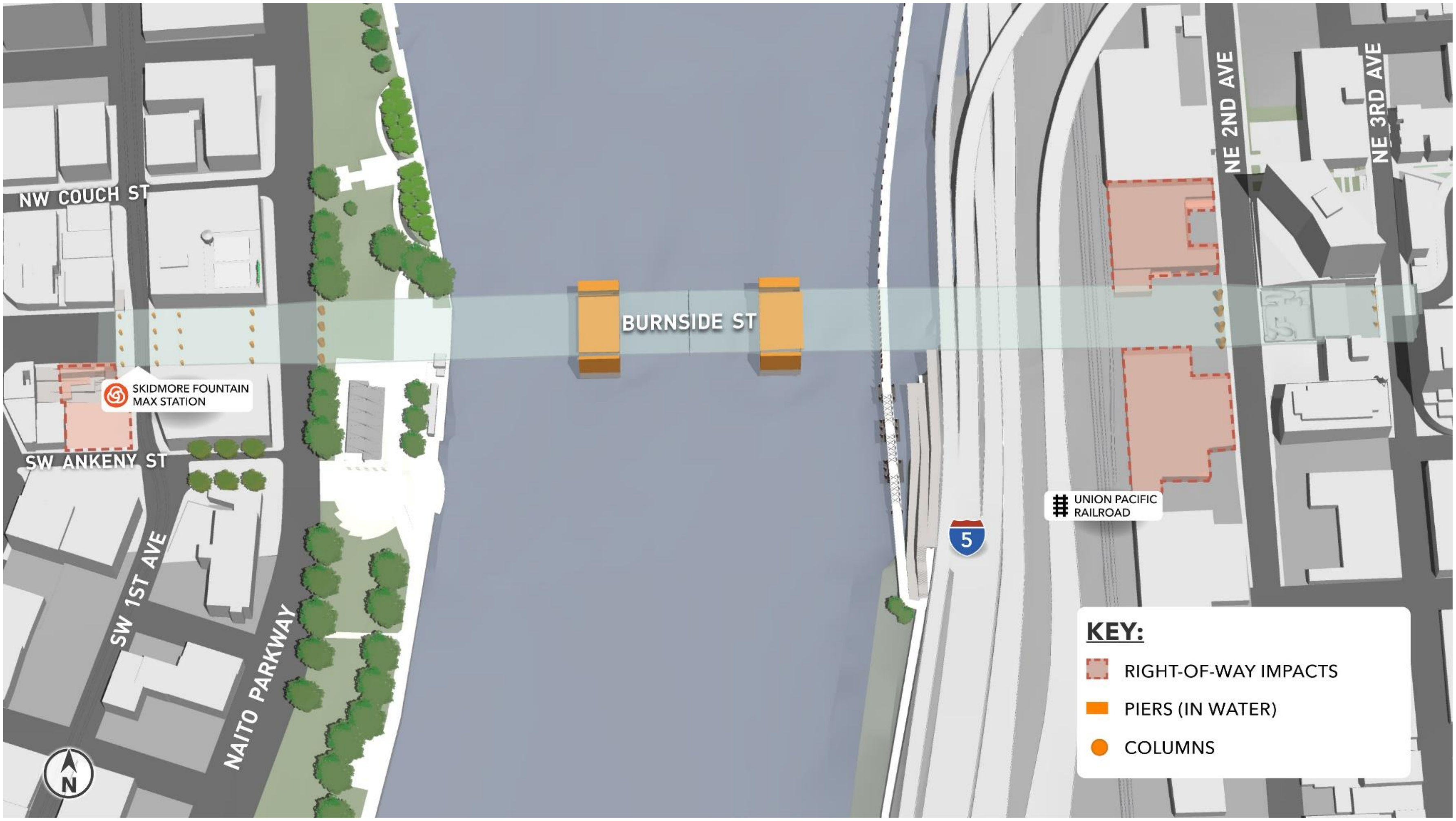


Figure 18. Replacement Alternative with Long-Span Approach – Profile (Bascule)

Figure 19. Replacement Alternative with Long-Span Approach – Profile (Lift)

Figure 20. Replacement Alternative with Long-Span Approach – Bent Locations



The west approach spans could all be supported on multi-column concrete bents founded on oversized drilled shafts. The bents and spans would provide more spacing between the bridge and the buildings on the north side of the current approach to prevent these structures from striking and damaging each other during an earthquake. The west approach spans over the Skidmore Fountain MAX Station would span both the eastbound and westbound tracks, which is an improvement to the existing condition. New bridge spans would also clear-span the existing Pier 1 bridge bent along the river wall and over Waterfront Park.

5.2.9 Movable Span

The movable span (Span 7 in the Short-span Alternative and Span 6 in the Long-span Alternative) would cross over the main navigation channel in the river. Movable bascule span (single- or double-leaf trunnion style with counterweights) and vertical lift span (tower drive with counterweights) options have been considered for replacement of the existing movable span. The lengths of the movable span could range from 289 feet for a double-leaf bascule span to 300 feet for a through-truss lift span. The proposed span layouts would each also have catwalks under the bridge deck for maintenance, inspections, and access to machinery. It is expected that the opening or closing of the movable span would take approximately 90 seconds under normal operating conditions, and the design would protect from catastrophic damage were an earthquake to strike during a bridge opening. Other bridge operations, such as lowering gates and protective barriers, would add additional time.

5.2.10 East Approach Spans and Bent Locations

With the Short-span Alternative (Figure 15, Figure 16, and Figure 17), the east approach encompasses six spans (Span 8 to Span 13), as shown in Table 5.2-3 and Table 5.2-4. The Long-span Alternative would combine spans 8, 9, 10, and part of 11 into a single clear span as shown in Figure 18, Figure 19 and Figure 20.

Table 5.2-3. Short-Span Alternative East Approach, Feasible Span Length and Structure Type (TBD during Type Selection)

Span Number	Feasible Span Length (feet)	Feasible Structure Type
8	192	Steel plate girder
9	221	Steel plate girder
10	192	Steel plate girder
11	135	Prestressed concrete girder
12	270	Steel plate girder
13	80	Prestressed concrete box beam

TBD = To be determined.

Table 5.2-4. Long-Span Alternative East Approach, Feasible Span Length and Structure Type (TBD during Type Selection)

Span Number	Feasible Span Length (feet)	Feasible Structure Type
7	740	Steel tied-arch
8	270	Steel plate girder
9	80	Prestressed concrete box beam

TBD = To be determined.

On the east approach design, multiple considerations have been given to the length and positioning of columns in regard to the existing and potential future improvements for I-5 and I-84, as well as to limit impacts to the existing I-5 and I-84 structures. Additionally, for the Short-span Alternative, Bent 10 was placed to the east of the Eastbank Esplanade in order to maintain the existing river navigation channel free of obstructions.

5.2.11 Bents and Bent Foundation Design

The soil profile near the surface is comprised of fill and fine-grained alluvial materials that are highly susceptible to liquefaction during an earthquake. These conditions suggest that the presence of competent material may not be reached until depths beyond 50 feet below ground level on the west, and up to 130 feet below ground level on the east. Therefore, this Alternative proposes the use of deep foundations (such as drilled shafts) rather than shallow foundations such as spread footings. Oversized drilled shafts (5 to 10 feet in diameter) would be embedded into the Troutdale Formation subsurface layer in order to provide sufficient support for the replacement bridge. Based on early geotechnical investigations, ground improvements would be required in near-surface soils in some locations to stabilize areas and protect against lateral spreading during a seismic event on both the west (within Waterfront Park) and east approaches (between the floating section of the Eastbank Esplanade trail and to the east of 2nd Avenue).

Each of the intermediate bents for the west and east approaches could be supported on a set of columns supported by drilled shafts. Link beams between columns are proposed at the top of shaft elevation for most bents to support the spans.

5.2.12 Traffic Patterns and Mode Allocation

These Alternatives would maintain the existing horizontal geometry of Burnside Street with the existing one-way couplet of NE Couch Street and E Burnside Street connecting to the east approach just west of Martin Luther King, Jr. Boulevard. Figure 21 and Figure 22 show the expected configurations and bridge widths at three different points along the bridge (from the EQRB Bridge Replacement Technical Report, Figures 5 and 6 [Multnomah County 2021b]) for the Short-span and Long-span Alternatives, respectively. These cross sections are based on current and planned transportation use on the bridge, but it is important to note that the Portland Bureau of Transportation has the ability to change these spatial allocations at any time. As shown, both Alternatives would provide substantially more space for bicycle and pedestrian infrastructure on the bridge than what currently exists.

Figure 21. Replacement Alternative with Short-Span Approach – Cross Sections

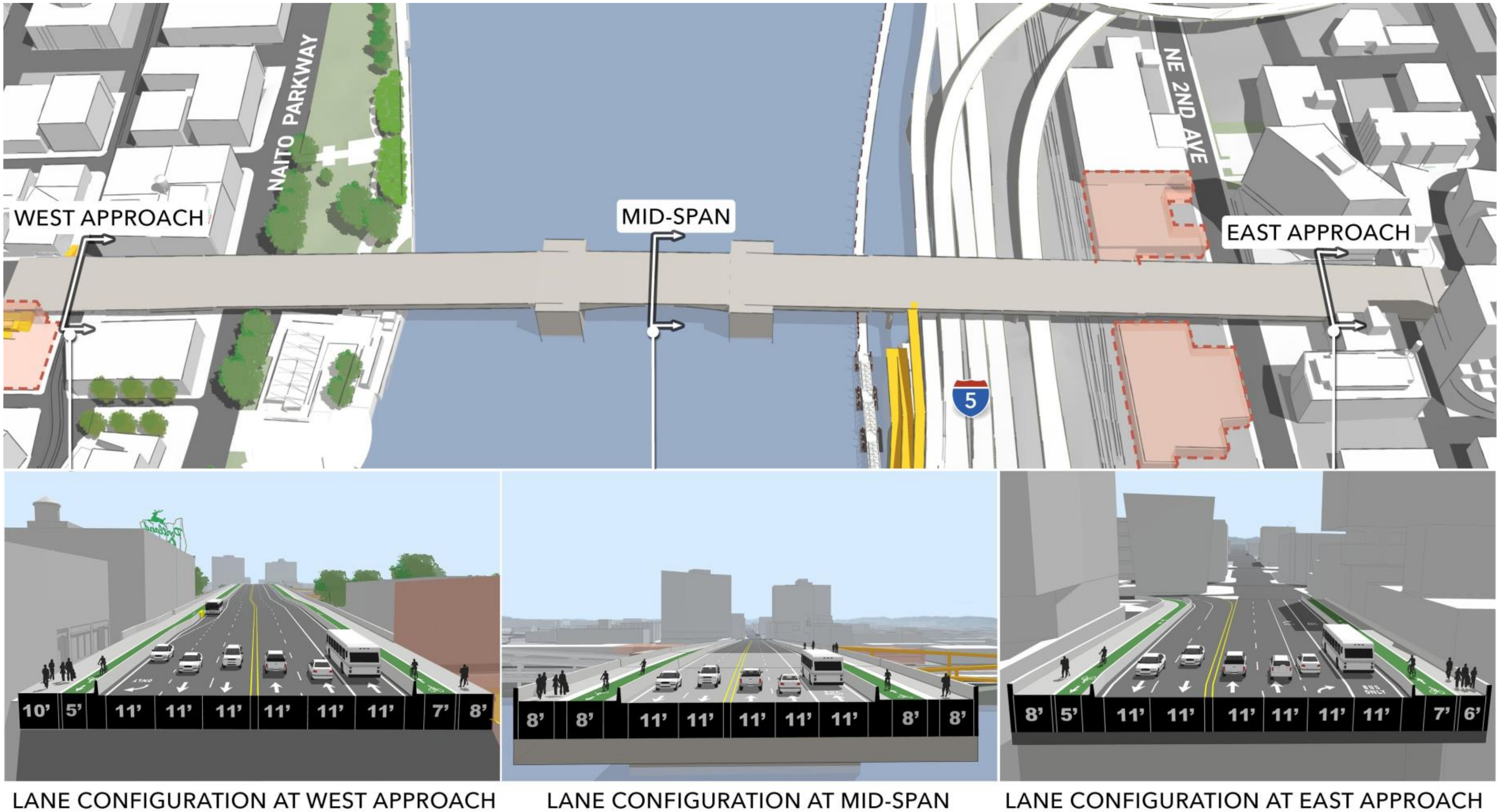
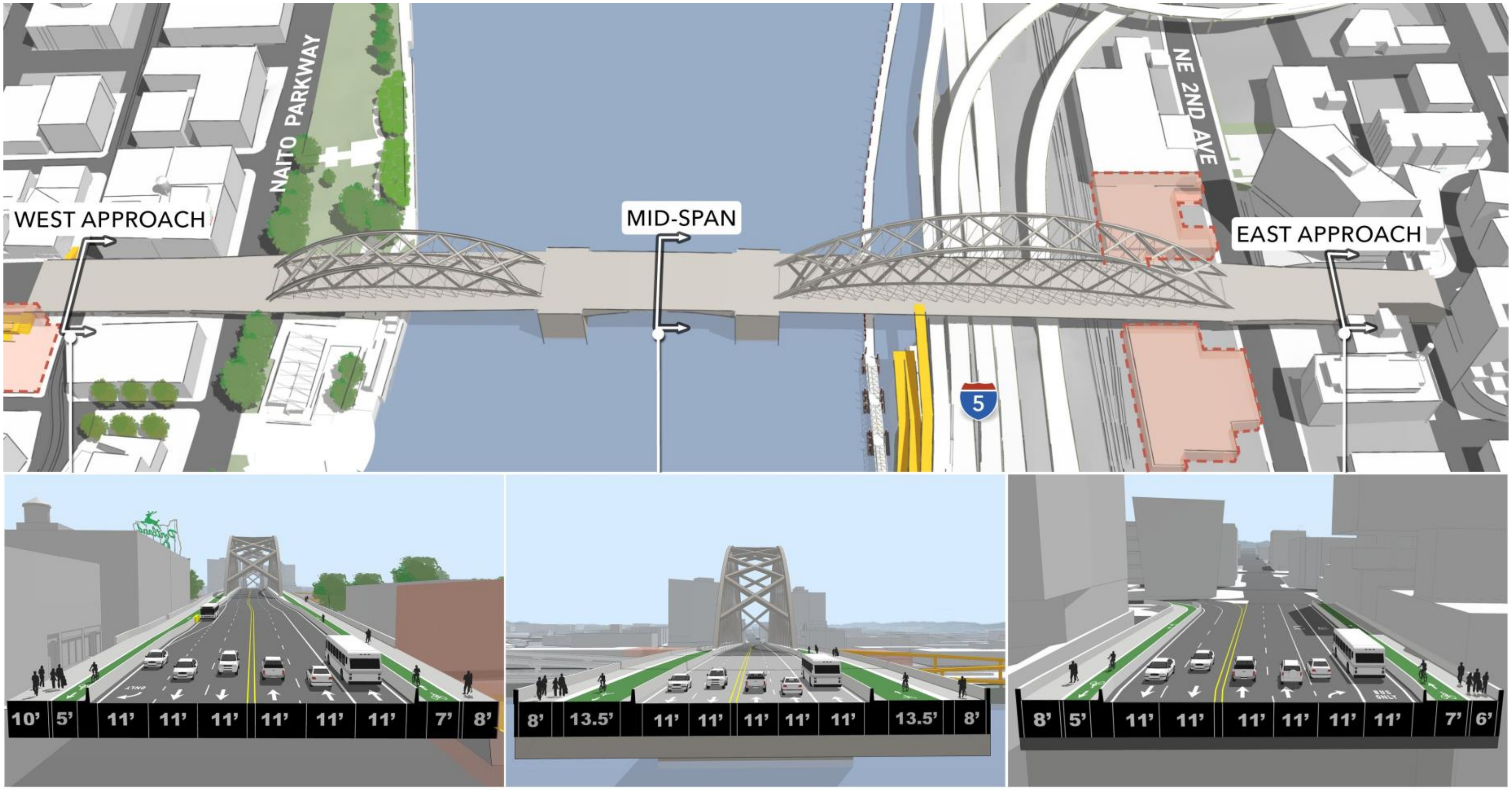


Figure 22. Replacement Alternative with Long-span Approach – Cross Sections



LANE CONFIGURATION AT WEST APPROACH
LANE CONFIGURATION AT MID-SPAN
LANE CONFIGURATION AT EAST APPROACH

Connection points for bicycles and connections at either end of the bridge would be the same as shown for the Retrofit Alternative in Figure 8 in the technical report. (See Appendix C of the Bridge Replacement Technical Report [Multnomah County 2021b])

5.2.13 Utilities

See the EQRB Utilities Technical Report (Multnomah County 2021j).

5.3 Replacement Alternative with Couch Extension

This Alternative consists of the same west approach and movable-span sections as the other Replacement Alternatives, but it would provide a different configuration for the east approach section. Under this Alternative, the east approach span would extend the Burnside/Couch couplet approximately 1,100 feet farther west with a northeast approach span and a southeast approach span extending both streets and ultimately connecting over the river, east of the movable span. Figure 23 and Figure 24 show the proposed layout aerial and profile views of this Alternative with bascule and vertical lift configurations.

5.3.1 Couch Extension, East Approach

The east approach consists of two separate bridge structures (northeast approach and southeast approach), with bents and spans denoted as north (N) and south (S). The northeast structure begins at span N9 and terminates at span N14. The eastbound southeast structure begins at span S9 and terminates at span S14. Table 5.3-1 outlines the span configurations and conceptual superstructure types for a preliminary layout.

Table 5.3-1. Couch Extension Alternative East Approach, Feasible Span Lengths and Structure Types (TBD during Type Selection)

Span Number	Feasible Span Length (feet)	Feasible Structure Type
N9	250	Steel plate girder
N10	196	Steel plate girder
N11	133	Prestressed concrete girder
N12	133	Prestressed concrete girder
N13	133	Prestressed concrete girder
N14	66	Prestressed concrete slab
S9	190	Steel plate girder
S10	223	Steel plate girder
S11	192	Steel plate girder
S12	135	Steel plate girder
S13	270	Steel plate girder
S14	80	Prestressed concrete box beam

TBD = To be determined

Figure 23. Replacement Alternative with Couch Extension – Aerial View

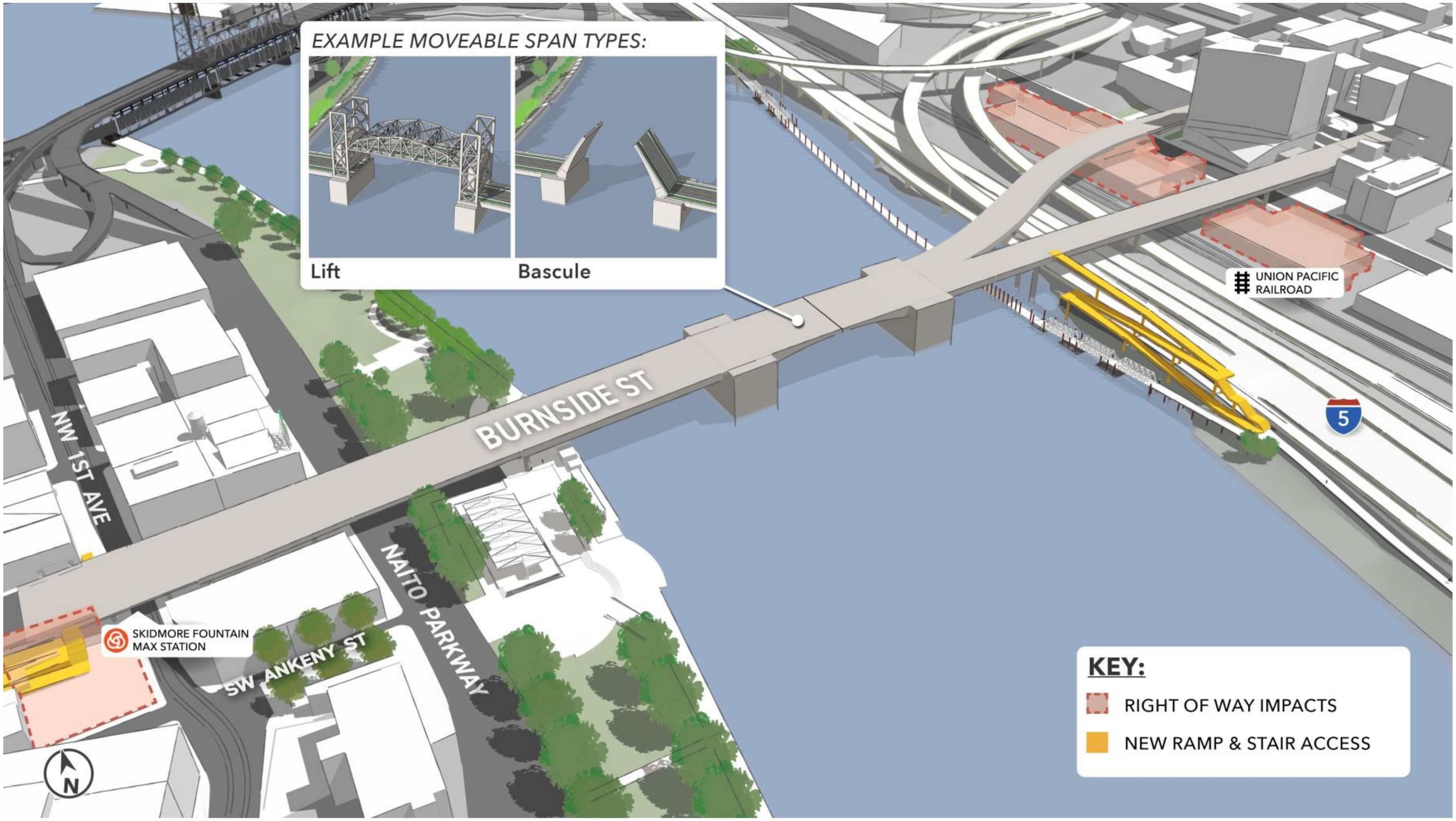
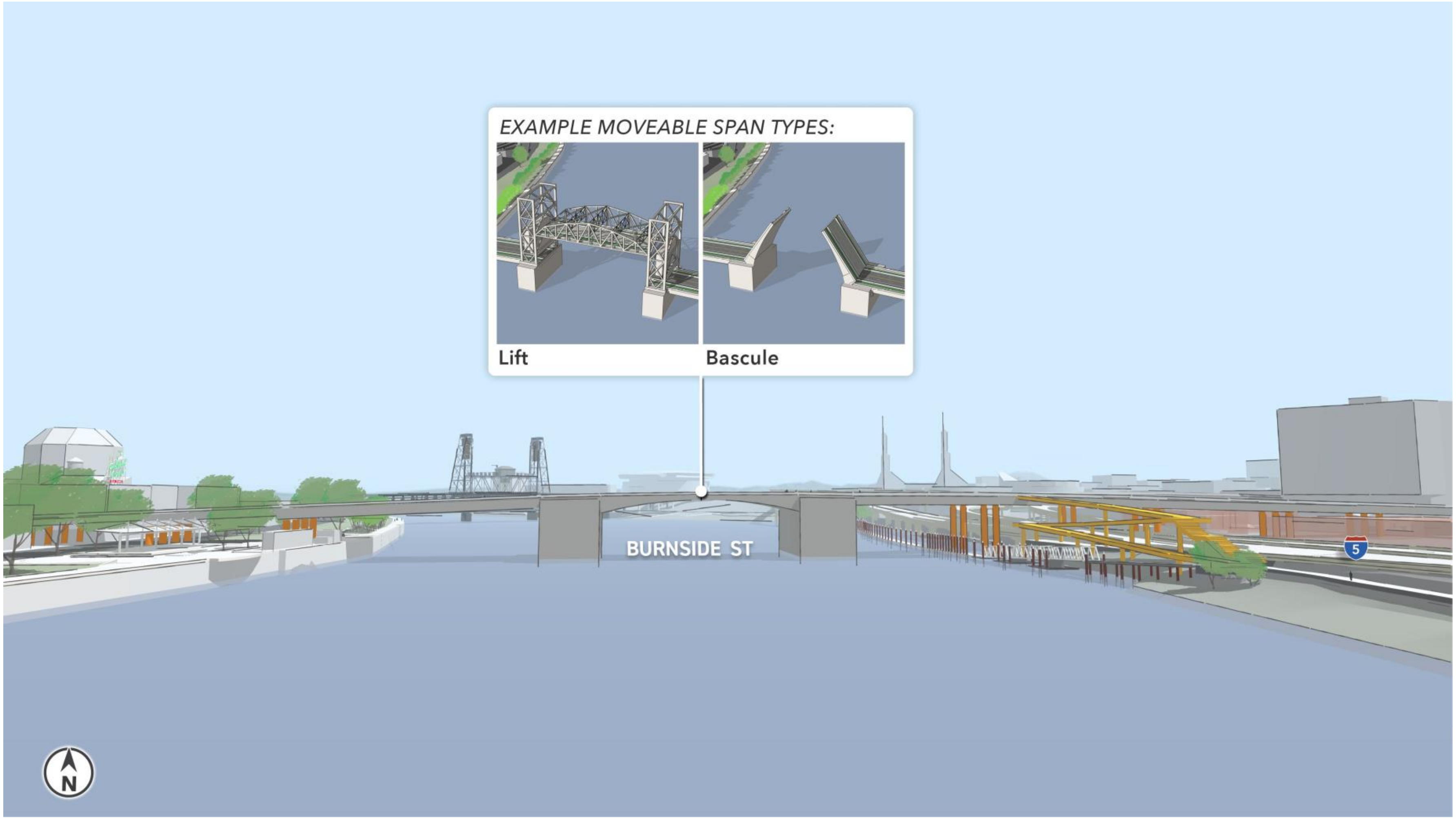


Figure 24. Replacement Alternative with Couch Extension – Profile View



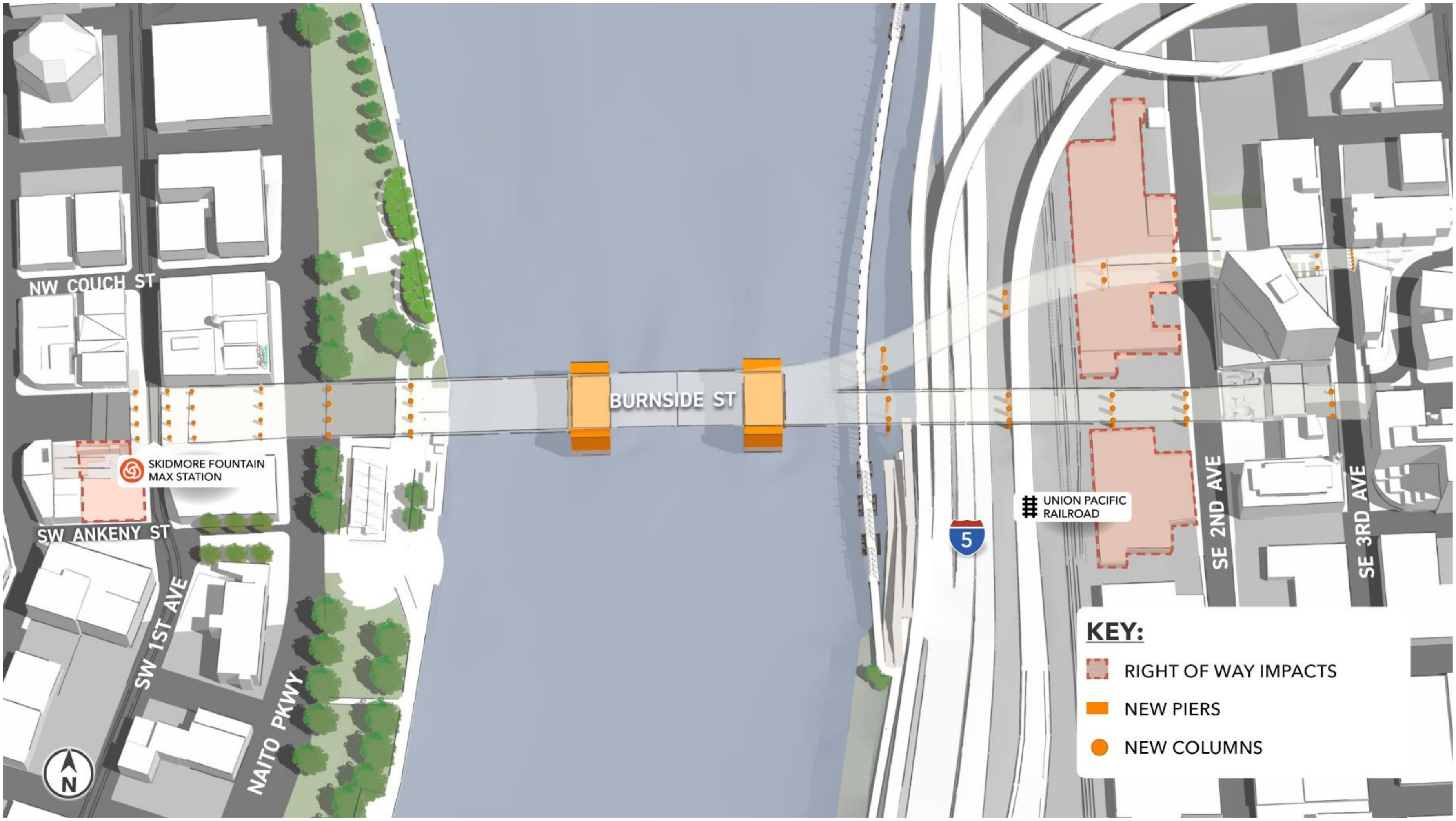
5.3.2 Bents and Bent Foundations

All bents for the northeast and southeast approaches would be oversized drilled pile columns 4 to 10 feet in diameter. Due to the alignment split and the additional northern bents, additional locations of ground improvements are anticipated in bents located in inadequate soil conditions. See Figure 25, Figure 26, and Figure 27 for pier and bent locations associated with the bascule and vertical lift configurations. (See Appendix B of the EQRB Bridge Replacement Technical Report [Multnomah County 2021b]. for more details.)

Figure 25. Replacement Alternative with Couch Extension – Profile (Bascule)

Figure 26. Replacement Alternative with Couch Extension – Profile (Lift)

Figure 27. Replacement Alternative with Couch Extension – Pier and Bent Locations



5.3.3 Traffic Patterns and Mode Allocation

Other than the westward extension of Couch Street, traffic patterns and mode allocation on the bridge would be the same as for the Short- and Long-span Alternatives. Figure 28 shows the expected configurations and bridge widths at three points along the bridge. (See the EQRB Bridge Replacement Technical Report [Multnomah County 2021b], cross section in Figures 5 and 6 for more detail.)

This Alternative would provide the same modal connections as the other Alternatives would with one exception. It would eliminate the recently constructed Couch Street–aligned pedestrian and bicycle courtyard and path between NE 3rd Avenue and Martin Luther King, Jr. Boulevard and would, therefore, need to provide an alternate bike connection. The replacement connection would extend north on 3rd Avenue, east on Davis Street, and then south on Martin Luther King, Jr. Boulevard to access the westbound multimodal path on the new bridge. See Figure 29 for the locations of pedestrian and bike connections.

5.3.4 Changes to Existing Infrastructure (Transportation Facilities and Adjacent Buildings)

As previously described, the Couch Extension would extend Couch Street on a structure from just west of Martin Luther King, Jr. Boulevard to over 3rd and 2nd Avenues, the UPRR tracks, the freeway ramps, and the Esplanade. Infrastructure changes associated with this Alternative are described below:

- Eliminate the existing short-radius curve that connects Couch Street back to the Burnside alignment just west of Martin Luther King, Jr. Boulevard.
- Eliminate the recently constructed Couch Street–aligned pedestrian and bicycle courtyard and path between NE 3rd Avenue and Martin Luther King, Jr. Boulevard.
- Lower portions of 3rd Avenue by up to 3 feet to allow clearance under the new elevated Couch Street overcrossing.
- Acquire several properties and displace existing uses as described in the Section 7.2.
- Locate the elevated Couch Street structure directly adjacent within 2 to 5 feet of three buildings including The Yard, the Eastside Exchange, and Block 75 (Slate Apartments and mixed use).

Other impacts of the Couch Street Alternative on transportation facilities are discussed in Section 7.

5.3.5 Utilities

See the EQRB Utilities Technical Report (Multnomah County 2021j).

Figure 28. Replacement Alternative with Couch Extension – Cross Sections

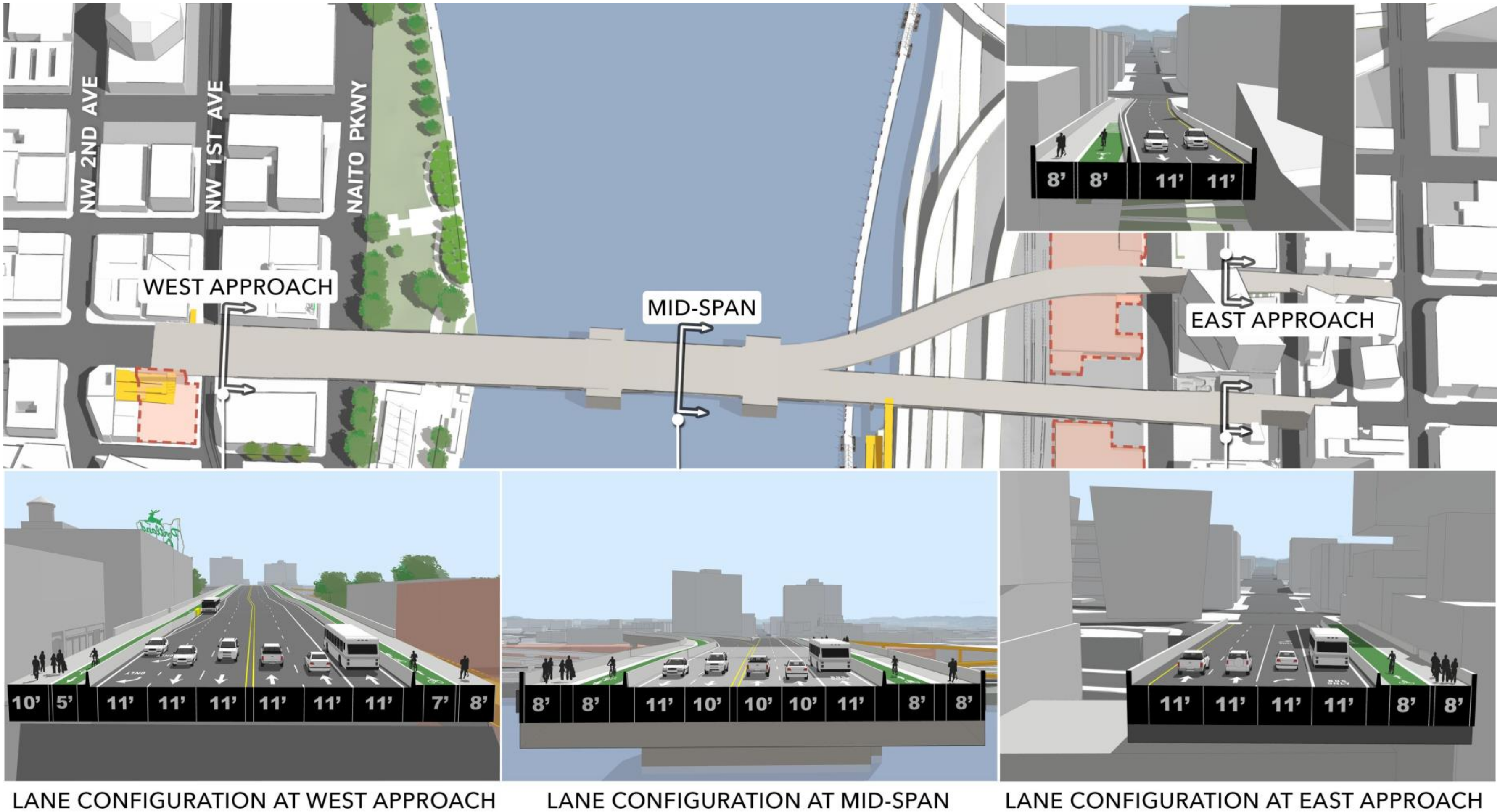


Figure 29. Replacement Alternative with Couch Extension – Modal Connections

6 Maintenance

As part of the Project's design criteria, all Alternatives shall be designed for a 100-year design life. As a design objective, the final design concepts selected will attempt to minimize maintenance requirements. However, there are significant differences between the Enhanced Retrofit and Replacement solutions.

As its core purpose, the objective of the Enhanced Seismic Retrofit Alternative is to minimize the work by relying on the existing bridge components to the maximum degree practical. This means that the existing bridge elements would be in service for approximately 200 years – which is much longer than the original design anticipated. Because of this, much more maintenance would be required for the Retrofit than for any of the Replacement Alternatives. The following is a summary of the bridge elements that have increased maintenance requirements for the Retrofit Alternative:

- Superstructure concrete girders (east and west side) – The Retrofit would require two to three times as many maintenance cycles to structurally repair the existing concrete girders than would the Replacement Alternatives. This includes constructing work platforms which could restrict traffic modes on and below the bridge, and reconstructing the structural elements.
- Superstructure fixed steel trusses (east and west side) and bascule trusses – The retrofit would require two to three times as many maintenance cycles to rehabilitate and repaint the steel truss than the Replacement Alternatives would. The steel girders require periodic inspection for fatigue cracks and corrosion. The painted surface would need to be kept in good condition as well. The repainting interval is affected by many factors such as general climate conditions and the effectiveness of the maintenance, so that the interval would be determined based on inspection reports. When needed, the work would include constructing work platforms over the river (restricting traffic modes on and below the bridge), removing and containing potentially hazardous materials, repainting the bridge, and reconstructing structural elements.
- Superstructure concrete-encased steel girders (east side) – The Retrofit would require at least two times as many maintenance cycles to structurally repair the existing concrete-encased girders than the Replacement Alternatives would. As part of the 2018 Maintenance Project, some of the members were repaired. Over the next 100 years, it is expected that the recently applied carbon fiber–reinforced polymer (CFRP) strips would need replacement and that further spalling will occur that would require additional CFRP strips. This would include constructing work platforms (which could restrict traffic modes on and below the bridge, including I-5 traffic) and re-installing the CFRP strips.
- Supports and in-water piers – Except for the areas where span replacements occur, the Retrofit Alternative would rely on the existing materials within the strengthened and enlarged columns, piers, footings, and pile systems. The existing interior concrete and steel would likely need to be replaced or rehabilitated in many locations over time, which would require access, removal, and reconstruction operations throughout the bridge. Especially important for the Retrofit Alternative would be

monitoring concrete beams and column surface conditions for early signs of cracks and rebar corrosion.

- Foundation settlement – Because the Retrofit would rely on the existing foundations for support, monitoring and surveying for symptoms of structural settlement is especially vital for this Alternative. This is required in order to verify that the soil improvements under the foundations are successful.

7 Construction

The following summarizes key construction information and assumptions. For a detailed description of the assumed construction approach see the EQRB Construction Approach Technical Report (Multnomah County 2021d).

7.1 Construction Duration and Sequencing for all Alternatives

The expected duration of Project construction is 3.5 to 6.5 years, with the variation depending on the Alternative and whether or not a temporary detour bridge is included, as shown in Table 7.1-1.

Table 7.1-1. Estimated Duration of Construction

Alternative	No Temp. Bridge (years)	With Temp. Bridge (years)
Retrofit Alternative	3.5	5
Short-span Alternative	4.5	6.5
Long-span Alternative	4.5	6.5
Couch Extension	4.5	6.5

The sequencing of construction activity also varies by Alternative, as summarized below:

7.1.1 Enhanced Seismic Retrofit Alternative

- Year 1 – Install cofferdams; install west work bridge; perform substructure retrofit on west approach spans; begin shaft installation at Pier 1 and Pier 2.
- Year 2 – Complete work bridge installation; install Pier 3 cofferdam; complete substructure retrofit on west approach spans; close bridge to traffic; begin replacement of west approach deck; begin substructure retrofit on east approach spans; complete Pier 1 and Pier 2 substructure retrofits; begin shaft installation at Pier 3.
- Year 3 – Install ground Improvements; complete replacement of west approach deck; complete Pier 3 substructure retrofits; demolish and replace spans over I-5 and I-84 ramps and UPRR right-of-way; pour replacement deck in main spans from west

approach to west bascule span; complete substructure retrofit on east approach spans; remove and replace east approach deck.

- Year 4 – Pour replacement deck in main spans from east approach to east bascule span; open retrofitted bridge to traffic (total closure time of 2 years); complete Project at 3.5 years.

7.1.2 Enhanced Seismic Retrofit Alternative with a Temporary Bridge

Construction sequencing would be similar to the above, the main difference being that a temporary bridge would be installed during year 1, opened in year 2, and removed during year 5 (no long-term closures).

7.1.3 Replacement Alternative with Short-Span Approach, with No Temporary Bridge

- Year 1 – Begin installing work bridges; close bridge to traffic; remove bascule spans; install coffer dams; demolish Pier 2; start work on approaches.
- Year 2 – Complete work bridge installation; install shafts and complete Bent 8; install ground improvements; continue work on approaches; demolish Pier 3.
- Year 3 – Continue work on approaches; complete Bent 8 substructure; finish ground improvements; install west bascule span; complete shaft installation and construct Bents 9 and 10; pour decks from west approach to west bascule span.
- Year 4 – Complete decks for approaches; install east bascule span; pour deck from east approach to east bascule span.
- Year 5 – Open new bridge to traffic (total closure time of 4 years); remove work bridges; complete the Project in about 4.5 years.

7.1.4 Replacement Alternative with Short-Span Approach, with a Temporary Bridge

Construction sequencing would be similar to that described above, but the total duration would be longer to accommodate the installation of a temporary bridge during year 1 and removal during year 6.5 (no long-term closures).

7.1.5 Replacement Alternative with Long-Span Approach

Construction sequencing would be similar to that for the Short-span Alternative for the far east and west spans and the river/bascule piers. The primary difference is in avoiding several features on both the west and east approaches. On the west side, long spans would avoid the harbor wall, City of Portland sewer infrastructure, and Pier 1, as well as eliminate one pier within Waterfront Park. On the east side, the long span would avoid an additional in-water pier, piers between I-5 and the I-84 ramp, and a pier near UPRR track. On both the east and west sides, constructing long spans would also mitigate the need for substantial ground improvements. The general sequence would be the same as for the short-span work. In lieu of constructing additional substructure, the same approximate duration would be consumed with long-span/superstructure construction.

7.1.6 Replacement Alternative with Couch Extension

Construction sequencing would be similar to that for the Replacement Alternatives, except for variations associated with constructing the separate bridge structure connecting to Couch Street. See Section 4.3 of the EQRB Construction Approach Technical Report (Multnomah County 2021d) for those as well as additional sequencing details of all Alternatives. Additionally, the ADA-compliant ramp from the bridge to the East Bank Esplanade would have one additional pier in the water than for the other Build Alternatives due to profile differences between the Couch Extension and the other Build Alternatives.

7.2 Constructing the Permanent Bridge Alternatives

The following describes key aspects of constructing the permanent bridge alternatives, as well as some of the related aspects of installing and removing the Temporary Bridge Option. Additional discussion of the Temporary Bridge Option is in Section 7.3.

7.2.1 Construction Access and Staging

Trucks hauling construction materials and debris to and from the site would be coming from and going to multiple locations in the region. Trucking to and from the Project site would occur essentially continually throughout the work. Figure 30 indicates potential trucking routes to be used by the contractor. Alternate legal routes may also be used by the contractor, depending on final Alternative selected, chosen means and methods, and portion of work being performed.

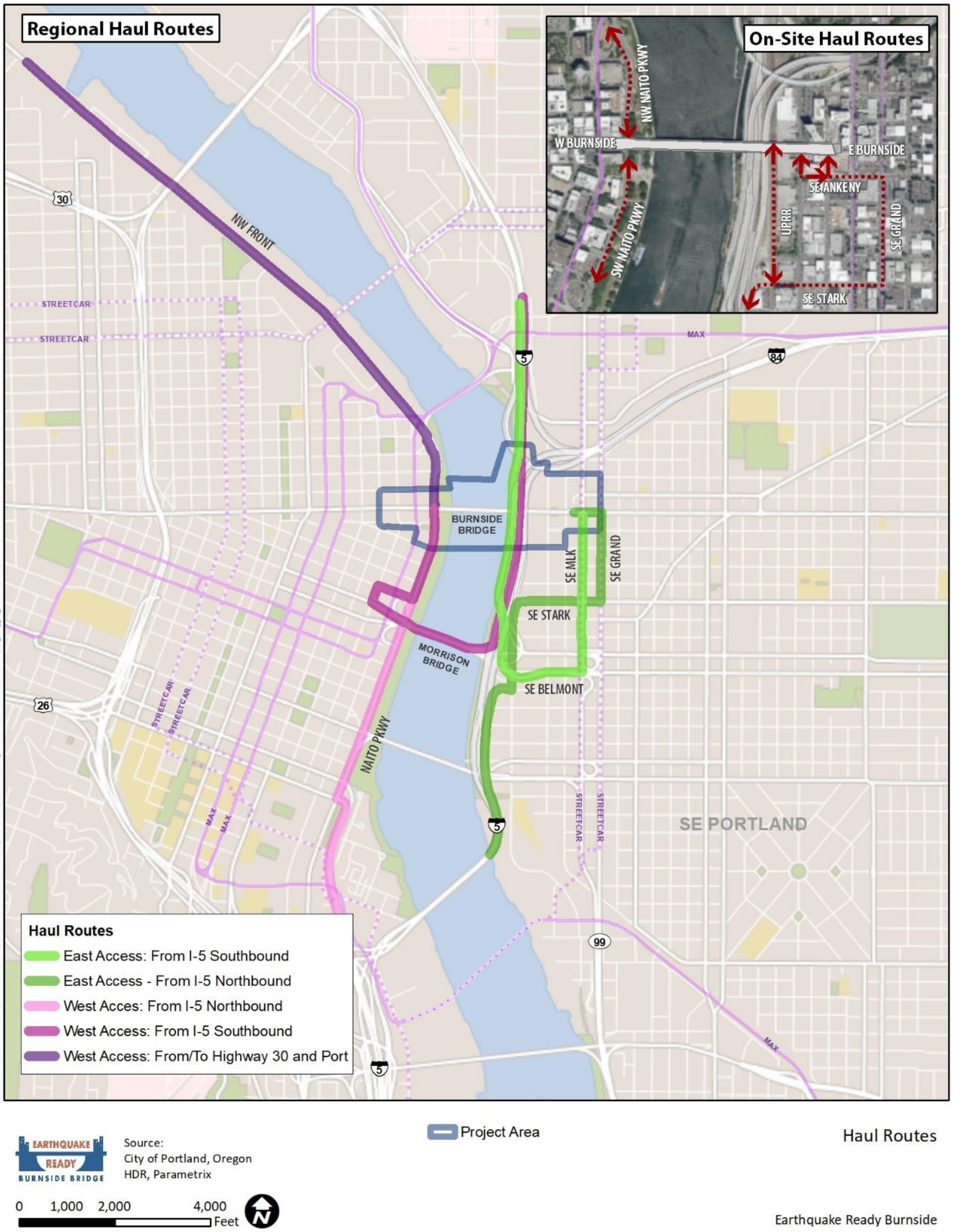
For access to the west end of the Project Area, the contractor would likely bring trucks in along either US 30 onto Naito Parkway, from I-5 northbound to Naito Parkway, and/or from I-5 southbound to the Morrison Bridge, to Naito Parkway. For access to the eastern end of the Project, the contractor would likely bring trucks from southbound I-5 to the Morrison off-ramp (eastbound) to NE Grand Street, to local roads into the Project Area, and/or from northbound I-5 to the Water Avenue off-ramp to local streets into the Project Area.

Truck traffic volumes would vary by phase and day. A typical day could range from zero to 40 trucks per day. Peak days, such as during concrete pours for large foundations, could require up to 150 trucks per day and last up to 2 days at a time.

Daily worker trips would also vary by phase and season, with approximately 100 people at the peak of construction, likely dropping to about 20 to 40 people during the winter. Construction would generally follow a 5-day work week except when nighttime and weekend work would occur for work over or around the I-5/I-84 ramps and UPRR tracks. Construction activity that would require temporary closure of the MAX line under the west end of the Burnside Bridge would likely involve 24-hour, 7-day work weeks to reduce the duration of closure.

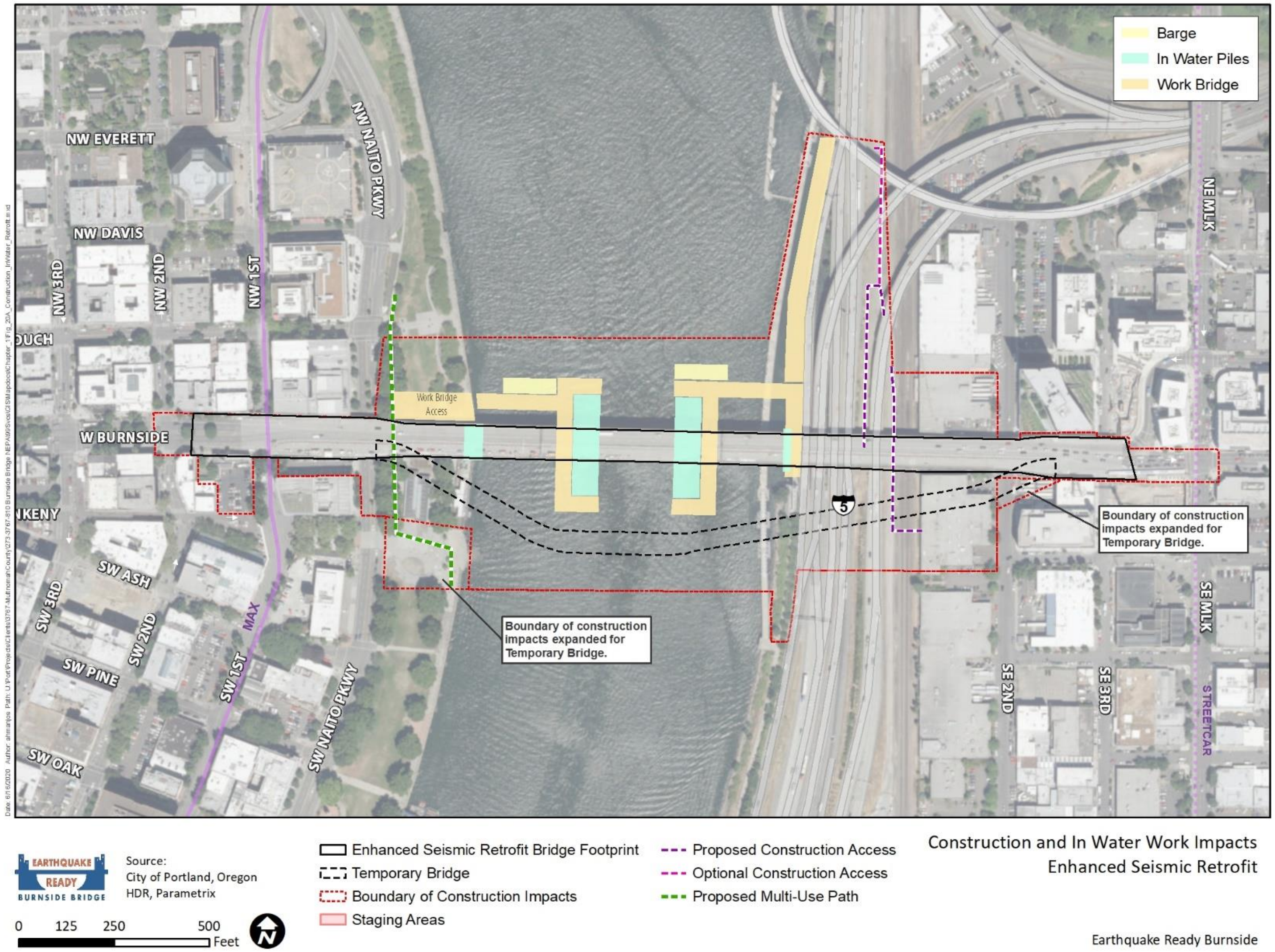
At the Project site itself, the contractor would need access alongside the bridge in as many locations as possible. Figure 31, Figure 32, and Figure 33 show the particular needs for construction access and in-water work for each of the Alternatives. Additionally, for the Couch Extension, the contractor would need access along the Couch tie-in and the alignment of the Couch couplet (see Figure 34). The access assumptions below use the following terms:

Figure 30. Potential Construction Haul Routes



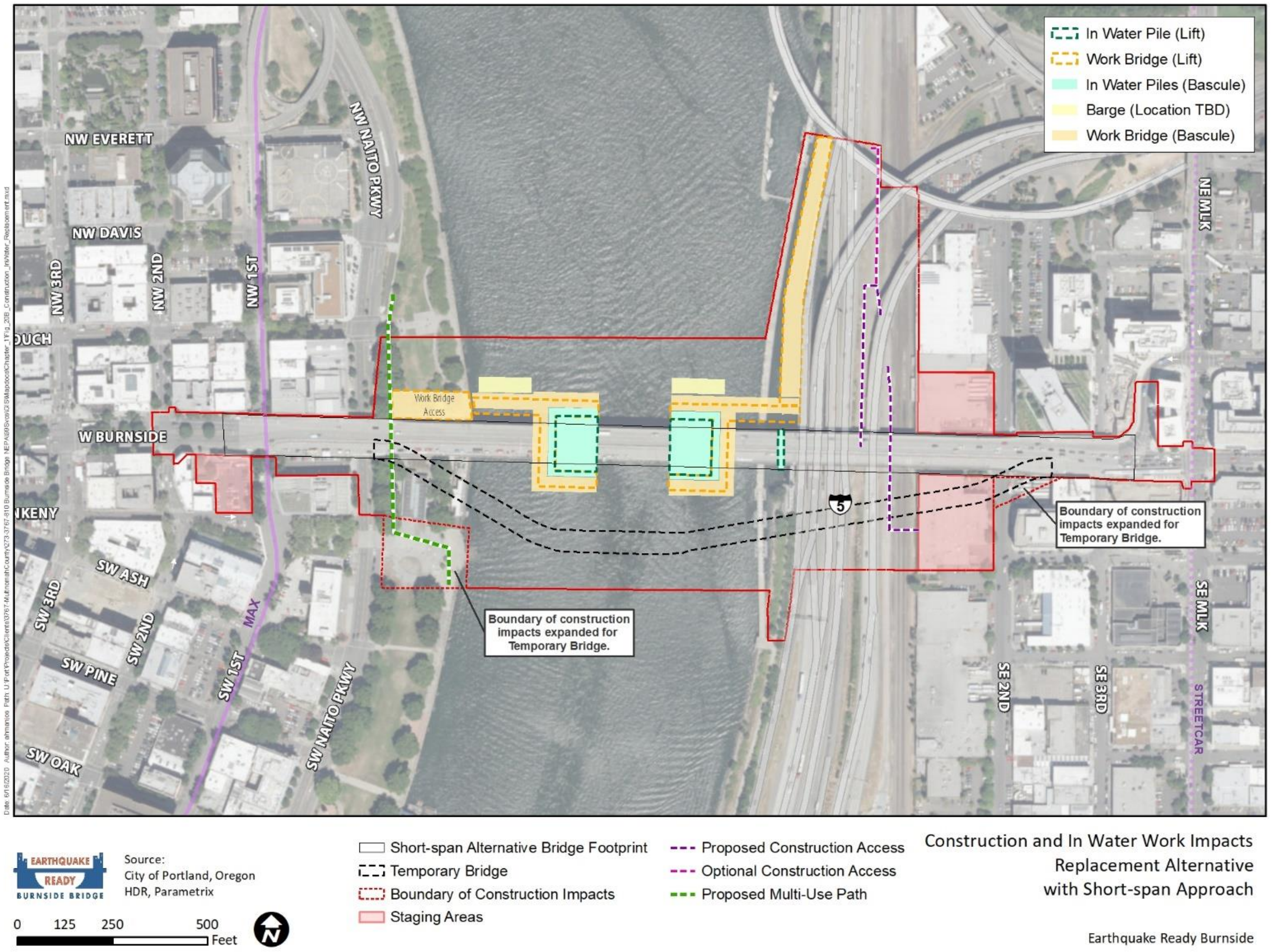
Source: City of Portland, HDR, Parametrix

Figure 31. Construction Access and In-Water Work – Retrofit Alternative



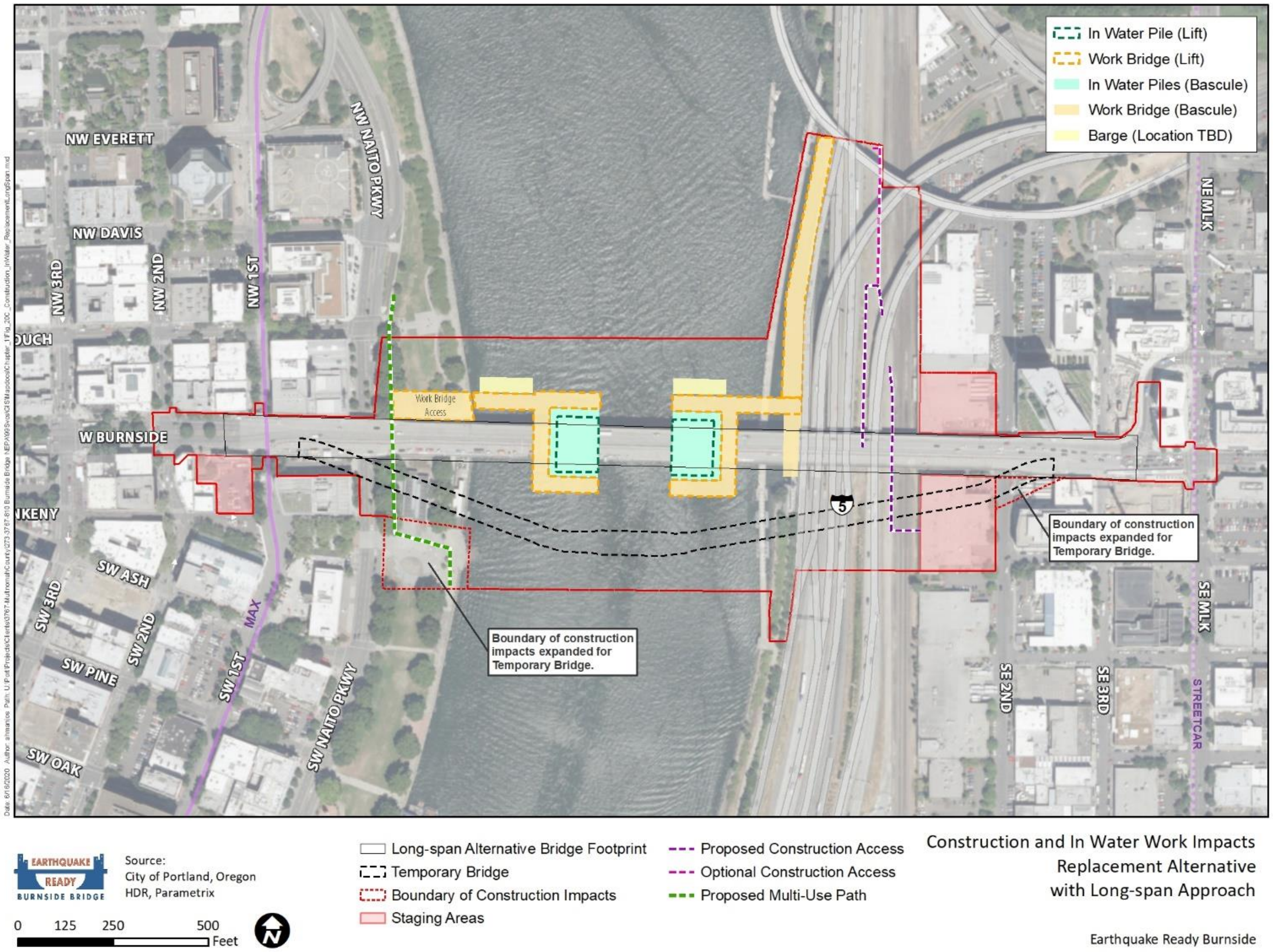
Source: City of Portland, HDR, Parametrix

Figure 32. Construction Access and In-Water Work – Short-Span Alternative



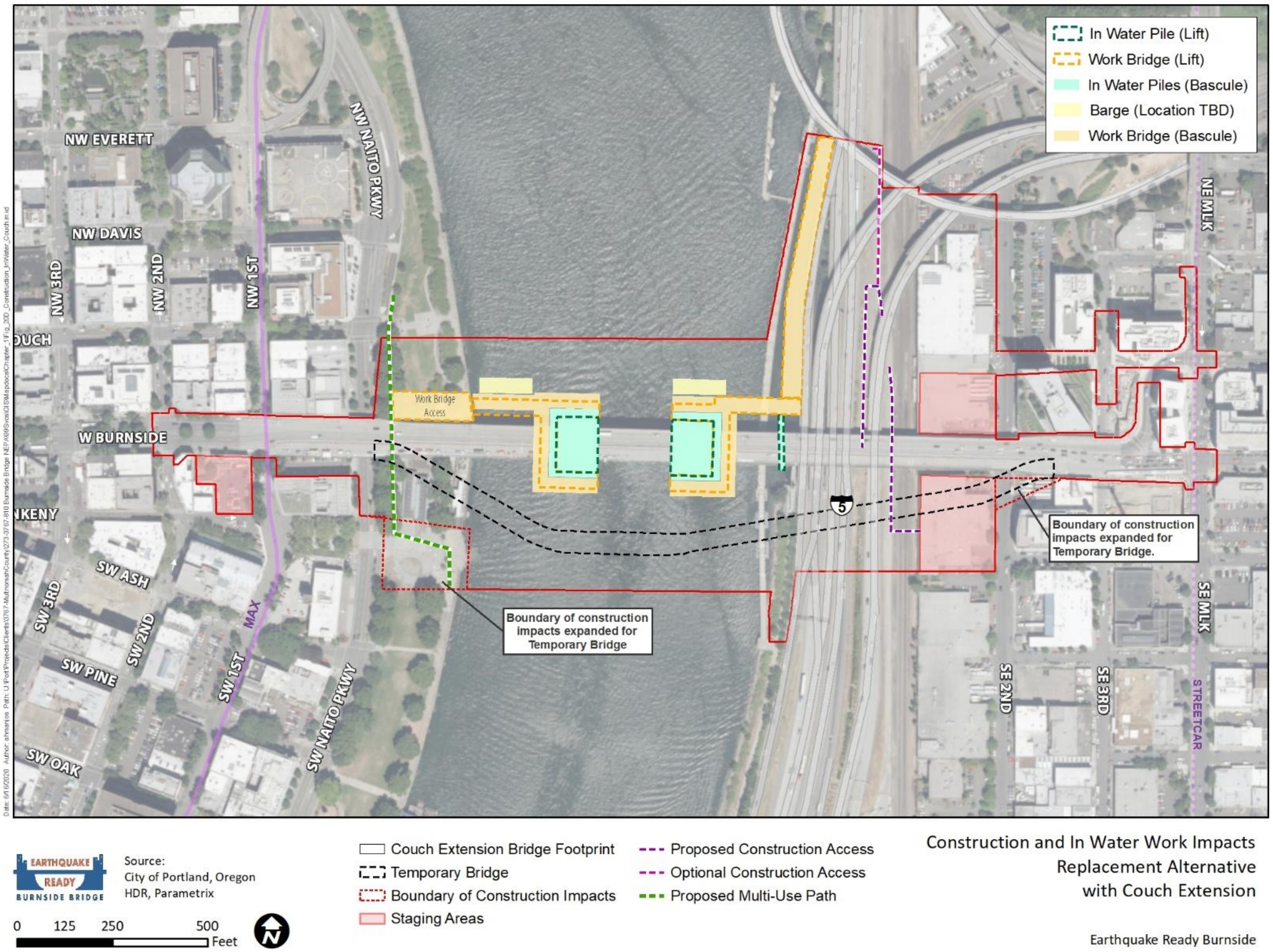
Source: City of Portland, HDR, Parametrix

Figure 33. Construction Access – Long-Span Alternative



Source: City of Portland, HDR, Parametrix

Figure 34. Construction Access and In-Water Work – Couch Extension



Source: City of Portland, HDR, Parametrix

- *Approach access* – Access needed to construct the landside approaches on the east and west ends.
- *Work bridge* – Temporary in-water, pile-supported platforms from which construction equipment and materials could access in-water work sites, particularly the two major piers on either side of the movable span.
- *Land access* – The ability to access, from the land, the work in the river including accessing the work bridges.

Key access assumptions are described below.

East land access and staging would require using either or both of the properties immediately north and south of the bridge. It would also require a temporary crossing over the railroad. If a temporary bridge is built, an additional temporary construction easement would be required for the parcel directly south of the bridge on the east side of SW 2nd Avenue. This property would be necessary to build the connection between the temporary bridge and the bridge itself.

An east work bridge to access the eastern piers (Pier 3/Bent 9 and Pier 4/Bent) would have to start several hundred feet north of the Burnside Bridge because of low ramps along the eastern shoreline that prohibit access to the water near the bridge. The work bridge would extend south just offshore to the Burnside Bridge eastern piers.

East approach access would be established through a combination of property acquisition and temporary construction easements on city streets. This access would include space on either side of the bridge for equipment such as large cranes for lifting girders into place. This work would require short-term street closures.

West land access would likely be from Naito Parkway, and the area around the bridge would be a necessary staging area for equipment and materials. The contractor would need a minimum of 40 feet outside the bridge limits on the north side in order to gain access to a work bridge in the river. For equipment and material staging, the contractor w would likely need to use the area of Waterfront Park under the bridge and north of the bridge encroaching into the Japanese American Historical Plaza. All greenscape north of the bridge to the paved area of the Japanese American Plaza would be cleared and likely rocked with gravel to accommodate construction vehicle access and materials. This would be removed and restored at the end of Project construction. North of the existing paved area within the Plaza could likely remain open and accessible to the public.

If a temporary bridge is built, the contractor would likely need to conduct staging and other activities in the area south of the existing bridge to the hardscape area north of the Bill Naito Legacy Fountain and south of the southern edge of the Ankeny Plaza Structure within Waterfront Park. The Ankeny Plaza Structure would be disassembled during construction and then reassembled/reconstructed afterward, and the fountain would be closed for the duration of construction. If a temporary bridge is not built, the contractor would likely need the area south of the bridge including the area around the Ankeny Plaza Structure within Waterfront Park, in addition to the area north of the bridge as described above. For this option, the Ankeny Plaza Structure would be disassembled during construction and then reassembled/reconstructed afterward, but the Bill Naito Legacy Fountain would likely remain operational for the duration of construction.

A west work bridge extending from the west bank just north of the existing bridge, would provide access to the western river pier (Pier 2/Bent 8). Depending on which Alternative is selected, the existing Pier 1 may need to be accessed by a work bridge as well.

West approach access would cross Waterfront Park with active bicycle/pedestrian paths, the TriMet MAX line, and city streets. Access would be accomplished through temporary construction easements on city streets, temporary use of Mercy Corps' parking lot to allow for equipment such as large cranes to install girders, and temporary use of a portion of Waterfront Park.

Barges would likely be used to provide flexible, supplemental space for equipment and material laydown/storage. They cannot provide all staging and assembly functions, but they can help reduce the impacts and displacements associated with upland staging and assembly. Barges would likely be intermittently tied to the seawall and work bridges throughout the duration of construction. From a construction efficiency perspective, this would include the area in front of the Japanese American Historical Plaza. If problematic, barges on the west bank could potentially be tied to the work bridge rather than the seawall, and could potentially be removed during fleet week. However, the work bridge at the west end would remain and may restrict access for fleet week vessels.

Off-site staging yards could be required due to limited storage space onsite. It is assumed that any off-site storage yard(s) would have a dock or at least riverfront access with potential to construct a temporary dock. The contractor would pre-stage materials and equipment at the yard, and then load it onto barges as needed, to be shipped to the Project Area. The County could secure off-site yard(s) or let the contractor do so during the pre-construction phase. Several potential locations of off-site storage yards are shown in Figure 35, with individual site maps found in Appendix B of the EQRB Construction Approach Technical Report (Multnomah County 2021d). These are only representative sites, as the contractor would have the ability to select a site based on their needs and preferences and the availability of permitted facilities or permittable sites. The four representative sites shown are:

- A Willamette Staging Option off Front Avenue
- B USACE Portland Terminal 2
- C Willamette Staging Option off Interstate Avenue
- D Ross Island Sand and Gravel Site

Figure 35. Examples of Potential Off-Site Staging Areas

(See individual site maps in Appendix B of the Construction Approach Technical Report [Multnomah County 2021d])

Source: City of Portland, HDR, Parametrix

7.2.2 In-Water Work Activity

All of the Alternatives would require extensive in-water work, much of it inside cofferdams that would isolate that work from the river itself. In-water work activities outside the cofferdams would include:

- Install temporary cofferdams, using barge-mounted cranes to drive and/or vibrate piles and sheets
- Install external bracing for cofferdams
- Drive or auger temporary piles for work bridges located outside cofferdams
- Install barge spuds for barges supporting construction
- Remove cofferdams
- Remove contractor work bridges
- Remove temporary detour bridge (Temporary Bridge Options only)

Work inside the cofferdams would include:

- Remove sediment inside the cofferdam
- Install cofferdam seal and internal bracing
- De-water
- Install temporary work bridges
- Demolish the existing in-water piers (Replacement Alternatives)
- Install large-diameter drilled shafts for main river piers
- Modify harbor wall at Pier 1 (Retrofit only)
- Remove Pier 1 (Replacement Alternatives only)
- Install pile caps and main river piers
- Remove work bridges

The depth of piles, temporary shoring walls, and other elements to be installed in the river bottom can only be approximated at this time. Current estimates are:

- Temporary shoring would be approximately 20 to 30 feet deep, and is not refusal-based.
- Piles and shafts would extend into the Troutdale Formation at approximately 80 feet deep (deeper on the east side than the west side).
- River shafts for two main piers may go 150 to 160 feet deep.
- Cofferdams would need to extend to about 2 feet below the bottom of the seal, or around elevation -74.5.

With the Retrofit Alternative, retrofitting the existing pier located at the harbor wall would require temporarily removing approximately 150 to 175 feet of the wall for approximately 6 months to 2 years. Retrofitting that pier and removing the harbor wall is not necessary for any other Alternative due to either shifting the pier to a new location, or, in the case of the Long-span Alternative, spanning over the area thus precluding the need for a pier.

No dredging is anticipated during construction, but there would likely be minor rip-rap removal around the existing large piers.

More details on the location, duration, and sequencing of in-water work for the Alternatives are described in Appendix D of the EQRB Construction Approach Technical Report (Multnomah County 2021d).

7.2.3 Ground Improvements

During a major CSZ event, the upper layers of soil beneath much of the eastern approach and a small portion of the western approach are expected to liquefy and flow down-gradient toward the river, causing significant displacement of structures in that area. To prevent significant earthquake-induced land subsidence that would damage the east approach piers and one of the west approach piers, ground improvements (assumed via the use of jet grouting) are anticipated in the areas of the existing Pier 1, Pier 4, Bent 22, between Bents 24 and 25, and at Bent 26 for the Retrofit and Replacement Alternatives (except the Long-span Alternative).

Potential adverse effects of jet grouting include destruction of any existing buried archaeological resources as well as damage to and settling of adjacent, existing structures. The latter risk increases with close proximity to existing structures on wood piling, including the harbor wall, Ankeny Pump Station, Eastbank Esplanade, I-5 mainline structures, I-84 ramps, UPRR right-of-way, private property (if the building is left in place), and Rose City Transportation (if the building is left in place). During the final design phase, careful consideration would need to be given to performing isolation work and/or providing other means of protecting the existing structures from potential damage.

The Long-span Alternative would clear-span most of this area, thus largely avoiding the risk of bridge damage due to land subsidence and minimizing the cost of ground improvements. It would require ground improvements for only one bent located east of the UPRR tracks.

7.2.4 Navigation Channel Closures and Restrictions

Except for short-term closures and restrictions, the navigation channel would remain open, with a minimum horizontal clearance of 165 feet and a minimum vertical clearance of 147 feet above OHW (or 167 feet NAVD 88), during construction of the Replacement and Retrofit Alternatives. Because the variability in movable-span structure type would influence construction access needs within the navigation channel, the number of closures required to accommodate the work could be as high as 10 or as low as 2, with vertical lift bridge options being toward the lower end of this range, and bascule options toward the higher end of the range. Each closure could be up to 3 weeks in duration. In addition, the Temporary Bridge Option could require up to two additional closures of up to 2 weeks each, as shown in Table 7.2-1. There could be a need for additional, short-duration closures or restrictions as well. Any temporary closures would be closely coordinated with the USCG. The Temporary Bridge Option, during the construction phase, would maintain the 165-foot minimum navigable width, but would increase the vessel transit length due to pass under the temporary bridge and its temporary fender systems. Based on survey responses, the 165-foot width would require tug assist for some vessels.

Table 7.2-1. Estimated Duration of Temporary Navigation Closures

Alternative	Estimated Navigation Closure Duration
Demolish/remove the bascule span (all Alternatives)	1-2 weeks per side
Install the new or retrofitted movable span (all Alternatives)	1-2 weeks per side
Install the temporary movable span (temporary bridge only)	1-2 weeks
Remove the temporary movable span (temporary bridge only)	1-2 weeks

7.2.5 Temporary Road, Rail, Street and Trail Closures

In addition to text below, see Section 7.3. Figures referenced in that section show likely routes for motor vehicles, bicycles, and pedestrians during construction due to closure or partial closure of the Burnside crossing and portions of the Vera Katz Eastside Esplanade and Waterfront Trail.

I-5 and I-84 – All of the Alternatives would require temporary highway lane closures in order to demolish and replace the Burnside Bridge elements over I-5 and I-84. Lane closures are anticipated to be for limited evening hours or on weekends, with dozens anticipated. Up to 10 weekend closures could be required, subject to the Alternative. Weekend closures would be preferable to nightly closures. This would allow more continuous work rather than repeated remobilizations that would be experienced if work were conducted during limited nightly closures. Weekend closures would further allow for fewer overall closures, and less cost related to traffic control.

For the Long-span Alternative, pending structural analysis of the existing bridge, it may be feasible to delay demolition of the bridge and instead use the existing deck as a work platform to aid in construction of the long span. Once the span was constructed (most likely without the deck cast), the long span would be lifted via jacks, and the existing deck demolished. If this sequence were adopted, it would be possible to significantly reduce the impacts to I-5 and I-84 by using the existing Burnside Bridge deck as a work and containment platform. Moving large structures with cranes would still require nightly closures, but the bulk of the work could be performed with live traffic flowing.

City Streets – For access to and around the bridge for demolition and construction activities, adjacent city streets would routinely be occupied by large equipment (such as cranes). Most notably, when girders are erected on the approach spans, city streets would need to be closed to allow equipment and material (girder) access. For the temporary detour bridge, the impacts to city streets would be approximately double those if no temporary bridge is used. This is because with the temporary detour bridge, the permanent girders would need to be erected in two phases, as opposed to one-phase erection where there is no temporary bridge.

UPRR Tracks – The contractor would need temporary access across the railroad tracks to connect the east side of the east approach to the river and the piers between the railroad and highway. UPRR right-of-way would also be impacted by construction work over and adjacent to the tracks including deck demolition, existing column and foundation demolition, new girder erection, and false deck installation/removal.

TriMet Bus Operations – Bus operations during construction would be the same with all Alternatives but would differ depending on whether or not they included a temporary bridge. Without a temporary bridge that accommodates buses, TriMet would need to redirect its bus service to adjacent bridges during construction. With a temporary bridge, bus service could be maintained for the majority of the construction period, although there would be intermittent closures of the temporary bridge for tie-ins that would need to occur near the beginning of the schedule and closures to switch traffic from the south side of the approaches to the north side of the approaches once the new or rehabilitated main structure was completed. These intermittent closures would be in the range of 1 week each. Bus route detours would likely be to the Steel Bridge and the Morrison Bridge.

During construction of the west approach, TriMet MAX operation would be affected around Skidmore Fountain:

- For the Retrofit, the deck would need to be removed, which would require a closure of TriMet's station and light trail service. Additionally, the catenary system would need to be shut down and the lines protected or removed and reinstalled. Further, foundation widening work is shown to extend under the existing tracks, meaning that the tracks would need to be removed and reinstalled or replaced with new. Since the tracks will be removed for foundation enhancement, a bus bridge would need to be used. After the foundations were widened, the tracks could be reinstalled. However, due to the proximity of the existing piers to the tracks and, more importantly, the catenary wires, the system would need to be shut down and a bus bridge used for column and cap enhancements. For the Retrofit, without a temporary bridge, the total time of shutdown would be approximately 8 weeks.
- For the Short-span, Long-span, and Couch Extension Alternatives, TriMet light rail service would need to be shut down to allow for superstructure and substructure demolition. A temporary catenary system would need to be set up to keep light rail operational after the superstructure was demolished, but before the new slab girders were erected. The shafts, columns, and caps for the new bridge could be installed during operation since the substructure elements are outside of the 10-foot minimum distance from the overhead catenary system. For the Replacement Alternatives, without a temporary bridge, the total time of shutdown would be approximately 5 weeks.
- For any Alternative using a temporary bridge, TriMet operations would be impacted at least twice (once for each phase depending on allowable length of shutdown and how much work could be completed). The reason for this is that if traffic were maintained across the approach, only half the bridge could be demolished and rebuilt at a time. Thus, a bus bridge or other accommodation would need to be implemented for each half of the bridgework. For the Retrofit, with a temporary bridge, the total time of shutdown would be approximately 16 weeks. For the Replacement Alternatives, with a temporary bridge, the total time of shutdown would be approximately 10 weeks.

Vera Katz Eastside Esplanade closure/trail rerouting – Where the Eastbank Esplanade trail crosses under the east fixed truss of the Burnside Bridge, it is on a floating structure that roughly parallels the river's east bank. The specific permanent bridge construction activities that would temporarily close use of this section of the Esplanade are listed in Table 7.2-2 below. These are generally worst-case assumptions. Temporary closures would require rerouting pedestrians and bikes around this section of the trail and onto streets and sidewalks. Construction of a temporary detour bridge would extend the duration of trail closure by approximately 4 months. The following activities are included in the table:

- A Constructing and deconstructing the east work bridge.
- B Erecting girders for the new spans over I-5 (it is expected that the girders would need to be erected from the river).
- C Building Bent 9 (or the new Pier 4 in the Enhanced Retrofit).
- D Installing ground improvements for pier construction directly below the Esplanade.
- E Removing the east truss.
- F Cutting back the east truss to the new Pier 4.

Table 7.2-2. Estimated Duration of Vera Katz Eastside Esplanade Closure During Construction

Alternative	Construction Activities Causing Temp. Closure*	Without Temp. Bridge	With Temp. Bridge
Retrofit Alternative	A, B, C, D, F	Up to 26 months	Up to 30 months
Short-span Alternative	A, B, C, D, E	Up to 30 months	Up to 34 months
Long-span Alternative	A, B, E	Up to 18 months	Up to 22 months
Couch Extension	A, B, C, D, E	Up to 30 months	Up to 34 months

*Main Bridge Construction Activities Causing Temporary Eastside Esplanade Closures

It is feasible to stage work in the area of the Esplanade, thus reducing impacts to the Esplanade. Doing this, however, would likely add costs for flagging and require the use of more specialized equipment to work in this area. In addition, certain Alternatives lend themselves better to minimizing impacts to the Esplanade. As a measure of comparison, the Long-span Alternative would likely result in the least disruption to the Esplanade users, while the Short-span and Couch Extension Alternatives would result in the most disruption. The Retrofit would likely impact the Esplanade less than the Short-span and Couch Alternatives but more than the Long-span Alternative.

7.2.6 Access for Pedestrians and Vehicles to Businesses, Residences, and Public Services

Access to local businesses and residences would be maintained whenever possible. When equipment is occupying city streets, traffic would be limited to single-lane traffic and flagged. In lieu of flaggers, stop/yield signs could be used. When not feasible for safety reasons to maintain traffic (in the case of demolition and girder erection), traffic would be detoured to adjacent city streets. Work would be phased from street to street to accommodate reasonable access to local businesses and residences. It is likely that the

Long-span Alternative would require less interference during east approach construction, compared to the other Alternatives.

Construction activities would require temporary closure of multiple pedestrian and vehicle access points into existing buildings. Access points include doors that provide access for pedestrians as well as driveways that provide access to garages, parking lots, or loading docks. Most of the temporary access closures could be mitigated with alternate access or temporary modifications to enable access during construction. Details of the temporary access impacts are shown in the following figures and tables:

- Figure 36 – Map of Temporary Access and On-street Parking Impacts – West Side
- Table 7.2-3 – Temporary Access Impacts – West Side
- Figure 37 – Map of Temporary Access and On-street Parking Impacts Map – East Side
- Table 7.2-4 – Temporary Access Impacts – East Side
- Table 7.2-5 – On-street Parking Impacts

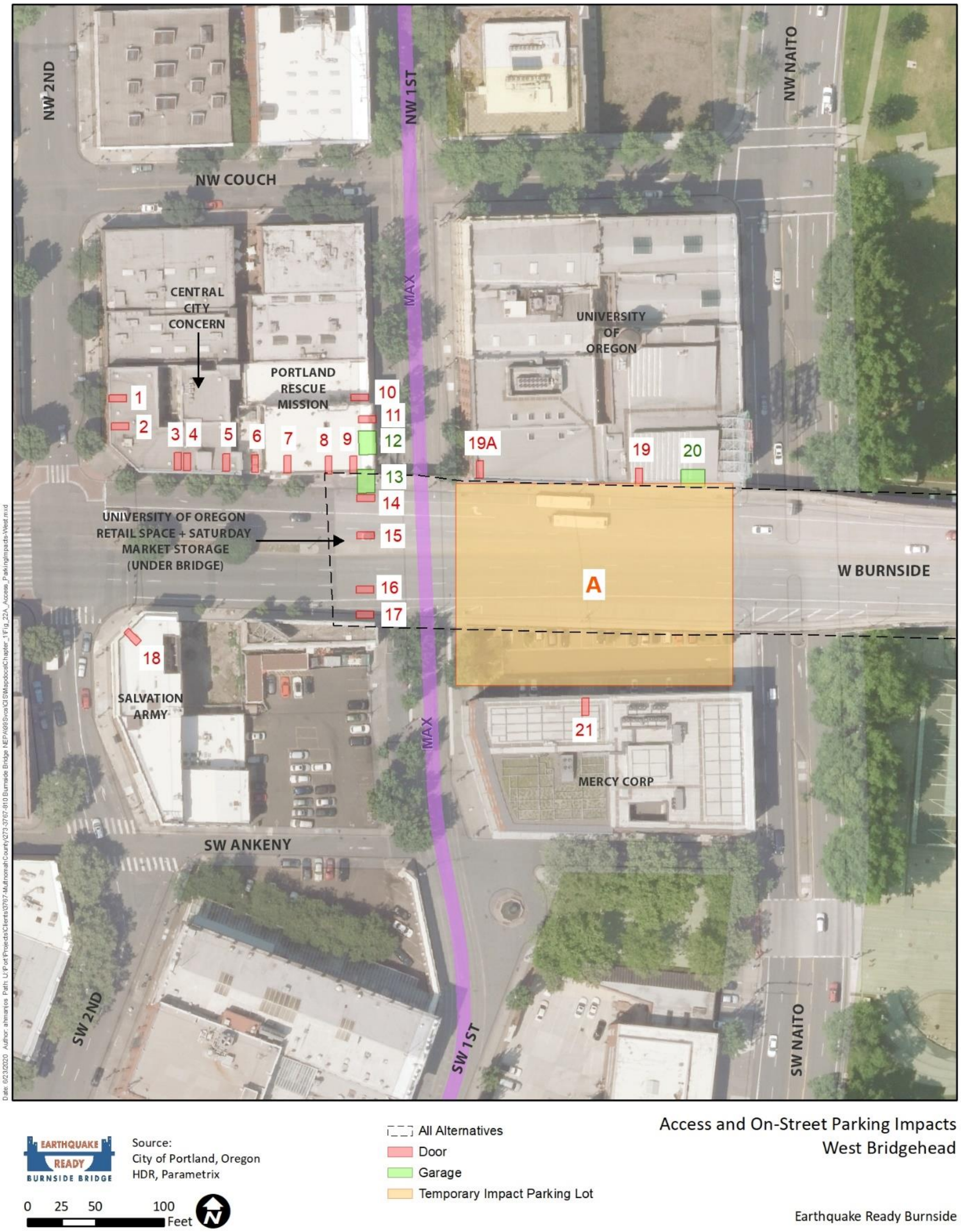
Temporary access impacts to the Portland Rescue Mission during construction of the Retrofit Alternative would halt provision of current services for a 2- to 3-month period.

Regarding Portland Fire Station #1, there would likely be short-term restrictions on Naito Parkway, but direct access to Naito from the fire station would be maintained at all times. Short-term restrictions during construction could block direct access from the fire station to northbound Naito Parkway, but southbound access would always be maintained.

7.2.7 On-Street Parking Impacts

Figure 36 and Figure 37 (cited above) also show the expected impacts to on-street parking, including temporary and permanent impacts. The Couch Extension Alternative would have both the highest temporary and permanent impacts. Construction of the Couch Street extension over 3rd Avenue to the waterfront would require more temporary street closures than the other Alternatives, and the extension would permanently close the courtyard between 3rd Avenue and 2nd Avenue that currently allows bicyclists to access the westbound bike lane over the bridge from 3rd Avenue. Mitigating this closure entails establishing an alternate route via a new bike lane that eliminates on-street parking on two block faces of 3rd Avenue, on one block face of Davis Street, and one block face of Martin Luther King, Jr. Boulevard.

Figure 36. Map of Temporary Access and On-Street Parking Impacts, West Side



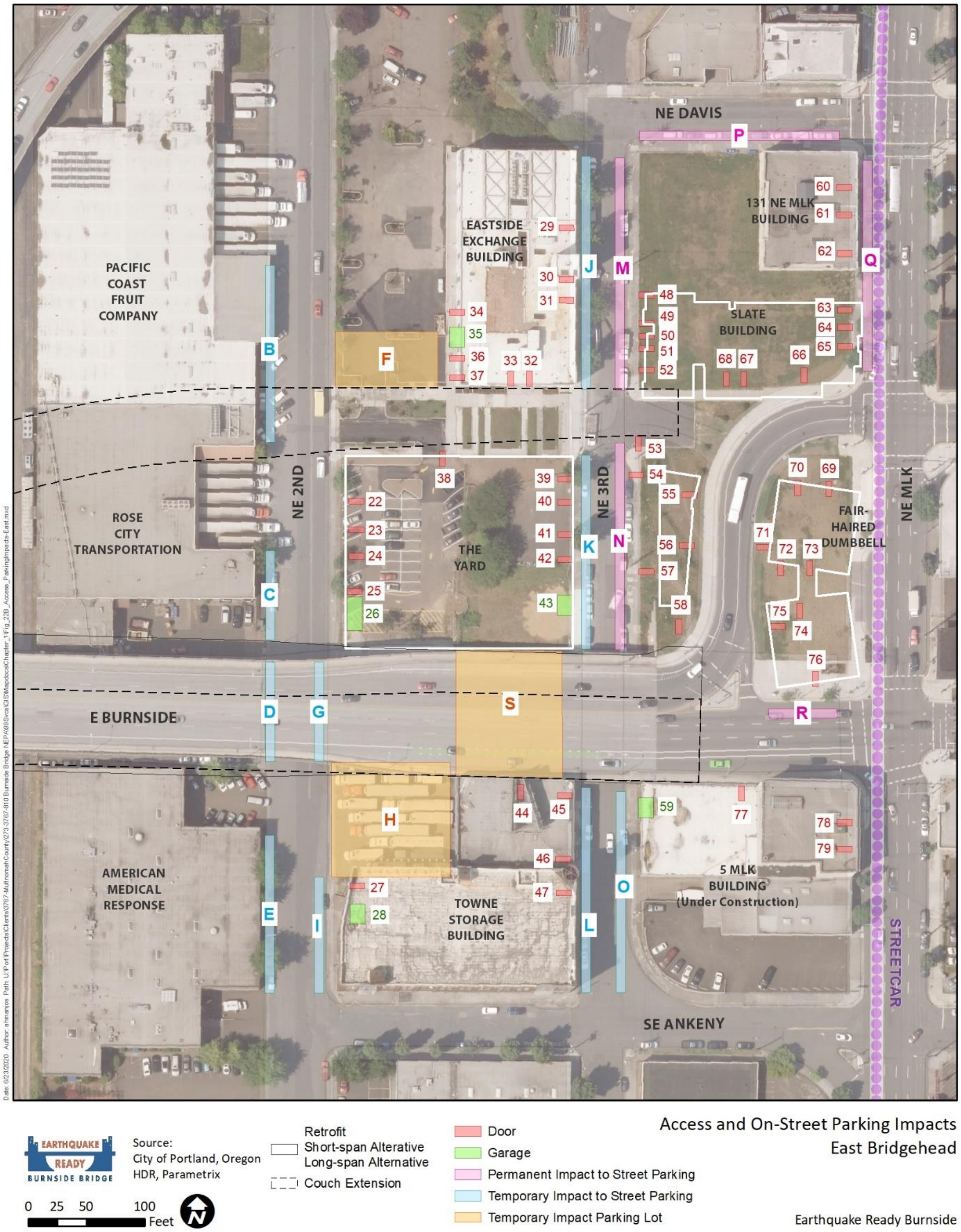
Source: City of Portland, HDR, Parametrix

Table 7.2-3. Access Impacts – West Side

Door ID Number	Property	Door Type	Anticipated Closure Due to Retrofit	Anticipated Closure Due to Short-Span or Long-Span Alternative	Anticipated Closure Due to Couch Extension	Notes
1	Shoreline Bldg LTD Partnership	Pedestrian	None	None	None	
2	Shoreline Bldg LTD Partnership	Pedestrian	None	None	None	
3	Shoreline Bldg LTD Partnership	Pedestrian	None	Temp Closure, Short-Term	Temp Closure, Short-Term	Sidewalk construction
4	Shoreline Bldg LTD Partnership	Pedestrian	None	Temp Closure, Short-Term	Temp Closure, Short-Term	Sidewalk construction
5	Shoreline Bldg LTD Partnership	Pedestrian	None	Temp Closure, Short-Term	Temp Closure, Short-Term	Sidewalk construction
6	Portland Rescue Mission	Garbage/Recycling	None	Temp Closure, Short-Term	Temp Closure, Short-Term	Sidewalk construction (still need to provide break in roadway barrier to allow access at this door)
7	Portland Rescue Mission	Pedestrian	Temp Closure, Short-Term	None	None	Sidewalk construction
8	Portland Rescue Mission	Pedestrian (onto bridge)	Temp Closure, Short-Term	None	None	Bridge construction
9	Portland Rescue Mission	Pedestrian (onto bridge)	Temp Closure, Short-Term	None	None	Bridge construction
10	Portland Rescue Mission	Pedestrian	Temp Closure, Short-Term	None	None	Staging for bridge construction
11	Portland Rescue Mission	Pedestrian	Temp Closure, Short-Term	None	None	Staging for bridge construction
12	Portland Rescue Mission	Garage	Temp Closure, Short-Term	None	None	Staging for bridge construction
13	City of Portland (under bridge)	Garage	Permanent Closure	Permanent Closure	Permanent Closure	
14	City of Portland (under bridge)	Pedestrian	Permanent Closure	Permanent Closure	Permanent Closure	
15	City of Portland (under bridge)	Pedestrian	Permanent Closure	Permanent Closure	Permanent Closure	

Door ID Number	Property	Door Type	Anticipated Closure Due to Retrofit	Anticipated Closure Due to Short-Span or Long-Span Alternative	Anticipated Closure Due to Couch Extension	Notes
16	City of Portland (under bridge)	Pedestrian	Permanent Closure	Permanent Closure	Permanent Closure	
17	City of Portland (under bridge)	Pedestrian	Permanent Closure	Permanent Closure	Permanent Closure	
18	Salvation Army	Pedestrian	None	Temp Closure, Short-Term	Temp Closure, Short-Term	Sidewalk construction
19	White Stag	Pedestrian (onto bridge)	Temp Closure, Long-Term	Temp Closure, Long-Term	Temp Closure, Long-Term	Bridge construction
19a	White Stag	Pedestrian (under bridge)	Temp Closure, Long-Term	Temp Closure, Long-Term	Temp Closure, Long-Term	Bridge construction
20	White Stag	Garage (under bridge)	Temp Closure, Short-Term	Temp Closure, Short-Term	Temp Closure, Short-Term	Bridge construction. Ongoing short-term (hours) closures throughout duration of the Project.
21	Mercy Corps Condominiums	Pedestrian	Temp Closure, Long-Term	Temp Closure, Long-Term	Temp Closure, Long-Term	Staging for bridge construction
N/A	University of Oregon Retail Space and Saturday Market Storage	Space (under bridge)	Permanent Closure	Permanent Closure	Permanent Closure	

Figure 37. Map of Temporary Access and On-Street Parking Impacts, East Side



Source: City of Portland, HDR, Parametrix

Table 7.2-4. Access Impacts – East Side

Door ID Number	Property	Door Type	Anticipated Closure Due to Retrofit	Anticipated Closure Due to Short-Span or Long-Span Alternative	Anticipated Closure Due to Replacement with Couch Extension	Notes
22	Block 67 Development (Yard Apts)	Pedestrian	None	None	None	
23	Block 67 Development (Yard Apts)	Pedestrian	None	None	None	
24	Block 67 Development (Yard Apts)	Pedestrian	None	None	None	
25	Block 67 Development (Yard Apts)	Pedestrian	None	None	None	
26	Block 67 Development (Yard Apts)	Garage	None	None	None	
27	5 Eastside Stories LLC	Pedestrian	None	None	None	
28	5 Eastside Stories LLC	Garage	None	None	None	
29	Bridgehead Development LLC	Pedestrian	None	None	None	
30	Bridgehead Development LLC	Pedestrian	None	None	Temp Closure, Short-Term	Sidewalk construction
31	Bridgehead Development LLC	Pedestrian	None	None	Temp Closure, Short-Term	Sidewalk construction
32	Bridgehead Development LLC	Pedestrian	None	None	Permanent Closure	New sidewalk 26' higher than extg at door, possibly open to path under bridge?
33	Bridgehead Development LLC	Pedestrian	None	None	Permanent Closure	New sidewalk 26' higher than extg at door, possibly open to path under bridge?
34	Bridgehead Development LLC	Pedestrian	None	None	None	

Door ID Number	Property	Door Type	Anticipated Closure Due to Retrofit	Anticipated Closure Due to Short-Span or Long-Span Alternative	Anticipated Closure Due to Replacement with Couch Extension	Notes
35	Bridgehead Development LLC	Garage	None	None	Temp Closure, Short-Term	
36	Bridgehead Development LLC	Pedestrian	None	None	Temp Closure, Short-Term	
37	Bridgehead Development LLC	Pedestrian	None	None	Temp Closure, Short-Term	
38	Block 67 Development (Yard Apts)	Pedestrian	None	None	Temp Closure, Long-Term	Bridge construction
39	Block 67 Development (Yard Apts)	Pedestrian	None	None	Temp Closure, Short-Term	Sidewalk construction
40	Block 67 Development (Yard Apts)	Pedestrian	None	None	Temp Closure, Short-Term	Sidewalk construction
41	Block 67 Development (Yard Apts)	Pedestrian	None	None	Temp Closure, Short-Term	Sidewalk construction
42	Block 67 Development (Yard Apts)	Pedestrian	None	None	None	
43	Block 67 Development (Yard Apts)	Garage	None	None	None	
44	Templeton Office Investments LLC	Pedestrian (onto bridge)	Temp Closure, Long-Term	Temp Closure, Long-Term	Temp Closure, Long-Term	Bridge construction
45	Templeton Office Investments LLC	Pedestrian	Temp Closure, Short-Term	Temp Closure, Short-Term	Temp Closure, Short-Term	Bridge construction
46	Templeton Office Investments LLC	Pedestrian	None	None	None	
47	5 Eastside Stories LLC	Pedestrian	None	None	None	
48	Block 75 LLC	Pedestrian	None	None	Temp Closure, Short-Term	Sidewalk construction
49	Block 75 LLC	Pedestrian	None	None	Permanent Closure	New sidewalk 1' higher than extg at door

Door ID Number	Property	Door Type	Anticipated Closure Due to Retrofit	Anticipated Closure Due to Short-Span or Long-Span Alternative	Anticipated Closure Due to Replacement with Couch Extension	Notes
50	Block 75 LLC	Pedestrian	None	None	Permanent Closure	New sidewalk 2' higher than extg at door
51	Block 75 LLC	Pedestrian	None	None	Permanent Closure	New sidewalk 2' higher than extg at door
52	Block 75 LLC	Pedestrian	None	None	Permanent Closure	New sidewalk 2' higher than extg at door
53	Block 76 LLC (Side Yard)	Pedestrian	None	None	Temp Closure, Short-Term	Sidewalk construction
54	Block 76 LLC (Side Yard)	Pedestrian	None	None	Temp Closure, Short-Term	Sidewalk construction
55	Block 76 LLC (Side Yard)	Pedestrian	None	None	None	
56	Block 76 LLC (Side Yard)	Pedestrian	None	None	None	
57	Block 76 LLC (Side Yard)	Pedestrian	None	None	None	
58	Block 76 LLC (Side Yard)	Pedestrian	None	None	None	
59	5 MLK RPO LLC	Garage	Temp Closure, Short-Term	Temp Closure, Short-Term	Temp Closure, Short-Term	Bridge construction
60	Union Arms LLC	Pedestrian	None	None	Temp Closure, Short-Term	Sidewalk construction
61	Union Arms LLC	Pedestrian	None	None	Temp Closure, Short-Term	Sidewalk construction
62	Union Arms LLC	Pedestrian	None	None	Temp Closure, Short-Term	Sidewalk construction
63	Block 75 LLC	Pedestrian	None	None	Temp Closure, Short-Term	Sidewalk construction
64	Block 75 LLC	Pedestrian	None	None	Temp Closure, Short-Term	Sidewalk construction
65	Block 75 LLC	Pedestrian	None	None	Temp Closure, Short-Term	Sidewalk construction
66	Block 75 LLC	Pedestrian	None	None	Permanent Closure	New sidewalk 2' higher than extg at door
67	Block 75 LLC	Pedestrian	None	None	Permanent Closure	New sidewalk 4' higher than extg at door

Door ID Number	Property	Door Type	Anticipated Closure Due to Retrofit	Anticipated Closure Due to Short-Span or Long-Span Alternative	Anticipated Closure Due to Replacement with Couch Extension	Notes
68	Block 75 LLC	Pedestrian	None	None	Permanent Closure	New sidewalk 4' higher than extg at door
69	The Fair-Haired Dumbbell LLC	Pedestrian	None	None	None	
70	The Fair-Haired Dumbbell LLC	Pedestrian	None	None	None	
71	The Fair-Haired Dumbbell LLC	Pedestrian	None	None	None	
72	The Fair-Haired Dumbbell LLC	Pedestrian	None	None	None	
73	The Fair-Haired Dumbbell LLC	Pedestrian	None	None	None	
74	The Fair-Haired Dumbbell LLC	Pedestrian	None	None	None	
75	The Fair-Haired Dumbbell LLC	Pedestrian	None	None	None	
76	The Fair-Haired Dumbbell LLC	Pedestrian	None	Temp Closure, Short-Term	Temp Closure, Short-Term	Sidewalk construction
77	5 MLK RPO LLC	Pedestrian	None	Temp Closure, Short-Term	Temp Closure, Short-Term	Sidewalk construction
78	5 MLK RPO LLC	Pedestrian	None	None	None	
79	5 MLK RPO LLC	Pedestrian	None	None	None	

Table 7.2-5. On-Street Parking Impacts

Parking ID Letter	East or West?	Property	Parking Type	Anticipated Closure Due to Retrofit	Anticipated Closure Due to Short-Span or Long-Span Alternative	Anticipated Closure Due to Replacement with Couch Extension	Notes
A	West	Mercy Corps, White Stag, Others?	Lot	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Staging for bridge construction
B	East	ROW, 2nd Ave	Street	None	None	Temp Closure, Duration of Project	Staging for bridge construction
C	East	ROW, 2nd Ave	Street	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Staging for bridge construction
D	East	ROW, 2nd Ave	Street	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Staging for bridge construction
E	East	ROW, 2nd Ave	Street	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Staging for bridge construction
F	East	Bridgehead Development LLC	Lot	None	None	Temp Closure, Duration of Project	Staging for bridge construction
G	East	ROW, 2nd Ave	Street	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Staging for bridge construction
H	East	Nemarnik Family Properties, LLC	Lot	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Staging for bridge construction
I	East	ROW, 2nd Ave	Street	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Staging for bridge construction
J	East	ROW, 3rd Ave	Street	None	None	Temp Closure, Duration of Project	Staging for bridge construction
K	East	ROW, 3rd Ave	Street	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Staging for bridge construction
L	East	ROW, 3rd Ave	Street	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Staging for bridge construction
M	East	ROW, 3rd Ave	Street	None	None	Permanent Closure	For Bike Lane
N	East	ROW, 3rd Ave	Street	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Permanent Closure	For Bike Lane
O	East	ROW, 3rd Ave	Street	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Temp Closure, Duration of Project	Staging for bridge construction
P	East	ROW, Davis St	Street	None	None	Permanent Closure	For Bike Lane

Parking ID Letter	East or West?	Property	Parking Type	Anticipated Closure Due to Retrofit	Anticipated Closure Due to Short-Span or Long-Span Alternative	Anticipated Closure Due to Replacement with Couch Extension	Notes
Q	East	ROW, Martin Luther King Jr Blvd	Street	None	None	Permanent Closure	For Bike Lane
R	East	ROW, Burnside St	Street	None	Permanent Closure	Permanent Closure	For Roadway

Note: ROW = right-of-way

7.2.9 Property Acquisitions and Relocations

Permanent and Temporary Acquisitions and Easements

All of the Build Alternatives would need to acquire property adjacent to the existing right-of-way either for construction or permanent use by the Project. Three types of acquisitions are expected for all of the Alternatives, including property in fee (full or partial), permanent easements for subsurface and aerial bridge improvements, and temporary construction easements for work areas. Approximate acquisition areas are shown on exhibits in Appendix E of the EQRB Construction Approach Technical Report (Multnomah County 2021d). An impacted parcel is defined as an individual tax lot that is within the identified Area of Potential Impact. Table 7.2-6 presents the number of parcels affected for each Build Alternative and the types of acquisitions required. The temporary bridge, with any of the Alternatives, would require two additional temporary construction easements.

Table 7.2-6. Estimated Total Property Acquisitions and Easements

Alternative	Fee Full Acquisition	Fee Partial Acquisition	Permanent Easement*	Temporary Construction Easement**
Retrofit Alternative	6	2	6	14
Short-span Alternative	6	2	6	17
Long-span Alternative	6	2	1	17
Couch Extension	8	4	7	20
Additional with Temporary Bridge	+0	+0	+0	+2

*Includes permanent easements for bridge facilities.

** Includes temporary construction easements for staging and work as well as building access closures.

There are some properties adjacent to the bridge across all Alternatives that would not require acquisition of property rights for construction, but would be impacted due to temporary and/or permanent access closures during construction. Table 7.2-6 above includes minor temporary easements that would be acquired from these properties to accommodate access closures and provide a means to compensate property owners for building modifications that would be necessary to keep real estate assets and businesses operational during and after the Project (cost to cure).

Displacements and Relocations

None of the Alternatives would displace residences. Without a temporary bridge, the Retrofit would permanently displace six businesses and is expected to temporarily close the Portland Rescue Mission for 2 to 3 months. The Short- and Long-span and Couch Extension Alternatives would displace six businesses (see Figure 38 through Figure 41). Constructing each of the Build Alternatives would require demolishing the existing buildings (Lots 17 and 18 on Figure 39, Figure 40, and Figure 41 and in Table 7.2-8), although only a small portion of these parcels would be needed for the new bridge, so the remainder of the parcel could be used for staging during construction and then resold after the Project is complete.

The Temporary Bridge Option would add another business relocation—a commercial parking lot that leases to the Pacific Coast Fruit Company—for a temporary construction easement. Table 7.2-7 presents the number of anticipated displacements/relocations for each Alternative. Figure 38 through Figure 41 show all of the right-of-way impacts for each Alternative; property impacts are outlined in Table 7.2-8 below as well. The lot numbers in the table correspond to the lot reference numbers shown in Figure 38 through Figure 41.

Table 7.2-7. Estimated Displacements/Relocations by Alternative

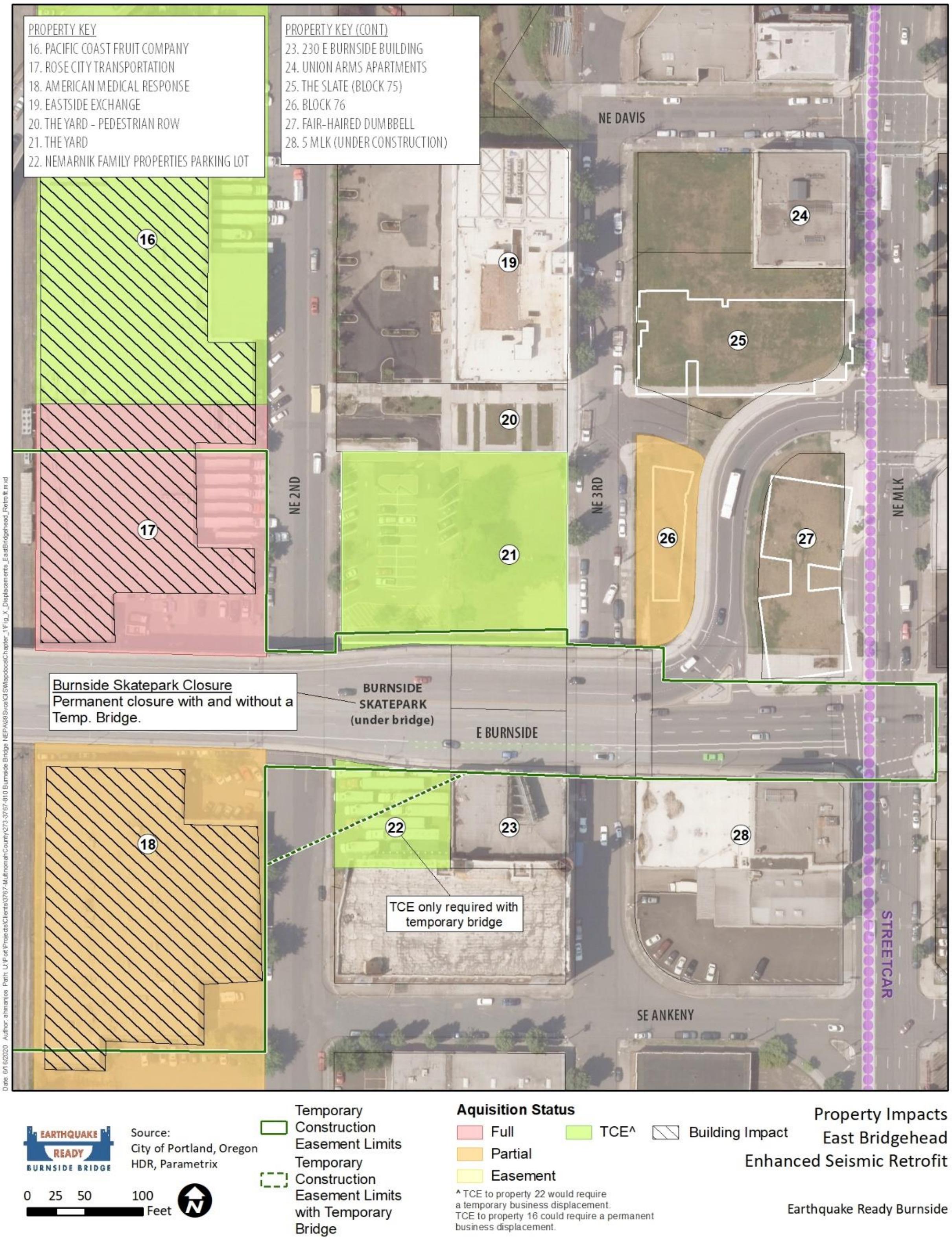
Alternative	Residential	Business
Retrofit Alternative	0	6 (1)*
Short-span Alternative	0	6 (0)
Long-span Alternative	0	6 (0)
Couch Extension	0	6 (0)
Additional with Temporary Bridge	+0	+0 (+1)

* Closure to the Portland Rescue Mission expected to be 2 to 3 months during construction.

Figure 38. Property Acquisitions and Displacements, West Side – All Build Alternatives

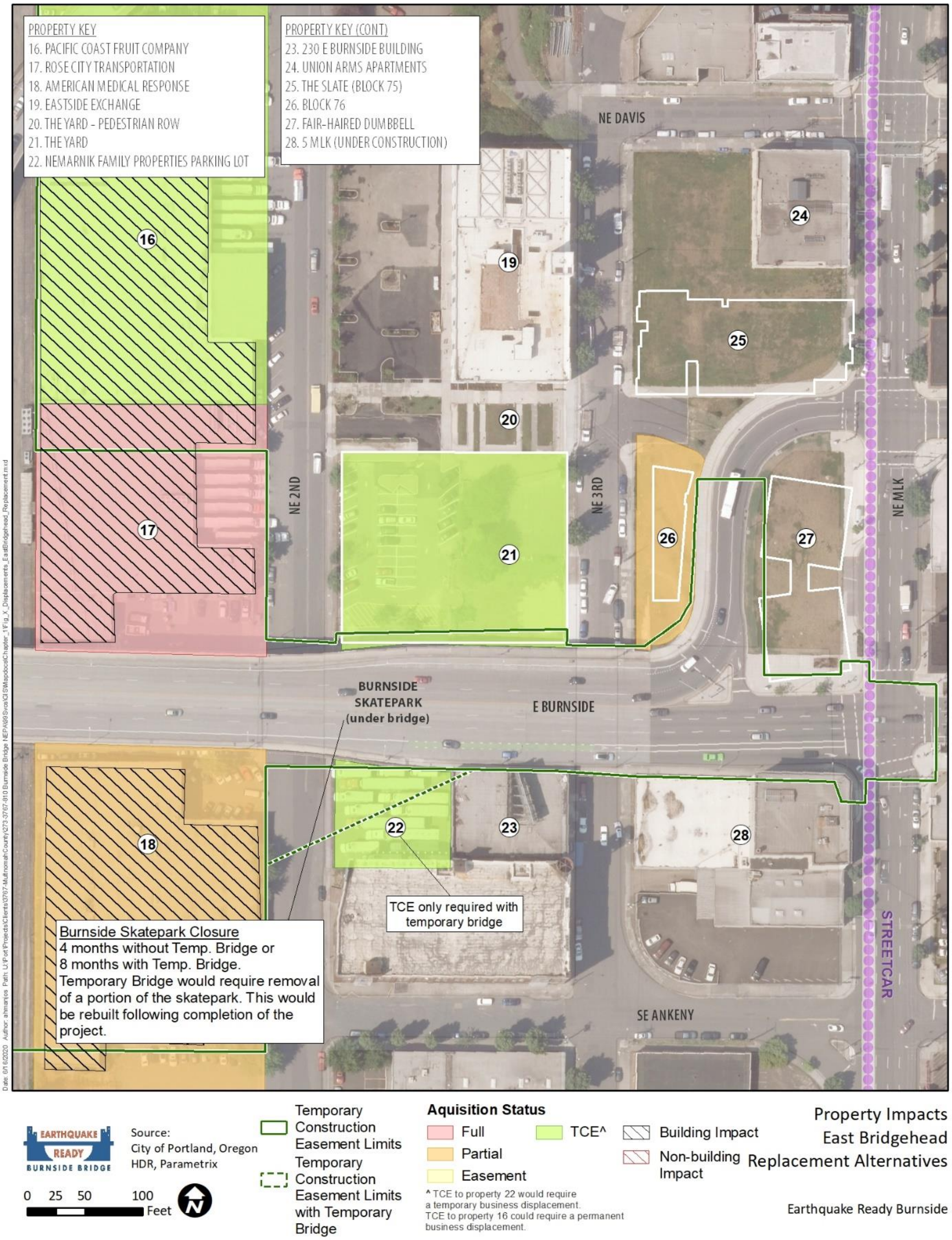
Source: City of Portland, HDR, Parametrix

Figure 39. Property Acquisitions and Displacements, East Side – Retrofit Alternative



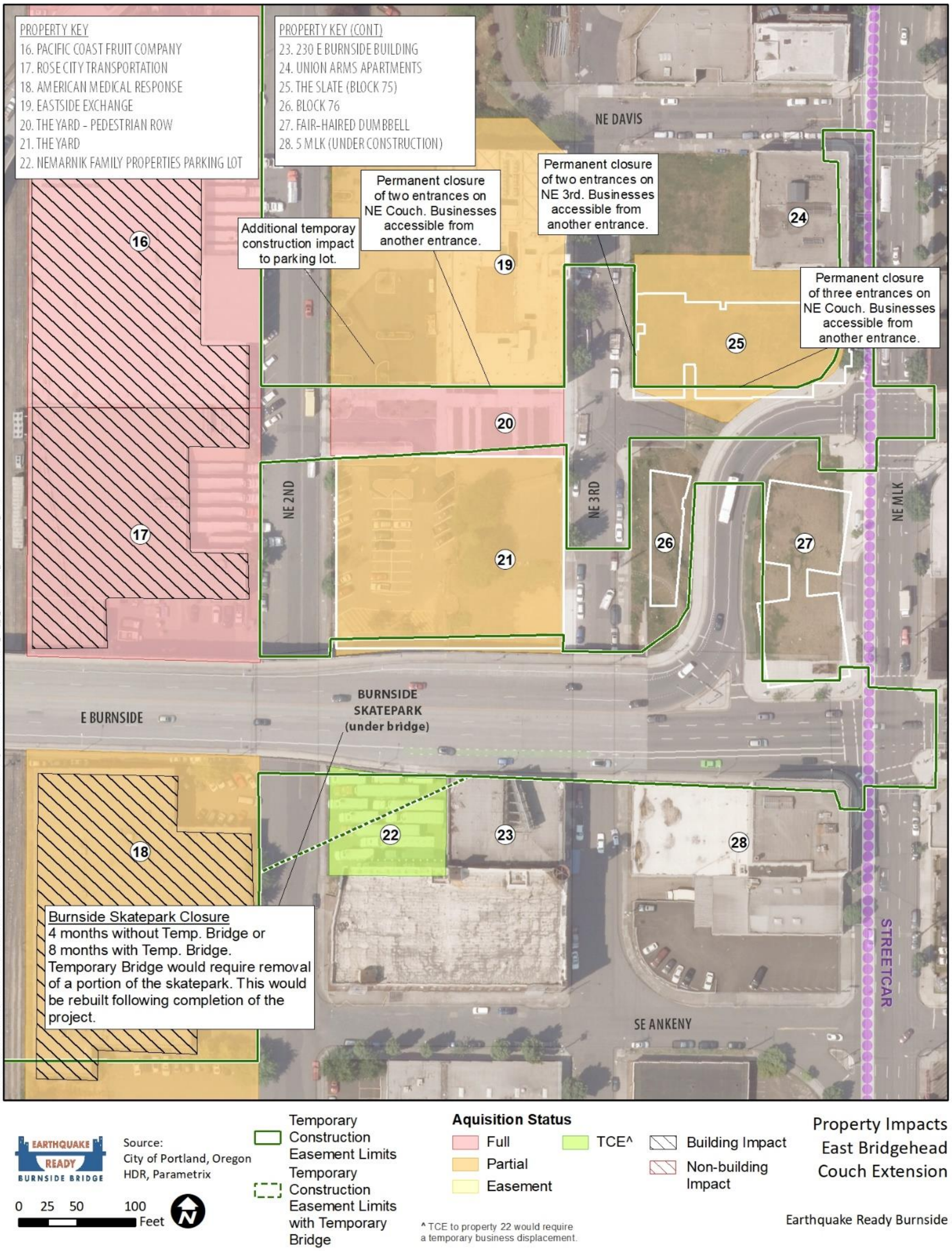
Source: City of Portland, HDR, Parametrix

Figure 40. Property Acquisitions and Displacements, East Side – Short-Span or Long-Span Alternative



Source: City of Portland, HDR, Parametrix

Figure 41. Property Acquisitions and Displacements, East Side – Couch Extension



Source: City of Portland, HDR, Parametrix

Table 7.2-8. Individual Property Acquisitions and Displacement

ID	TLID	Property Name	Retrofit (bus. displ.)	Short-span Alternative (bus. displ.)	Long-span Alternative (bus. displ.)	Couch Extension (bus. displ.)	Temp. Bridge (bus. displ.)
1	1N1E34CA - 09200	Central City Concern (Shoreline Building)	-	TCE Access	TCE Access	TCE Access	-
2	1N1E34DB - 00900	Portland Rescue Mission	TCE Access (1[a])	TCE Access	TCE Access	TCE Access	-
3	1N1E34DB - 01500	Portland Saturday Market Storage (City of Portland)	Easement	Easement	Easement	Easement	-
4	1N1E34DB - 01400	University of Oregon Retail Space (City of Portland)	Full[b] (1)	Full[b] (1)	Full[b] (1)	Full[b] (1)	-
5	1N1E34DC - 00800	Saturday Market Administration Offices (Skidmore Fountain Plaza, LLC)	Full[c] (1)	Full[c] (1)	Full[c] (1)	Full[c] (1)	-
6	1N1E34CD - 00300	Salvation Army	-	TCE Access	TCE Access	TCE Access	-
7	1N1E34CD - 00100	Vacant Lot (Skidmore Fountain Plaza, LLC)	Full	Full	Full	Full	-
8	1N1E34DC - 00900	Diamond Parking Services (Skidmore Fountain Plaza, LLC)	Full[d] (1)	Full[d] (1)	Full[d] (1)	Full[d] (1)	-
9	1N1E34DC - 01000	Diamond Parking Services (Skidmore Fountain Plaza, LLC)	Full	Full	Full	Full	-
10	1N1E34DB - 00600	University of Oregon (White Stag Building)	TCE Access	TCE Access	TCE Access	TCE Access	-
11	1N1E34DC - 90000	Mercy Corps	TCE	TCE	TCE	TCE	-
12	1N1E34DB - 01300	Japanese American Plaza (City of Portland)	Easement & TCE	Easement & TCE	TCE	Easement & TCE	-

ID	TLID	Property Name	Retrofit (bus. displ.)	Short-span Alternative (bus. displ.)	Long-span Alternative (bus. displ.)	Couch Extension (bus. displ.)	Temp. Bridge (bus. displ.)
13	1N1E34DC - 03600	Ankeny Plaza Structure (City of Portland)	Easement & TCE	Easement & TCE	TCE	Easement & TCE	-
14	1N1E34DC - 00100	BES Pump Station (City of Portland)	Easement & TCE	Easement & TCE	TCE	Easement & TCE	-
15	1N1E34DC - 03700	Bill Naito Legacy Fountain (City of Portland)	-	-	-	-	TCE
16	1N1E34DA - 01500	Pacific Coast Fruit Company	TCE[e] (1)	TCE[e] (1)	TCE[e] (1)	Full (1)	-
17	1N1E34DA - 01900	Rose City Transportation (David Nemarnik)	Full (1)	Full (1)	Full (1)	Full (1)	-
18	1N1E34DD - 01000	American Medical Response (Produce Row LLC)	Partial (1)	Partial (1)	Partial (1)	Partial (1)	-
19	1N1E34DA - 02800	Eastside Exchange Building (Bridgehead Development LLC)	-	-	-	Partial & TCE Access	-
20	1N1E34DA - 02602	The Yard – Pedestrian / Bike ROW (Bridgehead Development LLC)	-	-	-	Full	-
21	1N1E34DA - 02001	The Yard (Yard Residences LLC)	TCE	TCE	TCE	Partial & TCE	-
22	1N1E34DD - 00900	Nemarnik Family Properties Parking Lot	-	-	-	-	TCE (1)
23	1N1E34DD - 00700	230 E Burnside Building (Templeton Office Investments LLC)	TCE Access	TCE Access	TCE Access	TCE Access	-
24	1N1E34DA - 03100	Union Arms Apartments	-	-	-	TCE Access	-
25	1N1E34DA - 02900	The Slate (Block 75)	-	-	-	Partial & TCE Access	-
26	1N1E34DA - 03300	Block 76	Partial	Partial	Partial	TCE Access	-
27	1N1E34DA-3500	Fair-Haired Dumbbell	-	TCE Access	TCE Access	TCE Access	-

ID	TLID	Property Name	Retrofit (bus. displ.)	Short-span Alternative (bus. displ.)	Long-span Alternative (bus. displ.)	Couch Extension (bus. displ.)	Temp. Bridge (bus. displ.)
28	1N1E34DD - 00100	5 MLK (Under Construction)	TCE Access	TCE Access	TCE Access	TCE Access	-
A	NA	Willamette River (Dept. of State Lands)	Easement & TCE	Easement & TCE	TCE	Easement & TCE	-
B	NA	Eastbank Esplanade (City of Portland)	TCE	TCE	TCE	TCE	-
C	NA	I-5 & I-84 (ODOT)	Easement & TCE	Easement & TCE	TCE	Easement & TCE	-
D	NA	Union Pacific Railroad	TCE	TCE	TCE	Easement & TCE	-

TLID = Tax lot ID | Full = Full Acquisition | Partial = Partial Acquisition | Easement = Permanent Easement = | TCE = Temporary Construction Easement | TCE Access = Temporary Construction Easement for accesses only | bus. displ. = business displacements | Temp. = Temporary

a Under the Retrofit Alternative the Portland Rescue Mission will require Temporary Relocation for two to three months during construction due to their primary access being blocked.

b The University of Oregon uses this space and they are identified as a business displacement of personal property.

c Saturday Market would be permanently displaced from their administration offices but would only be temporarily displaced from their market location on the waterfront. A single permanent displacement has been tallied for this business.

d Diamond Parking Services would be displaced from Map IDs 8 and 9 but are only counted as one business displacement.

e The Retrofit and Replacement with Short-span and Long-span Approach Alternatives could potentially displace the Pacific Coast Fruit Company business due to impacts to the Rose City Transportation building next door which shares a wall. Because of the uncertainty surrounding the building impacts and the duration of the closure (greater than 12 months), Pacific Coast Fruit Company is being included as a business displacement.

More details on acquisitions and displacements are included in Appendix E of the EQRB Construction Approach Technical Report (Multnomah County 2021d) and in the EQRB Acquisitions and Displacements Technical Report (Multnomah County 2021a).

Temporary Use of Waterfront Park

Construction would temporarily use portions of Waterfront Park that would temporarily displace the Saturday Market for up to 3.5 to 6.5 years, and temporarily prohibit other uses in the affected portion of the park.

- The total duration of a Saturday Market closure would be shortest with the Long-span Alternative without a temporary bridge.
- The total duration of a Saturday Market closure would be second shortest with the Retrofit Alternative without a temporary bridge.
- The total duration of a Saturday Market closure would be longest with the Short-span Alternative with a temporary bridge.

For all Build Alternatives, the contractor would likely need to conduct staging and other activities in the area south of the existing bridge to the southern edge of the Ankeny Plaza Structure. The structure would be disassembled during construction and then reassembled/reconstructed afterward. For the Temporary Bridge Option, a portion of the hardscape north of the Bill Naito Legacy Fountain would be needed for staging, and the fountain would be closed for the duration of construction. See 7.2 and 7.3.

Temporary Use and Potential Removal of Burnside Skatepark

The Burnside Skatepark is situated directly beneath the bridge on the east side. For the Retrofit Alternative, the skatepark would need to be evacuated and demolished during construction due to the strut work between Bents 25 and 26 and pier strengthening that would be needed. For the Replacement Alternatives without a temporary bridge, the skate park could remain relatively unaffected during construction since the work occurring would be over the skatepark; however, intermittent skatepark closures would still be required for overhead work. For any of the Replacement Alternatives with a temporary bridge, partial demolition of the skatepark would be necessary to construct and stage the work (see Figure 42). The following list of activities would directly impact the skatepark:

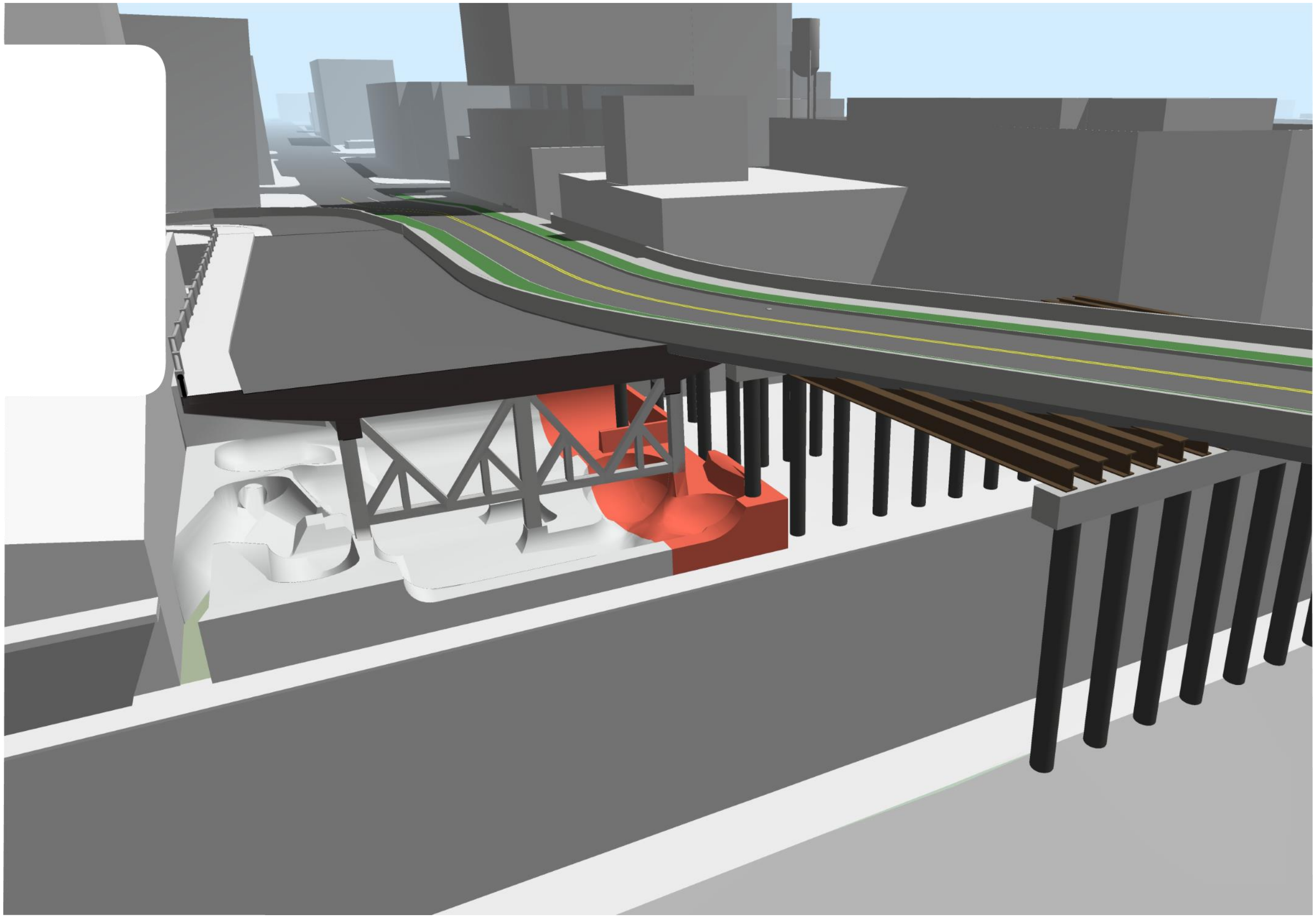
- Deck demolition (Retrofit)
- Complete structure demolition while leaving existing Bent 25 in place (all Replacement Alternatives)
- Installation of longitudinal struts (Retrofit)
- Girder erection on east approach (all Replacement Alternatives)
- Superstructure construction on east approach (all Build Alternatives)
- Girder erection on east approach associated with temporary bridge construction (All Replacement Alternatives with a temporary bridge)

Temporary Use of Public Property

Construction activities would require temporary use of publicly owned property, such as the following:

- Parking lots on city right-of-way under the bridge on both sides of the river that are being leased to adjacent property owners. These City lease agreements include bridge maintenance clauses.
- Temporary and permanent easements would be needed over and under the Willamette River and would be secured via the Oregon Department of State Land easement application process.
- Potential construction staging areas.

Figure 42. Partial Demolition of Burnside Skatepark for Temporary Bridge Construction (All Replacement Alternatives with Temporary Bridge)



7.2.10 Tree Removal During Construction

For all Build Alternatives, construction activities would require removing trees in the following locations:

- In Waterfront Park between the bridge and the paved area of the Japanese American Memorial (including four large trees and 20 or more smaller trees located in the park).
- Street trees along Burnside Street east of 2nd Avenue (10 to 12 trees).
- Street trees around the American Medical Response building on the east side.

The number of trees would be about the same for the different Build Alternatives, but would vary depending on whether or not a temporary bridge is built during construction. All of the temporary bridge options would remove six additional large trees located in Waterfront Park south of the Burnside Bridge and north of the open area south of the Ankeny Plaza fountain. Without a temporary bridge, these tree removals would be avoided.

7.2.11 Construction Equipment

The specific equipment that would be used during construction would depend upon the contractor’s chosen means and methods. General equipment usage includes 2 large drills, 2 mid-sized drills, 2 barge setups, 8 larger crawler cranes, 2 to 4 forklifts, 4 to 10 manlifts, 40 pickup trucks, 10 air compressors, and 10 generators.

7.3 Construction Traffic Management Options

Traffic would not be able to cross the existing Burnside Bridge during construction of any of the Build Alternatives. The EIS will evaluate two basic options for managing cross-river traffic during construction:

- With a Temporary Detour Bridge (with three modal options)
- Without a Temporary Detour Bridge

The Temporary Detour Bridge Option will be evaluated with three different modal options:

1. Two general traffic lanes (one in each direction) allowing all motor vehicles, bike lanes, and sidewalks.
2. Two bus-only lanes (no other motor vehicles), bike lanes, and sidewalks.
3. Bicycles and pedestrians only (no motor vehicles).

Any of the three temporary bridge options, as well as the No Temporary Bridge Option, could be paired with any of the Build Alternatives.

7.3.1 With a Temporary Detour Bridge

In order to allow some level of vehicular, pedestrian, and bicycle traffic to cross the river within the Burnside Corridor during construction, a temporary bridge could be built that would carry up to two traffic lanes as well as pedestrians and bicycles across the river.

This bridge would be constructed to the south of the permanent bridge and tie in to the permanent east and west approach spans (see Appendix A of the EQRB Construction Approach Technical Report [Multnomah County 2021d] for approximate locations). See Figure 42 and Figure 43 for a cross section and plan view of the Temporary Detour Bridge with traffic options. Due to the tie-in locations, the last several spans of the east and west approaches would need to be constructed in halves to accommodate traffic.

Crossing Closures During Construction

A temporary detour bridge would help reduce the duration of impacts on cross-river travel for different modes. Table 7.3-1 shows estimated closure durations for different modes, by Build Alternative.

Table 7.3-1. Modal Closure Durations during Construction by Temporary Bridge Option

Alternative	Without Temporary Bridge	Temporary Bridge Gen. Traffic, Bike Pedestrian	Temporary Bridge Transit/Bike/Pedestrian	Temporary Bridge Bike/Pedestrian Only
Retrofit Alternative	2 years, all modes	1 week, all modes	1 week, buses, bikes, peds 2 years, all other vehicles	1 week, bikes, peds 2 years, all vehicles
Short-span Alternative	4 years, all modes	1 week, all modes	1 week, buses, bikes, peds 4 years, all other vehicles	1 week, bikes, peds 4 years, all vehicles
Long-span Alternative	4 years, all modes	1 week, all modes	1 week, buses, bikes, peds 4 years, all other vehicles	1 week, bikes, peds 4 years, all vehicles
Couch Extension	4 years, all modes	1 week, all modes	1 week, buses, bikes, peds 4 years, all other vehicles	1 week, bikes, peds 4 years, all vehicles

Note: While the temporary bridge with two general traffic lanes would require only a brief full closure of the crossing, it would not accommodate all of the bridge's current vehicle travel demands. Traffic diversion is evaluated in the EQRB Transportation Technical Report (Multnomah County 2021).

See Section 2.2.4 of the EQRB Construction Approach Technical Report (Multnomah County 2021d) for additional details on temporary bridge construction.

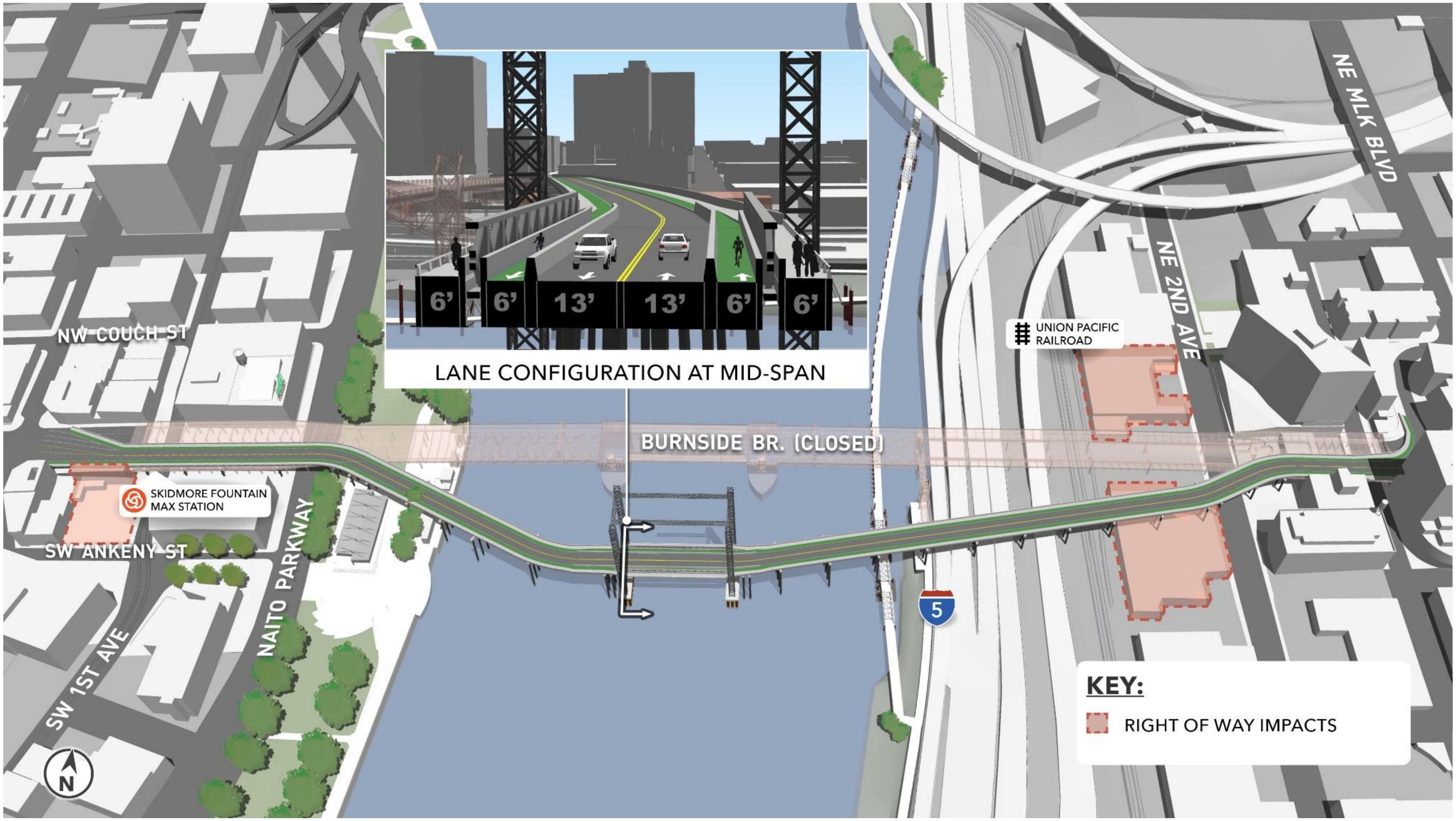
All of the temporary bridge options would allow emergency vehicle access.

Temporary Bridge Construction and the Navigation Channel

Over the active navigation channel (between Piers 2 and 3), the temporary bridge would include a movable lift section that would raise when needed to accommodate river traffic up to 147 feet above OHW. Although several options would be feasible for a temporary lift bridge, the EIS is based on a modular truss as one feasible option for spanning the channel and providing enough width for two vehicle lanes, pedestrians, and bicycles. The modular bridge would be pre-constructed on a barge and then floated into place and hoisted into position using the temporary bridge's lifting cables. Installation of the lift truss would require the navigable channel to be temporarily shut down. Performing this operation would require substantial planning and coordination with the USCG to ensure a proper window is selected that results in minimal disruption to marine traffic. A similar closure window would be required at the end of the Project to remove the temporary lift span.

Figure 43. Temporary Detour Bridge Profile with Traffic (or Transit Only) – Aerial View

(Inset – Mid-span Cross sections)



Pile Installation for a Temporary Bridge

The temporary bridge would be founded on steel piles, both on land and in the water (Willamette River). Piles would be driven using conventional methods, and it is assumed that vibration monitoring equipment would be placed throughout the site to monitor vibration caused by pile driving. During the final design phase, it could be determined that certain utilities are more vulnerable or sensitive to vibration, in which case, the pile holes could be pre-drilled to avoid vibratory installation techniques.

A temporary bridge would require a substantial number of piles to support the temporary approach spans, in-water spans, and the movable portion of the temporary bridge. Any in-water piles would need to be installed using barge-mounted equipment (cranes) within the Willamette River regulatory in-water work window (July 10 to October 15). The contractor would also be limited to a certain number of blows (impact hits) and a limited number of piles per day when driving piles. This restriction does not apply to vibratory installation methods. The contractor would likely need to use a combination of vibratory and driving methods to attain the required embedment and stay in compliance with limitations on pile driving. Typically, this is accomplished by using a vibratory hammer to install a pile as deep as possible and then driving the pile the remainder of the way to refusal. Actual restrictions on pile driving (in terms of number of blows and number of piles) are still in development.

The number of in-water piles estimated for the temporary bridge is 350, and the number of piles estimated for the work bridge is 300. This means that in a standard pile/vibratory in-water work window, the contractor would need to impact 10 piles per day to refusal to install all piles in one in-water work window.

Temporary Bridge Installation over I-5, I-84, and UPRR

The temporary bridge would need to span over mainline I-5, the Morrison off-ramp, the I-84 westbound to I-5 southbound on-ramp, and the I-5 northbound to I-84 eastbound ramp in a single span. This span (about 170 feet) would need to be set during a full closure of I-5, the I-84 ramps, and the Morrison exit. Due to an assumed limited closure window, it is likely that the temporary bridge would need to be pre-built and launched or lifted into place. The temporary bridge would also span the UPRR railroad tracks. Setting the temporary bridge over these tracks would involve coordination with UPRR to ensure that there is a long enough track window to lift the span into place with a crane that would likely be set up on the ODOT access road adjacent to the UPRR tracks. Installation would also require temporarily closing the Eastbank Esplanade and rerouting users.

7.3.2 No Temporary Bridge (Full Closure During Construction)

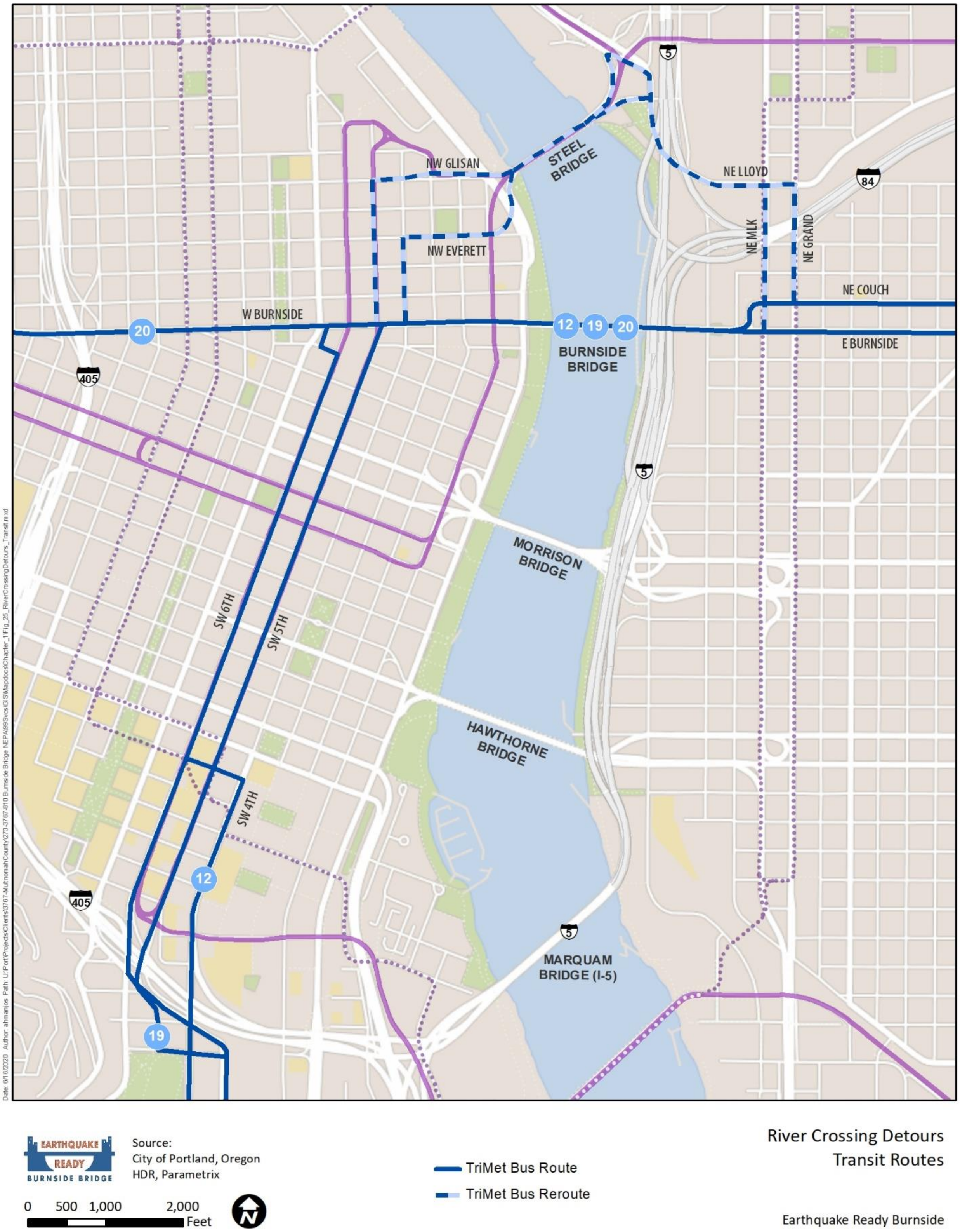
The Project is evaluating the option to not install a temporary bridge during construction. Traffic management could include rerouting vehicular, transit, bicycle, and pedestrian trips to other river crossings, as well as potentially implementing travel demand and transportation system management to reduce trips and encourage more transit, pedestrian, and bicycle use. Traffic management measures are discussed in the Transportation section of the Environmental Consequences chapter of the EIS. While rerouting would increase trip length for many travelers that typically use the Burnside crossing, it would also reduce the duration of Project construction, substantially reduce Project costs, and avoid the adverse impacts described above for constructing a temporary bridge.

Figure 44 shows that buses currently using the Burnside Bridge would need to use alternate routes when the crossing is closed with the No Temporary Bridge Option or the Pedestrian Only Temporary Bridge Option, as well as during the short-term closures needed before transitioning traffic to and then away from the temporary bridge that will allow motor vehicles.

Figure 45 shows the expected detour routes for bicyclists during temporary closures of the Burnside crossing, the Eastbank Esplanade, and the Waterfront Park Trail. Figure 46 shows the same information for pedestrians.

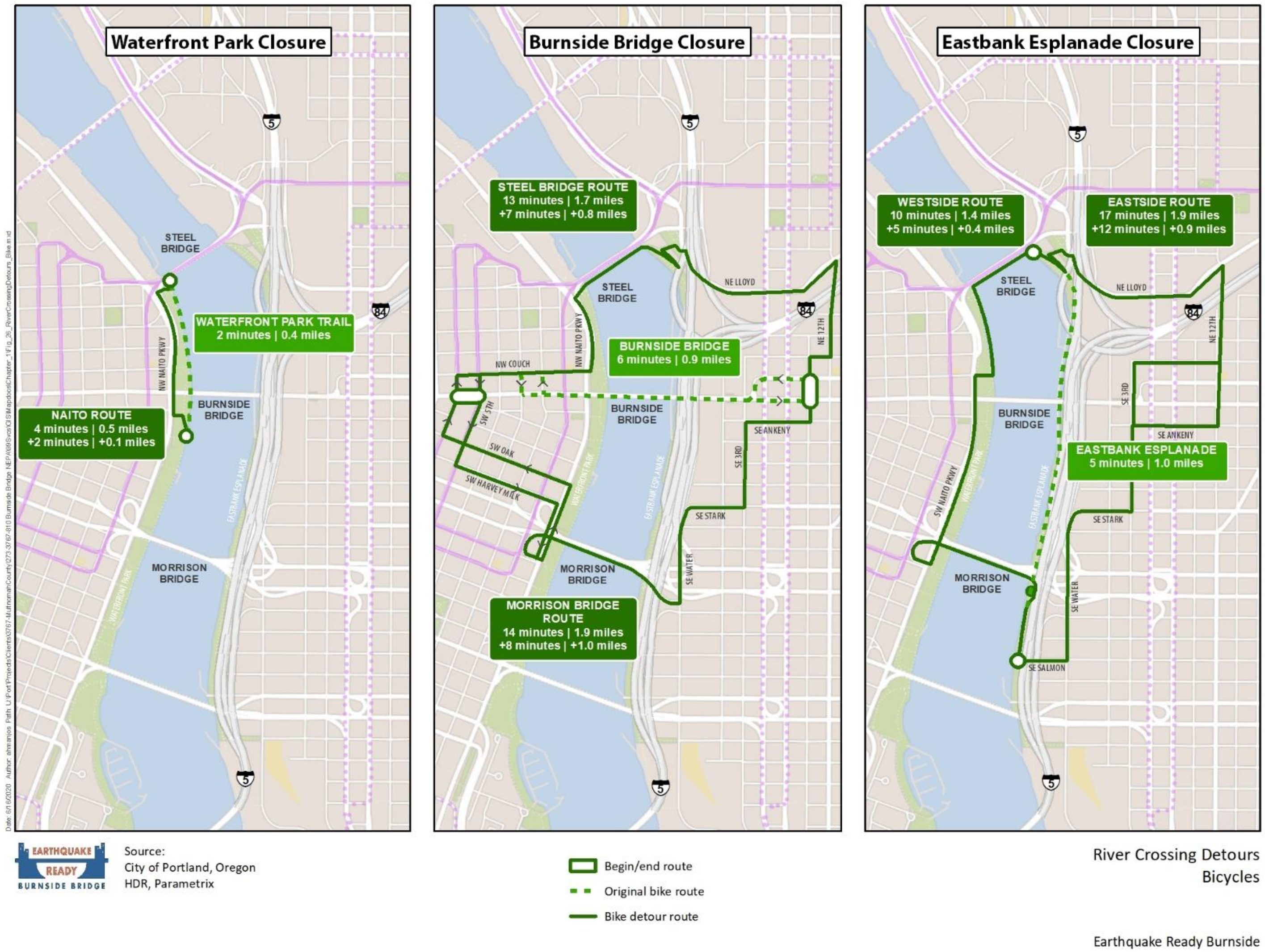
Other bridges adjacent to the Burnside Bridge carry more large freight trucks than does the Burnside Bridge, primarily because of their better connectivity to I-5. Depending on their destinations, freight trucks that would typically use the Burnside Bridge would likely use the Morrison Bridge or other bridges during construction. Over the long term, construction of the Build Alternatives would eliminate the current weight restrictions; some freight vehicles are expected to divert to the Burnside Bridge, with the highest likelihood of that being with the Couch Extension Alternative.

Figure 44. Likely Transit Detour Routes During Construction



Source: City of Portland, HDR, Parametrix

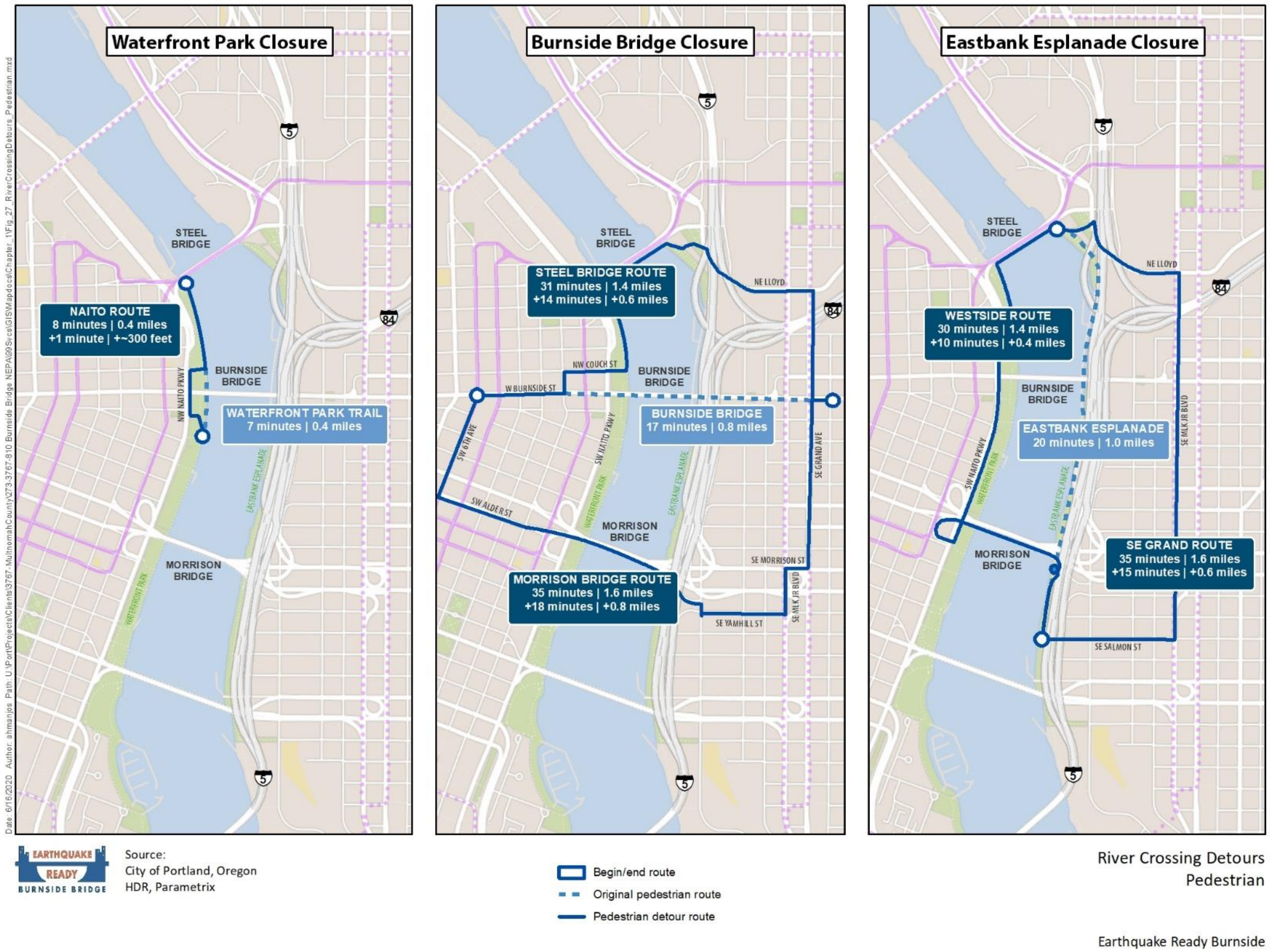
Figure 45. Likely Bicycle Detour Routes During Construction



Source:
City of Portland, Oregon
HDR, Parametrix

Source: City of Portland, HDR, Parametrix

Figure 46. Likely Pedestrian Detour Routes During Construction



Source: City of Portland, HDR, Parametrix

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