Soils and Geology Supplemental Memorandum

Multnomah County | Earthquake Ready Burnside Bridge Project

Portland, OR

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Earthquake Ready Burnside Bridge Soils and Geology Supplemental Memorandum

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Acronyms, Initialisms, and Abbreviations

ADA	Americans with Disabilities Act
API	Area of Potential Impact
DEIS	Draft Environmental Impact Statement
EIS	environmental impact statement
EQRB	Earthquake Ready Burnside Bridge
SDEIS	Supplemental Draft Environmental Impact Statement

Executive Summary

This supplemental soils and geology technical memorandum evaluates the impacts of potential design refinements to the Draft EIS Preferred Alternative on soils and geology within the project's Area of Potential Impact (API). The intent of the design refinements is to reduce the overall cost and improve the affordability of the Earthquake Ready Burnside Bridge (EQRB) Project. This technical memorandum is a supplement to the *EQRB Soils and Geology Technical Report* (Multnomah County 2021e) and as such does not repeat all of the information presented in that report, but instead focuses on the impacts of the design modification options, how they compare to each other, and how they compare to the version of the Preferred Alternative that was evaluated in the *EQRB Draft Environmental Impact Statement* (Multnomah County 2021d).

The affected environment for the Refined Long-span Alternative is the same that was included in the Draft EIS. Similarly, the analysis methodology is also the same as used in the Draft EIS. With respect to soils and geology, there are no differences in regulations with the Refined Long-span Alternative.

As with the Draft EIS Long-span Alternative (the Preferred Alternative) that was evaluated in the Draft EIS, the Refined Long-span Alternative would be supported on multi-column concrete bents founded on large drilled shafts up to 12 feet in diameter. Movable spans would be supported on a group of large-diameter shafts encased in a large footing cap referred to as bents. Also similar to the Draft EIS Long-span Alternative, design modifications also include a bascule bridge option and a vertical lift bridge option representing movable span options. The vertical lift bridge is slightly lighter than the bascule spans, and therefore, could have a slight decrease in the foundation size. The Refined Long-span Alternative also has a tied-arch option and a cable-stayed option. The Refined Long-span Alternative also includes a northwest and southwest elevator and stair bridge access point expected for bike, pedestrian, and Americans with Disabilities Act (ADA) access for both the west and east approach that would utilize foundation shafts.

Comparison of the number of shafts and overall total diameters of shafts indicates that the Refined Long-span Alternative has fewer shafts and a lower overall total diameter of shafts than the Draft EIS Long-span Alternative. The Refined Long-span Alternative with tied-arch and vertical lift bridge options would have the lowest number of shafts and total overall shaft diameter. A decrease in the number of shafts and the total overall shaft diameter represents a reduction in the area and volume of soils and geology that would be impacted by construction of the Project.

The current designs and construction assumptions for the Long-span (both Draft EIS and Refined) Alternatives incorporate measures to meet the seismic design criteria established for the Project. Bridge foundations and other bridge elements would be improved or constructed, and soil improvements would be implemented to address identified poor soil strength and potential for liquefaction in response to a seismic event. These design and construction measures are summarized in the Draft EIS and described in detail in the various design reports.

1 Introduction

In support of the Supplemental Draft Environmental Impact Statement (SDEIS) for the Earthquake Ready Burnside Bridge (EQRB) Project, this supplemental memorandum has been prepared to evaluate the impacts of potential design refinements to the Preferred Alternative on soils and geology within the project's Area of Potential Impact (API). The intent of the design modifications is to reduce the overall cost and improve the affordability of the EQRB Project. This technical memorandum is a supplement to the Draft EIS technical reports and as such does not repeat all of the information in those reports, but instead focuses on the impacts of the design modification options, how they compare to each other, and how they compare to the version of the Preferred Alternative that was evaluated in the *EQRB Draft Environmental Impact Statement* (Multnomah County 2021d).

Much of the information included in the Draft EIS and Draft EIS technical reports, including project purpose, relevant regulations, analysis methodology and affected environment, is incorporated by reference because it has not changed, except where noted in this technical memorandum.

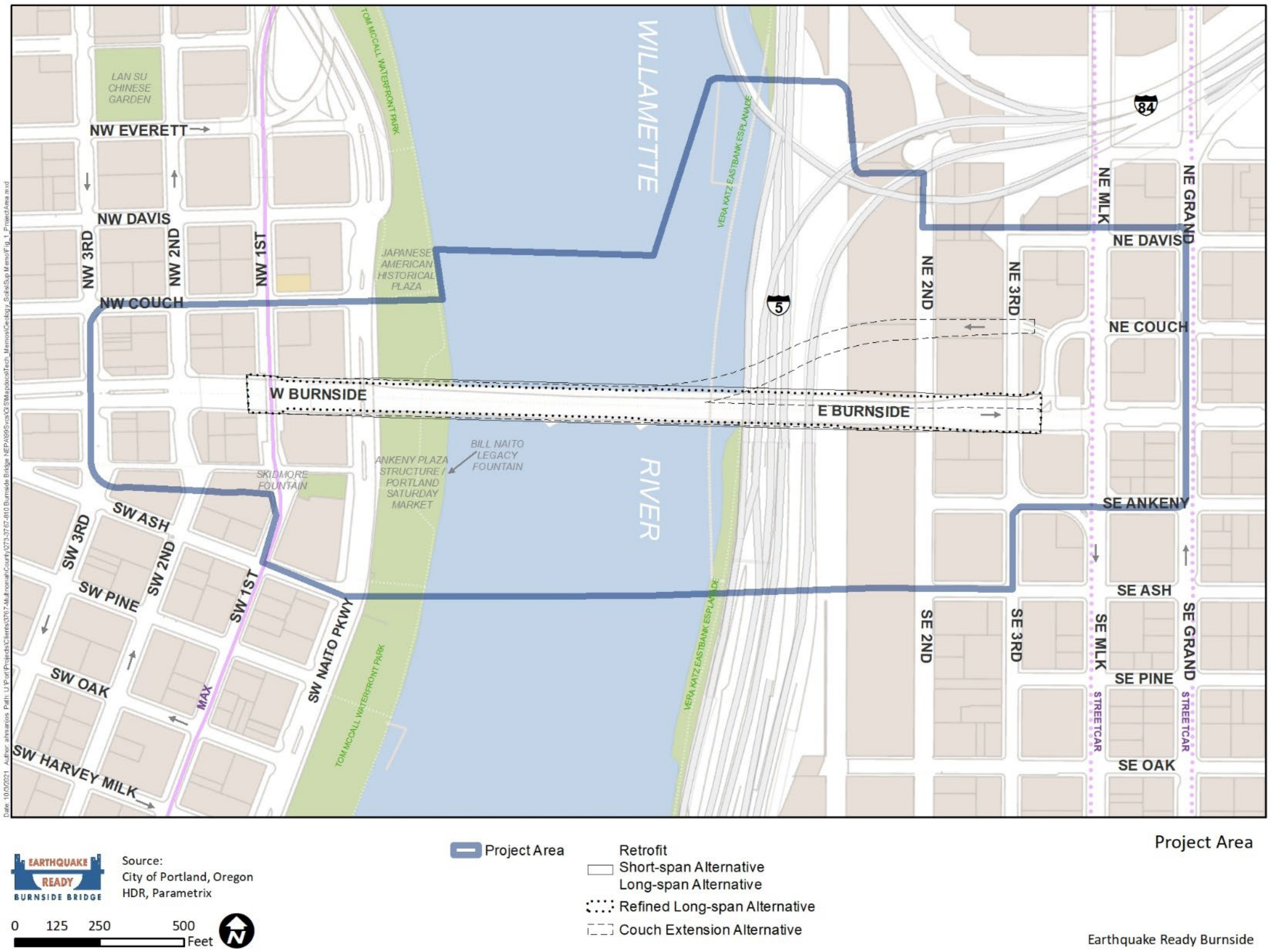
1.1 Project Location

The Project Area is located within the central city of Portland. The Burnside Bridge crosses the Willamette River connecting the west and east sides of the city. The Project Area encompasses a one-block radius around the existing Burnside Bridge and W/E Burnside Street, from NW/SW 3rd Avenue on the west side of the river and NE/SE Grand Avenue on the east side. Several neighborhoods surround the area including Old Town/Chinatown, Downtown, Kerns, and Buckman. Figure 1 shows the Project Area.

1.2 Project Purpose

The primary purpose of the Project is to build a seismically resilient Burnside Street lifeline crossing over the Willamette River that will remain fully operational and accessible for vehicles and other modes of transportation following a major Cascadia Subduction Zone earthquake. The Burnside Bridge will provide a reliable crossing for emergency response, evacuation, and economic recovery after an earthquake. Additionally, the bridge will provide a long-term safe crossing with low-maintenance needs.

Figure 1. Project Area



2 Project Alternatives

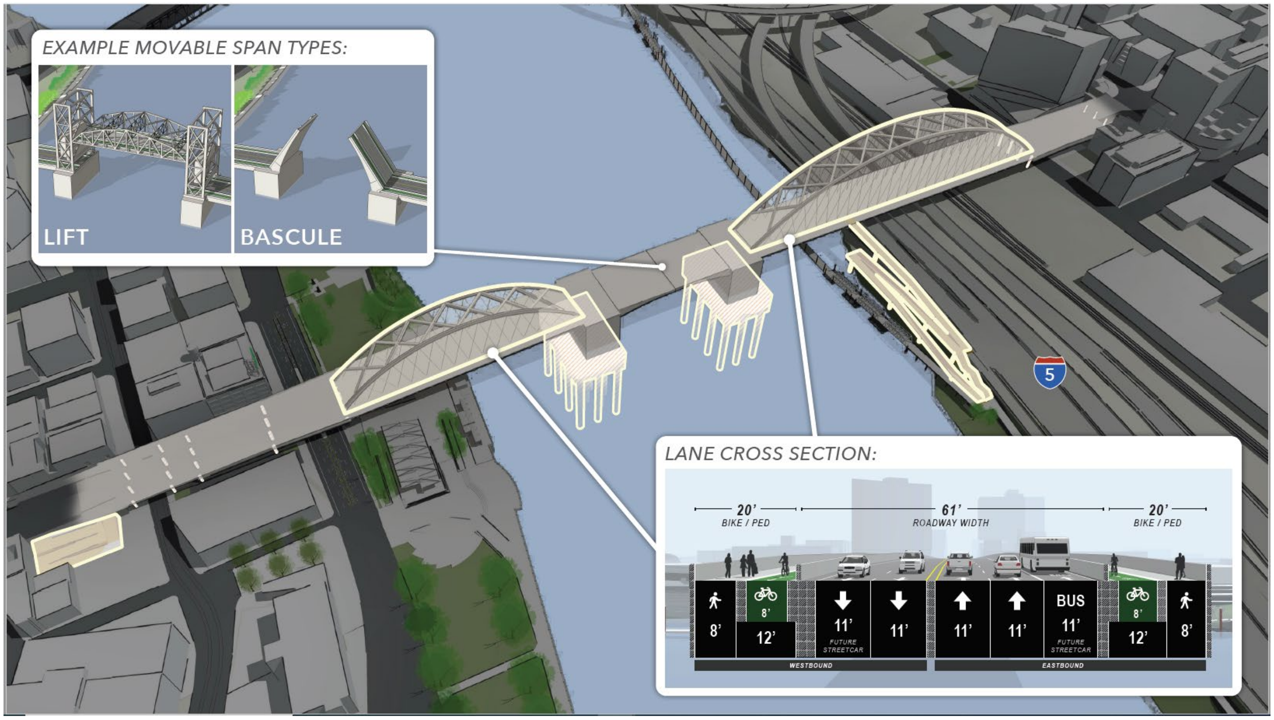
This technical memorandum evaluates potential design refinements to the Draft EIS Preferred Alternative. All of the Project Alternatives evaluated in the Draft EIS are summarized in Chapter 2 of the Draft EIS and described in detail in the *EQRB Description of Alternatives Report* (Multnomah County 2021b). Briefly, the Draft EIS evaluated a No-Build Alternative and four Build Alternatives. One of the Build Alternatives, the Long-span Alternative, was identified as the Preferred Alternative. The potential refinements evaluated in this technical memorandum are collectively referred to as the Refined Long-span Alternative (Four-lane Version) or the Refined Long-span. The Refined Long-span includes Project elements that were studied in the Draft EIS but have been modified as well as new options that were not studied in the Draft EIS. These refinements and new options are intended to provide lower cost and, in some cases, lower impact designs and ideas that could be adopted to reduce the cost of the Draft EIS Preferred Alternative while still achieving seismic resiliency. The potential design refinements, and how they differ from the Draft EIS Long-span Alternative, are described below.

- Bridge width – The total width of the bridge over the river would be approximately 82 to 93 feet (the range varies depending on the bridge type and segment). For comparison, the Draft EIS Replacement Alternatives were approximately 110 to 120 feet wide over the river. The refined bridge width would accommodate approximately 78 feet for vehicle lanes, bike lanes, and pedestrians, which is comparable to the existing bridge.
    - The refined bridge design would accommodate four vehicle lanes (rather than five as evaluated in the Draft EIS). The following lane configuration options are being evaluated:
        - Lane Option 1 (Balanced) – Two westbound lanes (general-purpose) plus two eastbound lanes (one general-purpose and one bus-only lane)
        - Lane Option 2 (Eastbound Focus) – One westbound lane (general-purpose) plus three eastbound lanes (two general purpose and one bus only)
        - Lane Option 3 (Reversible Lane) – One westbound lane (general-purpose) plus two eastbound lanes (one general-purpose and one bus-only) plus one reversible lane (westbound AM peak and eastbound PM peak)
        - Lane Option 4 (General Purpose with Bus Priority) – Two westbound general-purpose lanes plus two eastbound general-purpose lanes, plus bus priority access (e.g., queue bypass) at each end of the bridge.
    - The width of the vehicle lanes would be, at minimum, 10 feet and could vary depending on how the total bridge width is allocated between the different modes.
    - The total width of the bicycle lanes and pedestrian sidewalks would be approximately 28 to 34 feet. This is wider than the existing bridge but narrower than what was proposed in the Draft EIS for the replacement alternatives. Physical barriers between vehicle lanes and the bicycle lanes would be in addition to the above dimensions.

  - The refined bridge would allow narrower in-water piers, due to less weight needing to be transferred to the in-water supports.
- Other design refinements being evaluated:
  - West approach – This memo evaluates a refined girder bridge type for the approach over the west channel of the river, Gov. Tom McCall Waterfront Park, and Naito Parkway. Compared to the cable-stayed and tied-arch options evaluated in the Draft EIS, this option would not only reduce costs but also avoid an adverse effect to the Skidmore/Old Town National Historic Landmark District. It would have two sets of columns in Waterfront Park compared to just one with the Draft EIS tied-arch option and five with the existing bridge.
  - East approach – This memo evaluates a potential span length change for the east approach tied-arch option that would minimize the risks and reduce costs associated with placing a pier and foundation in the geologic hazard zone that extends from the river to about E 2nd Avenue. The refined tied-arch option would be about 720 to 820 feet long and approximately 150 feet tall (the Draft EIS Long-span Alternative was the same height and 740 feet long). The refined alternative would place the eastern pier of the tied-arch span either on the east side of 2nd Avenue (Option 1) or just west of 2nd Avenue (Option 2). Increasing the length of the tied-arch span would also reduce the length and depth of the subsequent girder span to the east.
  - Americans with Disabilities Act (ADA) access – This memo evaluates a refined approach for providing direct ADA access between the bridge and the Vera Katz Eastbank Esplanade, as well as between the bridge and W 1st Avenue and the Skidmore Fountain MAX station. The Draft EIS evaluated multiple ramp, stair, and elevator options for these locations. This SDEIS memo evaluates a refined option that would provide enhanced ADA access at both locations using both elevators and stairs. These facilities would also provide pedestrian and potentially bicycle access. For the west end, there is also the potential for replacing the existing stairs with improved sidewalk access from the west end of the bridge to 1st Avenue.

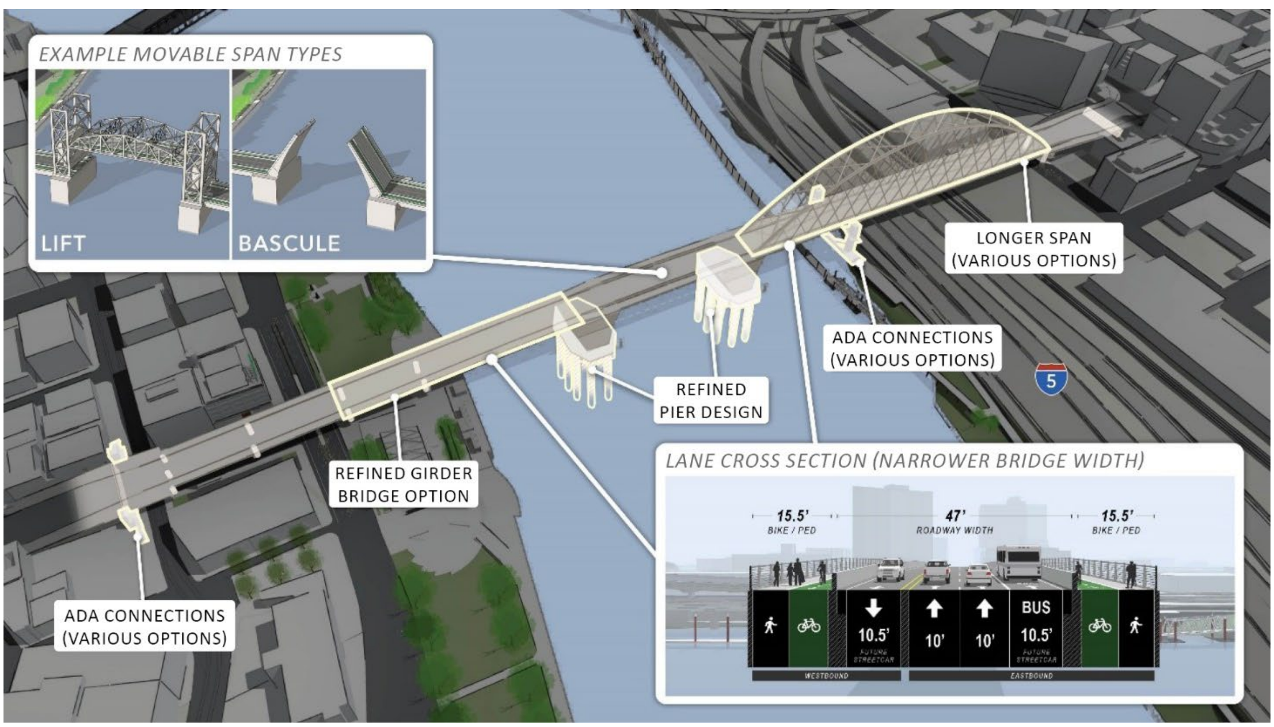
Figure 3 highlights the elements of the Draft EIS Long-span Alternative that have been modified to create the Refined Long-span Alternative, as described above. Figure 2 shows the Draft EIS Long-span Alternative and Figure 3 shows the Refined Long-span Alternative. Both figures include the tied-arch option for the east approach and the bascule option for the center movable span, but the east span could also be a cable-stayed bridge and the movable span could be a vertical lift bridge. For the west approach, the Draft EIS Long-span Alternative shows the tied-arch option while the Refined Long-span shows the refined girder bridge. The Refined Long-span Alternative image shows just one of the four possible lane configuration options being studied. All four configuration options, as well as more graphics of the Refined Long-span Alternative and how it compares to the Draft EIS Long-span Alternative, can be found in Chapter 2 of the *EQRB Supplemental Draft Environmental Impact Statement* (Multnomah County 2022b). Figure 3 also shows just one of the possible ways to allocate the bridge width between vehicle lanes, bicycle lanes, and sidewalks; the total width of the bicycle and pedestrian facilities could range from approximately 28 to 34 feet.

Figure 2. Draft EIS Long-Span Alternative



Note: The Draft EIS Long-span Alternative included multiple bridge types for both the east and west approaches. This figure shows only the tied-arch option.

Figure 3. Refined Long-Span Alternative



Notes: The Refined Long-span Alternative evaluated in this SDEIS includes both cable-stayed and tied-arch options for the east span. This figure shows only the tied-arch option. The Draft EIS studied, and SDEIS further studies, a bascule option and vertical lift option for the center movable span. The inset shows both options but the main figure shows the bascule option. This figure also shows just one of the lane configuration options considered in the SDEIS.

- Construction assumptions:
  - Construction duration – The expected duration of project construction is 4.5 to 5.5 years, dependent upon the design option. See Table 1 for more information regarding construction impact extent and closure timeframes.
  - Construction area – Compared to the Draft EIS Long-span Alternative, the main refinement is that the construction area would be smaller for the west approach south of the bridge, including a smaller area within Waterfront Park south of the bridge,
  - Construction access and staging – The construction access and staging is expected to be the same as that described in the Draft EIS.
  - Vegetation – The Refined Long-span Alternative would remove slightly fewer trees and vegetation impacts than the Draft EIS Long-span, primarily within Waterfront Park south of the bridge.
  - In-water work activity – The in-water work would be similar to that described in the Draft EIS, except that the replacement bridge in-water foundations would consist of a perched footing cap and a group of drilled shafts. Whereas the Draft EIS discussed the use of cofferdams to isolate in water work, the Refined Long-span Alternative proposes to use a temporary caisson lowered to an elevation about mid height of the water column to construct footing caps, avoiding additional disturbance of the riverbed that would needed for a cofferdam. Additionally, the existing Pier 4 would be fully removed, Pier 1 would be partially removed below the mudline and Piers 2 and 3 removed to below the mudline. Existing in water piles would be removed, subject to the design option advanced.
  - Temporary freeway, rail, street, and trail closures – Temporary closures are expected to be the same as those described in the Draft EIS.
  - Access for pedestrians and vehicles to businesses, residences, and public services – Access is expected to be the same as that described in the Draft EIS.
  - On-street parking impacts – On-street parking impacts are expected to be the same as those described in the Draft EIS.
  - Property acquisitions and relocations – Property acquisitions and relocations are similar to those listed in the Draft EIS, except that they have been modified to reflect a narrower set of bridge design options.
  - Temporary use of Governor Tom McCall Waterfront Park – The park area that would be temporarily closed for construction has changed since the Draft EIS. On the north side of the bridge, the closure area has been reduced to avoid removing 10 cherry trees and a berm that are part of the Japanese American Historical Plaza; this change would apply to all of the Build Alternatives. On the south side of the bridge, the park closure area has also been reduced to include only the area north of the Waterfront Park trellis; this revision applies only to the Refined Long-span Alternative.

Table 1. Construction Impacts, Closure Extents, and Timeframes by Build Alternative

Facility Impacted	Draft EIS Long-Span Alternative	Refined Long-Span Alternative
Gov. Tom McCall Waterfront Park	4.5-year closure within boundary of potential construction impacts	Same; Smaller closure area south of the bridge
Willamette River Greenway Trail	Portion of trail within Waterfront Park closed for same duration as park; detours in place for construction duration	Same
Japanese American Historical Plaza	Southern portion of plaza would be closed for same duration as Waterfront Park	Same
Ankeny Plaza Structure	Closure for duration of construction but no impacts to Ankeny Plaza structure	Plaza Structure would not be closed during construction or impacted
Bill Naito Legacy Fountain	No closure of fountain and associated hardscape	Same
Vera Katz Eastbank Esplanade	18 months (this could extend to 2 to 3 years if project builds ramps rather than elevators and stairs for the ADA/bicycle/pedestrian connection); detours in place for construction duration	Same
Burnside Skatepark	4 months full closure	Same
River Crossing on Burnside Street	4- to 5-year closure	Same
Saturday Market Location	4.5-year closure or use of alternative location	Same
Skidmore Fountain MAX Station	Approximately 5 weeks	Same
Navigation Channel/Willamette River Water Trail	Intermittent closures; 2 to 10 closures; each closure up to 3 weeks	Same
Overall Construction Duration	**4.5 to 5.5 years**	**Same**

3 Definitions

The following terminology is used when discussing geographic areas in the EIS:

- **Project Area** – The area within which improvements associated with the Project Alternatives would occur and the area needed to construct these improvements. The Project Area includes the area needed to construct all permanent infrastructure, including adjacent parcels where modifications are required for associated work such as utility realignments or upgrades. For the EQRB Project, the Project Area includes approximately a one-block radius around the existing Burnside Bridge and W/E Burnside Street, from NW/SW 3rd Avenue on the west side of the river and NE/SE Grand Avenue on the east side.
- **Area of Potential Impact (API)** – This is the geographic boundary within which physical impacts to the environment could occur with the Project Alternatives. The API is resource-specific and differs depending on the environmental topic being

addressed. For all topics, the API will encompass the Project Area, and for some topics, the geographic extent of the API will be the same as that for the Project Area; for other topics (such as for transportation effects) the API will be substantially larger to account for impacts that could occur outside of the Project Area. The API for soils and geology is defined in Section 5.1 of the *EQRB Soils and Geology Technical Report* (Multnomah County 2021d).

- **Project vicinity** – The environs surrounding the Project Area. The project vicinity does not have a distinct geographic boundary but is used in general discussion to denote the larger area, inclusive of the Old Town/Chinatown, Downtown, Kerns, and Buckman neighborhoods.

4 Relevant Regulations

There are no differences in regulations with the Refined Long-span Alternative.

5 Analysis Methodology

The analysis methodology is the same as was used the Draft EIS.

6 Affected Environment

The affected environment for the Refined Long-span Alternative is the same that was included in the Draft EIS.

7 Impacts from the Design Modifications and Comparison to Draft EIS Alternatives

This section describes the impacts from potential design refinements and how they differ from the Long-span Alternative (Preferred Alternative) that was evaluated in the Draft EIS. This comparison, specific to soils and geology, examines differences in foundation elements, specifically large drilled shafts. A comparison of design refinements to existing conditions (No-Build Alternative) is also presented.

The approach spans for the Refined Long-span Alternative would be supported on multi-column concrete bents founded on large drilled shafts (see the *EQRB Revised Bridge Replacement Technical Report* [Multnomah County 2022a]). Link beams between columns at the top of shaft elevation for select bents would reduce displacements and moments in the bents.

The movable spans would be supported on a group of large-diameter shafts encased in a large footing cap referred to as bents. The use of a seal course for cofferdam dewatering would be needed for installation of these bents. Analysis in the Draft EIS indicates that each bascule bridge and lift bridge pier would be the same as the Short-span Alternative: requiring 18, 12-foot-diameter shafts spaced at a minimum of three shaft diameters (see the *EQRB Bridge Replacement Technical Report* 2021a). Design refinements would also again be the same as the Short-span Alternative.

Similar to the Draft EIS Long-span Alternative, the design refinements also include a bascule bridge option and a vertical lift bridge option. The vertical lift bridge is slightly lighter than the bascule spans, and therefore, could have a slight decrease in the foundation size. The Refined Long-span Alternative also has a tied-arch option and a cable-stayed option.

The Refined Long-span Alternative includes a north and south elevator and stair/bridge access point expected for bike, pedestrian, and ADA access for both the west and east approaches. The west stair/bridge access point is located adjacent to the east side of Bent 2. The east stair/bridge access point is located just east of Bent 10 within the river. These alternative pedestrian connections for the Refined Long-span Alternative include drilled shafts.

Bents 1 through 5 are located west of the Willamette River, Bents 6 and 7 are located in the river, and Bents 8 through 10 are located east of the river. The locations of the bents for the Refined Long-span Alternative are the same locations as for the Draft EIS Long-span Alternative.

Table 2 and Table 3 list the shafts for the Draft EIS Long-span Alternative and the Refined Long-span Alternative. Table 2 provides a comparison with the Refined Long-span Alternative with the tied-arch option, while Table 3 provides comparison with the Refined Long-span Alternative with cable-stayed option.

Table 2. Long-Span Alternative Bridge Bent Shaft Foundations Comparison – Draft EIS Replacement and Refined Alternative with Tied-Arch Option

Support Location	Draft EIS Long-Span Alternative			Refined Long-Span Alternative with Tied-Arch Option		
	Number of Shafts	Shaft Diameter (feet)	Column Diameter (feet)	Number of Shafts	Shaft Diameter (feet)	Column Diameter (feet)
Bent 1	10	3	--	11	3	--
Bent 2	4	7	5	3	10	8
West Pedestrian Connections	-	-	-	2	3	3
Bent 3	4	7	5	2	11	9
Bent 4	4	8	6	2	11	9
Bent 5	8	10	Pier Wall	2	12	10
Bent 6	18 (Bascule Bridge) 14 (Lift Bridge)	12	--	13 (Bascule Bridge) 10 (Lift Bridge)	12	--
Bent 7	18 (Bascule Bridge) 14 (Lift Bridge)	12	--	13 (Bascule Bridge) 10 (Lift Bridge)	12	--
Bent 8	8	10	Pier Wall	2	10	10
Bent 9	4	7	5	4	8	--
Bent 10	13	3	--	9	4	--

Support Location	Draft EIS Long-Span Alternative			Refined Long-Span Alternative with Tied-Arch Option		
	Number of Shafts	Shaft Diameter (feet)	Column Diameter (feet)	Number of Shafts	Shaft Diameter (feet)	Column Diameter (feet)
East Pedestrian Connections	23	7	5	2	12	-
	2	5	3			
Total # Shafts (Bascule Bridge)	116			65		
Total # Shafts (Lift Bridge)	108			59		

As indicated in Table 2, the Refined Long-span Alternative would have 51 fewer shafts than the Draft EIS Long-span Alternative bascule lift and 49 fewer shafts with the vertical lift bridge. In terms of total shaft diameter footage, the Refined Long-span Alternative would have 387 feet less than the Draft EIS Long-span Alternative bascule lift and 363 feet less than the lift bridge.

Table 3. Long-Span Alternative Bridge Bent Shaft Foundations Comparison – Draft EIS Replacement and Refined Alternative with Cable Stay Option

Support Location	Draft EIS Long-Span Alternative			Refined Long-Span Alternative with Cable-Stayed Option		
	Number of Shafts	Shaft Diameter (feet)	Column Diameter (feet)	Number of Shafts	Shaft Diameter (feet)	Column Diameter (feet)
Bent 1	10	3	--	11	3	--
Bent 2	4	7	5	3	10	8
West Pedestrian Connections	--	--	--	2	3	3
Bent 3	4	7	5	2	11	9
Bent 4	4	8	6	2	11	9
Bent 5	8	10	Pier Wall	2	12	10
Bent 6	18 (Bascule Bridge) 14 (Lift Bridge)	12	--	13 (Bascule Bridge) 10 (Lift Bridge)	12	--
Bent 7	18 (Bascule Bridge) 14 (Lift Bridge)	12	--	13 (Bascule Bridge) 10 (Lift Bridge)	12	--
Bent 8	8	10	Pier Wall	6	10	10
Bent 9	4	7	5	4	8	--
Bent 10	13	3	--	9	4	--
East Pedestrian Connections	23	7	5	2	12	---
	2	5	3			

Support Location	Draft EIS Long-Span Alternative			Refined Long-Span Alternative with Cable-Stayed Option		
	Number of Shafts	Shaft Diameter (feet)	Column Diameter (feet)	Number of Shafts	Shaft Diameter (feet)	Column Diameter (feet)
Total # Shafts (Bascule Bridge)	116	--	--	69	--	--
Total # Shafts (Lift Bridge)	108	--	--	63	--	--

As indicated in Table 3, the Refined Long-span Alternative with the cable-stayed option would have 47 fewer shafts than the Draft EIS Long-span Alternative bascule bridge and 45 fewer shafts with the vertical lift bridge. In terms of total shaft diameter footage, the Refined Long-span Alternative would have 347 feet less than the Draft EIS Long-span Alternative bascule lift and 329 feet less than the lift bridge.

A comparison of Table 2 and Table 3 indicates that the greatest decrease in the number of shafts and total shaft diameter footage is associated with the Refined Long-span Alternative tied-arch option with a bascule lift followed by the tied-arch design using a vertical lift bridge. The Refined Long-span Alternative with tied-arch and cable-stayed options have the same number of shafts and associated total shaft diameter footage, with the exception of Bents 8 through 10 that are located east of the river. For these bents, the Refined Long-span Alternative with tied-arch option has 15 shafts with a total shaft diameter footage of 88 feet compared with the cable-stayed option which has 19 shafts resulting in a total shaft diameter footage of 128 feet.

Comparison of the number of shafts and overall total diameters of shafts indicates that the Refined Long-span Alternative has fewer shafts and a lower overall total diameter of shafts than the Draft EIS Long-span Alternative. The Refined Long-span Alternative with tied-arch and vertical lift bridge options would have the lowest number of shafts and total overall shaft diameter.

All shafts would need to be advanced down to the Troutdale Formation (seismically competent) material, which is typically at depths greater than 40 to 140 feet below ground surface at the Project Area.

East approach improvements would include a volume of cementitious grouting extending well beyond the bridge width, thereby creating a dam to hold back east bank flow failures during a seismic event at two locations (Bents 8 and 9) or include ground improvements extending down to the Troutdale Formation subsurface layer at Bent 8 to increase stability and withstand large-scale soil displacements that would occur during a seismic event at each bent. Retaining and buttressed walls are also included in the Replacement Alternatives. Buttressed walls would be located immediately adjacent (and open) to existing buildings. A new retaining wall would be installed directly south of the buttressed wall, allowing those voids to be backfilled and new sidewalk to be built on retained fill. At each of the in-water piers, new revetment would be placed to minimize future scour holes.

Comparison of the Refined Long-span Alternative to the No-Build Alternative is effectively the same as presented for the Draft EIS Long-span Alternative. Soils and geology, representing earth-material, and groundwater throughout the Project Area would not be disturbed under the No-Build Alternative; therefore, it would not be different from existing conditions. The existing earth-materials would remain in place except where disturbed by other non-related EQRB project activities such as construction of new buildings or other works. There is some potential that future maintenance in the project footprint could negatively affect earth-material present that may be associated with implementation of EQRB Project construction.

8 Potential Mitigation

The current designs and construction assumptions for the Long-span (both Draft EIS and Refined) Alternatives incorporate measures to meet the seismic design criteria established for the Project. Bridge foundations and other bridge elements would be improved or constructed, and soil improvements would be implemented to address identified poor soil strength and potential for liquefaction in response to a seismic event. These design and construction measures are summarized in the Draft EIS and described in detail in the various design reports.

As the Project advances, subsequent geotechnical investigations and advanced design analysis would be used to further develop and design more specific mitigation measures to minimize seismic, scour, and erosion impacts. These investigations would also provide additional detail on drilled shaft depths.

Excavation activities would address how to manage and control poor-strength soil and generally saturated earth-material while enhanced foundation elements are constructed. Excavation (drilling) activities would also need to be managed in a manner such that contaminants are not introduced into the ground, to groundwater, and surface water. Potential contaminants can be sourced from equipment used for excavating (drilling) or from other sources such as stormwater allowed to discharge into an excavation. Site control measures would also be needed to ensure open excavations are secure and do not pose a risk to human health or ecological health. Prior to construction starting, an approved erosion and sediment control plan would be required. During construction, best management practices listed in the current version of the City of Portland Erosion, Sediment, and Pollutant Control Plan would be implemented to prevent runoff with sediment or other pollutants from reaching drainage systems or the Willamette River. Measures for minimizing impacts are assumed to be part of the Project and are described in the draft *EQRB Construction Approach Technical Report* (Multnomah County 2021a) and the *EQRB Wetlands and Waters Technical Repor*t (Multnomah County 2021e).

9 Agency Coordination

Agency coordination is the same for the Refined Long-span Alternative as is described in the *EQRB Soils and Geology Technical Report* (Multnomah County 2021e).

10 Preparers

Name	Professional Affiliation	Education	Years of Experience
Rick Malin	Parametrix	Registered Geologist	25

11 References

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