

# **I-5 Boone Bridge** **and Seismic Improvement Project**



## **Summary Report** **to the Oregon State Legislature** **January 2021**



# Acknowledgements

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## Links to Supporting Documents

This document is supported by the **I-5 Boone Bridge and Seismic Improvement Project Technical Report**, which was completed and submitted to the Oregon Legislature in January 2021. To read the full technical report, click **here**.

To read ODOT's response to requests for further analysis of the project related to travel demand, land use, access management and active traffic management, visit the study website by clicking **here**.

There are also links throughout this executive summary for other plans, project websites or reports that have informed the I-5 Boone Bridge and Seismic Improvement Project Technical Report. See these links in one place below:

**2018 I-5 Wilsonville Facility Plan**

**2018 Regional Transportation Plan for the greater Portland region**

**House Bill (HB) 5050 Budget Note**

**2006 Wilsonville Bicycle and Pedestrian Master Plan**

**City of Wilsonville's French Prairie Bridge Project**

**City of Wilsonville's Transportation System Plan**

**City of Wilsonville's Parks & Recreation Master Plan**

**Oregon Bike Bill (ORS 366.514)**

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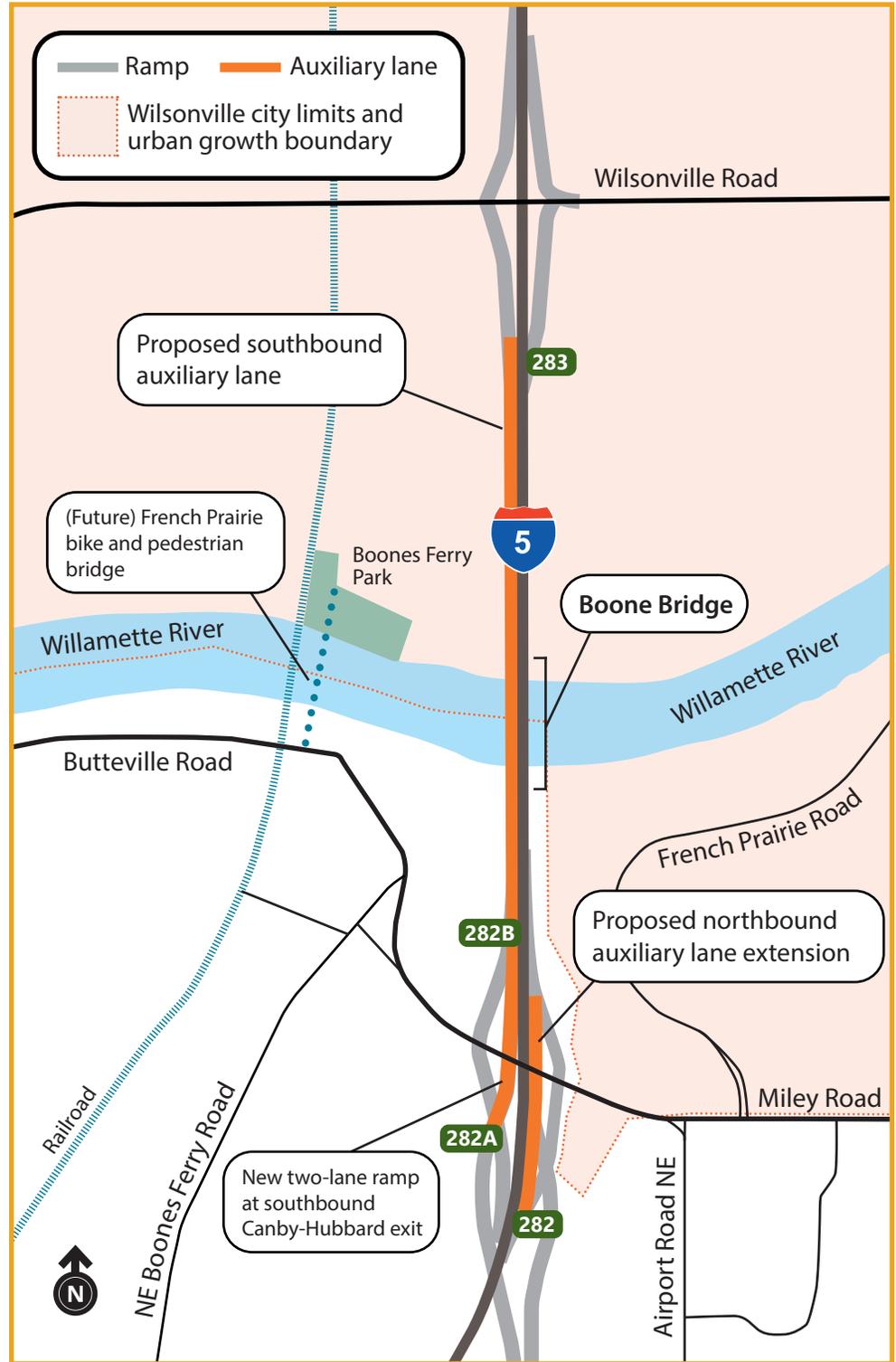
## Purpose of this report

The purpose of this study is to determine the best approach for addressing congestion, safety and the seismic resiliency of Interstate 5 in the vicinity of the Boone Bridge.

The I-5 Boone Bridge is located over the Willamette River south of Portland and north of Salem within Clackamas County. A portion of the project area is within the City of Wilsonville and spans the southern Urban Growth Boundary of the Portland Metropolitan Area.

This section of I-5 serves intercity, regional, statewide, interstate and international mobility. I-5 is the key freight corridor for the west coast of the United States, stretching from Canada to Mexico, and has been recognized as a federally designated “corridor of the future.” As such, I-5 – especially in the vicinity of the Boone Bridge – is an important Oregon Seismic Lifeline Route for destinations up and down the West Coast. Thus, providing adjacent interchange improvements to improve traffic operations and safety along with a wider, seismically-resilient Boone Bridge is of local, regional, statewide, national and international significance.

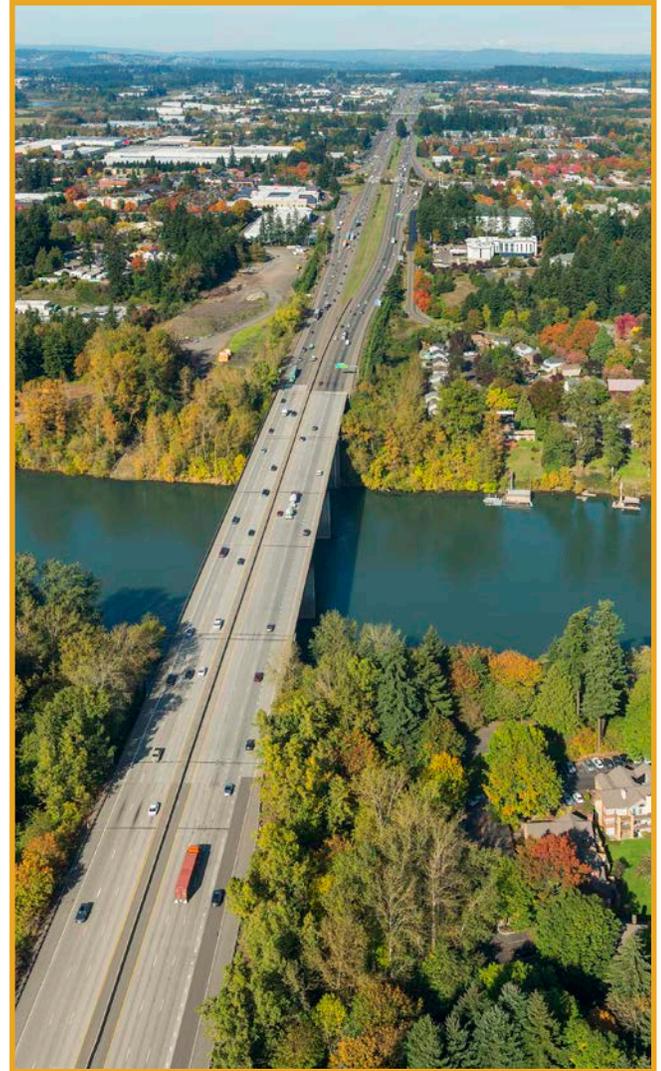
**Sections of the Boone Bridge are over 60 years old. The bridge has been widened (with minor retrofitting) piecemeal over time.**



The project area in Clackamas County. ODOT is proposing changes to the Boone Bridge and adjacent freeway interchanges that would improve traffic operations, safety and seismic resiliency. Proposed improvements include a new, widened bridge, a northbound auxiliary lane extension, a new southbound auxiliary lane, and an additional exit ramp lane at the southbound Canby-Hubbard exit (282A).

## Improving traffic operations and safety

Oregonians in every part of the state rely on getting through and to the Metro region. Today, the Boone Bridge and interchanges to the north and south of the bridge are a traffic bottleneck. Inefficient merging and weaving caused by short merging areas results in congestion and crashes that reduce travel speeds and travel-time reliability for people travelling by car and transit, or moving freight by truck. Without improvement, this bottleneck will continue to deteriorate, leading to slower travel, more costly freight movement and higher safety risks for those who use I-5 and the surrounding transportation network. Now is the time to modernize our regional transportation system and the way we use it. The **2018 I-5 Wilsonville Facility Plan** and **Regional Transportation Plan** (financially constrained) provide a solution to address these issues. The construction of a southbound auxiliary lane on I-5 between the Wilsonville Road entrance ramp and the Canby-Hubbard exit ramp (OR 551), which would become a two-lane exit ramp, addresses the bottleneck in this area. This feasibility study also considers safety issues and congestion on I-5 northbound and associated interchange improvements, specifically a concept to connect the OR 551 entrance ramp to the existing northbound auxiliary lane across the Boone Bridge to improve safety in this section of I-5.



*Above: The I-5 Boone Bridge over the Willamette River.*

*Left: The north end of the Boone Bridge viewed from the multi-use path underneath it.*



## Seismic lifeline

This segment of I-5, particularly the Boone Bridge over the Willamette River, represents a crucial link on one of Oregon's critical seismic lifeline routes that connects the Portland metro area to the Mid-Willamette Valley and areas to the south. The Boone Bridge, which is over 60 years old and has been widened and modified over time, will require significant upgrades to withstand a major Cascadia Subduction Zone quake and enable I-5 to continue to serve as a primary West Coast route for passenger and freight movement. The Boone Bridge is the only crossing of the Willamette River within 15 miles of the Wilsonville town center for motor vehicles or anyone walking or rolling.

**Due to the design and construction of the existing bridge, in the event of a Cascadia Subduction Zone earthquake, the existing bridge will be compromised, impacting an important lifeline route.**

## Oregon Legislature Directs ODOT to Consider Improvements to the Boone Bridge

In **House Bill (HB) 5050**, specifically in the budget note to HB 5050, the 2019 Oregon Legislature directed the Oregon Department of Transportation (ODOT) to determine the best way to widen and seismically retrofit the I-5 Boone Bridge over the Willamette River, and to provide a programming/funding estimate report back to the Legislature by February 1, 2021.

In spring 2020, using the funding allocated by the OTC, ODOT moved forward with the following tasks, in collaboration with Quincy Engineering, Inc. (Quincy) to resolve the question of structural retrofit vs. structure replacement, defining the necessary next steps and a cost range and delivery schedule:

- We assessed approaches for achieving a seismically resilient I-5 Boone Bridge with a southbound auxiliary lane, including analyses of both Phase 2 seismic retrofit and bridge replacement options. We identified risks associated with each option and recommended an approach.
- We assessed operational and safety improvements for I-5 northbound at the Charbonneau Miley Road/OR 551 Portland-Hubbard Highway interchange in coordination with the Boone Bridge improvements.
- We analyzed potential land use and related travel demand impacts associated with the project, per Metro's request for analysis.
- We developed a planning-level cost range for the recommended bridge replacement and other I-5 improvements assuming planning and environmental work commence in 2022 and construction begins in 2027.
- We developed a scope of work including additional field investigations, analyses, environmental-related tasks, and design work necessary to deliver the 15% design milestone for the recommended Boone Bridge and I-5 interchange improvements.
- We developed a cost estimate to advance the project to the 15% design milestone and further inform a financial programming report to deliver the recommended Boone Bridge Replacement and I-5 interchange improvements through construction.



*Right: I-5 northbound mile marker 283 on the south end of the Boone Bridge.*

## Assessing the Boone Bridge

To assess the existing bridge structure, the ODOT and the consultant team completed the following tasks during the bridge assessment:

- Summarized the existing conditions associated with I-5 southbound, with particular attention to the Boone Bridge and adjacent interchanges.
- Explored the site and prepared preliminary geotechnical analysis, including two cone penetrometer tests completed in June 2020 – one on the north side of the river and one on the south side of the river. Combined with past investigations, these tests furthered our understanding of the soil conditions beneath the Boone Bridge.
- Completed preliminary seismic analysis to identify seismic design criteria and ground motion parameters.
- Identified geologic hazards at the site, including liquefaction and related effects.
- Developed preliminary geotechnical parameters for bridge retrofit and replacement designs.
- Prepared conceptual-level recommendations for seismic mitigation strategies.
- Developed conceptual design, structural analysis, construction staging concept development, and construction access considerations for the retrofit/widening option vs. the full bridge replacement option.
- Identified project constraints and risks associated with each option.
- Developed environmental project prospectus in preparation for NEPA.

The bridge improvements were assessed based on the following assumptions for constructability:

- Maintain three lanes of traffic in each direction during construction.
- Maintain existing horizontal clearance and vertical clearance below the deck to avoid impacts to the navigable waterway of the Willamette River.
- Maximize the use of existing ODOT right-of-way.
- Maintain existing roadway alignment to the extent possible to minimize impacts to existing interchanges.



*Left: I-5 northbound at the Miley Road exit ramp to the south of the Boone Bridge.*



## Retrofit vs. Replacement

The bridge assessment work revealed that the benefits associated with a full bridge replacement outweigh the minimal construction cost savings associated with a retrofit of the existing bridge. Critically, the feasibility assessment found that the entire substructure of the Boone Bridge, including pier supports and foundations, must be replaced in the retrofit option to achieve seismic resiliency. Since the main spans of the bridge are supported by timber pile foundations, this means the substructure for this portion of the bridge is not functional in an earthquake unless these piles can be replaced or an alternate support system is provided. In addition, the foundation soils on both riverbanks consist of soils above the river bottom that will liquefy in an earthquake and flow into the river. These two significant issues associated with the retrofit option will necessitate the replacement of the bridge's entire substructure. Furthermore, a retrofitted and widened Boone Bridge would have substantial ongoing costs to monitor structural deficiencies and require the future replacement of the original bridge superstructure, representing an additional future major capital expense.

In accordance with ODOT Bridge Section guidelines, typically, it is advisable to consider a replacement structure if the cost of the retrofit is greater than one half of the cost of the replacement structure. An order of magnitude comparison for this structure indicates the retrofit and widening option would be over 85% of the cost to replace the Boone Bridge. When combined with additional future maintenance and known capital costs needed to maintain the structure over time, this study indicates the cost to retrofit and widen the bridge may exceed the cost to replace the bridge. Based on these findings, and in collaboration with the ODOT Bridge Section, ODOT recommends proceeding with the bridge replacement option to achieve the planned operational and seismic upgrades to ensure the bridge and this section of I-5 will continue to serve as a critical lifeline and recovery route after a seismic event.

**The bridge assessment conducted in this feasibility study recommends replacement of the existing Boone Bridge. It is more cost effective to replace the bridge than to retrofit and widen the existing bridge.**



*Above: Existing railing and pier supports of the Boone Bridge.*

*Below: Steel girders that support the weight of the Boone Bridge.*

## Traffic Operations and Safety Improvements at Interchanges

To address traffic operations and safety impacts within the corridor this project includes both southbound and northbound interchange improvements.

### **I-5 southbound**

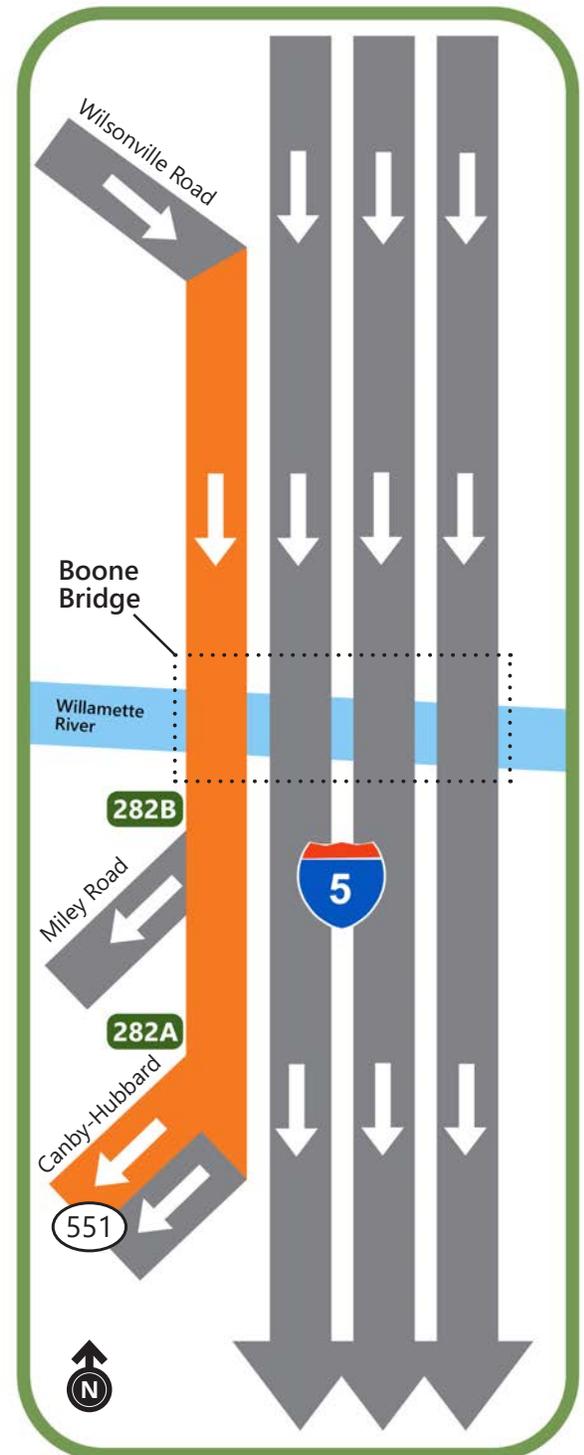
This project includes the addition of a southbound auxiliary lane connecting south Wilsonville and OR 551, including a two-lane exit to OR 551. This interchange improvement is critical to facilitating the operational and safety benefits from adding the southbound auxiliary lane between the Wilsonville Road entrance and the exit to OR 551, as it reduces merging conflicts between exiting traffic and mainline traffic consistent with the **I-5 Wilsonville Facility Plan** and **Regional Transportation Plan**. In addition, bus on shoulder will be possible with these improvements to I-5.

**Auxiliary lanes in both the northbound and southbound directions and associated interchange improvements will alleviate traffic bottlenecks, improve travel time reliability and enhance safety on I-5.**

*Right: Graphic showing the future southbound auxiliary lane on I-5 between the Wilsonville Road entrance and Exit 282A to OR 551 and two-lane southbound exit to OR 551. Proposed additions are shown in orange.*

*Below: The northbound OR 551 (Canby-Hubbard Highway) on-ramp to I-5, where a proposed auxiliary lane would increase safety by reducing merging crashes.*

### Proposed auxiliary lane on I-5 south



█ Proposed new auxiliary lane  
█ Existing through lane





## Traffic Operations and Safety Improvements, Continued

### I-5 northbound

To the immediate south of the Boone Bridge, at the intersection of I-5 and OR 551, high volumes of free-flow traffic, including a large number of trucks, are forced to merge immediately onto I-5 without enough space to zipper merge safely. This segment of I-5, from the Charbonneau entrance ramp to the southern end of the Boone Bridge, is a top 10% Safety Priority Index System (SPIS) location due to short merging distances, closely spaced interchanges and frequently congested conditions both on and just south of the Boone Bridge. This issue is exacerbated by I-5 traffic positioning in the outside lane to take the next northbound exit at Wilsonville Road.

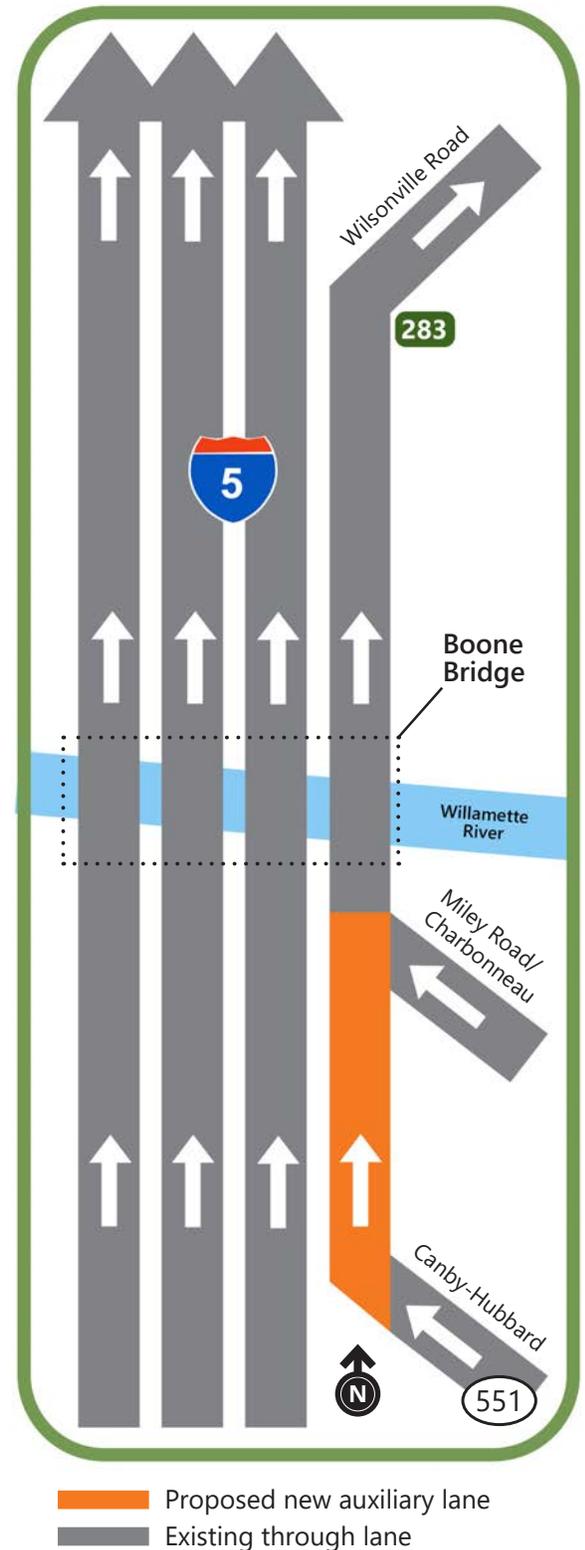
To improve safety in this section of I-5, we recommend extending an auxiliary lane from the northbound OR 551 Canby-Hubbard entrance ramp to the existing northbound auxiliary lane across the bridge. This safety improvement must be incorporated into the design of the Boone Bridge replacement, either as a consideration for implementation at the same time as the Boone Bridge (to realize efficiencies of scale) or as an improvement to be accommodated by the bridge replacement design in the event this safety improvement is built prior to the bridge work.



Above: Short merging distance between the OR 551 Canby-Hubbard entrance ramp and Charbonneau entrance ramp and heavy freight use cause safety conflicts resulting in a top 10% SPIS site.

Photo credit: Google, May 2019.

### Proposed auxiliary lane on I-5 north



## Consideration for a Parallel Route for Pedestrians and Bicycles: French Prairie Bridge

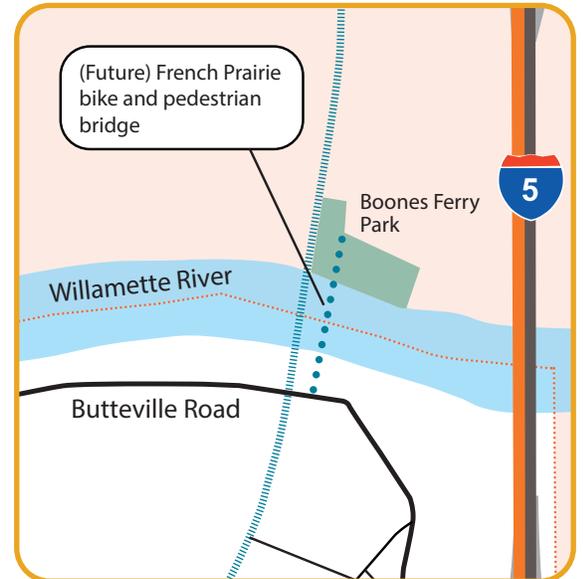
In 2019, the City of Wilsonville engaged in a planning effort to identify a parallel bicycle and pedestrian bridge over the Willamette River in the vicinity of the Boone Bridge. The City's preferred alignment from this effort is a proposed bridge located approximately 1,400 feet to the west of the I-5 Boone Bridge, adjacent to the existing railroad bridge.

In the **2006 Wilsonville Bicycle and Pedestrian Master Plan**, the City considered an option to add a cantilevered facility to the west side of the Boone Bridge. The City identified challenges with the cantilevered option such as safety from falling debris, as the proposed path would be below the vehicular deck for vertical separation, maintenance, and the need for improved connections to access the bridge on the north and south side of the Willamette River. Ultimately, the Master Plan recommended the construction of a standalone bicycle and pedestrian bridge, which the City has pursued since.

In 2015, the City considered the feasibility of a number of alternatives for their standalone bridge, including a separate bike and pedestrian facility immediately adjacent to the Boone Bridge. The adjacent to I-5 alternative was not selected as the preferred alternative due to challenges such as high cost retaining walls, below average user experience, no direct connection under I-5 to the regional trail, path and walls near a neighborhood, no direct connection between Charbonneau and Memorial Park, farther from Wilsonville Town Center and a lack of supporting bike and pedestrian facilities on Parkway Avenue.

The City's recent study identified a preferred alignment and a high-level cost estimate of roughly \$36 million to \$47 million (2019\$) for the suspension bridge alternative for the **French Prairie Bridge**. No further funding has been identified for project development or construction, however, if constructed, this bridge would provide a parallel dedicated bicycle/pedestrian facility to I-5 over the Willamette River in the vicinity of the Boone Bridge. The French Prairie Bridge alignment has since been adopted into the **City of Wilsonville's Transportation System Plan** and **Parks & Recreation Master Plan**. Wilsonville is currently working on a funding strategy to complete design and construction of the project and has developed a list of environmental and cultural analyses that would support the City's progression into a NEPA phase. ODOT has and will continue to participate and offer technical expertise to inform project development moving forward.

French Prairie Bridge preferred alignment



**A parallel bicycle and pedestrian bridge (French Prairie Bridge) is planned in the vicinity by the City of Wilsonville. Pedestrians and bicycles could be accommodated on a replaced I-5 Boone Bridge, but the preferred local option is the separate parallel bicycle and pedestrian bridge.**

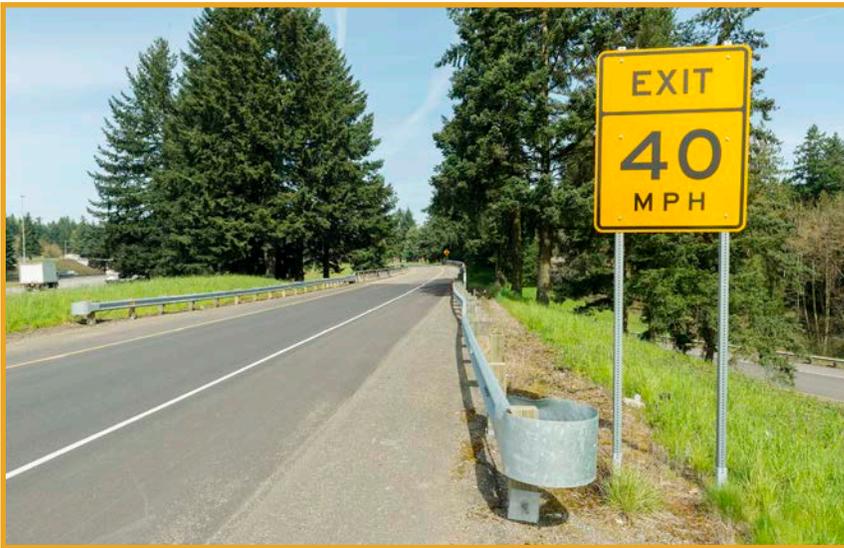
Presently, pedestrians and cyclists use the shoulder of Interstate 5 in the vicinity of the Boone Bridge. The current bridge replacement estimate assumes the shoulder of I-5 would continue to serve bikes and pedestrians on the new bridge to meet **Oregon Bike Bill (ORS 366.514)** obligations. However, understanding the use of I-5 in this area is not the preferred option if the French Prairie Bridge could be constructed prior to, or concurrently with the I-5 Boone Bridge replacement it would provide an enhanced user experience with regional connections to the existing and planned bicycle and pedestrian trail system that users, the local community and ODOT would prefer.



## Minimal Impact on Travel Demand, Land Use

Using the Oregon Statewide Integrated Model (SWIM), ODOT prepared model simulations of travel demand and land use with and without the addition of a southbound auxiliary lane on I-5 between the Wilsonville Road entrance ramp and the Canby-Hubbard exit ramp. The project was added to the SWIM road network to evaluate a ten-year period of 2030 to 2040. The results of the build scenario were compared to a no-build reference scenario in order to identify impacts of the project on travel demand and land use.

The analysis found the change in Annual Average Daily Traffic volumes (AADT) attributed to the southbound auxiliary lane is relatively modest. Growth in AADT is expected to be about 3% higher over the ten-year period (2030-2040) forecast after the project is built compared to the no-build scenario. This is consistent with the expectations for a project intended to address a congestion bottleneck by improving traffic flow and reliability and reducing crash rates. In addition, the analysis found only a negligible difference between the two forecast scenarios in terms of regional population, employment growth and vehicle miles traveled. The analysis likewise indicated no land use changes are expected to occur in the area evaluated due to the project.



Above: The I-5 north Charbonneau exit ramp south of the Boone Bridge.

**I-5 traffic can be maintained during construction of the new Boone Bridge.**

**The 2018 Regional Transportation Plan lists the I-5 Wilsonville Facility Plan project in the financially constrained project list. Inclusion of the southbound auxiliary lane on a replaced Boone Bridge will not impact the growth of neighboring communities and has minimal impact on travel demand as shown in ODOT's analysis of 2040 build and no-build scenarios.**

## \$450 Million to \$550 Million Investment Required

Based on preliminary studies and less than 3% design, the estimated cost range to deliver this project is \$450 million to \$550 million. This cost range reflects a conceptual planning level estimate to be refined after geotechnical/seismic investigations, environmental review and design work is completed. This cost range incorporates all phases of project delivery, including planning, preliminary and final design and construction resulting in the following improvements:

- Seismically resilient Boone Bridge.
- Southbound auxiliary lane between the Wilsonville Road entrance and the OR 551 exit.
- Two-lane southbound exit to OR 551.
- Northbound auxiliary lane extension from OR 551 to the Boone Bridge.

This preliminary estimate range assumes environmental analysis and NEPA will begin in 2022 and construction beginning in 2027. The cost range provides for consideration of alternative project delivery methods and the additional analysis required to address project risks. Please note, this estimate range does not include the \$36 million to \$47 million the City of Wilsonville estimates the French Prairie Bridge Project would cost that would provide the preferred pedestrian and bicycle route for crossing the Willamette River in the vicinity of the Boone Bridge, which ODOT supports.

### I-5 Boone Bridge Seismic Improvement Project Investment and Implementation Strategy



-  Planning Phase
-  Planning/Design Phase
-  Design/Construction Phase (Alternative Delivery)
-  Construction Phase

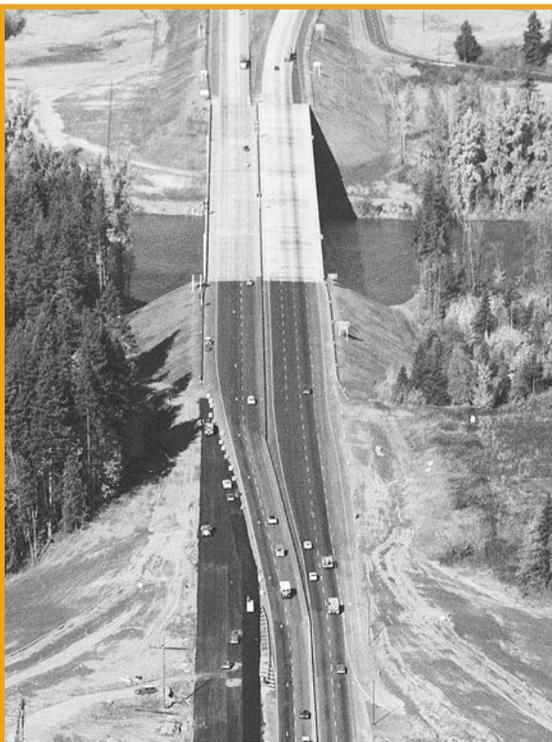
*Note: This phased delivery schedule is not financially constrained and it is subject to funding.*



Above: The I-5 Boone Bridge.

## Key Takeaways

- 1 Sections of the existing Boone Bridge are over 60 years old. The bridge has been widened (with minor retrofitting) piecemeal over time.
- 2 Auxiliary lanes in both the northbound and southbound directions and associated interchange improvements will alleviate traffic bottlenecks, improve travel time reliability and enhance safety on I-5.
- 3 Due to the design and construction of the existing bridge, in the event of a Cascadia Subduction Zone earthquake, the existing bridge will be compromised, impacting an important lifeline route.
- 4 The bridge assessment conducted in this feasibility study recommends replacement of the existing Boone Bridge. It is more cost effective to replace the bridge than to retrofit and widen the existing bridge.
- 5 I-5 traffic can be maintained during construction of the new Boone Bridge.
- 6 A parallel bicycle and pedestrian bridge (**French Prairie Bridge**) is planned in the vicinity by the City of Wilsonville. Pedestrians and bicycles could be accommodated on a replaced I-5 Boone Bridge, but the preferred local option is the separate parallel bicycle and pedestrian bridge.
- 7 The **2018 Regional Transportation Plan** lists the **I-5 Wilsonville Facility Plan** project in the financially constrained project list and the project is currently in Metro's land use and transportation model. Inclusion of the southbound auxiliary lane on a replaced Boone Bridge will not impact the growth of neighboring communities and has minimal impact on travel demand as shown in ODOT's analysis of 2040 build and no-build scenarios.
- 8 Cost range for the project is \$450 million to \$550 million, assuming construction in 2027.



*The Boone Bridge, November 1970.*

**The high-level estimated cost to replace the Boone Bridge with a widened and seismically resilient bridge ranges from \$450M to \$550M with construction beginning in 2027.**