

REVISED TRANSPORTATION SAFETY SUPPLEMENTAL TECHNICAL REPORT

Oregon Department of Transportation
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Contents

Executive Summary	1
1.0 Introduction	3
2.0 Build Alternative Design Changes	3
2.1 Design Process	3
2.2 Project Area	7
2.3 I-5 Mainline Improvements Changes.....	9
2.4 Highway Cover Changes.....	11
2.5 Related Local System Multimodal Improvements Changes	14
3.0 Regulatory Framework.....	18
4.0 Methodology and Data Sources.....	18
4.1 Area of Potential Impact.....	18
4.2 Existing Conditions Analysis.....	19
4.3 Freeway Mainline and Ramp Segments Crash Analysis	19
4.4 Local Street Multimodal Risk Assessment.....	23
5.0 Affected Environment.....	25
6.0 Environmental Consequences.....	26
6.1 No-Build alternative.....	26
6.1.1 Direct Impacts.....	26
6.1.2 Indirect Impacts.....	26
6.2 Revised Build Alternative.....	26
6.2.1 Direct Impacts.....	26
6.3 Local Street Multimodal Risk Assessment.....	35
6.3.1 Indirect Impacts.....	38
6.3.2 Cumulative Impacts	38
6.4 Conclusion.....	38
7.0 Avoidance, Minimization, and Mitigation Measures.....	40
8.0 Preparers.....	40
9.0 References.....	40
Appendix A. Local Street Multimodal Risk Analysis	1



Tables

Table 1 Study Intersections for Local Street Multimodal Risk Assessment	1
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Figures

Figure 1 Hybrid 3 Highway Cover Design Concept with Ramp Reconfiguration	6
Figure 2 Previous and Current Project Area	8
Figure 3 I-5 SB Exit Ramp: Traffic Splitting Eastbound from Westbound Traffic	10
Figure 4 Building Parameters on the Cover.....	12
Figure 5 Major Local System Multimodal Design Changes	15
Figure 6 Design Options for I-5 SB Exit Ramp: Traffic Heading West	17
Figure 7 I-5 Southbound Ramp Relocation.....	21
Figure 8 Study Segments and Ramps for Safety Analysis.....	22
Figure 9 Local Intersections Included in Local Street Multimodal Risk Analysis.....	25
Figure 10 Inside Shoulder Width of Study Corridor for the No-Build and Revised Build Alternatives	28
Figure 11 Outside Shoulder Width of Study Corridor for the No-Build and Revised Build Alternatives	29
Figure 12 Inside Shoulder Width of Study Corridor for Build Alternative and Revised Build Alternative	30
Figure 13 Existing Intersection vs Proposed I-5 Southbound Exit Ramp Terminal	33
Figure 14 Existing Intersection vs Proposed I-5 Northbound Exit Ramp Terminal	34
Figure 15 Summary of Change of Level of Complexity: 2-way Ramsay Design Option compared to No-Build	36
Figure 16 Summary of Change of Level of Complexity: 2-way Wheeler Design Option compared to No-Build	37



Executive Summary

This technical report presents revisions to the 2022 Transportation Safety Supplemental Technical Report, which supplemented the 2019 Transportation Safety Technical Report (ODOT 2019) with an evaluation of safety impacts of the Revised Build Alternative. Revisions to the 2022 Transportation Safety Supplemental Technical Report are based on comments on the I-5 Rose Quarter Improvement Project Supplemental Environmental Assessment and subsequent refinements to the project design. The design refinements evaluated in this report address public concerns regarding potential conflicts between I-5 exit ramp traffic and vulnerable users, cyclists, and pedestrians on the local street network. **New text inserted since the 2022 Transportation Safety Supplemental Technical Report is shown in bold text.** The largest safety benefit of the proposed Project results from widening shoulders for the majority of the corridor on both sides of the highway as compared to the No-Build Alternative. Additionally, the Project would substantially reduce emergency braking events, which would reduce the incidence of rapid deceleration that can result in rear-end crashes. The emergency braking analysis indicated the incidence of rapid deceleration decreases because there would be fewer lane changes when auxiliary lanes are provided in both directions. Similar to the findings of the 2019 Transportation Safety Technical Report, **the safety analysis indicated that,** in the opening year, the rate of crashes on I-5 under the Revised Build Alternative would be lower than the No-Build **Alternative.** As traffic volumes grow, the crash reduction benefits of the proposed geometric changes would decrease.

The analysis for the I-5 southbound exit ramps including the ramp to N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way and the flyover to NE Weidler Street indicates that crash rates on the proposed I-5 southbound exit ramp configuration would increase when compared to the No-Build alternative due primarily to motorists traveling longer routes on both ramps and navigating a horizontal curve on the flyover. To reduce the potential for crashes along the two new I-5 southbound ramps, the design would include shoulder and travel lane widths that are wider than the standard width along the curves. Additionally, proposed advance guide signing, delineation of the ramps, pavement markings and illumination would be further refined during the design phase.

The qualitative local street analysis showed that under the Revised Build Alternative, the majority of the local street intersections in the area would have largely the same or better performance as compared to the No-Build Alternative. The flyover to NE Weidler Street would route approximately 60 percent of the overall I-5 southbound exit ramp traffic away from highly congested blocks between N Broadway/ N Weidler Street and N Vancouver Avenue/ N Williams Avenue compared to the No-Build Alternative. Based on the qualitative local street assessment, the most substantive changes of the Revised Build Alternative from the No-Build condition occur at NE Broadway/ NE Victoria Avenue, **N/NE Weidler Street/**

N Williams Avenue, N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way, and N/NE Broadway/ N Williams Avenue. The Revised Build Alternative would improve safety conditions at the intersections of NE Broadway/ NE Victoria Avenue, and N/NE Weidler Street/ N Williams Avenue. At these intersections complexity is reduced through implementing separate bicycle lanes and protected pedestrian phase against northbound left turn movements at NE Broadway/ NE Victoria. The intersection of N/NE Broadway/ N Williams Avenue could see an increase in potential for crashes as in the westbound direction adding a third through lane would result in additional conflicts by having an additional lane to cross. At N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way the additional traffic accommodated in a single lane would see an increase in conflicts. The Revised Build Alternative would be designed to minimize these conflicts between vehicles and bicycles, pedestrians and people with disabilities through signal timing and providing separated bicycle facilities along N Williams Avenue. Under the 2-way Ramsay Design Option, the intersections of N Broadway/ N Vancouver Avenue and N Weidler Street/ N Vancouver would also improve safety conditions by reducing conflicts at these intersection as a result of the relocation of the I-5 southbound ramp and maintaining one-way directional patterns.

The Revised Build Alternative would improve safety for cyclists by providing sidewalk level and physically separated bicycle lanes along major routes of N/NE Broadway, N/NE Weidler Street, N Williams Avenue, N Ramsay Way, and portions of N Vancouver Avenue. New bicycle protected crossings would be provided for the southbound movement at N Broadway/ N Vancouver Avenue (for the 2-way Ramsay Design Option), for the eastbound movement at N Weidler Avenue/ N Vancouver Avenue and for the northbound movement at N/NE Hancock Street/ N Williams Avenue. Pedestrian crossings would be provided at all legs of the intersections with protected crossings at locations where conflicting turning movements are accommodated in exclusive turning lanes. As the design process proceeds, the design of these intersections would be refined using best practice treatments for multimodal intersections to reduce conflicts and the potential for crashes for all users including cyclists, pedestrians and people with disabilities.

With the inclusion of the new Clackamas Crossing, bicycle and pedestrian connections are anticipated to result in an alternative bicycle and pedestrian route that would allow users to avoid crossing intersections at ramp terminals while utilizing a low-stress route separated from automobile traffic. These new connections would provide a particular benefit for people walking, biking, or rolling during events.

1.0 INTRODUCTION

The I-5 Rose Quarter Improvement Project (Project) Environmental Assessment (EA) was released in February 2019. The Federal Highway Administration (FHWA) published a Finding of No Significant Impact (FONSI) and Revised EA (REA) for the Build Alternative on November 6, 2020. Since the issuance of the FONSI, the Oregon Department of Transportation (ODOT) has made changes to the design of the proposed Build Alternative to create a Revised Build Alternative and re-evaluated the changes in the context of the FONSI/REA. At the conclusion of the re-evaluation, FHWA and ODOT agreed that the design changes require additional analyses beyond what was presented in the REA, and FHWA rescinded the FONSI on January 18, 2022. **ODOT prepared a Transportation Safety Supplemental Technical Report, which was published with the I-5 Rose Quarter Improvement Project Supplemental Environmental Assessment (SEA) on November 15, 2022. In response to public comments received on the SEA, ODOT refined the design of the Revised Build Alternative. This Revised Transportation Safety Supplemental Technical Report reflects changes to the evaluation of the Transportation Safety impacts based on those design refinements, which are described below in Section 2.0. All updated information is shown in bold text.**

2.0 BUILD ALTERNATIVE DESIGN CHANGES

Changes to the Build Alternative include modification to the highway cover design and changes associated with advancements in other elements of the project design, some of which require expansion of the Project Area. This section describes the highway cover design changes and design changes that resulted from advancements in project engineering **and comments on the SEA**. The evaluation of these changes is presented in Section 6.2 of this supplemental technical report.

2.1 DESIGN PROCESS

Through 2021, ODOT facilitated an Independent Highway Cover Assessment, as directed by the Oregon Transportation Commission, that engaged the Project’s advisory committees and community members in a series of collaborative workshops to explore the design opportunities for the highway cover. The purpose of the Independent Highway Cover Assessment was to understand **partner** goals and objectives within the Project Area, generate potential highway cover scenarios, and assess the impacts and benefits of these scenarios. The Independent Highway Cover Assessment team worked directly with local community members from the historic Albina neighborhood to understand how the highway cover design concepts might best serve the historic Albina community. The Project’s Historic Albina Advisory Board (HAAB),

Executive Steering Committee (ESC) and the Community Oversight Advisory Board (COAC) also provided input as part of the Independent Highway Cover Assessment process. These sessions explored potential opportunities for economic development in the Albina community and the highway cover design concepts.

In July 2021, Oregon Governor Brown convened a series of meetings with Project **partners** and community organizations to discuss the design concepts developed in the Independent Highway Cover Assessment. In August 2021, the HAAB—as supported by the ESC and the COAC, and through the Governor-led process—recommended “Hybrid 3” as the preferred highway cover design concept (Figure 1). The Hybrid 3 highway cover design concept represents a proposed community solution to maximize developable space on a single highway cover. The Hybrid 3 highway cover design concept maintains the commitment for the Project to create opportunities for the local community to grow wealth through business ownership and long-term career prospects through the Project’s Disadvantaged Business Enterprise and workforce program. Following the community and **partner** recommendations, in September 2021, the Oregon Transportation Commission directed ODOT to advance further evaluation of the Hybrid 3 highway cover design concept, with conditions related to the Project’s funding process and other technical analyses.

In January 2022, Governor Brown entered into a Letter of Agreement with the City of Portland, Metro, and Multnomah County that demonstrated their shared understanding and collective support for the Hybrid 3 concept as part of the Project. The Letter of Agreement specifically highlights the desire to connect the Lower Albina neighborhood, create buildable space, and enhance wealth-generating opportunities for the community, while simultaneously addressing the area’s transportation needs. Additionally, the Letter of Agreement supports the development of a process to define the future development vision for what could ultimately be built on top of the highway cover upon Project completion – this process is referred to as a Community Framework Agreement. The Letter of Agreement states that the City of Portland will lead a Community Framework Agreement process and that it should be between the City of Portland, ODOT, other state agencies and local jurisdictions as necessary, with the participation of organizations that represent the Albina community and Black residents. Any future real estate or open space development on top of the cover would require executing long-term air rights and lease agreements, and that any such actions or decisions are subject at all times to applicable local, state, and federal laws including but not limited to land use and NEPA processes.

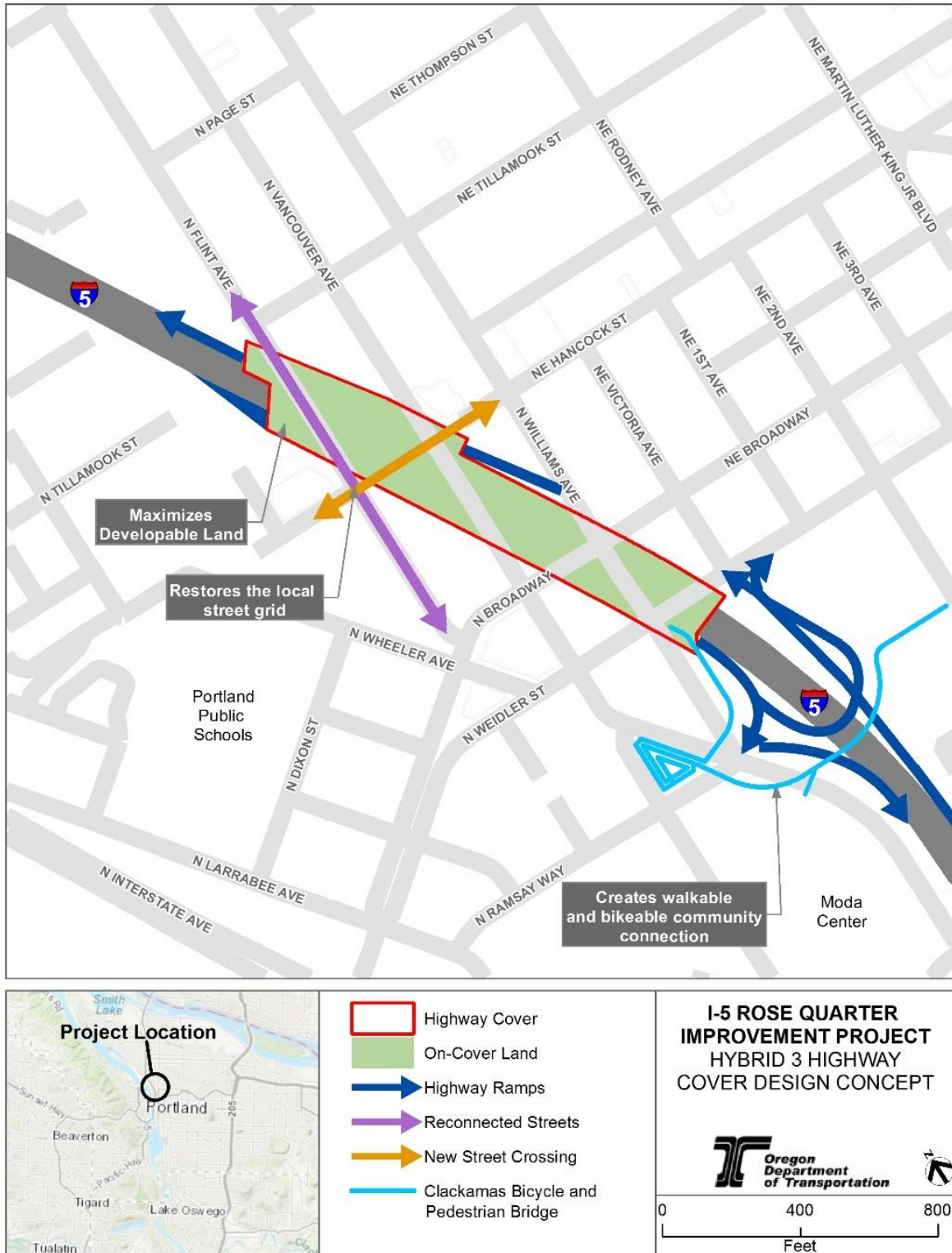
In June 2022, ODOT and the City of Portland executed an Intergovernmental Agreement (IGA), building upon the January 2022 Letter of Agreement. The IGA further states that the City will lead the future highway cover land use, programming and development processes and development of a Community Framework Agreement, in consultation with the ODOT to ensure

the highway, local streets and resulting land parcels within the Project are coordinated. As such, ODOT would construct the highway cover as part of the Project and the City of Portland would lead the process to define what is ultimately built on the new land created by the Project's highway cover. In the IGA, both ODOT and the City agreed that ODOT will retain ownership of the highway cover structure and the new developable area created on the highway cover structure upon Project completion.

FHWA and ODOT released the I-5 Rose Quarter Improvement SEA on November 15, 2022. In response to comments on the SEA, ODOT refined the design of the Revised Build Alternative.

The sections below describe the highway cover design changes and the design changes that resulted from advancements in project engineering and **comments on the SEA** and are incorporated into the Revised Build Alternative.

Figure 1 Hybrid 3 Highway Cover Design Concept with Ramp Reconfiguration

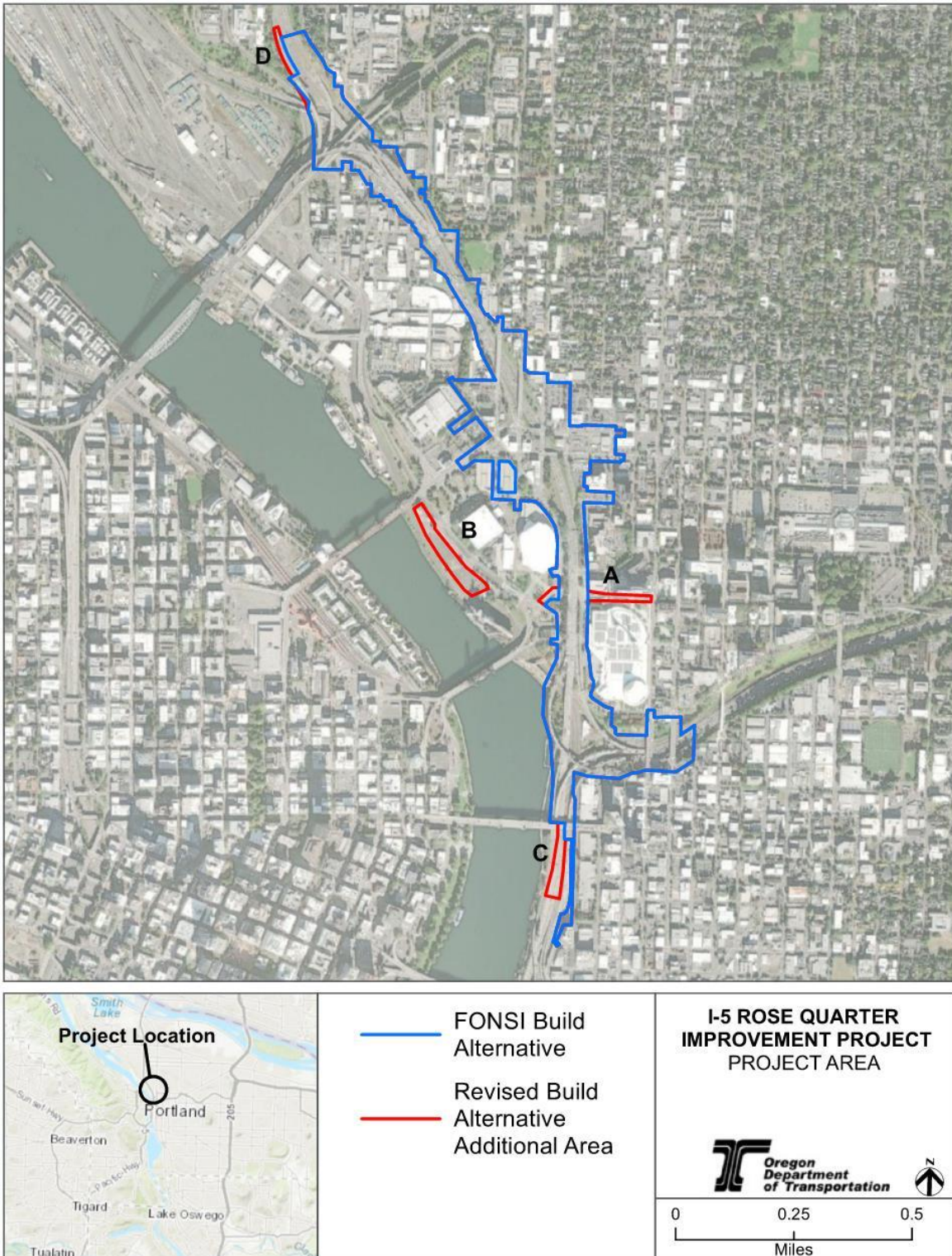


2.2 PROJECT AREA

The Project Area is defined as the area within which improvements are proposed, including where permanent modifications to adjacent parcels may occur and where potential temporary impacts from construction activities could result. As Project design information advanced, some changes required expansion of the Project Area presented in the REA and FONSI. In total, approximately 8.7 acres would be added to the Project Area. The changes are as follows, with letter references to the areas shown in Figure 2:

- A: Utility conflicts with Light Rail Transit (LRT) along NE Holladay Street between N Interstate Avenue and NE Martin Luther King Jr. Boulevard required expanding the Project Area by 1.9 acres to include additional overhead utility relocations (label A in Figure 2).
- B: An existing parking lot (known as Aegean Lot) south of N Interstate Avenue and the Broadway Bridge may be used for contractor staging during construction and is added to the Project Area (label B, Figure 2). ODOT identified this 4.3-acre construction staging area for contractor use based on its location, size, and suitability recognizing that, because of the urban setting and high-density land development in the construction area, it would be difficult for a construction contractor to find the space needed near or next to the project work areas for equipment staging, material storage, and the required co-location space for the contractor/construction personnel. This location meets all of the Project requirements: large level open space, proximity to the project work areas, and access for staging/storage of materials and equipment. Any materials stored in the area and site runoff would be subject to the same regulations as required throughout the project site.
- C: The southern end of the Project Area is expanded by 2.4 acres to include the portion of I-5 south of the Burnside Bridge proposed for a retrofit of the existing bridge rail, restriping the existing freeway, and installation of new guide signs (label C, Figure 2).
- D: At the northernmost end of the Project Area, a 1.1-acre area of ODOT right of way along the I-5 shoulders is now included in the Project Area for fiber optic conduit (label D, Figure 2).

Figure 2 Previous and Current Project Area.

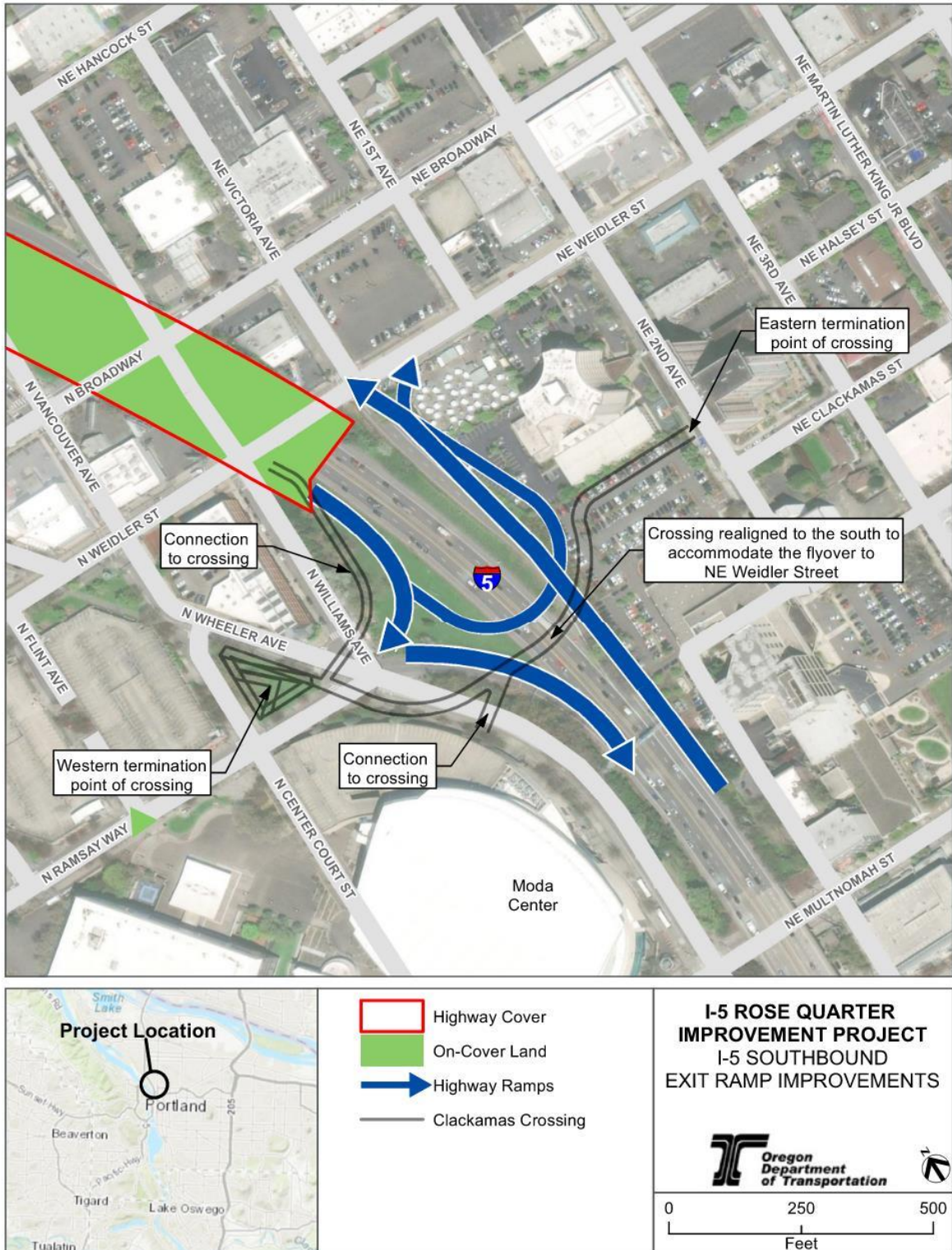


2.3 I-5 MAINLINE IMPROVEMENTS CHANGES

The Build Alternative included relocation of the I-5 southbound **entrance** ramp at N Wheeler Avenue to N/NE Weidler Street at N Williams Avenue via the new Weidler/Broadway/Ramsay highway cover, construction of auxiliary lanes and full shoulders (12 feet in width) on I-5 between I-405 and I-84 in both directions, and associated improvements to I-5 through the Project Area. The Revised Build Alternative includes the following changes to those elements of the Build Alternative:

- Move the I-5 southbound exit ramp termini from N Broadway to N Wheeler Avenue/ N Williams Avenue/N Ramsay Way (westbound) **and NE Weidler Street (eastbound). The exit ramp would divide westbound traffic from eastbound traffic as seen in Figure 3, with a single lane connection at N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way and single lane bridge (flyover) over I-5 to connect with NE Weidler Street.**
- Reduce the freeway median shoulder through the entire Project Area, from 12 feet to 8 feet (4 to 5 feet within highway cover). The outside shoulder width of 12 feet remains unchanged.
- Relocate Noise Wall 24 from N Commercial Avenue near Harriet Tubman Middle School to attach to Walls 1 and 2 along the east edge of I-5.
- Keep the I-5 southbound entrance ramp from N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way on the existing alignment rather than relocate it to parallel N Williams Avenue.
- On I-5 south of the Burnside Bridge: retrofit existing bridge rail, restripe freeway in both the northbound and southbound directions, and install new guide signs on an existing sign structure in the southbound direction.

Figure 3 I-5 SB Exit Ramp: Traffic Splitting Eastbound from Westbound Traffic

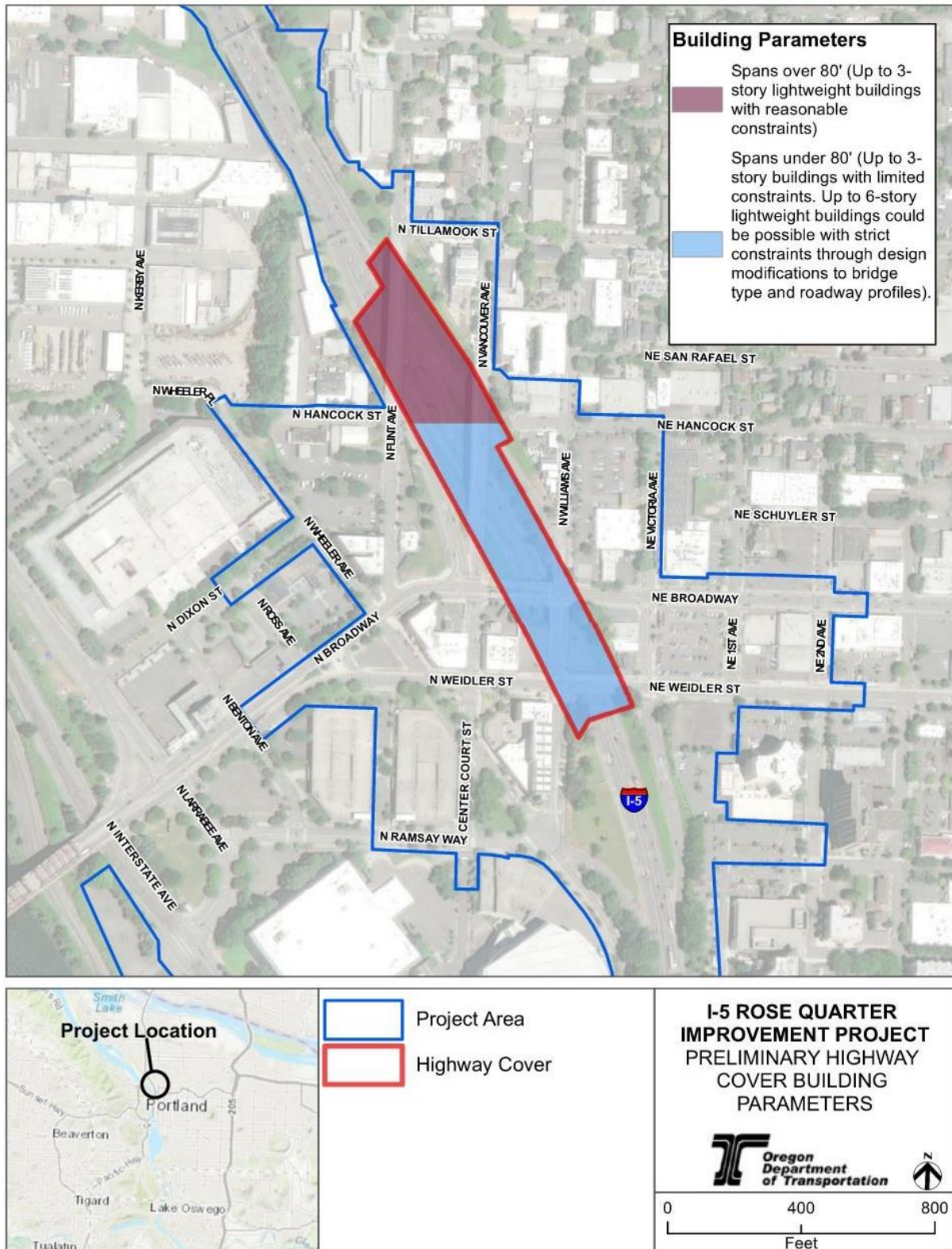


2.4 HIGHWAY COVER CHANGES

The Build Alternative included the construction of two highway cover structures over I-5 for roadway crossings and other purposes. The Revised Build Alternative, based on Hybrid 3 (see Figure 1), includes the following changes to the highway covers:

- Provide one continuous highway cover over I-5 rather than separate covers at the existing N Flint Avenue, NE Weidler Street, NE Broadway, N Williams Avenue, and the N Vancouver Avenue overcrossings.
- Expand the limits of the highway cover by approximately 35 feet to the west and approximately 400 feet to the north.
- Design and construct the highway cover to accommodate multi-story buildings. Due to span length and site constraints, design would constrain building size, location, type, and use on portions of the cover (Figure 4). Generally, buildings up to three stories could be accommodated throughout the highway cover. Buildings of up to six stories could be accommodated where span lengths are shorter than 80 feet with strict design constraints.

Figure 4 Building Parameters on the Cover



Future development on the highway cover would follow a community process according to the City-led Community Framework Agreement, as described in Section 2.1. ODOT anticipates this process could continue past completion of cover construction.

As part of the Project, ODOT anticipates programming interim uses on the highway cover for the time period between Project completion and when the City-led development process would be implemented. Upon Project completion, the added surface space created by the highway cover over I-5 could provide an opportunity for new and modern bicycle facilities, making the area more connected, walkable and bike friendly. It could also provide opportunity for various potential types of public spaces, to be precisely determined during the Project's final design phase and through robust community engagement, consisting of one or more of the following types of uses:

- Landscaped areas for **accessible**, active, and **passive** recreation and/or to provide a buffer, backdrop and visual comfort, such as gardens, lawns or planter beds.
- **Accessible** plazas and hardscaped open space for active and passive recreation, such as courts, plazas, splash pads, picnic areas, and community gathering spaces.
- **Accessible** interpretive signage, historical markers, landmarks and other areas of historical recognition and narrative such as art pieces and other historical signage/kiosks and pavement focused on the historic Albina community.
- Temporary and lightweight vertical features to support episodic, mobile commercial activities such as **accessible** food market shed, eating pavilion, food carts, or picnic venues.

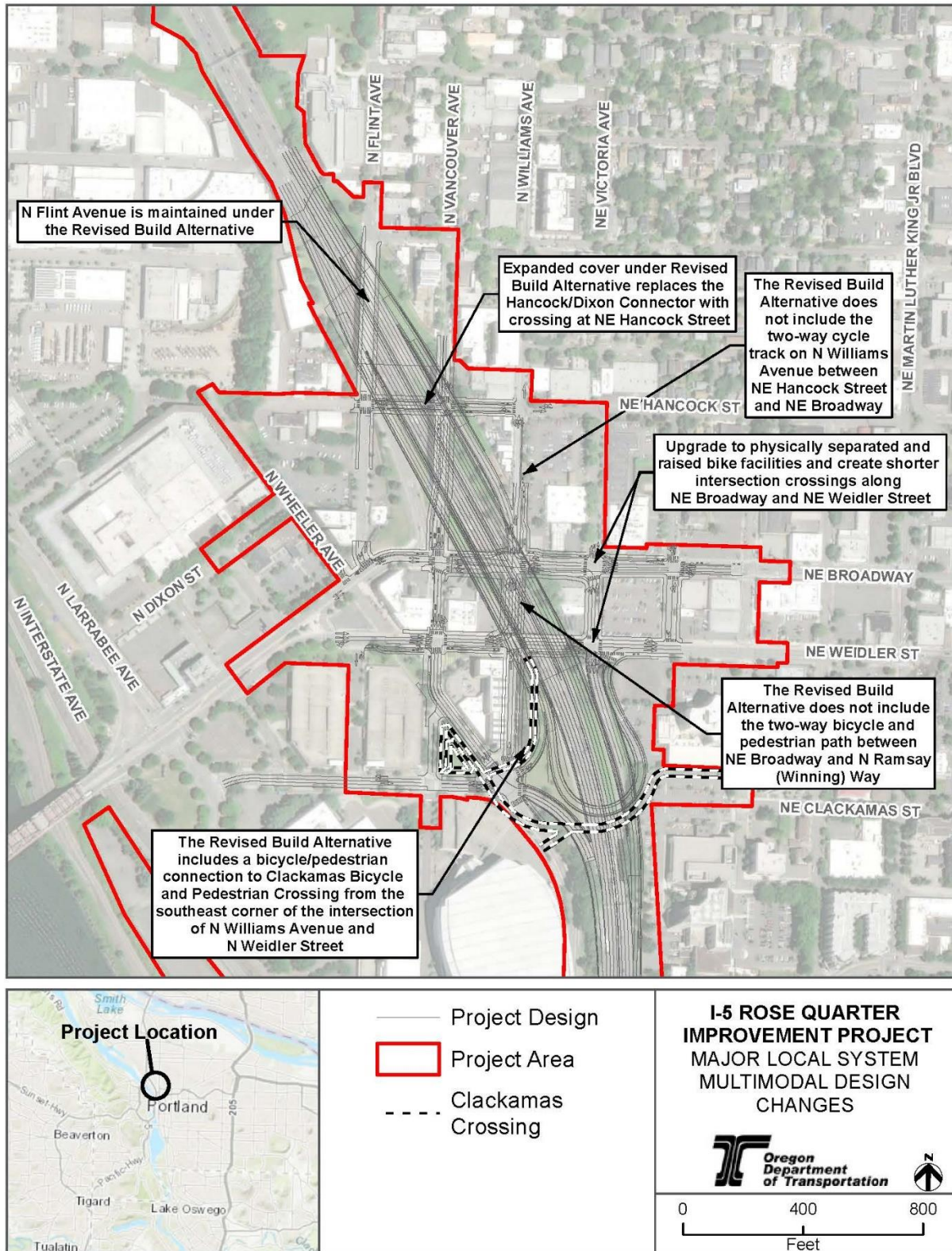
These features may be removed upon implementation of the development determined by the community process or may be incorporated into that development.

2.5 RELATED LOCAL SYSTEM MULTIMODAL IMPROVEMENTS CHANGES

The Revised Build Alternative includes the following changes to local system multimodal improvements to accommodate the Hybrid 3 design concept and subsequent design refinements (see Figure 5 below):

- **Construct the accessible Clackamas Bicycle and Pedestrian Crossing (a.k.a. Clackamas Crossing):**
 - » **Realign the crossing to the south to accommodate the flyover to NE Weidler Street**
 - » **Relocate the western termination point of the crossing to the triangle of land framed by N Center Court Street, NE Wheeler Avenue, and N Ramsay Way.**
 - » **Provide the following connections to the crossing (to be confirmed in the final design phase):**
 - / **From the southeast corner of the intersection of N Williams Avenue and N Weidler Street that spans over N Wheeler Avenue and connects to the crossing, and**
 - / **From the Garden Garage, which is attached to the Moda Center**
 - » **Construct wider sidewalks and bike lanes at sidewalk level and physically separated from the roadway with a curb and provide protected bike signal phases at multiple intersections along NE Broadway and NE Weidler Street.**
- **Connect N Flint Avenue across I-5 from NE Tillamook Street to N Hancock Street and terminate it at N Broadway.**
- **Remove the NE Hancock Street overcrossing of I-5 from N Williams Avenue to N Dixon Street as proposed in the Build Alternative. NE Hancock Street would be extended across I-5 and reconnect to NE Hancock Street west of N Flint Avenue as part of the expanded highway cover. Permitted traffic modes and roadway profile to be determined during design.**
- **Remove the two-way cycle track on N Williams Avenue between NE Hancock Street and NE Broadway and a two-way bicycle and pedestrian path between NE Broadway and N Ramsay Way from the design and instead convert the on-road bike lane to a protected bike lane, with a transition to the existing on-road bike lane at or near NE Hancock Street (to be confirmed in the final design phase).**

Figure 5 Major Local System Multimodal Design Changes

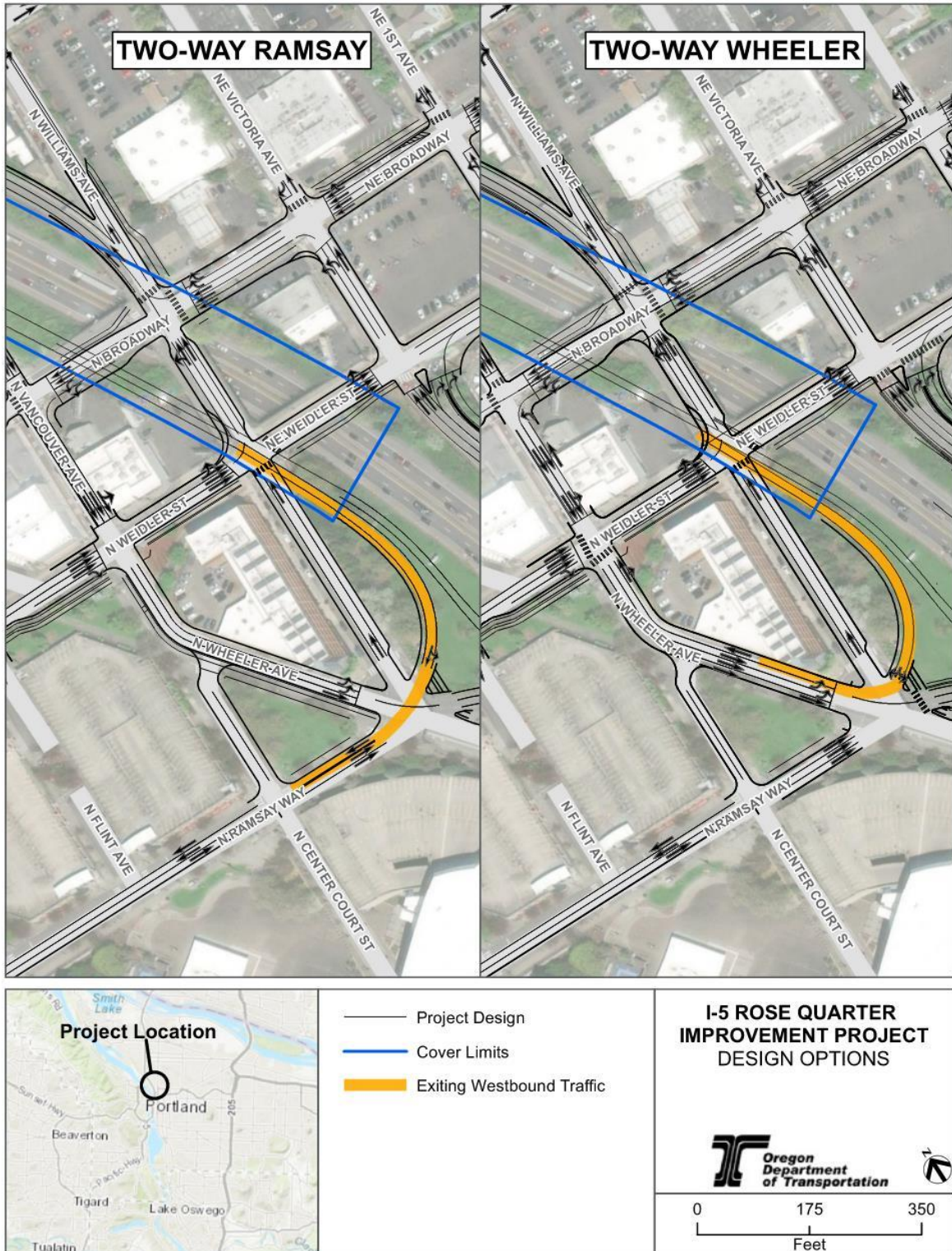


To accommodate I-5 southbound traffic exiting at N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way, ODOT is considering two design options, both of which are evaluated in this report (Figure 6):

- **2-way Ramsay Design Option - Convert N Ramsay Way between N Center Court Street and NE Wheeler Avenue from an eastbound one-way facility to a two-way facility.**
- **2-way Wheeler Design Option - Construct a new northbound travel lane on NE Wheeler Avenue between N Broadway and N Ramsay Way and maintain the three existing southbound travel lanes between N Weidler Street and N Ramsay Way.**

Both design options also include a left turn movement from the I-5 southbound exit ramp to southbound N Williams Avenue. This movement was previously accommodated via N Wheeler Avenue/ N Vancouver Avenue between N Broadway and N Ramsay Way.

Figure 6 Design Options for I-5 SB Exit Ramp: Traffic Heading West



3.0 REGULATORY FRAMEWORK

The safety related regulatory framework is the same as was evaluated in the 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project. The following documents that describe the regulatory framework in the 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project have not changed:

- ADA Standards (updated in 2010).
- ODOT **2023** Highway Design Manual (ODOT **2023**).
- ODOT (Oregon Department of Transportation). 1999. Oregon Highway Plan.
- Oregon Transportation Plan – (ODOT **2023**).
- NACTO (National Association of City Transportation Officials). 2018. Urban Street Design Guide.
- Oregon Bicycle and Pedestrian Plan (ODOT, 2016).
- Division 51 (ODOT 2012).

The American Association of State Highway and Transportation Officials (AASHTO) guidance document A Policy on Geometric Design of Highways and Streets 6th Edition (AASHTO 2011) has been updated in 2018 to A Policy on Geometric Design of Highways and Streets, 7th Edition (AASHTO 2018). The design and safety criteria related to this project remains unchanged with the new AASHTO 2018 document. **In 2023, a new rule for ADA guidance was issued for Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way.**

4.0 METHODOLOGY AND DATA SOURCES

The methodology and data sources are the same as those described in the 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project.

4.1 AREA OF POTENTIAL IMPACT

The API is the same as the Project Area as shown in Figure 2 except along N Broadway, where the API extends west to N Larrabee Avenue. This extension is the same as the area of potential impact shown in the 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project.

4.2 EXISTING CONDITIONS ANALYSIS

The existing conditions analysis in the 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project was not updated in this report. The findings from that work are the same for this report.

4.3 FREEWAY MAINLINE AND RAMP SEGMENTS CRASH ANALYSIS

The methodology and data sources for the freeway mainline analysis are the same as those described in the 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project. The AASHTO 2010 Highway Safety Manual (HSM) predictive method for freeways was applied using the Enhanced Interchange Safety Analysis Tool software (ISATe). To understand the change in forecast crash rate that can be attributed to improvements in the roadway cross-section, the 2045 predicted crash rates for No-Build and Revised Build alternatives were evaluated using the No-Build volumes. Because ODOT does not have HSM predictive method calibration factors for freeways, the analysis was performed without calibration factors and considered only relative results between the Revised Build and No-Build alternatives. This methodology is consistent with that used in the 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project and is standard practice when local calibration factors are not available. The safety models developed **for this 2023 Revised** Transportation Safety Supplemental Technical Report are more refined than those developed for the 2019 Transportation Safety Technical Report. Specifically, the inside and outside shoulder widths and median widths were estimated with more detail to develop a more refined comparison between the Revised Build Alternative with the No-Build and Build Alternatives.

Except for the I-5 southbound exit ramp **to Broadway and the I-5 northbound exit ramp to N/NE Weidler Street**, all other ramps in the Revised Build Alternative are very similar to the Build Alternative with only minor changes that would not influence the outcomes of the safety analysis. Therefore, the I-5 southbound exit ramp **to N/NE Broadway and the I-5 northbound exit ramp to N/NE Weidler Street** are considered in this analysis. **Under the Revised Build Alternative, the I-5 southbound exit ramp splits to N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way (westbound) and to NE Weidler Street (eastbound).** While the ramp diverges from the freeway mainline at approximately the same location, the relocated end **points extend** the length of the ramp from approximately 1,000 feet to approximately **1,900 feet for westbound traffic and approximately 2,700 feet for eastbound traffic (see Figure 7).** **Both eastbound and westbound ramps include sharper horizontal curves. At N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way, the ramp connection would add a single lane to the existing intersection. The I-5 northbound exit ramp to NE Weidler Street is designed with wider shoulders and longer through lanes and a longer right turn lane approaching the**

intersection. In addition, the flyover to NE Weidler Street would add a second right turn lane parallel to the I-5 northbound exit ramp right turn lane. An HSM Predictive method crash analysis was conducted to compare the safety performance of **these two ramps** in the Revised Build Alternative with that in the No-Build Alternative. Figure 8 shows highway segments and ramp location considered for this analysis.

Emergency braking events were identified as a surrogate for crashes in the I-5 Broadway/Weidler Interchange Improvements: Traffic Operations Analysis Summary (HDR 2015). In that analysis, an emergency braking event is defined as a vehicle decelerating faster than 14.8 feet per second squared (ft/s²). This methodology was applied again in the 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project. These emergency braking analysis results from the 2019 evaluation are still valid because freeway traffic operations are expected to be sufficiently similar between the Build Alternative and the Revised Build Alternative. Specifically, the Build Alternative and Revised Build Alternative include the same geographic extents for the auxiliary lanes, similar **entrance** and **exit** ramp spacings, and similar traffic volumes.

Figure 7 I-5 Southbound Ramp Relocation



Figure 8 Study Segments and Ramps for Safety Analysis



4.4 LOCAL STREET MULTIMODAL RISK ASSESSMENT

The methodology used for the local street safety assessment is the same as described in the 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project. The same framework for exposure, complexity and severity/risk is used to qualitatively evaluate conditions on the local street system in the No-Build and Revised Build Alternative. As any one of these measures increases, potential risk of a crash increases. These metrics provide a framework for qualitatively considering crash conditions at a site. Exposure is a measure of the number of cars, pedestrians or cyclists traveling through a location. Complexity refers to the physical characteristics of the location and how difficult or easy it is for users to travel through the location. Severity/Risk refers to the mix of speeds of different modes traveling through the intersection.

The local street assessment in this 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project **was** conducted at the locations **in red** shown in Figure 9. **To assess impacts due to the changes in local street circulation with the Revised Build Alternative, two additional intersections on N Ramsay Way have been added to this assessment.** Intersections were identified for analysis in this report if the Revised Build Alternative would change No-Build intersection configurations. All other intersections would remain the same as the No-Build Alternative in the 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project.

The 2045 Average Daily Traffic (ADT) volumes were derived based on the conservative assumption that PM peak hour traffic volume is approximately 10 percent of ADT. As described in more detail in the Traffic Analysis Supplemental Technical Report, the Metro Regional Travel Demand Models were used to forecast future demand for the horizon year 2045 including the PM peak hour traffic volumes. Small changes in traffic volumes between the Revised Build Alternative and the Build Alternative resulted in updates in volume ranges for the exposure rating. In addition, as documented in the Traffic Analysis Supplemental Technical Report, the 2045 bicycle volumes were also updated in this analysis. These updates also influenced the volume ranges for the bicycle exposure rating.

The following shows the assumed volume ranges for each mode:

- Motor vehicle exposure ratings were based on the following ranges of 2045 average daily traffic (ADT) (in vehicles per day [vpd]):
 - » No-Build:
 - / High: 19,684 - 27,900 vpd
 - / Moderate: 11,468 - 19,683 vpd
 - / Low: 3,250 - 11,467 vpd

-
- » Revised Build Alternative: **2-way Ramsay Design Option:**
 - / High: 20,751 – 30,400 vpd
 - / Moderate: 11,101 – 20,750 vpd
 - / Low: 1,450 - 11,100 vpd
 - » Revised Build Alternative: **2-way Wheeler Design Option:**
 - / High: 20,851 – 30,400 vpd
 - / Moderate: 11,301 – 20850 vpd
 - / Low: 2,200 – 11,600 vpd
 - Bicycle exposure ratings were based on the following ranges of 2045 PM peak hour (5:00–6:00 PM) bicycle volumes:
 - » No-Build:
 - / High: 1,081 - 1,570 bicycles per hour
 - / Moderate: 591 - 1,080 bicycles per hour
 - / Low: 100 - 590 bicycles per hour
 - » Revised Build Alternative: **2-way Ramsay and 2-way Wheeler Design Options:**
 - / High: 1,081 - 1,570 bicycles per hour
 - / Moderate: 591 - 1,080 bicycles per hour
 - / Low: 100 - 590 bicycles per hour
 - Pedestrian exposure ratings were based off the following ranges of 2045 PM peak hour (5:00–6:00 PM) pedestrian volumes:
 - » No-Build:
 - / High: 346 – 450 pedestrians per hour
 - / Moderate: 242 – 345 pedestrians per hour
 - / Low: 136 - 241 pedestrians per hour
 - » Revised Build Alternative: **2-way Ramsay and 2-way Wheeler Design Options:**
 - / High: 340 – 440 pedestrians per hour
 - / Moderate: 238 - 339 pedestrians per hour
 - / Low: 136 – 237 pedestrians per hour

Bicycle and pedestrian volume information was not available for the N Wheeler Avenue/ N Dixon Street and N Vancouver Avenue/ N Hancock Street intersections. Pedestrian volume information was not available at the N Williams Avenue/ N/NE Hancock Street intersection. For

these intersections, it was assumed that the volumes would be low based on professional judgement and knowledge of the area, and hence the exposure ratings were assigned as “low.” All of these intersections are unsignalized intersections.

Figure 9 Local Intersections Included in Local Street Multimodal Risk Analysis



5.0 AFFECTED ENVIRONMENT

The affected environment is the same as was evaluated in the 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project.

6.0 ENVIRONMENTAL CONSEQUENCES

6.1 NO-BUILD ALTERNATIVE

6.1.1 Direct Impacts

The No-Build Alternative would have the same direct impacts as described in the 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project.

6.1.2 Indirect Impacts

The No-Build Alternative would have the same indirect impacts as described in the 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project.

6.2 REVISED BUILD ALTERNATIVE

6.2.1 Direct Impacts

Forecast Freeway Conditions - Mainline

For the purposes of the safety analysis, the relevant differences between the Revised Build and No-Build Alternative on the freeway mainline are the change in inside shoulder width (Figure 10), right shoulder width (Figure 11), and the provision of auxiliary lanes on both I-5 northbound and southbound between I-84 and the N Weidler Street **exit** ramp. Under No-Build traffic volumes, the forecast crash rates in the Revised Build Alternative would be lower than the forecast crash rates for the No-Build Alternative between approximately the I-405 ramps and the existing southbound I-5 **entrance** ramp from N **Ramsay** Way (segments 3 - 7 and 9 on Figure 8). The forecast crash rates for both the Build Alternative and the Revised Build Alternative would be similarly lower than the forecast crash rates for the No-Build Alternative in the same locations. However, the Revised Build Alternative is forecast to have a slightly higher crash rate (up to 9% higher, yet still below No-Build Alternative) as compared to the Build Alternative due primarily to the changes in the inside shoulder widths. Figure 12 shows the differences between the Build and Revised Build inside shoulder width. Outside shoulder widths are the same for both Build and Revised Build alternatives.

There are additional safety benefits of the Revised Build Alternative not captured using the HSM methods. Providing the auxiliary lanes under the Revised Build Alternative would result in enhanced traffic operations, more uniform lane speeds, and reduction in lane changes as compared to the No-Build. As documented in the 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project under the Build Alternative and Design Year traffic volumes, the number of emergency braking events on the freeway mainline would decrease in both northbound and southbound directions of I-5. In both directions, the analysis shows

substantial reduction of emergency braking during peak hours due to the addition of the auxiliary lanes. This analysis of the Build Alternative is also valid to the Revised Build Alternative since they both have the same geographic extents for the auxiliary lanes, similar **entrance** and **exit** ramp spacings, and similar traffic volumes. From a safety perspective, fewer emergency braking maneuvers also have the outcome of fewer unexpected driver maneuvers, less rapid acceleration and deceleration, and less potential for rear-end crashes.

As documented in the Traffic Analysis Supplemental Technical Report traffic volumes and improvements in the freeway traffic operations under the Revised Build and Build Alternatives are expected to be similar; therefore, the outcomes from the previous emergency breaking analysis remain valid and the Revised Build Alternative would also have the benefit of fewer emergency braking maneuvers and lower crash risk as compared to the No-Build alternative.

In addition, as compared to the No-Build Alternative, the Revised Build Alternative would improve traffic operations at both I-5 southbound and northbound **exit** ramps by reducing ramp queue lengths and providing increased ramp storage that would reduce the potential for queues extending onto the I-5 mainline.

Similarly, the HSM analysis method does not capture the safety benefits associated with wider right shoulders in the context of traffic incident management. With wider right shoulders, there is space for vehicles to move to the side of the road in the event a break down or non-injury crash. In addition, this space can be used by emergency vehicles to access crashes or other events. Effectively, the wider shoulder provides space for motorists to move out of the travel lane in unusual situations which would reduce congestion and the potential for secondary rear-end crashes associated with queuing in these situations.

Figure 10 Inside Shoulder Width of Study Corridor for the No-Build and Revised Build Alternatives

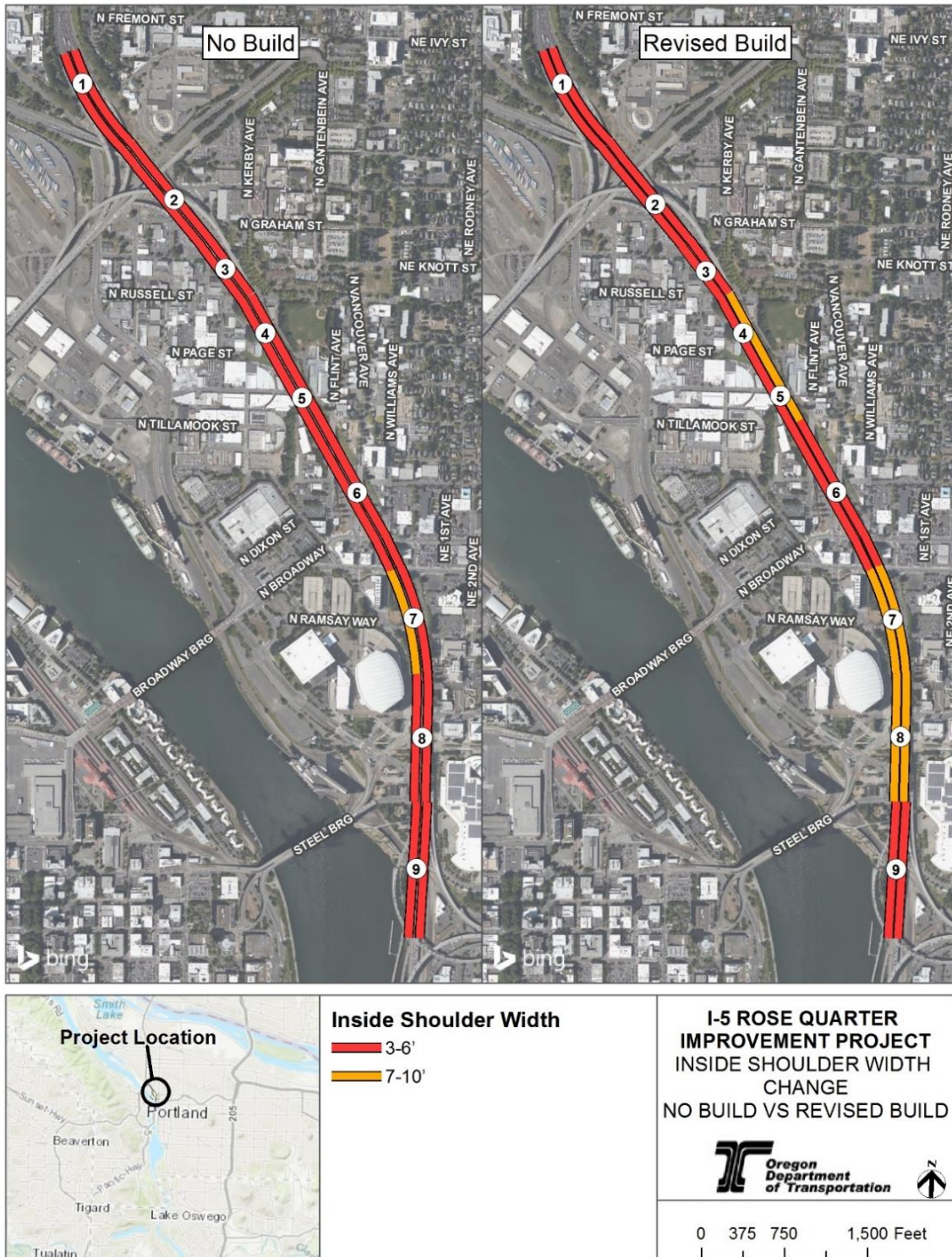


Figure 11 Outside Shoulder Width of Study Corridor for the No-Build and Revised Build Alternatives

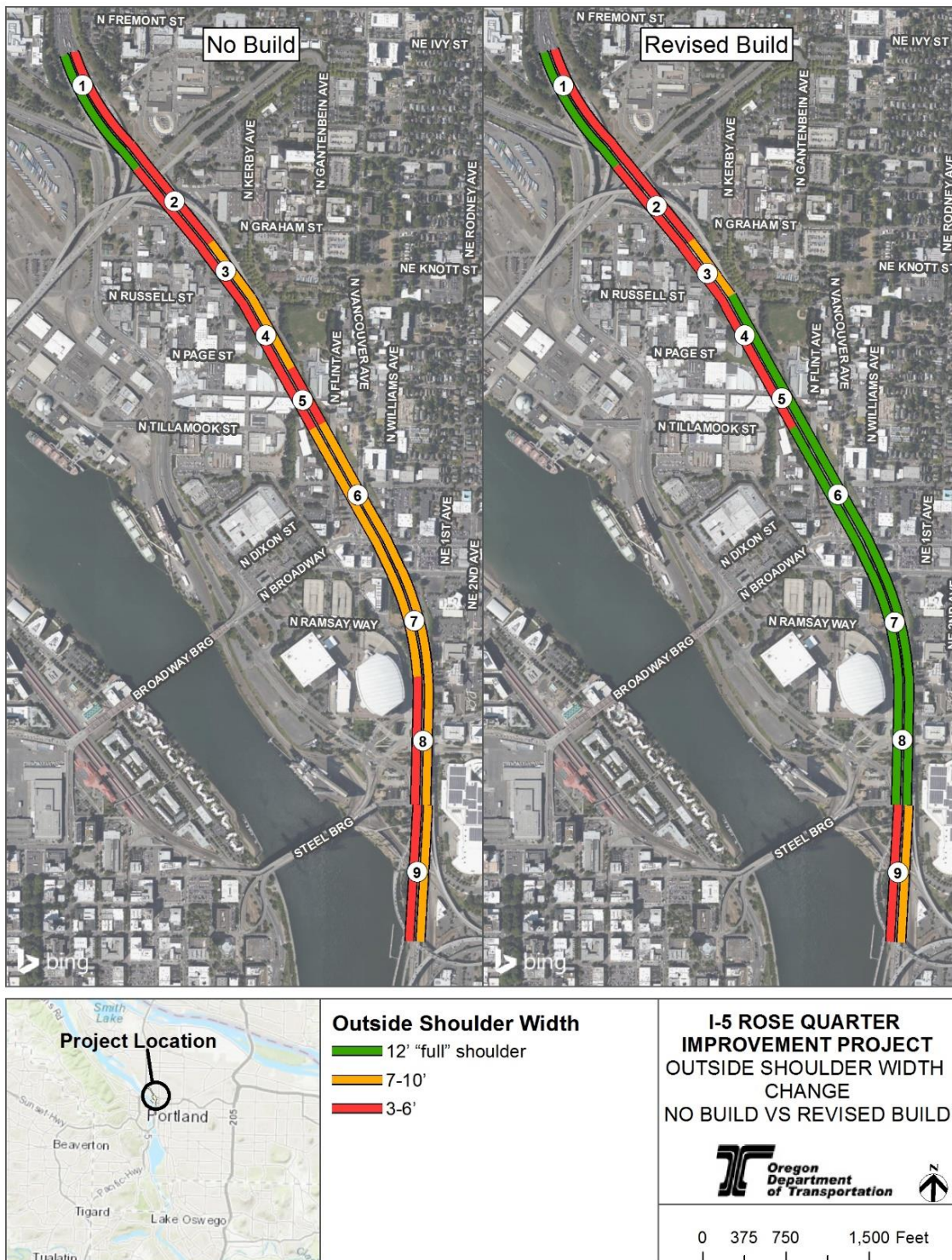
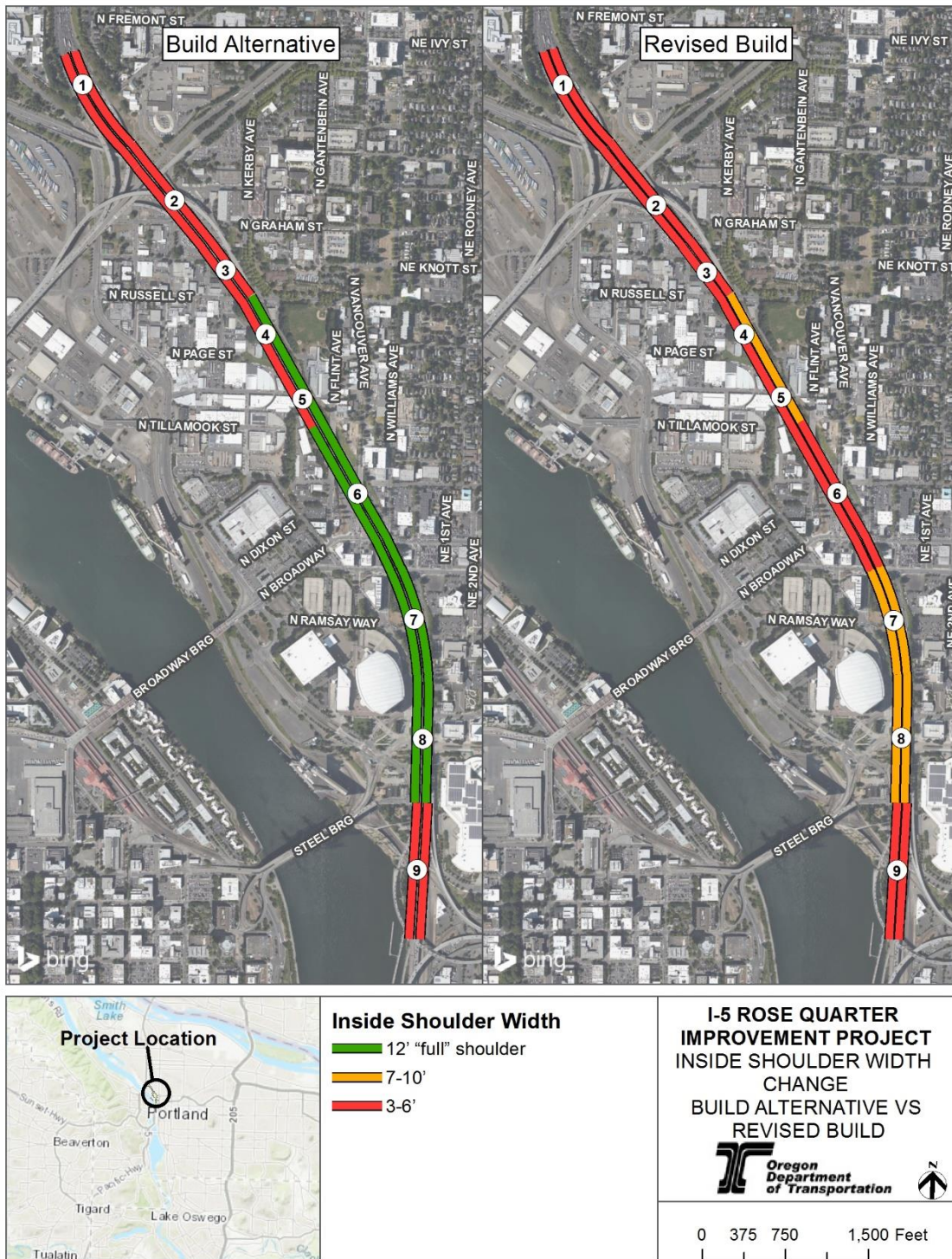


Figure 12 Inside Shoulder Width of Study Corridor for Build Alternative and Revised Build Alternative



Forecast Freeway Conditions - Ramps

The HSM predictive method for ramps is used to evaluate relative safety performance **of the two reconfigured ramps as compared to the No-Build Alternative:**

- 1. the I-5 southbound exit ramp reconfigured with the ramp connecting at two locations (N Williams Avenue/ NE Wheeler Avenue/ N Ramsay Way intersection and a flyover to NE Weidler Street), and**
- 2. the I-5 northbound exit ramp to the intersection of NE Weidler Street/ NE Victoria Avenue.**

These ramp configurations are investigated in this **2023 Revised** Transportation Safety Supplemental Technical Report because it is substantially different from the configuration in the No-Build and Build Alternatives.

Under the HSM method, the number of crashes which **could** occur on a ramp is sensitive to geometric conditions, traffic volume, and length of the ramp. There are no major changes in geometry in the I-5 southbound exit ramp between the No-Build and Build conditions, hence they have similar forecast crash rates. However, **reconfiguring** the I-5 southbound exit ramp connection to the local system from a **single ramp connection at N Broadway to a ramp configuration in which westbound traffic would connect to the N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way intersection and eastbound traffic would connect to NE Weidler Street**, would increase the ramp length from approximately 1,000 feet in the No-Build conditions to approximately **1,900 feet for the ramp to N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way and to approximately 2,700 feet for the flyover ramp to NE Weidler Street** in the Revised Build conditions, which would provide **approximately 1,000 to 1,700** feet of additional traffic queue storage. The new ramp design also includes wider shoulders than existing conditions.

In terms of traffic volumes, the Revised Build Alternative includes an I-5 southbound ramp design that distributes the overall I-5 southbound traffic onto two ramps: approximately one third of traffic goes to the N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way intersection and two-thirds go to the flyover to NE Weidler Street. This new ramp configuration would reduce traffic volumes circulating on the local streets through N Vancouver Avenue and NE Weidler Avenue west of NE Victoria Avenue. Also, the Revised Build Alternative would eliminate the large skew angle and travel lane offset at the existing exit ramp terminal intersection at N Broadway/ N Vancouver Avenue, which would remain in the No-Build Alternative. The reduction of vehicular conflicts at intersections such as N Broadway/ N Vancouver Avenue and N/NE Weidler Street/ N/NE Williams with anticipated high number of vulnerable users, cyclists, pedestrians, and people with disabilities could reduce the potential for crashes and severity at these locations.

Based on the HSM, the forecast crash rate **at the I-5 southbound ramp** would be approximately **26 percent** higher than the No-Build and Build condition. In the HSM, the number of crashes on a facility is highly sensitive to volume and **length of the ramps**. **As the length of the ramp connections increase, potential for crashes increases and therefore so does the crash rate.** Also, HSM analysis for the Revised Build Alternative considers the horizontal curve introduced with the flyover. This curve indicates a potential increase in the crash rate on the I-5 southbound ramp as compared to the relative straight segment of the ramp in the No-Build Alternative. To minimize this potential for crashes along the horizontal curve, the I-5 southbound ramp is designed so motorists would have adequate length to decelerate on the tangent section of the ramp and prior to the split of the ramp. This would allow motorists to navigate the horizontal sections of the ramps at lower and safer speeds and continue to decelerate while approaching the signalized intersection. From a traffic operation perspective, the additional storage on the I-5 southbound exit-ramp would reduce the potential for queue spill-back onto the freeway. Under the No-Build Alternative, queue on the exit ramp is expected to propagate upstream onto the freeway mainline, creating a safety concern. The additional storage provided in the Revised Build Alternative would be able to accommodate the queue on the ramp without encroaching onto the freeway. This is particularly beneficial during peak hours and event conditions.

Each ramp terminal includes a horizontal curve prior to the ramp terminal intersection. **While these curves are outside the minimum radius specified in the ODOT HDM, they are within the range of minimum radii as defined within the AASHTO Design guidelines. To reduce the potential for truck “off-tracking” outside of a standard travel lane, the curves would be designed to include wider shoulders and lanes than other sections of the ramp.** Adequate delineation, signing, markings and lighting to inform drivers of the sharp curves as they approach the ramp terminal intersections would also be considered. These design treatments would be refined in the design process as the project proceeds. Figure 13 shows the existing **N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way** intersection and the lane configuration for the proposed I-5 southbound terminal. **Figure 14 shows the existing NE Weidler Street/ NE Victoria Avenue intersection and the proposed lane configuration for accommodating the flyover at this intersection.** Similar to the 2019 Transportation Safety Technical Report, the analysis did not perform a quantitative analysis of the local street network or the ramp terminal intersections. Therefore, the potential crash rates of the ramp terminal intersections or crash rates of the local street network which would use the flyover to NE Weidler Street instead of local streets to navigate the interchange area are not reflected in the reported crash rates.

Figure 13 Existing Intersection vs Proposed I-5 Southbound Exit Ramp Terminal

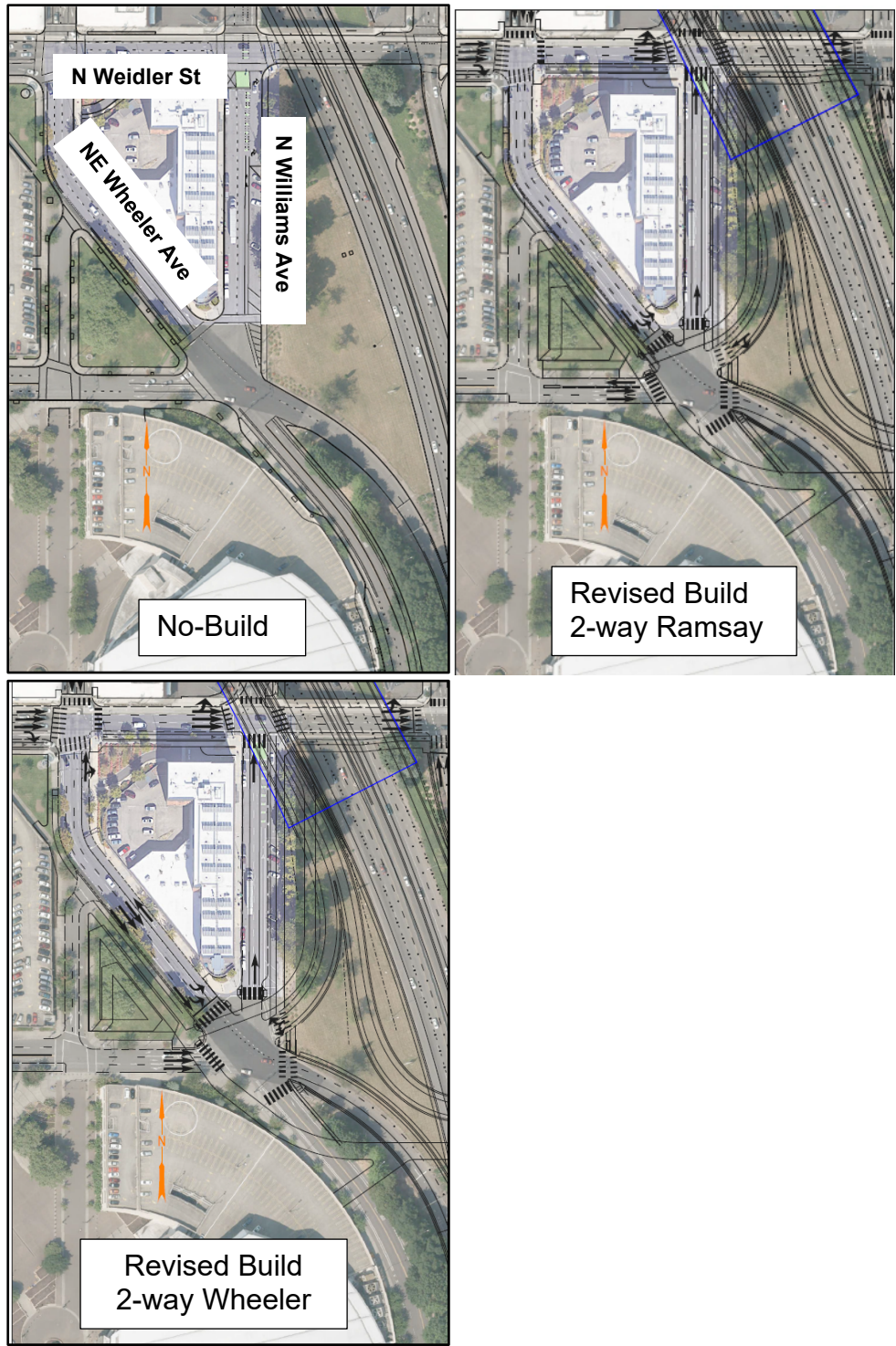
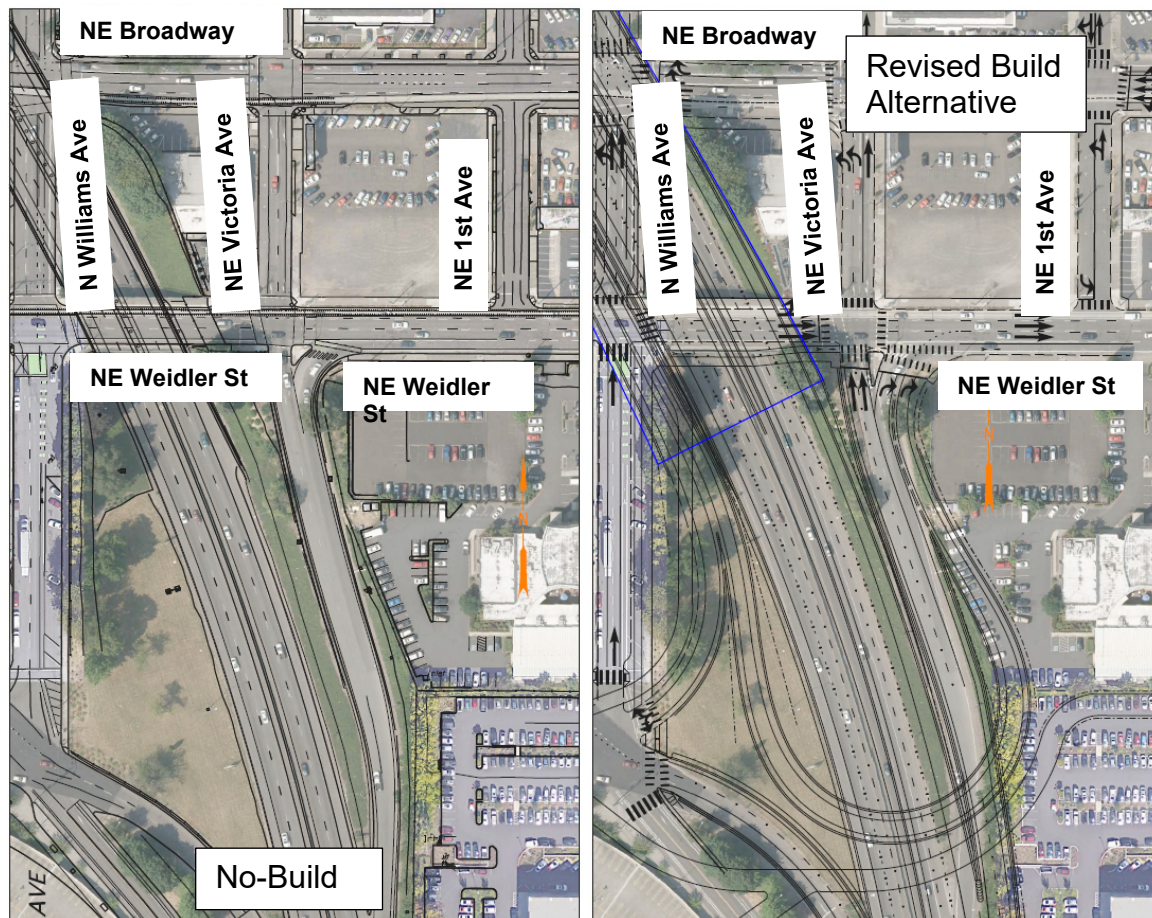


Figure 14 Existing Intersection vs Proposed I-5 Northbound Exit Ramp Terminal



The I-5 northbound exit ramp to NE Weidler Street is designed with wider shoulders and additional storage as a result of longer travel lanes approaching the intersection. The I-5 southbound flyover would add a second right turn lane adjacent to the I-5 northbound right turn to accommodate the I-5 southbound ramp traffic destined to eastbound NE Weidler Street. The project would provide channelized right turn lane with a pedestrian island separating through lanes from right turn lanes. A physical separation between the right turn lanes would also be provided to remove any potential lane changes approaching the intersection. In addition, the right turn movement would be signalized providing protected bicycle and pedestrian crossings across the dual right turn movements (with prohibition of right turns on red). HSM analysis for the Revised Build Alternative indicates that the I-5 northbound ramp segments would experience lower crash rates (6 percent lower) than those in the No-Build Alternative due primarily to wider shoulders.

Similarly, the I-5 southbound entrance and exit ramp to N Williams Avenue would have wider shoulders and additional storage to better accommodate queues during peak hours. The

operational improvements at specific ramps are expected to improve traffic flow and minimize weaving maneuvers, improving the overall safety of these ramps.

6.3 LOCAL STREET MULTIMODAL RISK ASSESSMENT

Appendix A provides the detailed tabular summary of No-Build and Revised Build condition ratings (**exposure, complexity, risk**) for the **2-way Ramsay and 2-way Wheeler design options and for each of the intersections influenced by the Revised Build Alternative**. In both options, the level of vehicular exposure (i.e., number of vehicles entering the intersection) would decrease at the intersection of N Broadway/ N Vancouver Avenue due to the relocation of the ramp and would increase at the intersection of N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way. Figure 15 and Figure 16 summarize the change in complexity for each of the Revised Build Alternative design options compared to the No-Build Alternative. As described in the 2019 Transportation Safety Report complexity generally refers to intersection physical characteristics (e.g., number and type of lanes, alignment, signal phasing, separated/non-separated pedestrian and bicycle facilities). Intersections with conventional layouts or operations and modal separation were deemed less complex. Intersections with less conventional layouts or operations and mixed modal operations were deemed more complex. In summary, it is estimated that as compared to the No-Build Alternative, the Revised Build Alternative **in both options** is expected to improve safety conditions **for all users including cyclists, pedestrians, and people with disabilities by reducing the complexity** at the following intersections:

- NE Broadway/ NE Victoria Avenue
- N/NE Weidler Street/ N Williams Avenue

In the 2-way Ramsay Design Option, safety is expected to improve by reducing the level of complexity at two additional intersections:

- N Broadway/ N Vancouver Avenue
- N Weidler Street/ N Vancouver Avenue

As compared to the No-Build Alternative, the Revised Build Alternative **in both options would increase the level of complexity of the intersection at:**

- N/NE Broadway and N Williams Avenue

The remaining intersections would maintain the same level of complexity as identified in the No-Build Alternative. Appendix A includes the details of the local street multimodal risk assessment.

Figure 15 Summary of Change of Level of Complexity: 2-way Ramsay Design Option compared to No-Build

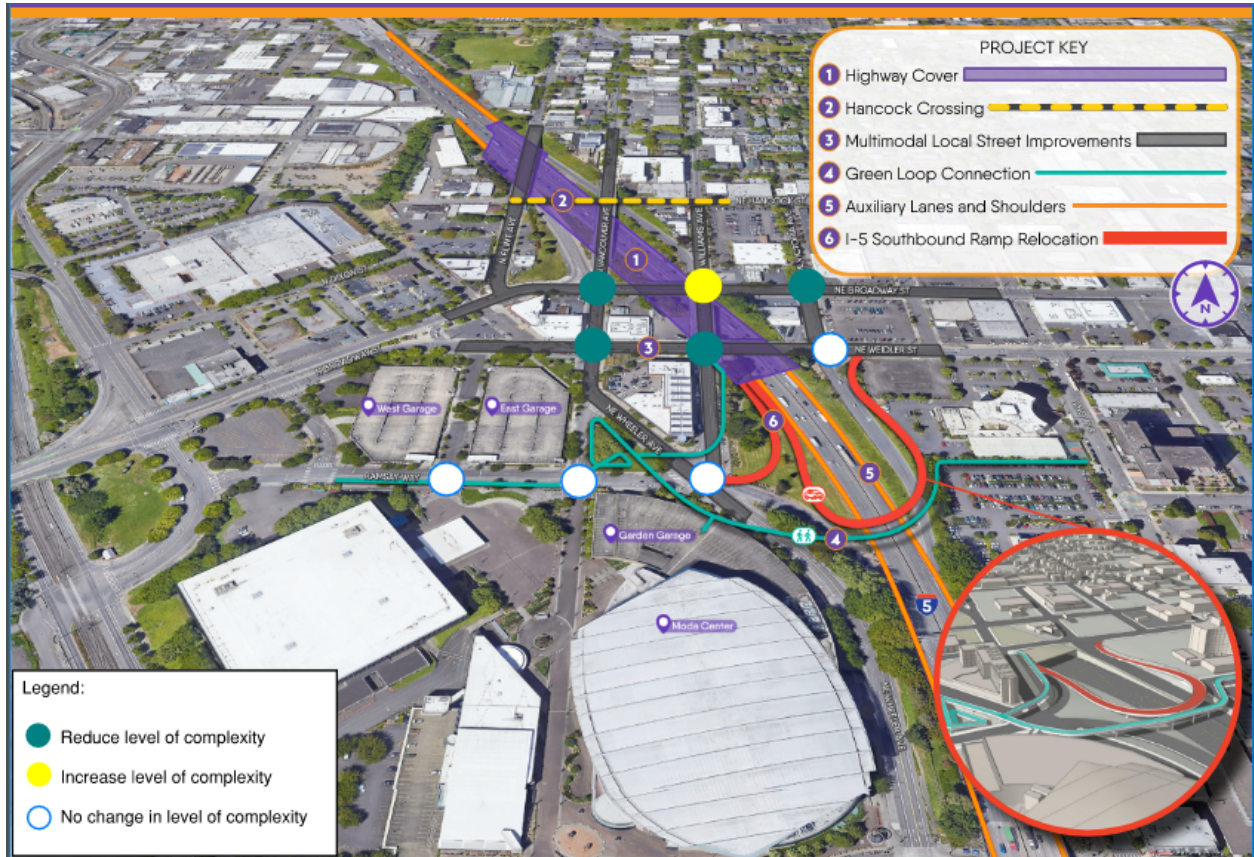
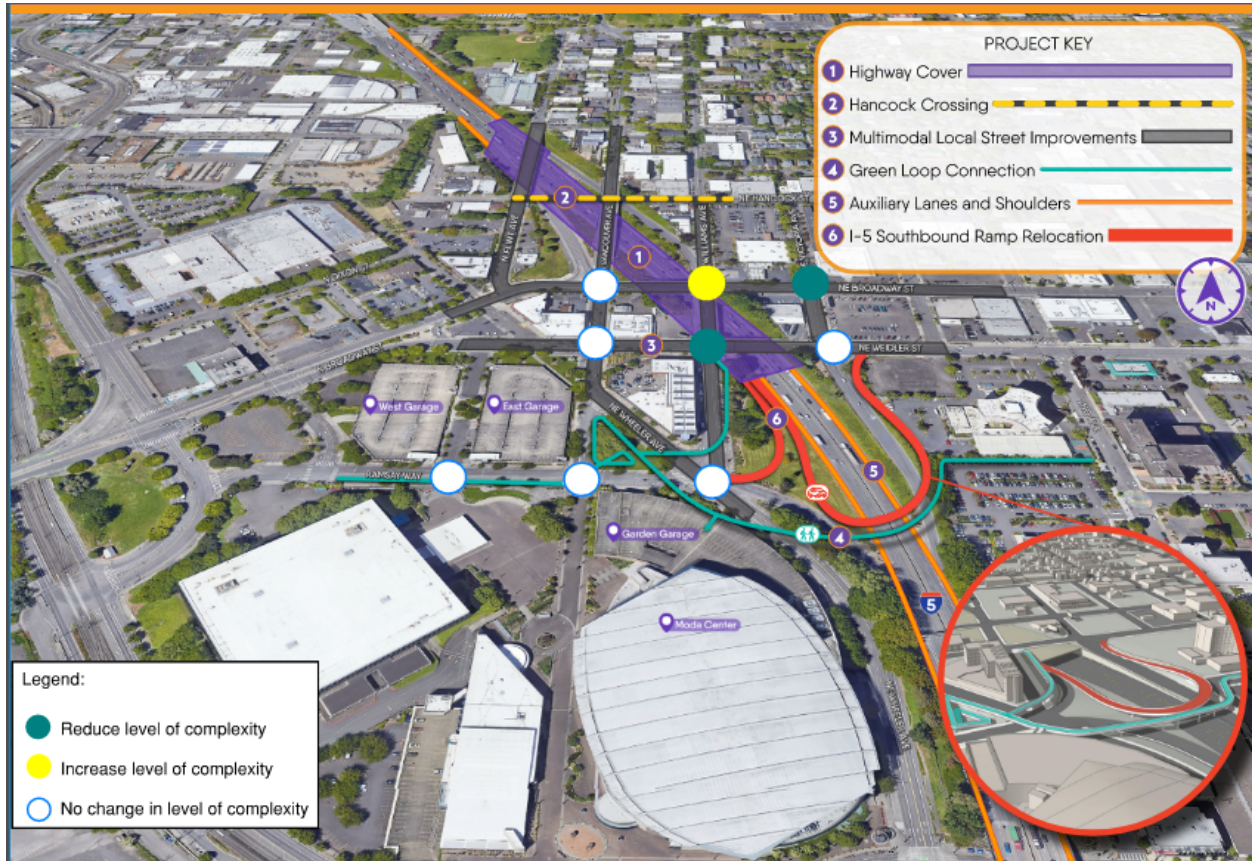


Figure 16 Summary of Change of Level of Complexity: 2-way Wheeler Design Option compared to No-Build



As design continues, the following options are provided as a menu of possible treatments to improve pedestrian, bicycle and vehicular traffic safety, access and mobility:

- Verify signal timing provides sufficient crossing time.
- Address potential bicycle/motor vehicle conflicts through proactive signing, striping, and signal phasing (e.g., leading pedestrian interval, or pedestrian or bicycle protected signal phasing). Bicycle storage requirements at signalized intersection will be carefully assessed and integrated into the design.
- Review and adjust, if necessary, adjacent on-street parking to improve stopping and intersection sight distance.
- Verify intersection turning radii are consistent with desired interactions between motorists, pedestrians, and cyclists.

These treatments would be considered for improving safety during all conditions including conditions during both Moda Center event ingress and egress conditions. **Other proven safety countermeasures will be further evaluated and considered during design refinement.**

6.3.1 Indirect Impacts

Similar to the Build Alternative, no indirect safety impacts are anticipated under the Revised Build Alternative.

6.3.2 Cumulative Impacts

The cumulative impact analysis considers the Project's impacts combined with other past, present, and reasonably foreseeable future actions that would result in the environmental impacts in the Project Area. The travel demand model for this project is based on the 2014 Metro Regional Transportation Plan (RTP) and changes from the 2014 and 2018 RTP have been evaluated and reviewed. There are no changes in the projects considered for the RFFA list and therefore there are no updates on the trip generation, travel demand, or modeling used in the evaluation the safety of the Project. Therefore, the cumulative impacts of the Revised Build Alternative would be the same as those reported in the 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project.

6.4 CONCLUSION

The proposed geometric changes (increased shoulder width and auxiliary lane additions) along the whole corridor would reduce crash rates and address existing crash issues identified in the 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project. The auxiliary lanes would provide traffic operation benefits including more uniform lane speeds and fewer lane changes that **would** reduce the potential for congestion related rear-end crashes. The emergency braking analysis forecasts that the number of emergency braking events under future Build traffic volumes would decrease as compared to No-Build conditions. In the opening year (i.e., No-Build traffic volumes), the rate of crashes on I-5 under the Revised Build Alternative would be lower than the No-Build conditions. As traffic volumes grow, the crash reduction benefits of the proposed geometric changes would decrease.

As compared to the No-Build Alternative, the new auxiliary lanes under the Revised Build Alternative would result in smoother traffic flows, and the operational improvements at the existing ramp terminal intersections would reduce the potential for ramp queueing extending onto the highway resulting in a reduced risk of congestion related crashes.

The Revised Build Alternative would relocate **and reconfigure** the I-5 southbound ramp terminal from N Broadway to **include two ramps: one connecting to the N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way intersection, and a flyover connecting to NE Weidler**

Street. In the Revised Build condition, **these ramp connections would then be extended to approximately 1,900 feet long or longer.** This would provide ample storage for forecast queues and the additional storage space would reduce the potential for queue spillback onto the freeway. As design proceeds, potential mitigations for the curve at the end of **each of the ramps** include positive guidance along the ramp, advance guide signs, enhanced delineation, pavement markings, and illumination. All of these elements would be included as part of the Revised Build Alternative and would be refined through the Preliminary Design phase of the project.

The qualitative safety analysis rates the local intersections for exposure (i.e., number of people), complexity (i.e., user experience and familiarity with physical characteristics, modal separation) and risk (i.e., posted speed limits). **The Revised Build Alternative would increase/change potential crash risk at the intersections N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way by increasing the level of exposure, and N/NE Broadway/ N Williams Avenue by increasing the level of complexity. Whether the third westbound through lane can be removed from the proposed cross-section at the westbound approach at N/NE Broadway/ N Williams Avenue and bicycle facility options along N Williams Avenue will be further evaluated during design in coordination with PBOT. While the Revised Build Alternative under both design options would improve safety conditions for cyclists and pedestrians along N Vancouver Avenue between N Broadway and N Weidler Street by implementing separated bicycle facilities, protected bicycle and pedestrian phases at locations where turning movements are provided with exclusive turn lanes, and reducing the traffic volumes in the southbound direction with the removal of the I-5 southbound traffic, under the 2-way Wheeler Design Option the level of complexity would continue to be high as there would be additional conflicts introduced by the accommodation of the northbound traffic.** As design continues, the following options are provided as a menu of possible treatments to improve pedestrian and bicycle access and mobility:

- Verify signal timing provides sufficient crossing time
- Address potential bicycle/motor vehicle conflicts through proactive signing, striping, and signal phasing (e.g., leading pedestrian interval, or pedestrian or bicycle protected signal phasing). Bicycle storage requirements at signalized intersection **would** be carefully assessed and integrated into the design.
- Review and adjust, if necessary, adjacent on-street parking to improve stopping and intersection sight distance
- Verify intersection turning radii are consistent with desired interactions between motorists, pedestrians, and cyclists

7.0 AVOIDANCE, MINIMIZATION, AND MITIGATION MEASURES

This section is the same as described in the 2019 Transportation Safety Technical Report I-5 Rose Quarter Improvement Project.

8.0 PREPARERS

Name	Discipline	Education	Years of Experience
Elizabeth Wemple	Transportation Safety	<ul style="list-style-type: none">• Bachelor of Science, Civil Engineering• Master of Science, Transportation Engineering,• Master City Planning	30
Harshala Sardar	Transportation	<ul style="list-style-type: none">• Bachelor of Technology, Civil Engineering• Master of Science, Transportation Engineering	5
Marcela Rodriguez	Transportation	<ul style="list-style-type: none">• Bachelor of Science, Civil Engineering• Master of Science, Civil Engineering	17

9.0 REFERENCES

AASHTO (American Association of State Highway and Transportation Officials). 2010. Highway Safety Manual. First Edition. Washington D.C.

HDR. 2015. Broadway/Weidler Interchange Improvements: Traffic Operations Analysis Summary.

HDR Transportation Safety Technical Report, January 2019

NCHRP 17-45 Safety Prediction Methodology and Analysis Tool for Freeways and Interchanges, Texas Transportation Institute, May 2012,

Transportation Research “Safety aspects of freeway weaving sections” Transportation Research Part A 38 (2004) 35-51

Appendix A. Local Street Multimodal Risk Analysis

The Local Street Multimodal Risk Analysis is based on three characteristics: Exposure, Complexity, and Severity, as described in detail in the 2019 Transportation Safety Technical Report. Exposure represents the total volume of pedestrians, cyclists, and motor vehicles entering an intersection. Complexity generally refers to an intersection’s physical characteristics (e.g., operations, modal separation, intersection layout) that could impact user comfort and safety. Severity is a rating assigned to each intersection based on posted speed limits for motorized travel through major and minor streets at the intersections. **Table 1 shows the qualitative ratings (i.e., low, moderate, and high) for the No-Build and Revised Build Alternative at those study intersections where: 1) two of three criteria were rated as moderate or higher (including two of three modes in the exposure category), and 2) there is a possible change in criteria rating between the Revised Build Alternative compared to the No-Build.** *Note, according to the City of Portland’s Vision Zero Program, Broadway is a high crash street for all modes.*

Table 1 Study Intersections for Local Street Multimodal Risk Assessment

Study Intersection	Scenario	Exposure (Motorist, Bicycle, Pedestrian)	Complexity	Severity	Impact of Proposed Project
N Broadway/ N Vancouver Avenue	No-Build	H, L, L	H	H	
	Revised Build Alternative: 2-way Ramsay	M, L, L	L	H	4-leg intersection with lower traffic volumes compared to No-Build Alternative.
	Revised Build Alternative: 2-way Wheeler	M, L, L	H	H	Due to ramp relocation in the Revised Build Alternative, the intersection is proposed to be 4-leg signalized intersection instead of skewed 5-leg intersection with lower traffic volumes. The south leg is a two-way street to accommodate NB left turn movements. This configuration introduces a two-way that is opposing the alignment of the one-way SB configuration on the north leg at this intersection.

Study Intersection	Scenario	Exposure (Motorist, Bicycle, Pedestrian)	Complexity	Severity	Impact of Proposed Project
N Weidler Street/ N Vancouver Avenue	No-Build	H, M, M	H	H	
	Revised Build Alternative: 2-way Ramsay	M, M, M	M	H	Lower traffic volume resulting from relocation of SB exit ramp. Fewer travel lanes on N Vancouver Ave.
	Revised Build Alternative: 2-way Wheeler	H, M, M	H	H	The north and south leg are two-way streets. Some SB exit ramp traffic still using intersection.
N/NE Weidler Street/ N Williams Avenue	No-Build	M, H, H	M	H	
	Revised Build Alternative: 2-way Ramsay	M, H, H	L	H	Less I-5 traffic going east, Separated bicycle lanes.
	Revised Build Alternative: 2-way Wheeler	M, H, H	L	H	Less I-5 traffic going east Separated bicycle lanes.
N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way	No-Build	M, M, M	H	L	
	Revised Build Alternative: 2-way Ramsay	H, M, M	H	L	Increase in traffic volume due to relocation of the current N Broadway exit ramp making this a six-leg signalized intersection.
	Revised Build Alternative: 2-way Wheeler	H, M, M	H	L	Increase in traffic volume due to relocation of the current N Broadway exit ramp making this a six-leg signalized intersection.
NE Weidler Street/ NE Victoria Avenue	No-Build	H, L, H	H	M	NB unsignalized right turn lane across existing pedestrian crossing and bicycle lane.
	Revised Build Alternative: 2-way Ramsay	H, L, H	H	M	Adds second right turn lane. Traffic increases by 11% due to I-5 SB exit ramp. New signalized pedestrian crossing and bicycle signal across NB right turn lane.
	Revised Build Alternative: 2-way Wheeler	H, L, H	H	M	Adds second right turn lane. Traffic increases by 11% due to I-5 SB exit ramp. New signalized pedestrian crossing and bicycle signal across NB right turn lane.

Study Intersection	Scenario	Exposure (Motorist, Bicycle, Pedestrian)	Complexity	Severity	Impact of Proposed Project
N/NE Broadway / N Williams Avenue	No-Build	H, H, H	M	M	Existing northern crosswalk is closed due to conflicts with traffic
	Revised Build Alternative: 2-way Ramsay	H, H, M	H	M	Exposure between WB traffic and pedestrian/bicycles increases due to increase in number of WB through lanes. Project will provide crosswalks on all crossings.
	Revised Build Alternative: 2-way Wheeler	H, H, M	H	M	Exposure between WB traffic and pedestrian/bicycles increases due to increase in number of WB through lanes. Project will provide crosswalks on all crossings.
N Ramsay Way/ N Center Court Street	No-Build	L, L, L	L	L	
	Revised Build Alternative: 2-way Ramsay	L, L, L	L	L	The WB traffic from the new SB ramp will be navigated through the Ramsay Way. The Ramsay Way is a two-way street. Separated two-way bicycle facility is planned on the southside of Ramsay Way.
	Revised Build Alternative: 2-way Wheeler	L, L, L	L	L	Separated two-way bicycle facility is planned on the southside of Ramsay Way
N Ramsay Way/ N Flint Ave	No-Build	L, L, L	L	L	No separated bicycle facilities
	Revised Build Alternative: 2-way Ramsay	L, L, L	L	L	This intersection is signalized, and the Ramsay Way is a two-way street. The Ramsay Way is a two-way street. Separated two-way bicycle facility is planned on the southside of Ramsay Way
	Revised Build Alternative: 2-way Wheeler	L, L, L	L	L	Separated two-way bicycle facility is planned on the southside of Ramsay Way

Study Intersection	Scenario	Exposure (Motorist, Bicycle, Pedestrian)	Complexity	Severity	Impact of Proposed Project
N Broadway/ NE Victoria Avenue	No-Build	M, L, M	H	M	There are NB left turn conflicts with pedestrian phase as there is no existing “No Left Turn on Red” sign to restrict left turning vehicles from turning left during the ped phase.
	Revised Build Alternative: 2-way Ramsay	M, L, M	M	M	With two dedicated left turn lanes, a separated through lane, and “No Left Turn on Red” sign, pedestrian crossings would be protected from northbound left turn movements.
	Revised Build Alternative: 2-way Wheeler	M, L, M	M	M	With two dedicated left turn lanes, a separated through lane, and “No Left Turn on Red” sign, pedestrian crossings would be protected from northbound left turn movements.

Notes: H = high; L = low; M = moderate

Exposure is the number of people traveling through the site, complexity reflects the user experience and familiarity with physical characteristics of the site, and severity (risk) is mix of posted speed limits on cross streets.

A green letter indicates an improvement from the No-Build; a red letter indicates a worsening of conditions from the No-Build;

Summary of the Revised Build Alternative (both 2-way Ramsay Design Option and 2-way Wheeler Design Option) impacts:

- N/NE Weidler Street / N Williams Avenue** – The proposed changes are expected to decrease the traffic volume by 40 percent in the Revised Build Alternative compared to No-Build. In addition, the northbound protected bicycle lane would improve the safety of cyclists on the north and south legs of the intersection. Providing separate pedestrian and bicycle signal phases would mitigate any potential conflict **with turning vehicles**.
- N/NE Broadway/ N Williams Avenue** – At this intersection, the proposed configuration would have three westbound through lanes which might increase **complexity of the intersection by increasing crossing length** for cyclists, pedestrians, and the motor-vehicle traffic. **While in the south leg, the crossing length would be reduced as the number of travel lanes would be reduced from three to two. Westbound cyclists and pedestrians would continue to have a protected signal phase (with prohibition of right turns on red) against the westbound right turning vehicles.** In addition, the proposed bicycle facility

would be separated from traffic on the east side of N Williams Avenue eliminating the existing weaving conflict between northbound traffic and the bicycles. **The Revised Build Alternative would include a new protected pedestrian crossing on the north leg of the intersection across N Williams Avenue where the existing crosswalk is closed, thereby improving the pedestrian crossing condition by avoiding the need to cross N/NE Broadway.**

- **NE Weidler Street/ NE Victoria Avenue** – One lane of the proposed southbound exit ramp meets at this intersection adding a right turn lane. The volume at this intersection might increase by 11 percent. A physical separation is provided between the two right turn lanes to eliminate any potential weaving maneuvers approaching the intersection. Potential conflicts for the pedestrian and cyclists traveling eastbound would be minimized using the refuge island and protected phasing through the traffic signal.
- **N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way** – The current N Broadway exit ramp is proposed to be relocated to the N Wheeler Avenue/ N Williams Avenue/ N Ramsay Way intersection in the Revised Build Alternative. This would make it a six-leg signalized intersection with an increase in traffic volume, increasing exposure to all modes of transportation traveling through this intersection. Overall, there might be an increase in traffic by 30 percent.
- **N Broadway/ NE Victoria Avenue** - The south leg of this intersection is a two lane, with left turn only and one shared left turn with through movement. Because of the shared movements some drivers tend to take left turns during the pedestrian phase of the west leg. The proposed intersection configuration would provide two dedicated left turn lanes, a separated through lane and protected west pedestrian crossing (with prohibition of left turns on red). These improvements will improve the safety conditions for the pedestrian, cyclist and motor vehicles.

Summary of Revised Build Alternative 2-way Ramsay Design Option: This option would accommodate the I-5 southbound traffic heading west on N Ramsay Way with a westbound travel lane between NE Wheeler Avenue and N Center Court Street.

- **N Broadway/ N Vancouver Avenue** - The proposed relocation of the southbound exit ramp could reduce the traffic by 50 percent and thus reduce vehicular conflicts with all users including bicycles and pedestrians and improve its performance. The users would easily navigate through the four-leg non-skewed intersection with separated one-directional bicycle lanes. Protected bicycle phases would be provided against the southbound right turn.
- **N Weidler Street/ N Vancouver Avenue** – The proposed relocation of the exit ramp would relocate the eastbound ramp traffic to NE Weidler Street, thus reducing the

traffic at this intersection by 30 percent. The proposed separate bus and bicycle lanes in the Revised Build Alternative would improve the safety conditions for cyclists by eliminating potential conflicts due to the current shared bus and bicycle lane.

- **N Ramsay Way/ N Center Court Street** – The proposed separate bicycle lanes in the Revised Build Alternative would improve the safety conditions for cyclists. The traffic could increase by 30 percent.
- **N Ramsay Way/ N Flint Avenue** – In addition to the improvements proposed in the 2-way Wheeler Design Option, this intersection is proposed to be signalized.

Summary of the Revised Build Alternative 2-way Wheeler Design Option Impacts: This design option accommodates the I-5 southbound exit ramp traffic heading west on N Wheeler Avenue by implementing a new northbound lane between N Ramsay Avenue and N Broadway.

- **N Broadway/ N Vancouver Avenue** – The relocation of the current N Broadway exit ramp could reduce the traffic by 40 percent. This option would reduce the complexity for pedestrian and cyclists at the N Broadway/ N Vancouver Avenue intersection. With no-skewed intersection and separate one-directional bicycle lanes, the transition of road users through this intersection would be more familiar and easier to navigate. With this option, the south leg is a two-way street and would add left turn maneuvers from N Vancouver Avenue onto N Broadway. This configuration introduces a two-way that is opposing the alignment of the one-way southbound configuration on the north leg at this intersection. Additional vehicular conflicts between the northbound left turn movements and pedestrians/ cyclists would be minimized using protected signal phasing. No southbound right turn would be provided.
- **N Weidler Street/ N Vancouver Avenue** – The proposed relocation of the exit ramp would navigate the eastbound ramp traffic to NE Weidler Street, thus reducing the traffic at this intersection by 20 percent. With this option, N Vancouver Avenue is a two-way street and would add vehicular conflicts with the accommodation of northbound through and right turn maneuvers from N Vancouver onto N Weidler Street.
- **N Ramsay Way/ N Center Court Street** – The proposed separated two-way bicycle facility in the Revised Build Alternative would improve the safety conditions for cyclists. The traffic could decrease by 30 percent.
- **N Ramsay Way/ N Flint Avenue** – N Ramsay Way is proposed to be two-way with two lanes, one separate bicycle lane and one optional westbound lane which would be used during events. The traffic could decrease by 30 percent. Cyclist safety would be improved with a two-way bicycle facility.