FINAL

Water Resources Technical Report

I-5 Rose Quarter Improvement Project

Oregon Department of Transportation

January 8, 2019

Contents

Tables

Figures[1]

[1] Appendix E includes written descriptions of all figures referenced in this Technical Report. If needed, additional figure interpretation is available from the ODOT Senior Environmental Project Manager at (503) 731-4804.

Appendices

Acronyms and Abbreviations

API	Area of Potential Impact
CIA	contributing impervious area
DDT	dichlorodiphenyltrichloroethane
DEQ	[Oregon] Department of Environmental Quality
EB	eastbound
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FAHP	Federal-Aid Highway Program
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
GIS	geographic information system
I-405	Interstate 405
I-5	Interstate 5
I-84	Interstate 84
mvmt	million vehicle miles traveled
MMFD	modified media filter ditch
NB	northbound
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
ODOT	Oregon Department of Transportation
OWRD	Oregon Water Resources Department
PBO	Programmatic Biological Opinion
Project	I-5 Rose Quarter Improvement Project
ROW	right of way
SAC	Stakeholder Advisory Committee
SB	southbound
SPIS	Safety Priority Index System
TMDL	total maximum daily load
WB	westbound

Executive Summary

The I-5 Rose Quarter Improvement Project (Project) is located in Portland, Oregon, along the 1.7-mile segment of Interstate 5 (I-5) between Interstate 405 (I-405) to the north (milepost 303.2) and Interstate 84 (I-84) to the south (milepost 301.5). The Project also includes the interchange of I-5 and N Broadway and NE Weidler Street (the Broadway/Weidler interchange) and the surrounding transportation network from approximately N/NE Hancock Street to the north, N Benton Avenue to the west, N/NE Multnomah Street to the south, and NE 2nd Avenue to the east.

The Build and No-Build Alternatives have been reviewed for effects on existing water resources within the Area of Potential Impact (API). It is anticipated that the Build Alternative would result in positive effects (overall improvement) to water resources within the API. The Build Alternative would provide stormwater quality treatment and would meet the stormwater management requirements of Oregon Department of Transportation (ODOT) and the City of Portland. The Build Alternative would include approximately 41 acres of impervious area that would require water quality treatment. A conceptual stormwater analysis has identified potential locations for stormwater treatment facilities to accommodate this area. Conventional water quality treatment facilities, such as planters, swales, basins, and media filtration, would treat impervious area. Non-traditional treatment methods (i.e., those not found in the *ODOT Hydraulics Manual* or City of Portland *Stormwater Management Manual*) have also been identified and would be proposed where site constraints may preclude a more conventional water quality facility. Non-traditional treatment methods offer smaller facility footprints than conventional methods and may be similar to operations and maintenance costs of traditional approaches. The conceptual stormwater analysis identifies on-site and off-site facility locations. Some water quality facilities would need to be located off-site. Site constraints and utility conflicts make treating all Project impervious area on-site impractical.

1 Introduction

1.1 Project Location

The I-5 Rose Quarter Improvement Project (Project) is located in Portland, Oregon, along the 1.7-mile segment of Interstate 5 (I-5) between Interstate 405 (I-405) to the north (milepost 303.2) and Interstate 84 (I-84) to the south (milepost 301.5). The Project also includes the interchange of I-5 and N Broadway and NE Weidler Street (Broadway/Weidler interchange) and the surrounding transportation network, from approximately N/NE Hancock Street to the north, N Benton Avenue to the west, N/NE Multnomah Street to the south, and NE 2nd Avenue to the east.

Figure 1 illustrates the Project Area in which the proposed improvements are located. The Project Area represents the estimated 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.

1.2 Project Purpose

The purpose of the Project is to improve the safety and operations on I-5 between I-405 and I-84, of the Broadway/Weidler interchange, and on adjacent surface streets in the vicinity of the Broadway/Weidler interchange and to enhance multimodal facilities in the Project Area.

In achieving the purpose, the Project would also support improved local connectivity and multimodal access in the vicinity of the Broadway/Weidler interchange and improve multimodal connections between neighborhoods located east and west of I-5.

1.3 Project Need

The Project would address the following primary needs:

- **I-5 Safety:** I-5 between I-405 and I-84 has the highest crash rate on urban interstates in Oregon. Crash data from 2011 to 2015 indicate that I-5 between I-84 and the merge point from the N Broadway ramp on to I-5 had a crash rate (for all types of crashes[2]) that was approximately 3.5 times higher than the statewide average for comparable urban interstate facilities (ODOT 2015a).

[2] Motor vehicle crashes are reported and classified by whether they involve property damage, injury, or death.

Figure 1. Project Area

  - Seventy-five percent of crashes occurred on southbound (SB) I-5, and 79 percent of all the crashes were rear-end collisions. Crashes during this 5-year period included one fatality, which was a pedestrian fatality. A total of seven crashes resulted in serious injury.
  - The Safety Priority Index System (SPIS) is the systematic scoring method used by the Oregon Department of Transportation (ODOT) for identifying potential safety problems on state highways based on the frequency, rate, and severity of crashes (ODOT 2015b). The 2015 SPIS shows two SB sites in the top 5 percent and two northbound (NB) sites in the top 10 percent of the SPIS list.
  - The 2015 crash rate on the I-5 segment between I-84 and the Broadway ramp on to I-5 is 2.70 crashes per million vehicle miles. The statewide average for comparable urban highway facilities is 0.77 crashes per million vehicle miles travelled (mvmt).
  - The existing short weaving distances and lack of shoulders for accident/ incident recovery in this segment of I-5 are physical factors that may contribute to the high number of crashes and safety problems.
- **I-5 Operations:** The Project Area is at the crossroads of three regionally significant freight and commuter routes: I-5, I-84, and I-405. As a result, I-5 in the vicinity of the Broadway/Weidler interchange experiences some of the highest traffic volumes in the State of Oregon, carrying approximately 121,400 vehicles each day (ODOT 2017), and experiences 12 hours of congestion each day (ODOT 2012a). The following factors affect I-5 operations:
  - Close spacing of multiple interchange ramps results in short weaving segments where traffic merging on and off I-5 has limited space to complete movements, thus becoming congested. There are five on-ramps (two NB and three SB) and six off-ramps (three NB and three SB) in this short stretch of highway. Weaving segments on I-5 NB between the I-84 westbound (WB) on-ramp and the NE Weidler off-ramp, and on I-5 SB between the N Wheeler Avenue on-ramp and I-84 eastbound (EB) off-ramp, currently perform at a failing level-of-service during the morning and afternoon peak periods.
  - The high crash rate within the Project Area can periodically contribute to congestion on this segment of the highway. As noted with respect to safety, the absence of shoulders on I-5 contributes to congestion because vehicles involved in crashes cannot get out of the travel lanes.
  - Future (2045) traffic estimates indicate that the I-5 SB section between the N Wheeler on-ramp and EB I-84 off-ramp is projected to have the most critical congestion in the Project Area, with capacity and geometric constraints that result in severe queuing.
- **Broadway/Weidler Interchange Operations:** The complexity and congestion at the I-5 Broadway/Weidler interchange configuration is difficult to navigate for vehicles (including transit vehicles), bicyclists, and pedestrians, which impacts

access to and from I-5 as well as to and from local streets. The high volumes of traffic on I-5 and Broadway/Weidler in this area contribute to congestion and safety issues (for all modes) at the interchange ramps, the Broadway and Weidler overcrossings of I-5, and on local streets in the vicinity of the interchange.

- The Broadway/Weidler couplet provides east-west connectivity for multiple modes throughout the Project Area, including automobiles, freight, people walking and biking, and Portland Streetcar and TriMet buses. The highest volumes of vehicle traffic on the local street network in the Project Area occur on NE Broadway and NE Weidler in the vicinity of I-5. The N Vancouver Avenue/N Williams couplet, which forms a critical north-south link and is a Major City Bikeway within the Project Area with over 5,000 bicycle users during the peak season, crosses Broadway/Weidler in the immediate vicinity of the I-5 interchange.
- The entire length of N/NE Broadway is included in the Portland High Crash Network—streets designated by the City of Portland for the high number of deadly crashes involving pedestrians, bicyclists, and vehicles.[3]
- The SB on-ramp from N Wheeler and SB off-ramp to N Broadway experienced a relatively high number of crashes per mile (50-70 crashes per mile) compared to other ramps in the Project Area during years 2011-2015. Most collisions on these ramps were rear-end collisions.
- Of all I-5 highway segments in the corridor, those that included weaving maneuvers to/from the Broadway/Weidler ramps tend to experience the highest crash rates:
  - SB I-5 between the on-ramp from N Wheeler and the off-ramp to I-84 (SB-S5) has the highest crash rate (15.71 crashes/mvmt).
  - NB I-5 between the I-84 on-ramp and off-ramp to NE Weidler (NB-S5) has the second highest crash rate (5.66 crashes/mvmt).
  - SB I-5 between the on-ramp from I-405 and the off-ramp to NE Broadway (SB-S3) has the third highest crash rate (4.94 crashes/mvmt).

- **Travel Reliability on the Transportation Network:** Travel reliability on the transportation network decreases as congestion increases and safety issues expand. The most unreliable travel times tend to occur at the end of congested areas and on the shoulders of the peak periods. Due to these problems, reliability has decreased on I-5 between I-84 and I-405 for most of the day. Periods of congested conditions on I-5 in the Project Area have grown over time from morning and afternoon peak periods to longer periods throughout the day.

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[3] Information on the City of Portland's High Crash Network is available at https://www.portlandoregon.gov/transportation/54892.

1.4 Project Goals and Objectives

In addition to the purpose and need, which focus on the state's transportation system, the Project includes related goals and objectives developed through the joint ODOT and City of Portland N/NE Quadrant and I-5 Broadway/Weidler Interchange Plan process, which included extensive coordination with other public agencies and citizen outreach. The following goals and objectives may be carried forward beyond the National Environmental Policy Act (NEPA) process to help guide final design and construction of the Project:

- Enhance pedestrian and bicycle safety and mobility in the vicinity of the Broadway/Weidler interchange.
- Address congestion and improve safety for all modes on the transportation network connected to the Broadway/Weidler interchange and I-5 crossings.
- Support and integrate the land use and urban design elements of the Adopted N/NE Quadrant Plan (City of Portland et al. 2012) related to I-5 and the Broadway/Weidler interchange, which include the following:
    - Diverse mix of commercial, cultural, entertainment, industrial, recreational, and residential uses, including affordable housing
    - Infrastructure that supports economic development
    - Infrastructure for healthy, safe, and vibrant communities that respects and complements adjacent neighborhoods
    - A multimodal transportation system that addresses present and future needs, both locally and on the highway system
    - An improved local circulation system for safe access for all modes
    - Equitable access to community amenities and economic opportunities
    - Protected and enhanced cultural heritage of the area
    - Improved urban design conditions
- Improve freight reliability.
- Provide multimodal transportation facilities to support planned development in the Rose Quarter, Lower Albina, and Lloyd.
- Improve connectivity across I-5 for all modes.

2 Project Alternatives

This technical report describes the potential effects of no action (No-Build Alternative) and the proposed action (Build Alternative).

2.1 No-Build Alternative

NEPA regulations require an evaluation of the No-Build Alternative to provide a baseline for comparison with the potential impacts of the proposed action. The No-Build Alternative consists of existing conditions and any planned actions with committed funding in the Project Area.

I-5 is the primary north-south highway serving the West Coast of the United States from Mexico to Canada. At the northern portion of the Project Area, I-5 connects with I-405 and the Fremont Bridge; I-405 provides the downtown highway loop on the western edge of downtown Portland. At the southern end of the Project Area, I-5 connects with the western terminus of I-84, which is the east-west highway for the State of Oregon. Because the Project Area includes the crossroads of three regionally significant freight and commuter routes, the highway interchanges within the Project Area experience some of the highest traffic volumes found in the state (approximately 121,400 average annual daily trips). The existing lane configurations consist primarily of two through lanes (NB and SB), with one auxiliary lane between interchanges. I-5 SB between I-405 and Broadway includes two auxiliary lanes.

I-5 is part of the National Truck Network, which designates highways (including most of the Interstate Highway System) for use by large trucks. In the Portland-Vancouver area, I-5 is the most critical component of this national network because it provides access to the transcontinental rail system, deep-water shipping and barge traffic on the Columbia River, and connections to the ports of Vancouver and Portland, as well as to most of the area’s freight consolidation facilities and distribution terminals. Congestion on I-5 throughout the Project Area delays the movement of freight both within the Portland metropolitan area and on the I-5 corridor. I-5 through the Rose Quarter is ranked as one of the 50 worst freight bottlenecks in the United States (ATRI 2017).

Within the approximately 1.5 miles that I-5 runs through the Project Area, I-5 NB connects with five on- and off-ramps, and I-5 SB connects with six on- and off-ramps. Drivers entering and exiting I-5 at these closely spaced intervals, coupled with high traffic volumes, slow traffic and increase the potential for crashes. Table 1 presents the I-5 on- and off-ramps in the Project Area. Table 2 shows distances of the weaving areas between the on- and off-ramps on I-5 in the Project Area. Each of the distances noted for these weave transitions is less than adequate per current highway design standards (ODOT 2012b). In the shortest weave section, only 1,075 feet is available for drivers to merge onto I-5 from NE Broadway NB in the same area where drivers are exiting from I-5 onto I-405 and the Fremont Bridge.

Table 1. I-5 Ramps in the Project Area

I-5 Travel Direction	On-Ramps From	Off-Ramps To
Northbound	• I-84 • N Broadway/N Williams Avenue	• NE Weidler Street/NE Victoria Avenue • I-405 • N Greeley Avenue
Southbound	• N Greeley Avenue • I-405 • N Wheeler Avenue/N Ramsay Way	• N Broadway/N Vancouver Avenue • I-84 • Morrison Bridge/Highway 99E

Notes: I = Interstate

Table 2. Weave Distances within the Project Area

I-5 Travel Direction	Weave Section	Weave Distance
Northbound	I-84 to NE Weidler Street/NE Victoria Avenue	1,360 feet
Northbound	N Broadway/N Williams Avenue to I-405	1,075 feet
Southbound	I-405 to N Broadway	2,060 feet
Southbound	N Wheeler Avenue/N Ramsay Way to I-84	1,300 feet

Notes: I = Interstate

As described in Section 1.3, the high volumes, closely spaced interchanges, and weaving movements result in operational and safety issues, which are compounded by the lack of standard highway shoulders on I-5 throughout much of the Project Area.

Under the No-Build Alternative, I-5 and the Broadway/Weidler interchange and most of the local transportation network in the Project Area would remain in its current configuration, with the exception of those actions included in the Metro 2014 *Regional Transportation Plan* financially constrained project list (Metro 2014).[4] One of these actions includes improvements to the local street network on the Broadway/Weidler corridor within the Project Area. The proposed improvements include changes to N/NE Broadway and N/NE Weidler from the Broadway Bridge to NE 7th Avenue. The current design concept would remove and reallocate one travel lane on both N/NE Broadway and N/NE Weidler to establish protected bike lanes

[4] Metro Regional Transportation Plan ID 11646. Available at: https://www.oregonmetro.gov/sites/default/files/Appendix%201.1%20Final%202014%20RTP%20%20Project%20List%208.5x11%20for%20webpage_1.xls

and reduce pedestrian crossing distances. Proposed improvements also include changes to turn lanes and transitions to minimize pedestrian exposure and improve safety. The improvements are expected to enhance safety for people walking, bicycling, and driving through the Project Area. Implementation is expected in 2018-2027.

2.2 Build Alternative

The Project alternatives development process was completed during the ODOT and City of Portland 2010-2012 N/NE Quadrant and I-5 Broadway/Weidler Interchange planning process. A series of concept alternatives were considered following the definition of Project purpose and need and consideration of a range of transportation-related problems and issues that the Project is intended to address.

In conjunction with the Stakeholder Advisory Committee (SAC) and the public during this multi-year process, ODOT and the City of Portland studied more than 70 design concepts, including the Build Alternative, via public design workshops and extensive agency and stakeholder input. Existing conditions, issues, opportunities, and constraints were reviewed for the highway and the local transportation network. A total of 19 full SAC meetings and 13 subcommittee meetings were held; each was open to the public and provided opportunity for public comment. Another 10 public events were held, with over 100 attendees at the Project open houses providing input on the design process. Of the 70 design concepts, 13 concepts advanced for further study based on SAC, agency, and public input, with six concepts passing into final consideration.

One recommended design concept, the Build Alternative, was selected for development as a result of the final screening and evaluation process. The final I-5 Broadway/Weidler Facility Plan (ODOT 2012a) and recommended design concept, herein referred to as the Build Alternative, were supported by the SAC and unanimously adopted in 2012 by the Oregon Transportation Commission and the Portland City Council.[5] The features of the Build Alternative are described below.

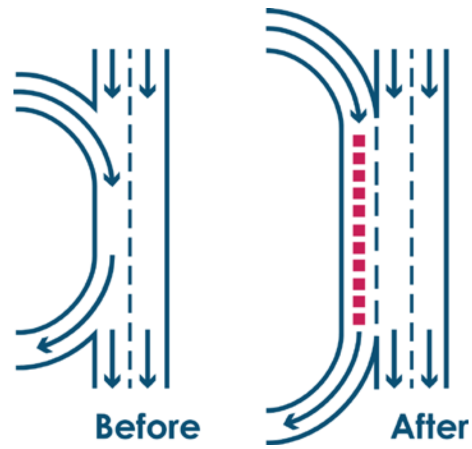
The Build Alternative includes I-5 mainline improvements and multimodal improvements to the surface street network in the vicinity of the Broadway/Weidler interchange. The proposed I-5 mainline improvements include the construction of auxiliary lanes (also referred to as ramp-to-ramp lanes) and full shoulders between I-84 to the south and I-405 to the north, in both the NB and SB directions. See Section 2.2.1 for more detail.

Construction of the I-5 mainline improvements would require the rebuilding of the N/NE Weidler, N/NE Broadway, N Williams, and N Vancouver structures over I-5.

[5] Resolution No. 36972, adopted by City Council October 25, 2012. Available at: https://www.portlandoregon.gov/citycode/article/422365

With the Build Alternative, the existing N/NE Weidler, N/NE Broadway, and N Williams overcrossings would be removed and rebuilt as a single highway cover structure over I-5 (see Section 2.2.2). The existing N Vancouver structure would be removed and rebuilt as a second highway cover, including a new roadway crossing connecting N/NE Hancock and N Dixon Streets. The existing N Flint Avenue structure over I-5 would be removed. The I-5 SB on-ramp at N Wheeler would also be relocated to N/NE Weidler at N Williams, via the new Weidler/Broadway/Williams highway cover. A new bicycle and pedestrian bridge over I-5 would be constructed at NE Clackamas Street, connecting Lloyd with the Rose Quarter (see Section 2.2.4.3).

Surface street improvements are also proposed, including upgrades to existing bicycle and pedestrian facilities and a new center-median bicycle and pedestrian path on N Williams between N/NE Weidler and N/NE Broadway (see Section 2.2.4.4).



What are Ramp-to-Ramp or Auxiliary Lanes?

Ramp-to-Ramp lanes provide a direct connection from one ramp to the next. They separate on-and off-ramp merging from through traffic, and create better balance and smoother maneuverability, which improves safety and reduces congestion.

2.2.1 I-5 Mainline Improvements

The Build Alternative would modify I-5 between I-84 and I-405 by adding safety and operational improvements. The Build Alternative would extend the existing auxiliary lanes approximately 4,300 feet in both NB and SB directions and add 12-foot shoulders (both inside and outside) in both directions in the areas where the auxiliary lane would be extended. Figure 2 illustrates the location of the proposed auxiliary lanes. Figure 3 illustrates the auxiliary lane configuration, showing the proposed improvements in relation to the existing conditions. Figure 4 provides a cross section comparison of existing and proposed conditions, including the location of through lanes, auxiliary lanes, and highway shoulders.

A new NB auxiliary lane would be added to connect the I-84 WB on-ramp to the N Greeley off-ramp. The existing auxiliary lane on I-5 NB from the I-84 WB on-ramp to the NE Weidler off-ramp and from the N Broadway on-ramp to the I-405 off-ramp would remain.

The new SB auxiliary lane would extend the existing auxiliary lane that enters I-5 SB from the N Greeley on-ramp. The existing SB auxiliary lane currently ends just south of the N Broadway off-ramp, in the vicinity of the Broadway overcrossing structure.

Figure 2. Auxiliary Lane/Shoulder Improvements

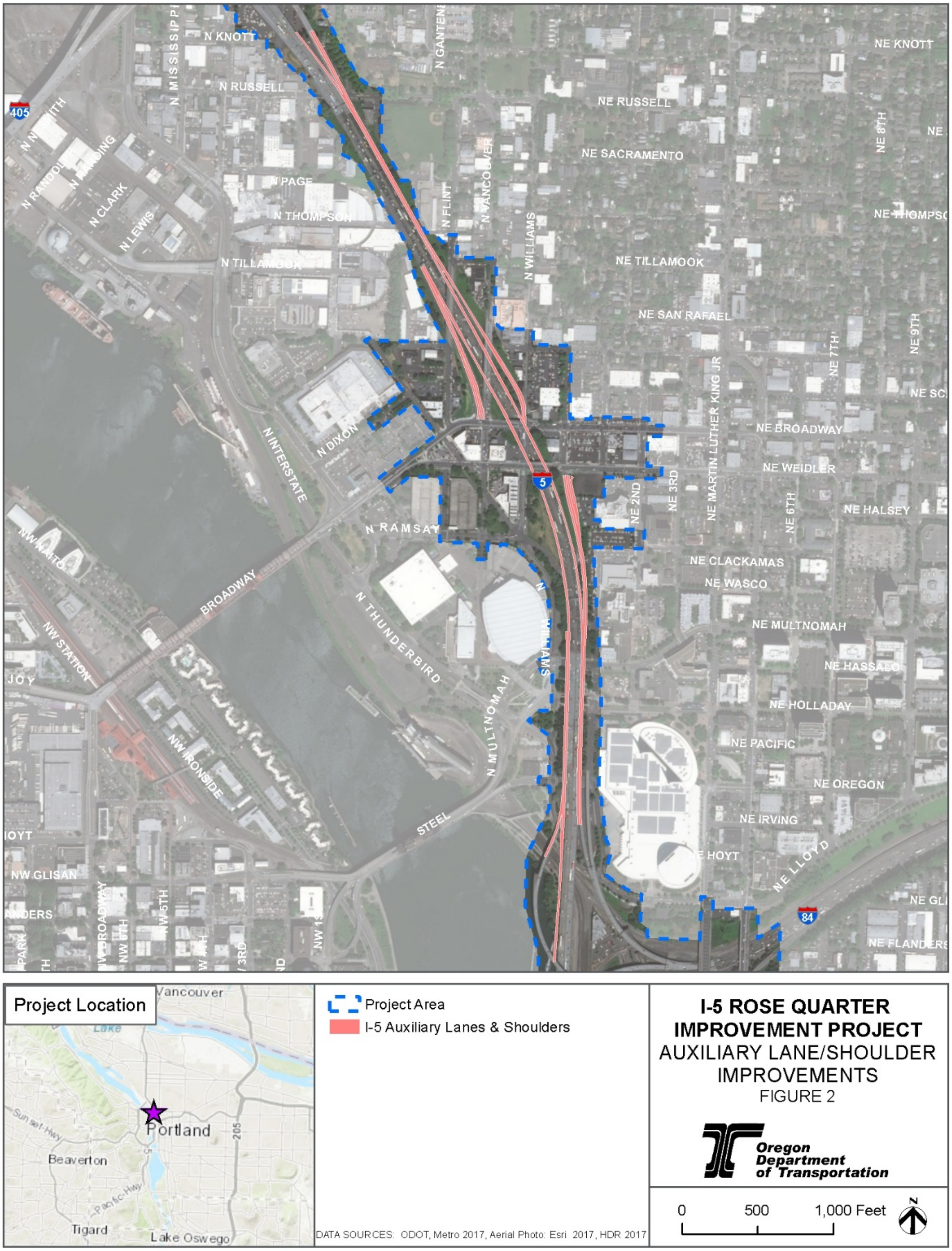


Figure 3. I-5 Auxiliary (Ramp-to-Ramp) Lanes – Existing Conditions and Proposed Improvements

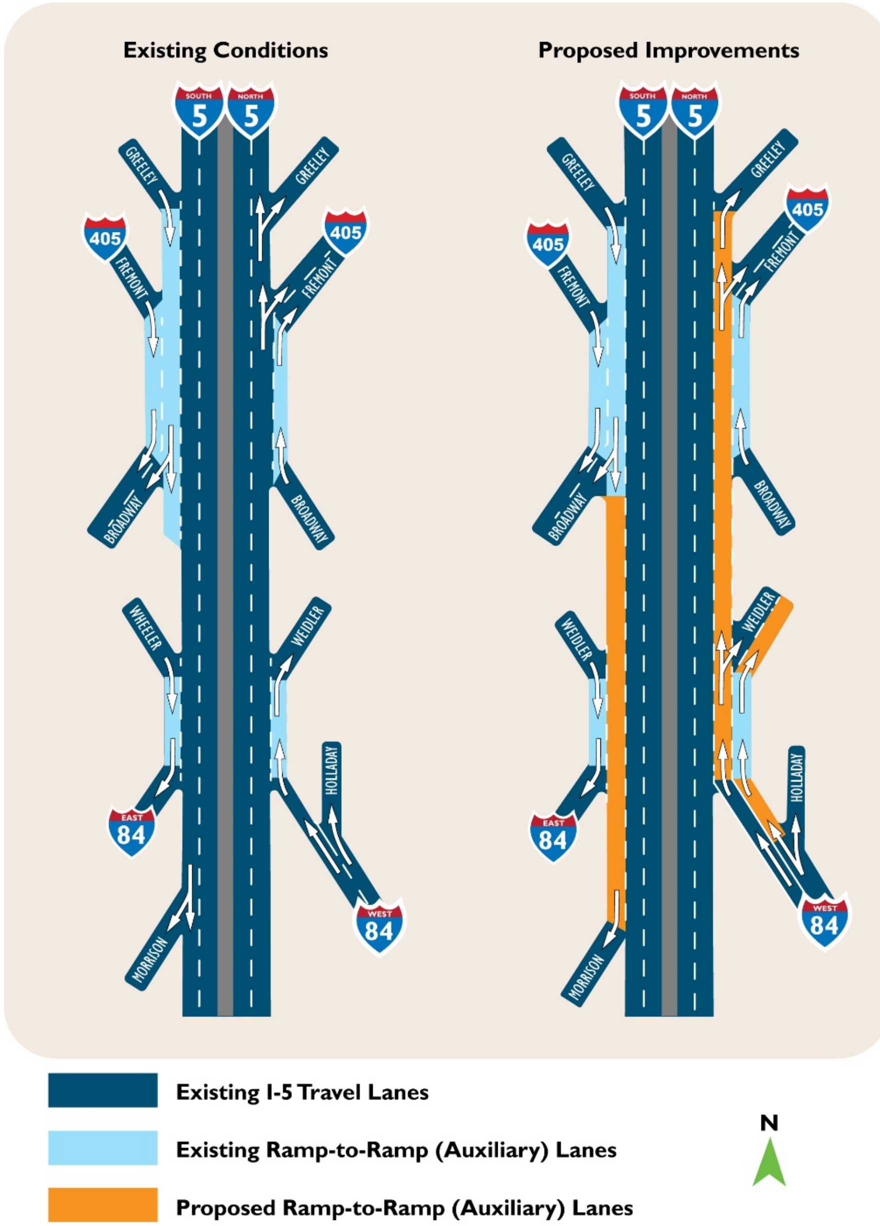
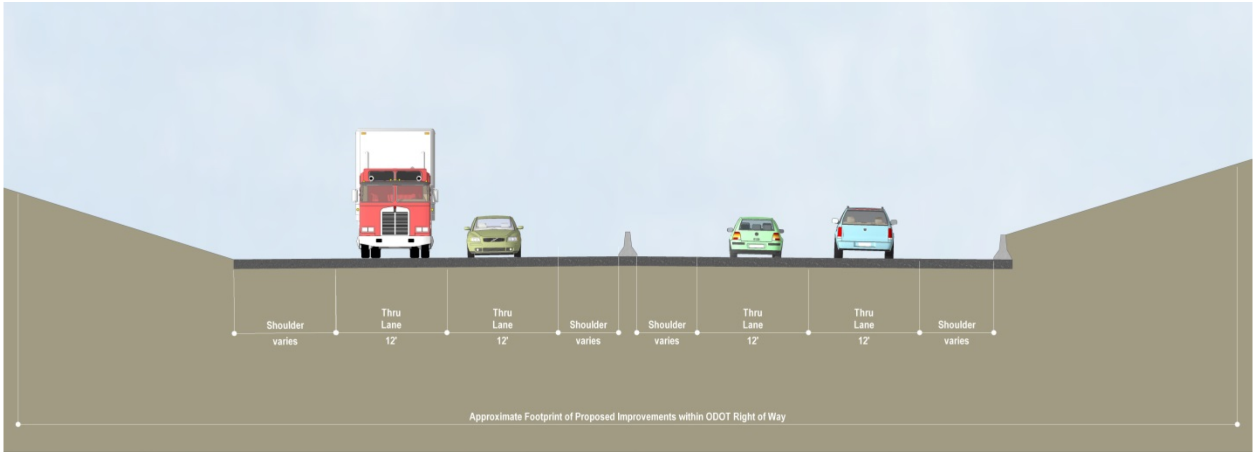
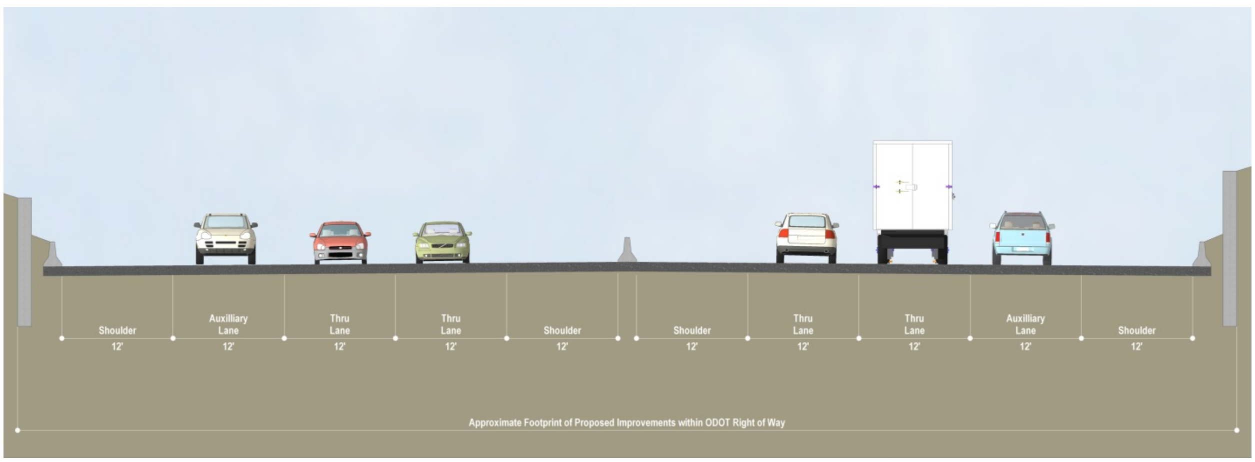


Figure 4. I-5 Cross Section (N/NE Weidler Overcrossing) – Existing Conditions and Proposed Improvements



Existing Lane Configuration



Proposed Lane Configuration

Under the Build Alternative, the SB auxiliary lane would be extended as a continuous auxiliary lane from N Greeley to the Morrison Bridge and the SE Portland/Oregon Museum of Science and Industry off-ramp. Figure 4 presents a representative cross section of I-5 (south of the N/NE Weidler overcrossing within the Broadway/Weidler interchange area), with the proposed auxiliary lanes and shoulder, to provide a comparison with the existing cross section.

The addition of 12-foot shoulders (both inside and outside) in both directions in the areas where the auxiliary lanes would be extended would provide more space to allow vehicles that are stalled or involved in a crash to move out of the travel lanes. New shoulders would also provide space for emergency response vehicles to use to access an incident within or beyond the Project Area.

No new through lanes would be added to I-5 as part of the Build Alternative; I-5 would maintain the existing two through lanes in both the NB and SB directions.

2.2.2 Highway Covers

2.2.2.1 Broadway/Weidler/Williams Highway Cover

To complete the proposed I-5 mainline improvements, the existing structures crossing over I-5 must be removed, including the roads and the columns that support the structures. The Build Alternative would remove the existing N/NE Broadway, N/NE Weidler, and N Williams structures over I-5 to accommodate the auxiliary lane extension and new shoulders described in Section 2.2.1.

The structure replacement would be in the form of the Broadway/Weidler/Williams highway cover (Figure 5). The highway cover would be a wide bridge that spans east-west across I-5, extending from immediately south of N/NE Weidler to immediately north of N/NE Broadway to accommodate passage of the Broadway/ Weidler couplet. The highway cover would include design upgrades to make the structure more resilient in the event of an earthquake.

Figure 5. Broadway/Weidler/Williams and Vancouver/Hancock Highway Covers

The highway cover would connect both sides of I-5, reducing the physical barrier of I-5 between neighborhoods to the east and west of the highway while providing additional surface area above I-5. The added surface space would provide an opportunity for new and modern bicycle and pedestrian facilities and public spaces when construction is complete, making the area more connected, walkable, and bike friendly.

2.2.2.2 N Vancouver/N Hancock Highway Cover

The Build Alternative would remove and rebuild the existing N Vancouver structure over I-5 as a highway cover (Figure 5). The Vancouver/Hancock highway cover would be a concrete or steel platform that spans east-west across I-5 and to the north and south of N/NE Hancock. Like the Broadway/Weidler/Williams highway cover, this highway cover would provide additional surface area above I-5. The highway cover would provide an opportunity for public space and a new connection across I-5 for all modes of travel. A new roadway connecting neighborhoods to the east with the Lower Albina area and connecting N/NE Hancock to N Dixon would be added to the Vancouver/Hancock highway cover (see element "A" in Figure 6).

2.2.3 Broadway/Weidler Interchange Improvements

Improvements to the Broadway/Weidler interchange to address connections between I-5, the interchange, and the local street network are described in the following subsections and illustrated in Figure 6.

2.2.3.1 Relocate I-5 Southbound On-Ramp

The I-5 SB on-ramp is currently one block south of N Weidler near where N Wheeler, N Williams, and N Ramsay come together at the north end of the Moda Center. The Build Alternative would remove the N Wheeler on-ramp and relocate the I-5 SB on-ramp north to N Weidler. Figure 6 element "B" illustrates the on-ramp relocation.

2.2.3.2 Modify N Williams between Ramsay and Weidler

The Build Alternative would modify the travel circulation on N Williams between N Ramsay and N Weidler. This one-block segment of N Williams would be closed to through-travel for private motor vehicles and would only be permitted for pedestrians, bicycles, and public transit (buses) (Figures 6 and 7). Private motor vehicle and loading access to the facilities at Madrona Studios would be maintained.

2.2.3.3 Revise Traffic Flow on N Williams between Weidler and Broadway

The Build Alternative would revise the traffic flow on N Williams between N/NE Weidler and N/NE Broadway. For this one-block segment, N Williams would be converted from its current configuration as a two-lane, one-way street in the NB direction with a center NB bike lane to a reverse traffic flow two-way street with a 36-foot-wide median multi-use path for bicycles and pedestrians. These improvements are illustrated in Figures 6 and 7.

Figure 6. Broadway/Weidler Interchange Area Improvements

Figure 7. Conceptual Illustration of Proposed N Williams Multi-Use Path and Revised Traffic Flow

The revised N Williams configuration would be designed as follows:

- Two NB travel lanes along the western side of N Williams to provide access to the I-5 NB on-ramp, through movements NB on N Williams, and left-turn movements onto N Broadway.
- A 36-foot-wide center median with a multi-use path permitted only for bicycles and pedestrians. The median multi-use path would also include landscaping on both the east and west sides of the path.
- Two SB lanes along the eastern side of N Williams to provide access to the I-5 SB on-ramp or left-turn movements onto NE Weidler.

2.2.4 Related Local System Multimodal Improvements

2.2.4.1 New Hancock-Dixon Crossing

A new roadway crossing would be constructed to extend N/NE Hancock west across and over I-5, connecting it to N Dixon (see Figure 6, element “E”). The new crossing would be constructed on the Vancouver/Hancock highway cover and would provide a new east-west crossing over I-5. Traffic calming measures would be incorporated east of the intersection of N/NE Hancock and N Williams to discourage use of NE Hancock by through motor vehicle traffic. Bicycle and pedestrian through travel would be permitted (see Figure 6, element “F”).

2.2.4.2 Removal of N Flint South of N Tillamook and Addition of New Multi-Use Path

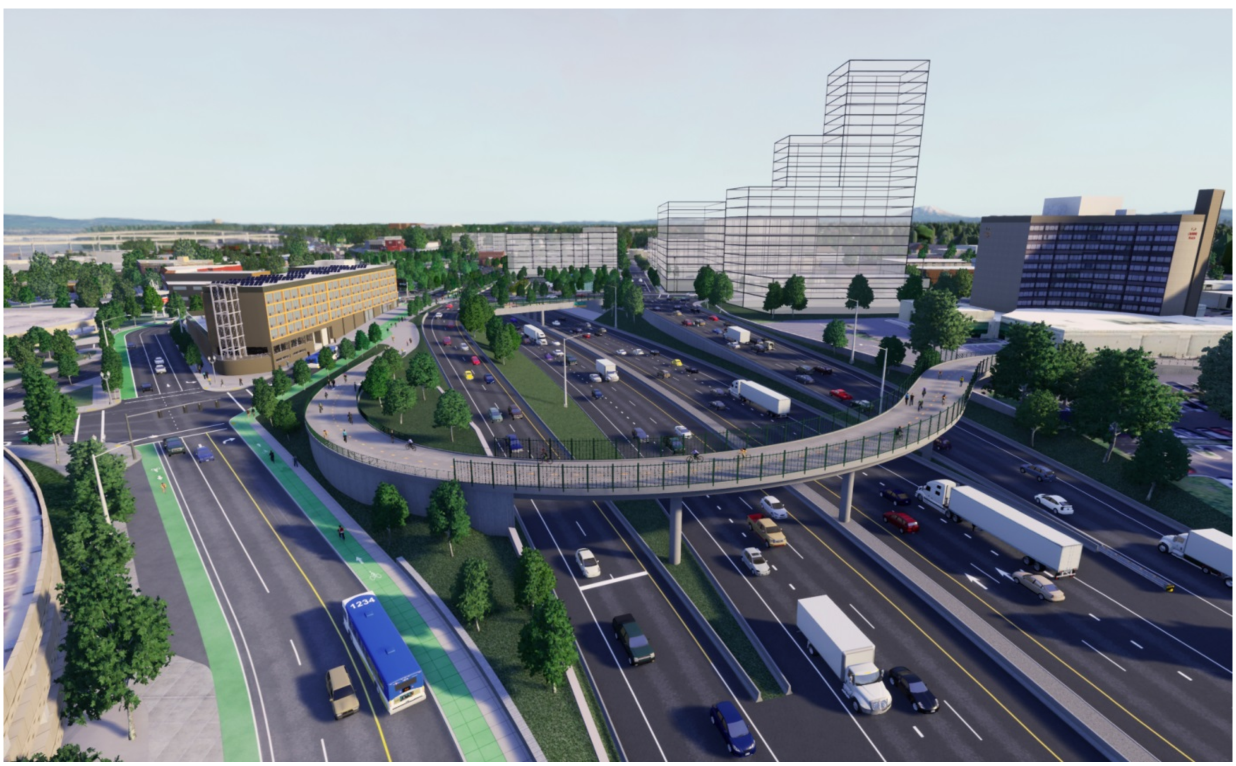
The existing N Flint structure over I-5 would be removed, and N Flint south of N Russell Street would terminate at and connect directly to N Tillamook (see Figure 6, element "G"). The portion of Flint between the existing I-5 overcrossing and Broadway would be closed as a through street for motor vehicles. Driveway access would be maintained on this portion of N Flint to maintain local access.

A new multi-use path would be added between the new Hancock-Dixon crossing and Broadway at a grade of 5 percent or less to provide an additional travel route option for people walking and biking. The new multi-use path would follow existing N Flint alignment between N Hancock and N Broadway (see Figure 6, element "G").

2.2.4.3 Clackamas Bicycle and Pedestrian Bridge

South of N/NE Weidler, a new pedestrian- and bicycle-only bridge over I-5 would be constructed to connect NE Clackamas Street near NE 2nd Avenue to the N Williams/N Ramsay area (see Figure 6, element "H," and Figure 8). The Clackamas bicycle and pedestrian bridge would offer a new connection over I-5 and would provide an alternative route for people walking or riding a bike through the Broadway/Weidler interchange.

Figure 8. Clackamas Bicycle and Pedestrian Crossing



2.2.4.4 Other Local Street, Bicycle, and Pedestrian Improvements

The Build Alternative would include new widened and well-lit sidewalks, Americans with Disabilities Act-accessible ramps, high visibility and marked crosswalks, widened and improved bicycle facilities, and stormwater management on the streets connected to the Broadway/Weidler interchange.[6]

A new two-way cycle track would be implemented on N Williams between N/NE Hancock and N/NE Broadway. A two-way cycle track would allow bicycle movement in both directions and would be physically separated from motor vehicle travel lanes and sidewalks. This two-way cycle track would connect to the median multi-use path on N Williams between N/NE Broadway and N/NE Weidler.

The bicycle lane on N Vancouver would also be upgraded between N Hancock and N Broadway, including a new bicycle jug-handle at the N Vancouver and N Broadway intersection to facilitate right-turn movements for bicycles from N Vancouver to N Broadway.

Existing bicycle facilities on N/NE Broadway and N/NE Weidler within the Project Area would also be upgraded, including replacing the existing bike lanes with wider, separated bicycle lanes. New bicycle and pedestrian connections would also be made between the N Flint/N Tillamook intersection and the new Hancock-Dixon connection.

These improvements would be in addition to the new Clackamas bicycle and pedestrian bridge, upgrades to bicycle and pedestrian facilities on the new Broadway/Weidler/Williams and Vancouver/Hancock highway covers, and new median multi-use path on N Williams between N/NE Broadway and N/NE Weidler described above and illustrated in Figure 6.

[6] Additional details on which streets are included are available at http://i5rosequarter.org/local-street-bicycle-and-pedestrian-facilities/

3 Regulatory Framework

3.1 Relevant Laws and Regulations

Several state and federal laws, regulations, and plans have been developed to protect water resources that would apply to the proposed Project. The Oregon Department of Environmental Quality (DEQ) and U.S. Environmental Protection Agency are the primary agencies responsible for water quality in the Area of Potential Impact (API); however, the Oregon Department of State Lands, U.S. Army Corps of Engineers, ODOT, and the City of Portland have regulations that apply to the Project. The Endangered Species Act (ESA) applies if stormwater runoff is discharged to water resources containing ESA-listed species. In addition, groundwater is protected by the Safe Drinking Water Act, and floodplains are regulated by the Federal Emergency Management Agency (FEMA) and local municipalities. The City and ODOT each hold a National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System Permit issued by Oregon DEQ to manage their respective storm sewer systems.

3.2 Design Standards

The design standards used to size stormwater facilities are based on the *ODOT Hydraulics Manual* (ODOT 2014) and the City of Portland *Stormwater Management Manual* (City of Portland 2016). The ODOT and City of Portland standards meet or exceed the standards required by the Federal-Aid Highway Program (FAHP) Agreement between the Federal Highway Administration (FHWA) and the National Marine Fisheries Service and the requirements provided in their respective NPDES permits and associated Stormwater Management Manuals.

The following minimum design standards would apply to the Project:

- The ODOT water quality design storm is 50 percent of the 2-year, 24-hour storm (1.2 inches) and the City water quality design storm is 0.83 inches in 24 hours.
- Water quality treatment of the post-Project contributing impervious area (CIA) is required. Per the *ODOT Hydraulics Manual*, CIA is defined as all impervious surfaces within the strict project limits plus impervious surfaces outside the project limits that drain to the project via direct flow or discrete conveyance. ODOT further clarifies the CIA as limited to ODOT-owned or operated right of way (ROW) or facilities.
- Stormwater generated from impervious area on ODOT or City ROW would be managed within the respective ROW. Stormwater treatment facilities within ODOT ROW would be sized using ODOT standards, and stormwater treatment facilities within City ROW would be sized using City standards.

- Minimum time of concentration is 5 minutes, and the associated rainfall intensity is 2.86 inches per hour (10-year return interval).
- Since the existing storm system outfalls directly into the Willamette River, a large waterbody, neither ODOT nor the City requires flow control.

4 Methodology and Data Sources

4.1 Project Area and Area of Potential Impact

The API for the water resources technical analysis is the same as the Project Area as shown in Figure 1.

4.2 Resource Identification and Evaluation

Data used to prepare the report were compiled from existing information and field study. No subsurface investigations were conducted. Computer modeling of pollutant loading was not conducted as part of this work. Field study was limited to observations from roadways and within ODOT and City ROWs. Information on existing water resources located within the Project Area was obtained by:

- Contacting local agencies, including the City of Portland Bureau of Transportation, the City of Portland Bureau of Environmental Services, and the Portland Water Bureau, to obtain existing utility geographic information system (GIS) data; and
- Reviewing as-builts provided by ODOT for past projects within the Project Area.

Other sources of information used to assess existing conditions included the following:

- Reviewing the DEQ’s list of water quality limited waterbodies (DEQ 2012) to determine if receiving waters are water quality limited
- Reviewing the Oregon Water Resources Department (OWRD) well logs and the U.S. Geological Survey *Estimated Depth to Ground Water and Configuration of the Water Table in the Portland, Oregon Area Scientific Investigations Report 2008-5059* to determine the approximate depth to groundwater within the Project limits (OWRD 2017; USGS 2008)
- Using existing topographic information obtained from ODOT and the City to determine the CIA and existing drainage subbasins
- Assessing existing soils and infiltration rates using the U.S. Department of Agriculture’s Web Soil Survey (USDA 2017), in addition to previous investigations obtained from the City
- Reviewing FEMA National Flood Insurance Program maps for potential hazard areas within Project boundaries
- Reviewing DEQ hazards and environmental cleanup site databases for contaminated sites within Project boundaries
- Reviewing City of Portland Central City 2035 Willamette River Central Reach Natural Resources Protection Plan (City of Portland 2017) and City of Portland River Overlay Regulations

Existing topographic information and GIS data were used to estimate drainage patterns and contributing impervious areas of the Build Alternative for water quality analysis.

The Build Alternative was compared with the No-Build Alternative (baseline conditions) to determine how the Project may affect water quality and impacts to base and peak flows in receiving waterbodies.

4.3 Assessment of Impacts

To establish baseline conditions, available information (see Section 4.2) was reviewed to gain an understanding of the surface and groundwater resources and FEMA-mapped floodplains. Temporary effects were determined qualitatively by assessing potential impacts to water resources (receiving waters) resulting from typical transportation construction activities. Permanent effects were evaluated based on the changes in impervious surfaces and flow patterns resulting from the Project.

4.4 Cumulative Impacts

The cumulative impacts analysis considered the Project's impacts combined with other past, present, and reasonably foreseeable future actions that would have environmental impacts in the Project Area. A list of reasonably foreseeable future actions was developed through consultation with City and Metro staff (Appendix A). This list included permitted public and private projects within the Project Area and projects that are in the permit application process. The cumulative impact assessment qualitatively assessed the magnitude of impacts expected from reasonably foreseeable future actions in combination with anticipated Project impacts. This assessment also identified the contribution of the Project to overall cumulative impacts.

5 Affected Environment

The water resources potentially affected by the Project include existing stormwater facilities, surface water, groundwater, and floodplains. These resources can be influenced by existing stormwater facilities, surface water and groundwater, floodplains, soils, land uses, contaminated sites, and other utilities. These affected environments are discussed below.

5.1 Existing Stormwater Facilities

Existing stormwater collection and conveyance within the API is developed and built-out, but water quality treatment is only provided for approximately 1.04 acres of the 41-acre Project contributing impervious area. Within the API, approximately 0.87 acre of City ROW and 0.17 acre of ODOT ROW are currently treated. The API is drained by both stormwater-only systems and combined stormwater-sanitary systems. Stormwater-only conveyance is generally east to west and terminates at several outfalls on the east bank of the Willamette River. Combined stormwater-sanitary conveyance terminates at the Columbia Boulevard Wastewater Treatment Facility. Much of the combined stormwater-sanitary flow is conveyed via a large-diameter north-south conduit (also known as “the Big Pipe”) to prevent overflow discharges to the Willamette River.

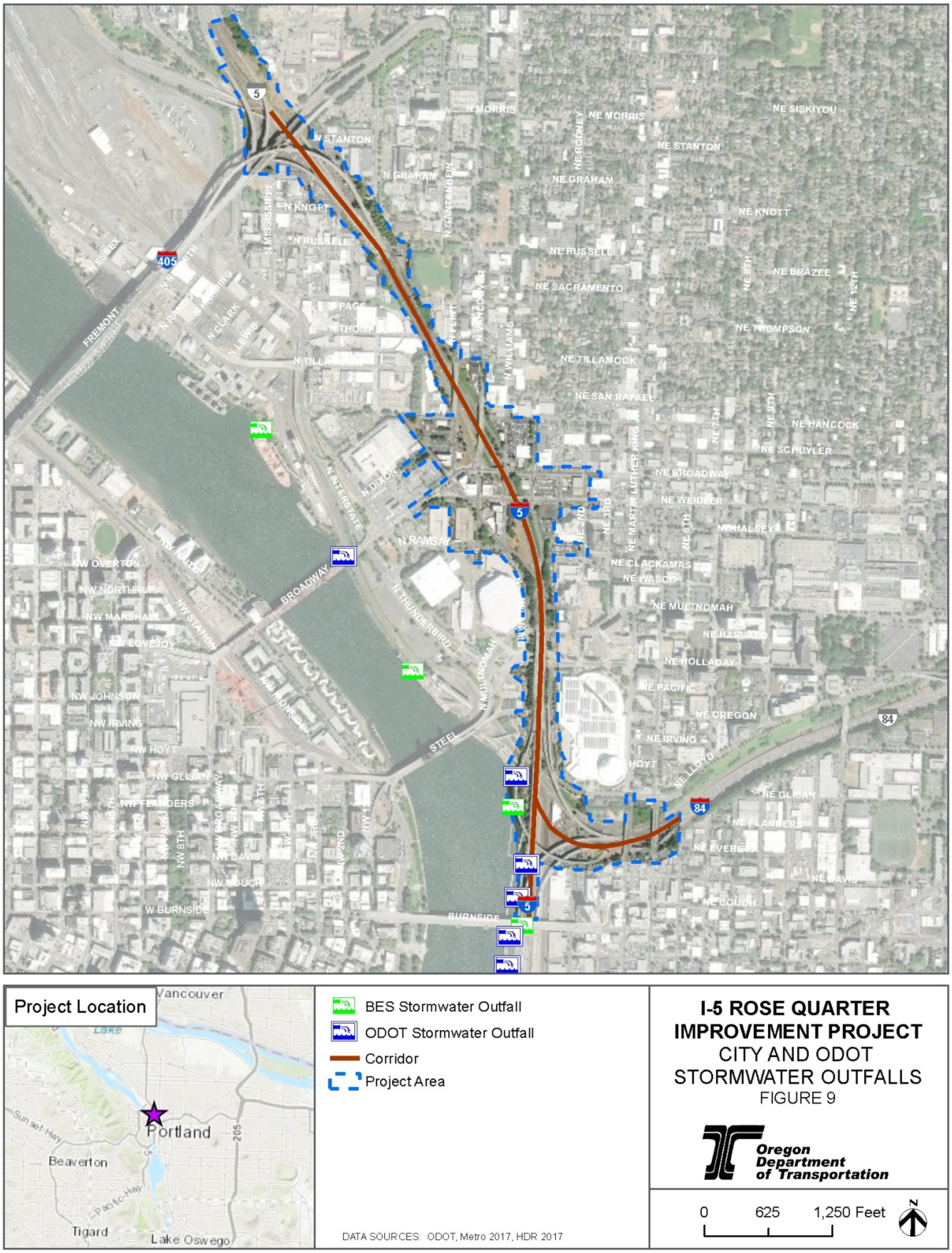
Stormwater runoff from the ODOT ROW within the Project Area is collected and conveyed in stormwater-only systems that outfall to the Willamette River at four locations. These stormwater conveyance systems are located within the highway alignments and do not connect to the City’s combined stormwater-sanitary system.

Stormwater runoff from City ROW drains to both stormwater-only and combined stormwater-sanitary systems. Portions of the City ROW within the Project Area drain to ODOT stormwater systems. Typically, these flows join near outfalls to the Willamette River. Figure 9 shows the locations of City and ODOT stormwater outfalls.

An existing water quality biofiltration swale is located at the Broadway/I-5 off-ramp. This water quality swale treats 0.17 acre of ODOT impervious area and 0.19 acre of City impervious area, for a total of 0.36 acre of treated impervious area.

City-owned green street water quality facilities exist along NE Weidler and NE Broadway within the Project Area. These existing facilities treat approximately 0.68 acre of impervious runoff from the City ROW within the API.

Figure 9. City and ODOT Stormwater Outfalls



5.2 Surface Water

The Willamette River is located immediately west of the API. The stormwater runoff from the Project Area within ODOT ROW is discharged to the Willamette River. Portions of the Project Area within City ROW drain to the Willamette River. According to DEQ, the Willamette River is listed as an impaired water body under Section 303(d) of the Clean Water Act for the following pollutants:

- Aldrin
- Aquatic weeds or algae
- Arsenic
- Bacteria
- Biological criteria
- Copper
- Dichlorodiphenyltrichloroethane (DDT) and DDT metabolite
- Dichloroethylene
- Dieldrin
- Dissolved oxygen
- Iron
- Lead
- Mercury
- Manganese
- Polychlorinated biphenyl and polycyclic aromatic hydrocarbon
- Pentachlorophenol
- pH
- Temperature
- Turbidity
- Tetrachloroethylene
- Turbidity
- Zinc

Of these pollutants, only bacteria, DDT, dieldrin, dissolved oxygen, mercury, temperature, and turbidity have currently approved total maximum daily loads (TMDLs; DEQ 2006). Stormwater that is directly discharged into the Willamette River or into a storm sewer that discharges to the Willamette River must be treated to meet these TMDLs.

5.3 Groundwater

The OWRD databases show more than 3,000 wells located within Township 1 North Range 1 East, Sections 27 and 34, which are the one-square-mile sections that contain the API. Most of these wells (84 percent) are geotechnical explorations, 13 percent are monitoring wells, and 3 percent are water wells. A total of 1,009 wells reported depth of water, which ranged between 1 and 163 feet below ground surface. Mean depth to groundwater was 21 feet below ground surface.

5.4 Floodplains

Flood Insurance Rate Maps (FIRM) were analyzed to determine if any part of the Project API was within a flood hazard area. FIRM number 4101830093E indicates that a portion of the southern Project Area is within Zone X and Zone AE (FEMA 2004). These flood hazard areas are shown in Appendix B. Zone X is an area of minimal flood hazard, projected to have a 0.2 percent annual chance of flood (500-year flood). Zone AE is an area considered to be at high risk of flood, with a 1 percent annual chance of inundation (100-year flood).

Portions of the Project Area may also be located within the FEMA Floodway. Development within the Floodway is not permitted by FEMA or the City without an engineered analysis certifying no-rise of the 100-year water surface elevations as a result of the development.

5.5 Soils

A map of soil map units is provided in Appendix C. Soils within the Project Area consist of two map units:

- 50A – Urban Land, 0 to 3 percent slopes
- 50C – Urban Land, 3 to 15 percent slopes

Urban land soil complexes have historically been graded, cut, filled, or otherwise anthropogenically altered and are predominately paved or covered by impervious surfaces.

5.6 Land Use

Land uses within the Project Area consist of a mix of industrial, residential, and commercial uses. Additional information regarding land uses and maps is included in the *Land Use Technical Report* (ODOT 2019a). Several existing automobile service and gas stations are located within the Project Area. These types of facilities may have released contaminants to the environment. Stormwater designs would need to take site contamination into consideration when siting facilities near these locations.

5.7 Contaminated Sites

A total of 176 sites within the API are known or suspected to be contaminated (either soil or groundwater); further information regarding these sites is provided in the *Hazardous Materials Technical Report* (ODOT 2019b). These sites may constrain placement of stormwater facilities within the API.

5.8 Utility Constraints

The Project is located within a heavily urbanized corridor and has extensive utilities within the API. Subsurface facilities include natural gas, fiber optics, and storm and sanitary sewers. Aerial facilities include power, communication, and cable. A primary utility constraint is the 264-inch sewer, sanitary pump station, and pump station piping, all of which the Bureau of Environmental Services has stated to be infeasible to relocate or allow disruptions in service. Further information regarding utilities is provided in the *Utilities Technical Report* (ODOT 2019c).

6 Environmental Consequences

The following sections describe the potential effects on water resources from the Build and No-Build Alternatives. Effects are described in terms of short-term (construction) impacts, long-term and operational impacts, and cumulative impacts to water resources. Short-term impacts are the result of construction (e.g., in-water work) or changes to water quality that can result from stormwater runoff from impervious surfaces and associated pollutant loads from operation and maintenance activities. Long-term and operational impacts occur later in time or further in distance or are caused by changes in land development because of the Project. Cumulative impacts are those that result from various past, present, or reasonably foreseeable future actions that may contribute to the effects on water resources resulting from the Project. Individually, these impacts are minor over the short term but build incrementally over time and can result in more substantial impacts to water resources.

6.1 No-Build Alternative

As described in Section 2.1, the No-Build Alternative consists of existing conditions and other planned and funded transportation improvement projects that would be completed in and around the Project Area by 2045.

6.1.1 Direct Impacts

Under the No-Build Alternative, the proposed I-5 mainline and Broadway/Weidler interchange area improvements would not be constructed, and the current road system would remain in place. Current water quality conditions would continue to perpetuate direct impacts to water resources. Almost all the development within the API on ODOT ROW predates current water quality requirements, thus existing water quality infrastructure is limited. Within the Project Area, 0.17 acre of ODOT ROW receives water quality treatment, and 0.87 acre of City ROW receives water quality treatment.

6.1.2 Indirect Impacts

The indirect water quality impacts of the No-Build Alternative consider a broader timeline and environment. As part of this larger scope, future projects or actions would be considered in the context of water quality impacts. The two planned transportation projects mentioned in Section 2.1 would likely trigger City stormwater management requirements, which would result in the construction of water quality facilities. The scale of water quality infrastructure would be in direct proportion to the area of impervious surface that is developed.

6.2 Build Alternative

As mentioned in Section 2.2, the proposed I-5 mainline improvements include the construction of auxiliary lanes and full shoulders between I-84 and I-405, in both the NB and SB directions, and ramp modifications. Full pavement reconstruction of I-5 from the Fremont Bridge south to the I-84 overcrossing is expected. The total CIA within ODOT ROW is approximately 30.4 acres.

Local surface street improvements include new overcrossing structures and roadway, bike, and pedestrian improvements. These local improvements would occur on City ROW. The total CIA from City ROW is 10.7 acres.

It is anticipated that the Build Alternative would result in a net increase of impervious area. The net increase of impervious area within City ROW would be approximately 1.9 acres. The net increase of impervious area within ODOT ROW would be approximately 5.9 acres.

6.2.1 Potential Water Quality Locations

As shown in Appendix B, water quality treatment facilities to manage ODOT CIA would be developed at three locations:

- ODOT Area 1 – N Mississippi Avenue
- ODOT Area 2 – Adjacent to N Knott Street
- ODOT Area 3 – Eastbank Viaduct/Esplanade

Water quality treatment methods meeting the ODOT standards for water quality facilities would be developed at each of the three locations. These three locations would treat approximately 96 percent of the overall ODOT CIA. Table 3 presents a summary of the ODOT conceptual water quality treatment facilities. Stormwater quality treatment requirements could also be fulfilled through the acquisition of credits at an ODOT regional water quality facility under development within the larger basin area. Stormwater credits are expected to be available. Additional credits may become available in 2020 after monitoring of the site confirms the site is performing in accordance with the design parameters. Due to possible site constraints within the API, the impervious area requiring treatment may not be able to be managed within the API, and these regional water quality facility credits could be used to meet the Project stormwater management requirements. Other water quality treatment options not currently included in the *ODOT Hydraulics Manual* may also be used if it is demonstrated that the non-traditional water quality treatment options meet or exceed the minimum treatment criteria.

Several existing stormwater planters along Broadway and NE Weidler manage approximately 6 percent of the CIA within the City ROW. Water quality treatment of proposed Project CIA within City ROW would be accomplished with additional stormwater planters along City streets within the Project Area. Potential locations of stormwater planters capable of treating City stormwater are shown in Appendix B. In addition to stormwater planters, potential sites exist for larger water quality facilities within City ROW within the API:

- City Area 1 – N Center Court Street
- City Area 2 – N Williams (formerly NE Wheeler Avenue)

Conceptual water quality treatment options are summarized in Tables 3 and 4 and described further in the following sections.

Table 3. ODOT Water Quality Summary

Stormwater Treatment Area Name	Total Impervious Area Treated (acres)	CIA Treated (acres)	Non-CIA Treated (acres)	Water Quality Facility Type
ODOT Area 1: N Mississippi Avenue	16.46	0.00	16.46	Swale
ODOT Area 2: N Knott Street	4.43	2.75	1.68	Basin/MMFD
ODOT Area 3: Eastbank Viaduct	8.26	8.26	0.00	MMFD
Contech Metal Rx Filters	1.44	0.00	1.44	Basin
Existing Broadway Swale	0.36	0.36	0.00	Swale
Total	30.95	11.37	19.58	

Notes: CIA = contributing impervious area; MMFD = modified media filter ditch;
ODOT = Oregon Department of Transportation

Table 4. City of Portland Water Quality Summary

Stormwater Treatment Area Name	Total Impervious Area Treated (acres)	CIA Treated (acres)	Non-CIA Treated (acres)	Water Quality Facility Type
City Area 1: N Center Court Street	0.91	0.91	0.00	Basin/ Swale
City Area 2: N Williams (formerly NE Wheeler Avenue)	2.04	2.04	0.00	Basin/Swale
Existing Stormwater Planters	0.68	0.68	0.00	Planter
Proposed Stormwater Planters	7.95	7.32	0.63	Planter
Total	11.58	10.95	0.63	

Notes: CIA = contributing impervious area

6.2.1.1 ODOT Area 1 – N Mississippi Avenue

Area 1 is located adjacent to N Mississippi Avenue, north of the N Kerby Avenue exit and east of I-5. This is a vacant ODOT property that is moderately sloped with grass cover. This site would accommodate a water quality facility capable of treating approximately 16.46 acres of highway impervious area outside of the Project CIA. A new piped conveyance system would be constructed that would connect to the existing highway stormwater system and divert the water quality flows to the water quality facility. The new conveyance system would connect to an existing ODOT stormwater conveyance system located on the south side of the site to convey stormwater after receiving water quality treatment.

The site topography is suited to a water quality swale. Two side-by-side swales 12 feet wide and 150 feet long would treat approximately 16.46 acres. A berm may be needed to separate the swales longitudinally.

6.2.1.2 ODOT Area 2 – N Knott Street

Area 2 is located southeast of the intersection of N Knott and N Borthwick Avenue, adjacent and under the elevated I-5 structure. This is an ODOT property currently leased to the City for truck and equipment storage. A portion of the property is grass-covered, with most of the area paved for parking. This area would be able to accommodate a water quality facility that could treat approximately 4.43 acres of impervious area: 2.75 acres of CIA and 1.68 acres of area outside of the Project CIA. A new piped conveyance system would need to be constructed that would capture stormwater from the existing structure scupper drains and convey the stormwater to the site.

6.2.1.3 ODOT Area 3 – Eastbank Viaduct

Area 3 is located adjacent and below the elevated I-5 structure, between the Union Pacific property and the Eastbank Esplanade multi-use path. This ODOT property has riprap ballast covering the site. This area would accommodate a water quality facility that could treat approximately 8.26 acres of CIA. A new piped conveyance system would be constructed that would connect to the existing highway stormwater system and divert the water quality flows to the water quality facility. Treated water would be discharged to the Willamette River via an existing pipe. The new conveyance pipe would need to cross under the Union Pacific tracks.

This site is well suited to a non-vegetated best management practice due to a significant portion of the property being located under a highway structure and not receiving sunlight. A modified media filter ditch (MMFD) would be effective at this site. An MMFD with an area of approximately 36,000 square feet (82 feet X 440 feet) could treat approximately 8.26 acres.

6.2.1.4 Additional Treatment Options

The water quality treatment options mentioned above use conventional methods, as described in the ODOT hydraulics manuals. Typically, these methods involve passive treatment processes and utilize relatively large areas. Other non-traditional or proprietary treatment methods exist and may be available to treat stormwater generated from the Project. Implementation of the non-traditional and proprietary treatment methods on the Project would result in equivalent treatment levels and would be constructed within the API.

Non-traditional and proprietary treatment methods include filtration and/or chemical precipitation processes. These technologies originated from wastewater treatment practice and are applied in the treatment of wastewater, industrial effluent, and, in limited applications, stormwater. Cloth disk filters, ballasted sedimentation, and media filters are some examples. Most of the alternative treatment options require power, pumps and some of these systems separate the pollutants from the filter media by backwashing. The backwash water may be disposed of in a sanitary sewer or filtered to a solid “cake” and disposed of at a landfill. Flocculation /coagulation chemicals can be used for treatment beyond what is currently required. Higher water quality can be produced with lower incremental capital costs with these technologies compared to increasing efficiency of swales and bioslopes. Operation and maintenance costs may be similar to conventional stormwater treatment facilities for comparable effluent water quality targets.

6.2.1.5 Portland Water Quality Facilities

As mentioned in Section 6.1, approximately 0.68 acre of City impervious area currently receives treatment via City-owned green street facilities within the API. Impervious area requiring treatment within the City ROW is 10.7 acres. Existing treatment occurs at stormwater planters located between the curb and sidewalk at several locations in the Project Area. Similar stormwater planters located at all feasible locations would provide water quality treatment of approximately 7.95 acres of arterial street impervious area. Stormwater swales and/or basins located at City Areas 1 and 2 could provide water quality treatment of approximately 2.95 acres of arterial street impervious area.

To fully meet the Project’s water quality requirements, approximately 1,736 linear feet of stormwater planters, swales, or stormwater basins would be needed. Site constraints and drainage patterns would limit planter locations; therefore, additional water quality treatment would likely be needed for the City to treat the entirety of the CIA.

6.2.2 Short-Term (Construction) Impacts

Construction activities for the Build Alternative could increase sediment loads if erosion and sediment control measures and construction best management practices are not implemented. Vegetation removal, soil compaction from heavy equipment, excavation, and use of staging areas are typical sources of increased sediment loads, and if uncontrolled, these would have adverse impacts on water quality in receiving waters. Other impacts that could result from construction activities include inadvertent releases of hazardous materials such as petroleum products, paint, or coatings.

Groundwater impacts are not expected to result from demolition or construction activities. Staging may result in vegetation removal and soil compaction at staging sites, which could inhibit infiltration of groundwater. However, these areas would be small and not present impacts to the groundwater system.

In-water work would be associated with the widening of the SB I-5 to EB I-84 off-ramp at the south end of the Project Area. This work would widen the ramp and relocate six existing columns to support the new structure. The relocated columns would be moved slightly to the west (toward the Willamette River) from their existing locations. A temporary work bridge would be used to complete the construction. Sheet piles would be driven into the river bed to create coffer dams that would enclose an area large enough for pilings and a footing and/or drilled shafts to be constructed. The temporary work bridge would be constructed with pilings and short structural spans (50 to 60 feet in length). The pilings and structure would be removed when the permanent structure is complete.

A technical memorandum summarizing an assessment of the ESA considerations associated with this in-water work is presented in Appendix D. Potential impacts identified in the memorandum include increased turbidity from the resuspension of fine silts and sands, hydroacoustic impacts from pile-driving activities, and the potential release of contaminants into the water from equipment or materials used in the construction process. Mitigation measures to protect fish during installation of the temporary work bridge would include the use of bubble curtains to reduce the underwater noise from percussive piling and potentially using vibratory piling. The Project would also conform to in-water work windows (i.e., July 1–October 31) that restrict the timing of in-water construction activities. It is anticipated that proposed in-water activities and impacts would be covered by the FHWA FAHP Agreement.

6.2.3 Long-Term and Direct (Operational) Impacts

The Build Alternative would result in approximately 41 acres of CIA requiring stormwater treatment and disposal. Water quality facilities would be designed to meet current regulatory requirements defined in Section 3.2 and would treat stormwater that is not currently treated for water quality. The treated stormwater would be discharged to the Willamette River, which is known to contain ESA-listed fish. ESA-listed species would benefit from the improved water quality of the stormwater discharge treated in compliance with the FAHP Agreement. This improved stormwater treatment would result in a long-term, direct benefit to the quality of water within the Willamette River.

Groundwater impacts are not expected to result from long-term operation of the Project associated with stormwater management. Water quality facility design per *ODOT Hydraulics Manual* and the City's *Stormwater Management Manual* incorporate a minimum distance from groundwater to protect groundwater quality and ensure the functionality of the facility. Additionally, water quality facilities may be designed with an impermeable membrane to protect groundwater quality.

Floodplain impacts are not expected to result from long-term and operational Project activities associated with stormwater management. Stormwater facilities built within the floodplain are expected to result in a net removal of material, thus resulting in no impact to the floodplain.

6.2.4 Long-Term and Indirect (Operational) Impacts

The Build Alternative is not anticipated to result in any long-term and indirect impacts.

6.3 Cumulative Effects

Cumulative impacts are those environmental effects that result from the incremental effect of the proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes the other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 Code of Federal Regulations 1508.7).

The analysis of cumulative impacts involves a series of steps conducted in the following order:

- Identify the resource topics that could potentially experience direct or indirect impacts from construction and operation of the proposed project.
- Define the geographic area (spatial boundary) within which cumulative impacts will be assessed, as well as the timeframe (temporal boundary) over which other past, present, and reasonably foreseeable future actions will be considered.
- Describe the current status or condition of the resource being analyzed as well as its historic condition (prior to any notable change) and indicate whether the status or condition of the resource is improving, stable, or in decline.
- Identify other actions or projects that are reasonably likely to occur within the area of potential impact during the established time frame and assess whether they could positively or negatively affect the resource being analyzed.
- Describe the combined effect on the resource being analyzed when the direct and indirect impacts of the project are combined with the impacts of other actions or projects assumed to occur within the same geographic area during the established time frame.

6.3.1 Spatial and Temporal Boundaries

The geographic area used for the cumulative impact analysis is the same as the API described in Section 4.1 and shown in Figure 1.

The time frame for the cumulative impact analysis extends from the beginning of large-scale urban development in and around the Project Area to 2045, the horizon year for the analysis of transportation system changes.

6.3.2 Past, Present, and Reasonably Foreseeable Future Actions

For the Project, the past, present, and reasonably foreseeable future actions that were considered in assessing cumulative effects are summarized in the following subsections.

6.3.2.1 Past Actions

Past actions include the following:

- Neighborhood and community development
  - Historical development of Portland area and accompanying changes in land use
  - Development of local transportation system (including roads, bicycle and pedestrian facilities, and bus transit)
  - Utilities (water, sewer, electric, and telecommunications)
  - Water quality improvements associated with development and redevelopment per City of Portland *Stormwater Management Manual*
  - Parks, trails, bikeways
- Commercial and residential development in and around the Project Area
  - Veterans Memorial Coliseum (1960)
  - Lloyd Center (1960)
  - Legacy Emanuel Medical Center (1970)
  - Oregon Convention Center (1990)
  - Rose Garden (1995)
- Regional transportation system development
  - Marine terminal facilities on the Willamette River
    - Port of Portland (1892)
    - Commission of Public Docks (1910)
    - Port of Portland (1970; consolidation of Port of Portland and Commission of Public Docks)
  - Freight rail lines (late 1800s and early 1900s)
  - Highways
    - I-84 (1963)
    - I-5 (1966)

    - I-405 (1973)
  - Rail transit system
    - MAX light rail (1986)
    - Portland Streetcar (2001)

6.3.2.2 Present Actions

Present actions include the ongoing operation and maintenance of existing infrastructure and land uses, including the following:

- Ongoing safety improvements for bicycles and pedestrians
- Local and regional transportation system maintenance
- Utility maintenance
- Water quality improvements associated with development and redevelopment per City of Portland *Stormwater Management Manual*

6.3.2.3 Reasonably Foreseeable Future Actions

Reasonably foreseeable future actions were identified collaboratively with the City and consist of the following:

- Redevelopment of existing urban areas in the Project Area and vicinity
- Ongoing maintenance and development of existing urban infrastructure in the Project Area and vicinity

These actions include private redevelopment, public development, and infrastructure projects, as well as combined public and private redevelopments. Specific projects and the plans identifying them are described in detail in a memorandum provided in Appendix A. Given the highly developed nature of the Project Area and vicinity, the reasonably foreseeable future actions are not expected to substantially change the types or intensities of existing land uses.

6.3.3 Results of Cumulative Impact Analysis

The results of past actions have affected water quality in several ways. Historically, water quality has been negatively affected as urban development replaced pervious surfaces with impervious surfaces. Impervious surfaces create increased amounts of stormwater runoff during rainfall events, creating conditions that erode natural channels and prevent groundwater recharge.

The introduction of the Clean Water Act of 1972 led to the creation of the NPDES. Requirements of NPDES permits include mitigating for water quality upon construction of new development or redevelopment. Hence, as older development is redeveloped, the implementation of water quality treatment facilities has had a beneficial impact and positive trend in water quality and quantity. As new development occurs on undeveloped land, the water quality effects are mitigated.

The anticipated trends in the condition of water quality are generally positive as existing developments without water quality facilities are required to implement mitigation. Additionally, new development is required to mitigate for impacts to water quality.

The Project is a redevelopment action, where existing pervious and impervious surfaces are replaced with new impervious surfaces. Existing impervious surfaces within the Project Area pre-date water quality requirements and have no water quality mitigation. The proposed impervious surfaces to be redeveloped are required to implement water quality and quantity mitigation; therefore, the condition of water quality in the Project Area is expected to improve.

The cumulative effect on water resources while accounting for past, present, and reasonably foreseeable future actions, in the given spatial and temporal boundaries, is positive. As a result of updated stormwater treatment that would occur, the Project's contribution to positive cumulative effects is considered greater than identified reasonably foreseeable future actions.

7 Avoidance, Minimization, and Mitigation Measures

7.1 Design

All stormwater facilities would be designed to meet current design standards for water quality. Facilities in ODOT ROW would be designed to ODOT standards, and facilities within City ROW would be designed to City standards, as outlined in Section 3.2.

7.2 Construction

Potential temporary impacts to water quality during construction would be mitigated through implementation of standard best management practices and erosion control practices. These measures would follow the *ODOT Erosion Control Manual* (ODOT 2005), ODOT *Standard Specifications for Construction* (ODOT 2018d), and local stormwater requirements. The following measures would be implemented for the Build Alternative to minimize potential impacts to water resources:

- Comply with the requirements of the ODOT Regional 1200-CA NPDES permit for all construction runoff, including non-stormwater discharges such as concrete washout water.
- Comply with City of Portland Title 10 Erosion and Sediment Control Regulations.
- Prepare a Pollution Control Plan and Erosion Control Plan that contains the elements outlined in Sections 00280 and 00290 of the *Standard Specifications for Construction* (ODOT 2018d) and that meets requirements of all applicable laws and regulations. Measures outlined in these plans would include the following:
    - A description of any hazardous products or materials that will be used, including procedures for inventory, storage, handling, and monitoring.
    - A spill containment and control plan with notification procedures, specific clean-up and disposal instructions for different products, quick response containment and clean-up measures that will be available on-site, proposed methods for disposal of spilled materials, and employee training for spill containment.
    - Practices to prevent construction debris from dropping into any stream or water body and to remove any material that does drop with minimal disturbance to the streambed and water quality.
- Obtain and comply with all required permits and facility approvals for discharges to surface water, storm drains, or sanitary sewers or for land application.

Additional special provisions provided below are expected to be necessary to adequately protect listed species in and around the Project Area:

- **SP00245 (2018 Specifications: 12-01-17).** *Temporary Water Management*: This special provision is required by FHWA's FAHP Programmatic Biological Opinion (PBO) whenever there is "substantial excavation, backfilling, embankment construction, or similar work below OHW [ordinary high water] where adult or juvenile fish are reasonably certain to be present" (NMFS 2012). The intent of this special provision is to ensure that fish are isolated from the activity and there is no "visible release of pollutants or sediment into the water" (NMFS 2012). If this special provision is deemed necessary, then SP00290.34c would likely also be necessary, which basically requires work area isolation.
- **SP00290.30(a) (2018 Specifications: 08-01-18).** *Environmental Protection*: This special provision relates to water quality and ensuring no releases into the water that would compromise water quality, including turbidity (SP00290.3(a)(8)).
- **SP00290.34(a and b) (2018 Specifications: 08-01-18).** *Environmental Protection*: These special provision sections restrict certain activities such as water jetting and release of petroleum products and restrict timing of the project to the in-water work window designated for the river reach. For the Project Area, the in-water work window is July 1 through October 31. Although the in-water work period includes a winter window from December 1 to January 31, the FAHP PBO specifically disallows activities during that period.
- **SP00290.34(c)(7) (2018 Specifications: 08-01-18).** *Environmental Protection*: This special provision addresses potential hydroacoustic impacts. The special provision prescribes the materials that can be used in pilings and the manner in which they can be installed. The provision requires sound attenuation measures that could include work area isolation or bubble curtains. Many of the specifics associated with this provision can be changed "as needed based on site conditions and alternatives as negotiated/approved by the NMFS" (NMFS 2012).
- **SP00290.34(c)(10) (2018 Specifications: 08-01-18).** *Environmental Protection*: This special provision addresses activities associated with piling removal. This provision suggests that pile removal should be done with a vibratory hammer if feasible.

8 Conclusion

In summary, the proposed Project would be designed to meet ODOT and City water quality standards and would improve long-term stormwater quality. Based on the contents of this technical report, the proposed Project would result in an overall improvement to water resources within the API. Therefore, significant impacts to water resources from this Project are not anticipated.

The total CIA on ODOT ROW is approximately 30.4 acres. This area could be treated to current water quality standards with a combination of vegetated facilities and MMFDs, existing water quality facilities, and off-site treatment credits. Furthermore, non-traditional treatment methods are available which may be necessary depending on possible site constraints.

The total CIA on City ROW is approximately 10.7 acres. This area could be treated to current water quality standards through a combination of existing and proposed vegetated water quality facilities.

9 Preparers

Name	Discipline	Education	Years of Experience
Ryan Sheean, PE, HDR, Inc.	Water Resources Engineering	M. Engineering	5
Christine Higgins, PE, HDR, Inc.	Water Resources Engineering	B.S., Civil Engineering	24

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