Climate Change Technical Report

May 2026

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Climate Change Technical Report

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ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Definition
°C	degrees Celsius
°F	degrees Fahrenheit
AASHTO	American Association of State Highway and Transportation Officials
BMP	best management practice
BRT	bus rapid transit
CCFS	Columbia Corridor Flood Safety
C-D	collector-distributor
CEQ	Council on Environmental Quality
CFEC	Climate-Friendly and Equitable Communities
CO_2	carbon dioxide
CRC	Columbia River Crossing
CTR	Commute Trip Reduction
C-TRAN	Clark County Public Transit Benefit Area Authority
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
GHG	greenhouse gas
I-5	Interstate 5
IBR	Interstate Bridge Replacement
ICE	Infrastructure Carbon Estimator
LPA	Locally Preferred Alternative
LRT	light-rail transit
LRV	light-rail vehicle
MAX	Metropolitan Area Express
NAICS	North American Industry Classification System
NAVD 88	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act
ODOT	Oregon Department of Transportation
OMF	Operations and Maintenance Facility
ORS	Oregon Revised Statutes
OTC	Oregon Transportation Commission
PMLS	Portland Metro Levee System
PNCD	Preliminary Navigation Clearance Determination

Acronym/Abbreviation	Definition
RCP	Representative Concentration Pathway
RTC	Southwest Washington Regional Transportation Council
RTP	Regional Transportation Plan
SCC	social cost of carbon
SEIS	Supplemental Environmental Impact Statement
SOV	single-occupancy vehicle
SR	State Route
TPSS	traction power substations
TriMet	Tri-County Metropolitan Transportation District of Oregon
UFSWQD	Urban Flood Safety and Water Quality District
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
VHD	vehicle hours of delay
VHT	vehicle hours traveled
VMT	vehicle miles traveled
VNHR	Vancouver National Historic Reserve
WSDOT	Washington Department of Transportation
WSTC	Washington State Transportation Commission

1. INTRODUCTION

This report outlines the context of the Interstate Bridge Replacement (IBR) Program as it may affect, and be affected by, climate change. Washington and Oregon, along with their local agency partners, have policy directives to reduce greenhouse gas (GHG) emissions from transportation and other activities. Reducing emissions to the targets established by these entities will require aggressive action at the local, state, and private levels.

The Council on Environmental Quality (CEQ) issued draft guidance to agencies involved in federal actions in January 2023 to address climate in National Environmental Policy Act (NEPA) documents. The CEQ guidance, entitled *Interim Guidance on Greenhouse Gas Emissions and Climate Change* (CEQ 2023), directed federal agencies to do the following:

- Consider GHG emissions and climate change in the identification of proposed actions and alternatives.
- Quantify a proposed action's projected GHG emissions or reductions for the expected lifetime of the action.
- Place GHG emissions in the appropriate context and disclose relevant GHG emissions and relevant climate impacts.
- Identify alternatives and mitigation measures to avoid or reduce GHG emissions.
- Provide additional context for GHG emissions to allow decision makers and the public to understand any tradeoffs associated with an action, including through the use of the best available social cost of GHG estimates.
- Incorporate environmental justice considerations into their analysis of climate-related effects.
- Use the information developed during the NEPA review to consider reasonable alternatives that would make the actions and affected communities more resilient to the effects of a changing climate (CEQ 2016).

The CEQ interim guidance was withdrawn on May 28, 2025, in light of changes to federal requirements for GHG and climate change evaluation. However, Washington State agencies must comply with GHG emission reduction targets under the State Environmental Policy Act (SEPA), which requires environmental reviews that account for GHG impacts from specific projects. Accordingly, this report, developed initially in support of the IBR Program's NEPA/SEPA Draft Supplemental Environmental Impact Statement (SEIS), has been updated to address compliance with SEPA requirements. The report follows the 2023 CEQ draft guidance and outlines a strategy for addressing climate change in the planning, design, construction, and operation of the IBR Program Modified Locally Preferred Alternative (LPA), as well as providing an initial baseline for measuring potential GHG effects. The IBR Program has limited modifications to the methodology and analysis that was published in the NEPA/SEPA Draft SEIS for public review as much as possible, while continuing to comply with SEPA legislative requirements.

Data used to support the GHG emissions estimates presented here are derived from several other IBR Program technical reports, including the Transportation Technical Report for vehicle miles traveled (VMT) and mode shift estimates and the September 2024 Energy Technical Report for estimates of

GHG emissions[1] associated with operations and construction of the Modified LPA. Data to evaluate resiliency and future conditions were drawn from scientific literature and agency sources. This Climate Change Technical Report references these data and provides additional context and a description of next steps. It also evaluates consistency with state, regional, and local agency plans and directives. This report has been updated to reflect comments received during the Draft SEIS public comment period.

In addition to considering impacts on the climate, this report considers the potential effects or influence of the changing climate on the Modified LPA. Chapter 4, Planning for Adaptation and Resiliency, outlines anticipated future conditions and lays the groundwork for designing infrastructure that is resilient and adaptable to climate change. Chapter 6, Designing for Resiliency, goes into more detail regarding project design and identifies steps to design for resiliency to changing climate conditions.

1.1 Greenhouse Gases, Climate Change, and Transportation

The earth's climate is changing. According to the U.S. Environmental Protection Agency (EPA), multiple lines of evidence show changes in weather, oceans, and ecosystems (EPA 2022b). Examples include the following:

- Changing temperature and precipitation patterns.
- Increases in ocean temperatures, sea level, and acidity.
- Melting of glaciers and sea ice.
- Changes in the frequency, intensity, and duration of extreme weather events.
- Shifts in ecosystem characteristics, like the length of the growing season, timing of flower blooms, water temperatures for fish, and migration of birds.

These changes to the earth's climate are due to a recent buildup of GHGs in the atmosphere.[2] GHGs absorb energy, slowing or preventing the loss of heat to space. They act as insulation, or like a blanket, making the earth warmer than it would otherwise be. This process, commonly known as the "greenhouse effect," is natural and necessary to support life. However, the recent buildup of GHGs in the atmosphere from human activities has changed the earth's climate and resulted in dangerous effects on human health and welfare and to ecosystems (EPA 2022a). These changes will result in

[1] Estimates of GHG emissions have been removed from the Energy Technical Report that accompanies the Final SEIS. This SEPA technical report uses the GHG estimates that were presented in a previous version of the Energy Technical Report, published in September 2024 with the Draft SEIS. For clarity, that document is referred to hereafter as the September 2024 Energy Technical Report.

[2] GHG emissions presented in this report are represented in metric tons of carbon dioxide equivalent. The gases considered in the analysis are consistent with protocol and include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), chlorofluorocarbons, sulfur hexafluoride (SF_6), and perfluorocarbons per the Kyoto Protocol. All GHG calculations use 100-year global warming potentials as defined in the Intergovernmental Panel on Climate Change's 5th Assessment Report (IPCC 2014). Many emissions factors were taken from sources that reported only in CO_2e, such as Environmental Product Declarations used in the materials analysis, and therefore a more detailed breakdown of the constituent gasses is not possible. All emissions are referred to as GHGs or GHG emissions in this report for simplicity.

localized effects in the IBR Program study area; the effects are explored in Chapter 4, Planning for Adaptation and Resiliency.

In Oregon and Washington, the transportation sector is the largest single emitter of GHGs, accounting for about 35 and 40% of total GHG emissions, respectively (DEQ 2025a; Ecology, 2025). U.S. EPA data show that between 1990 and 2019, GHG emissions in the transportation sector increased more in absolute terms than any other sector (EPA 2022b).

The developed world's transportation systems are changing rapidly toward reduced reliance on fossil fuels and increased use of electric and renewable fuels for vehicles and energy production. Along the Interstate 5 (I-5) corridor, California, Oregon, and Washington all have regulations to reduce fossil fuel use over time, and these regulations will help reduce the GHG emissions associated with transportation sources. The IBR Program aims to accelerate the reduction of GHG emissions by developing improved alternatives to driving, managing transportation demand, and minimizing emissions associated with construction. Through design, the IBR Program also intends to minimize the expected GHG emissions associated with the long-term maintenance of the proposed new infrastructure. This report identifies the Program's impacts on GHG emissions and provides potential mitigation measures for unavoidable adverse effects.

1.2 Existing Emissions Sources

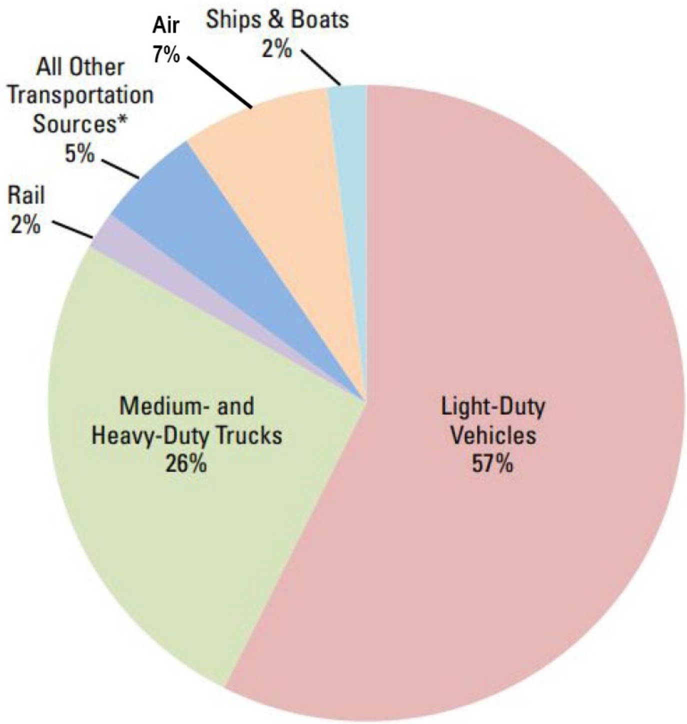
This section provides context on how the transportation sector generates GHG emissions through vehicle use and construction.

1.2.1 User Emissions

Emissions from vehicles using transportation facilities make up the majority of the transportation sector's GHG emissions. In a case study of six state departments of transportation, the National Cooperative Highway Research Program found that user emissions by passenger and freight vehicles made up approximately 94% of transportation-related GHG emissions, while 6% comes from construction and maintenance of the system and 0.2% results from administrative functions (e.g., office buildings) (NCHRP 2022). Thus, reducing user emissions provides the greatest potential to make large improvements in total transportation-related emissions.

Across the U.S. transportation sector, roadway users account for over 80% of transportation emissions, with light-duty vehicles (passenger cars and trucks) producing the majority (57%) and medium- and heavy-duty trucks adding 26%, as shown in Figure 1-1.

Figure 1-1. 2020 U.S. Transportation Sector Greenhouse Gas Emissions by Source



Source: EPA 2022

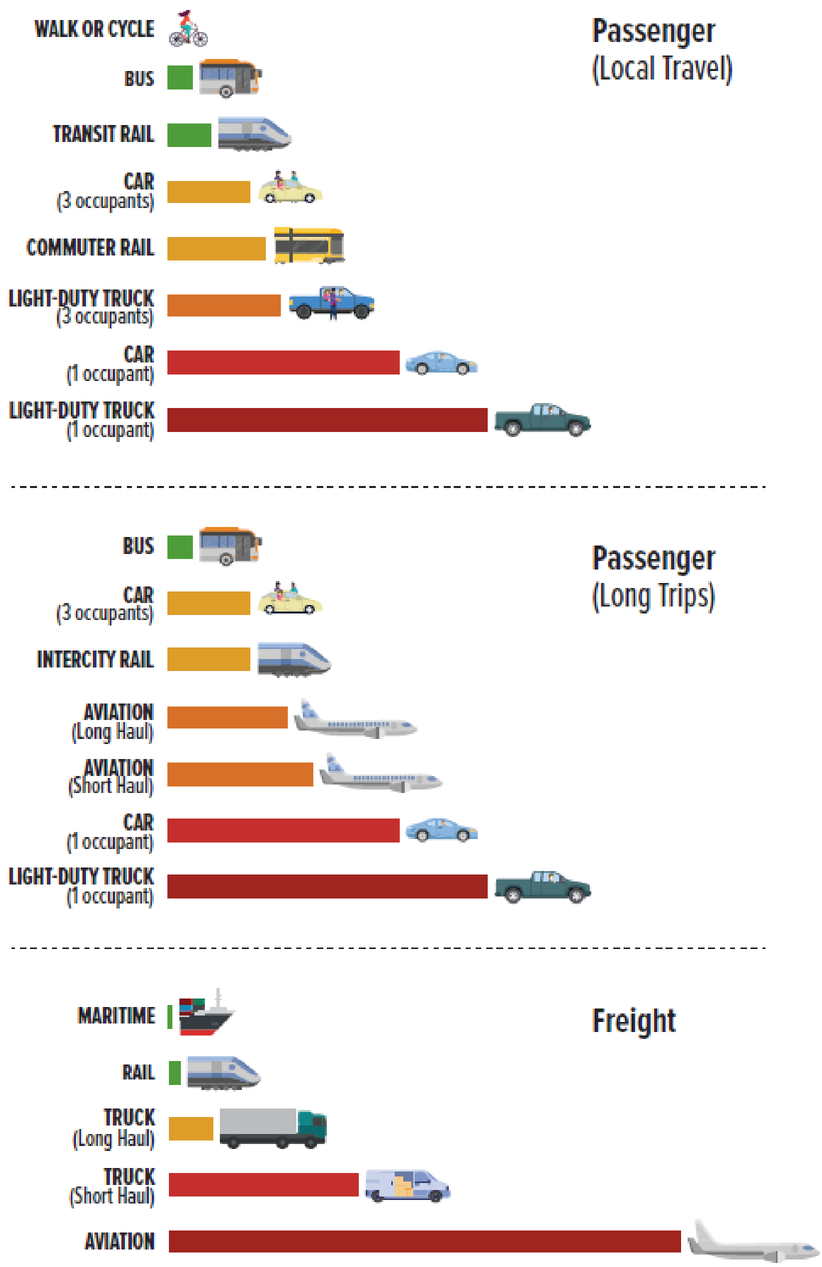
Notes: Totals may not add to 100% due to rounding. Transportation emissions do not include emissions from non-transportation mobile sources, such as agriculture and construction equipment. “Other” sources include buses, motorcycles, pipelines, and lubricants.

Of vehicle types, single-occupancy light-duty trucks (which include the sport-utility vehicle class) are the least efficient mode, and they are a continuously growing share of the personal vehicle fleet. Figure 1-2 shows the relative emissions per passenger mile associated with different modes and types of transport for passenger and freight trips.

The transportation sector is also responsible for the emission of “black carbon,” an element of particulate matter that results from burning coal, oil, or biomass (e.g., wood).[3] Black carbon can absorb light and generate heat, warming the air and furthering the effects of climate change. Diesel engines are a primary source of black carbon emissions in the United States.

[3] For more information on black carbon, see the EPA factsheet, “Black Carbon Research and Future Strategies” (EPA 2011).

Figure 1-2. Relative Greenhouse Gas Emissions from Different Modes and Types of Travel



Average pounds of GHG emissions per passenger mile or freight ton-mile for existing fossil fuel technologies.

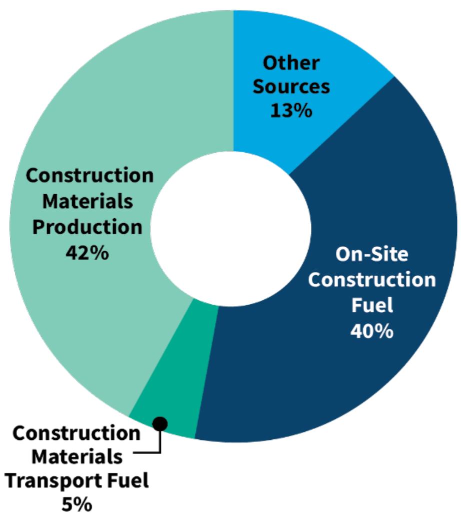
Source: DOE 2023

1.2.2 Construction Emissions

Although construction emissions represent a smaller proportion of transportation-sector GHG emissions, construction still produces substantial quantities. Figure 1-3 represents the average proportion of GHG emissions by category for the construction of transportation structures, highways, and streets per dollar spent.

As shown in Figure 1-3, the two largest categories of emissions are fuels used by construction equipment and the production of construction materials. These categories provide the greatest opportunities for minimizing GHG emissions from the construction activities. Construction material production includes concrete, asphalt, and steel products. The largest emissions in this category come from cement and concrete products and asphalt concrete pavement, including binders and aggregate. The remainder of construction-related GHG emissions come from fuel used in transporting materials and from other sources (e.g., engineering services, waste disposal).

Figure 1-3. Sources of Greenhouse Gas Emissions from Construction



Source: NCHRP 2022

Figure data notes: The values for this graphic are provided by the EPA's U.S. Environmentally Extended Economic Input-Output Model. This model considers emissions for a wide variety of sectors in the U.S. economy, categorized by the North American Industry Classification System (NAICS). The NAICS sector most closely aligned with transportation infrastructure construction is 237310: Transportation Structures, Highways, and Streets. The model provides GHG emissions factors per U.S. dollar of purchase price (kg CO_2e/$) and details about largest sources of emissions for each industry.

1.3 The IBR Program and GHG Emissions

The IBR Program is a continuation of the previously suspended Columbia River Crossing project with the same purpose: to replace the aging Interstate Bridge across the Columbia River with a modern, seismically resilient multimodal structure. The proposed infrastructure improvements are located along a 5-mile stretch of the I-5 corridor that extends from approximately Victory Boulevard in Portland to State Route (SR) 500 in Vancouver as shown in Figure 1-4, and are described in Sections 1.5 and 1.6 in more detail.

The Interstate Bridge connects Portland, Oregon, and Vancouver, Washington, on I-5 where it crosses the Columbia River. I-5 is the primary transportation spine running north and south through the westernmost U.S. and an international link from Canada to Mexico, carrying freight and passenger vehicles to all major cities on the West Coast. In the Portland-Vancouver vicinity, I-5 is one of only two highway routes across the Columbia River, making it a critical connection for access to jobs and services, interstate commerce, and freight movement. With one span now 105 years old, the Interstate Bridge is at risk for collapse in the event of a major earthquake and no longer satisfies the needs of commerce and travel. Replacing it with a modern, seismically resilient, multimodal structure that provides improved mobility for people, goods and services is a high priority for Oregon and Washington.

The transportation system in the vicinity of the Interstate Bridge is complex and has a diverse array of transportation elements, including freeways, highways, local roads, transit, and active transportation networks. The bridge supports local, regional, and interstate traffic, as well as transit and active transportation modes, with the majority of users in cars and trucks. The transportation system serves commuters making recurring trips during the weekdays, trucks traveling to and from the ports on either side of the river, public transit routes, and traffic related to local businesses and residences, as well as active transportation users.

This report identifies, describes, and evaluates construction and operational effects from GHGs resulting from the IBR Program. The Program is anticipated to reduce GHG emissions compared to the No-Build Alternative as a result of:

- An extension of the Tri-County Metropolitan Transportation District of Oregon's (TriMet) dedicated light-rail transit facility, including three new light-rail transit stations, as well as expanded express bus service and park and rides.
- Provision of shoulders for maintenance and emergency use during traffic incidents, reducing congestion and idling.
- Use of demand management methods such as variable-rate tolling of the highway facility, to reduce travel demand, promote mode shifts, and reduce travel during peak commuting periods.
- Provision of active transportation connections to provide a safe, comfortable, and direct path for walking, biking, and rolling, which is expected to draw more trips to those modes.

This report complies with SEPA requirements to evaluate GHG emissions resulting from state agency actions. This work is also consistent with Oregon Department of Transportation (ODOT) and Washington Department of Transportation (WSDOT) climate commitments.

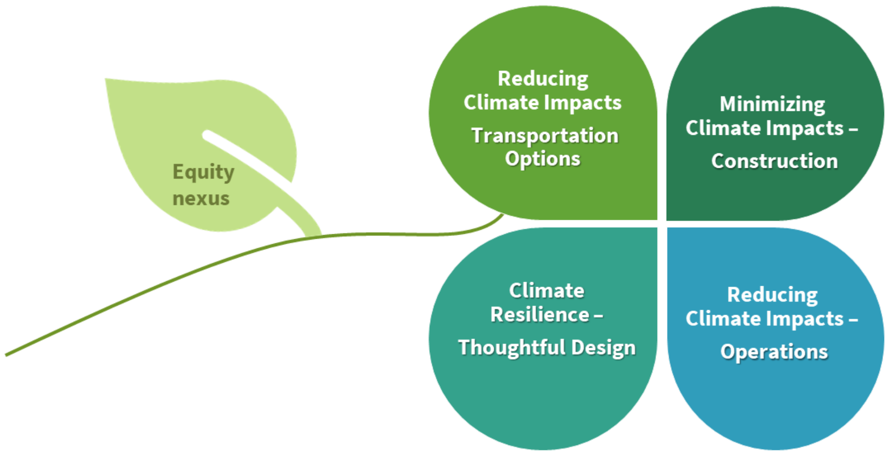
The impacts of transportation projects on climate are typically analyzed by relying on air emissions models, including the EPA MOVES model and construction-phase models, to estimate GHG emissions. These models rely on inputs from transportation modeling and assumptions regarding vehicle fleet composition and fuels used in the region. The IBR Program completed these analyses, which were presented in the Transportation Technical Report, Air Quality Technical Report, and Energy Technical Report published with the Draft SEIS in September 2024. This Climate Change Technical Report summarizes the results of GHG emissions modeling and provides additional context and framing of next steps.

Figure 1-4. IBR Program Location Overview

1.4 IBR Program Climate Framework

The IBR Program published a climate framework (Appendix A) with two main objectives to guide processes and desired outcomes for climate: (1) reduce climate impacts and (2) improve climate adaptation and resilience through deliberate actions. The framework is intended to be applied during design, construction, and long-term operations and maintenance (as described in Figure 1-5) with a goal of accounting for environmental impacts throughout the infrastructure life cycle.

Figure 1-5. Climate Framework



This definition and the objectives derived from the Program's climate framework form the basis for the analysis described in this report.

The IBR Program's performance related to climate objectives will be evaluated at different stages of the Program's development. Table 1-1 provides an overview of the objectives for each stage.

Table 1-1. Climate-Related Objectives by Program Phase

IBR Program Objective	Program Phase: Design/Refinement	Program Phase: Program Development and SEPA	Program Phase: Construction	Program Phase: Opening Day and Long-Term Operation
Design for resilience and adaptation	Avoid design choices that would restrict resilience to future climate conditions.	Assess future climate conditions, evaluate adaptability of design, develop climate-resilient design, and establish mitigation commitments.	Evaluate on-site needs regarding flooding, stormwater, heat tolerance, etc.; plan for and manage worker safety.	N/A; design and construction would be complete.
Reduce operational emissions	Design to support mode shift and VMT reduction. Develop high-capacity transit, improve active transportation, and	Evaluate reasonable alternatives and design options in the SEPA process. Establish best management practices to reduce impacts.	N/A	Consider adaptive management and partner support. Consider posting air quality or temperature data on variable message boards for users.

	implement roadway pricing.			Monitor user trips by mode across the bridge and report on IBR Program website.
Reduce emissions during operations and maintenance activities	Design to support low or lower maintenance needs. Consider using on-site renewable energy for signage or other electricity needs.	Evaluate alternatives and design options in the SEPA process.	N/A	Consider adaptive management and requirements for lower-GHG approaches to ongoing operations and maintenance. Optimize transit fuel use and equipment investments.
Minimize construction emissions and embodied carbon (emissions from extraction and production of construction materials)	Maintain options to use innovative approaches in construction equipment and materials.	Evaluate and establish baseline.	Track equipment and materials.	N/A; construction would be complete.

N/A = not applicable; SEPA = State Environmental Policy Act; VMT = vehicle miles traveled

1.4.1 Applying the Climate Framework During Program Development and SEPA

In coordination with Program partners and the community, the IBR Program developed and evaluated design options, desired outcomes, and transit investments to identify a Modified LPA.[4] The Modified LPA reflects strong regional consensus to move foundational elements forward into the environmental review process and accompanying planning and preliminary engineering.

The Program elements identified in the Modified LPA would encourage people to choose transportation modes other than driving alone (referred to as "mode shift"), reduce travel demand, and improve the efficiency of the transportation network—all of which could result in the decrease of GHG emissions in the region. Specifically, the Program is expected to reduce GHG emissions by affecting travel choices and traffic operations in the following ways:

- Encouraging mode shift to transit by providing a new high-capacity transit option between Portland and Vancouver.

[4] The screening and evaluation process is summarized in the IBR Program's *Design Option Development and Screening Report* (IBR Program 2022).

- Using demand management methods such as variable-rate tolling in the corridor to promote mode shifts and reductions in travel during the peak commuting periods.
- Improving traffic operations through the use of ramp metering, auxiliary lanes where needed, provision of shoulders, etc. By reducing congestion and disruptions due to over-capacity facilities, vehicle crashes and other incidents, these measures allow vehicles to operate more efficiently than in idling traffic.
- Encouraging mode shift from cars to active transportation options (walking and bicycling) due to improvements in facilities in the corridor.

1.4.2 Applying the Climate Framework through Design

The IBR Program has an opportunity to design for resilient, future-focused infrastructure. Climate modeling can predict with increasing confidence that extreme weather events are increasing and becoming more severe. Modeling also provides a better idea of potential future ranges for temperature and precipitation changes. While the details are still uncertain, and uncertainty increases with extended modeling timeframes and with more extreme events, these improved predictions provide the IBR Program the opportunity to design for performance in a range of environmental conditions. The following are examples of design measures that the Program will consider:

- Managing stormwater to account for **increased storm intensities**.
- Designing bridge footings, boat, and barge clearances to anticipate **increased river elevations and changes in water flows** and consider potential **increases of water pressure or other stressors to the adjacent levees**.
- Making material selections and design for road surfaces to account for **increased temperature extremes**.
- Using native and other resilient species to ensure **plant survival and resiliency**.
- Incorporating **renewable energy–harnessing technology**, such as solar panels or wind turbines, that can help to support the local electricity grid and offset emissions directly from bridge operations.
- Incorporating **regenerative braking and power storage** for the light-rail system to minimize energy needs and reduce power outages that can disrupt service.
- Using **green energy** sources to power illumination, signage, and potentially devices to monitor traffic, equipment, or other functions on the bridge.
- Designing pedestrian and active transportation facilities that **anticipate extreme weather associated with climate change (e.g., heat, increased storm intensity)** and take advantage of opportunities to mitigate or manage exposure.

The Program is also considering what might happen as extreme weather and sea level change displace communities and create a range of other impacts. As climate becomes more unpredictable, changes in the Pacific Northwest could include an influx of population (climate refugees), changes in work patterns (shifting commute times to avoid hottest times of day), or changes in the types and volumes of seasonal work and products (such as agricultural products). In light of all these considerations, creating a resilient bridge to withstand the unpredictability of the next 100 years is critical to managing future transportation needs.

1.4.3 Applying the Climate Framework During Contracting and Construction

The IBR Program's climate framework was also designed to be applied during the contracting and construction phases of the Program. Some construction methods can be harmful to the surrounding environment, resulting in impacts on air quality and noise, as well as material waste. The Program will investigate and consider construction materials, equipment, and practices to reduce embedded carbon in construction (e.g., the carbon emitted during the production, transport, and installation of the materials required for construction), maximize recycling, and reduce GHG emissions from construction. Estimates of construction GHG emissions are outlined in Section 5.4.1, Modified LPA, and Section 5.4.3, Potential Measures to Reduce Construction Emissions, describe approaches to reduce GHGs from Program construction activities.

1.4.4 Applying the Climate Framework: Reducing Impacts from Operations and Maintenance

GHG emissions attributable to operations and maintenance do not include emissions from vehicles using the roadway, but rather are a function of how the bridge, highway, and associated facilities are run and maintained. Within this category, the Program is focused on areas under the direct control of ODOT and WSDOT. Operational emissions from roadway users are discussed in Section 5.3 Operational Greenhouse Gas Impacts.

As construction of the Modified LPA concludes, final refinements will be made to Program elements including the climate framework, objectives, and screening metrics. These refinements may include final design changes or studies to monitor climate performance throughout the life of the bridges. Impacts that may occur through operation and maintenance include wear and tear of materials, lighting, and maintenance vehicles and equipment. The infrastructure design choices made by the Program will determine the extent of requirements associated with future maintenance and operation programs (e.g., type of structure, paint on the structure, transit stations and track). Other factors that may be considered in mitigating impacts from operations include:

- Electrification of and alternate fuels for the maintenance fleet.
- Establishment of replacement equipment and materials standards.
- Minimization of energy use for toll collection (e.g., ensure the office space used to oversee and operate tolls on the bridges is carbon neutral or negative).

These and other approaches to reduce GHG emissions from the operation and maintenance activities of ODOT, WSDOT, and transit operators are discussed in Section 6.2, Emissions During Program Operation and Maintenance.

1.4.5 Advancing Climate Objectives Through Future Partnerships

Further GHG emission reductions are anticipated from changes that would be controlled, funded, and deployed from outside the IBR Program or could be supported by local and state policies, such as:

- Accelerated adoption of electric vehicles and decarbonization of the grid.[5,6,7]
- Changes in land use policies.
- Investments in regional transit systems.
- Development of housing and jobs with access to transit or otherwise reducing need for car trips.

These and other options are introduced in Chapter 8, Next Steps, and will be explored with partners as a means to further accelerate the Program's reduction of GHG emissions.

1.5 Components of the Modified LPA

The basic proposed components of the Modified Locally Preferred Alternative (LPA)[8] include:

- A new pair of Columbia River bridges—one for northbound and one for southbound travel—built west of the existing bridge. The new bridges would each include three through lanes, safety shoulders, and one auxiliary lane in each direction. When all highway, transit, and active transportation would be moved to the new Columbia River bridges, the existing Interstate Bridge (both spans) would be removed.[9] The primary navigation channel would be relocated approximately 500 feet south (measured by the channel centerline) of its existing location near the Vancouver shoreline.
- A 1.9-mile light-rail transit (LRT) extension of the current Metropolitan Area Express (MAX) Yellow Line from the Expo Center MAX Station in North Portland, where it currently ends, to a terminus near Evergreen Boulevard in Vancouver. Improvements would include new stations at Hayden Island, downtown Vancouver (Waterfront Station), and near Evergreen Boulevard (Evergreen Station), as well as reconstruction of the existing Expo Center MAX Station. TriMet, which operates the MAX system, would also operate the Yellow Line extension.

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[5] California, Oregon, Washington, and British Columbia all have regulations that require their medium- and heavy-duty fleets to convert to zero-emission vehicles over time. Additionally, California, Oregon, Washington, and British Columbia all have regulations requiring electricity to be all renewable by 2050.

[6] Every major auto manufacturer in the world has committed to making all electric vehicles by 2025, 2030, 2035 and 2040, and transit vehicles are rapidly adopting electric powertrains as the future standard.

[7] Life-cycle analysis of electric vehicles compared to internal combustion engine vehicles finds that GHG emissions during the life cycle of electric vehicles are substantially lower than those of traditional gasoline or diesel vehicles (Argonne National Laboratory 2022).

[8] All transportation facilities would be designed to current AASHTO, WSDOT, and ODOT specifications.

[9] For purposes of this report, the existing I-5 bridges over the Columbia River are referred to as the "Interstate Bridge." The new replacement I-5 bridges over the Columbia River are referred to as the "Columbia River bridges."

- Associated LRT improvements such as traction power substations (TPSS),[10] an overhead catenary system, signal and communications support facilities, an overnight light-rail vehicle (LRV) facility at the Expo Center, 19 new LRVs, and an expanded maintenance facility at TriMet's existing Ruby Junction Light-Rail Operations and Maintenance Facility (OMF).
- Connections to local bus transit service, including bus rapid transit (BRT) and express bus routes, in collaboration with the Clark County Public Transit Benefit Area Authority (C-TRAN), in addition to the proposed new LRT service.
- Shoulders on I-5 from Interstate Avenue/Victory Boulevard to SR 500/39th Street to accommodate express bus-on-shoulder service in each direction.
- Associated bus transit service improvements, including three additional bus bays for new buses at the existing C-TRAN OMF (see Section 1.5.7, Transit Operating Characteristics, for more information about this service).
- Improvements to seven I-5 interchanges and I-5 mainline improvements between Interstate Avenue/ Victory Boulevard in Portland and SR 500/39th Street in Vancouver. Some adjacent local streets would be reconfigured to complement the new interchange designs and improve local east-west connections.
- Six new adjacent bridges across North Portland Harbor: one on the east side of the existing I-5 North Portland Harbor bridge and five on the west side or overlapping with the existing bridge (which would be removed). The bridges would carry (from west to east) LRT tracks, southbound I-5 off-ramp to Marine Drive, southbound I-5 mainline, northbound I-5 mainline, northbound I-5 on-ramp from Marine Drive, and an arterial bridge for local traffic to Hayden Island with a shared-use path for pedestrians and bicyclists.
- A variety of improvements for people who walk, bike, and roll throughout the study area, including a system of shared-use paths, bicycle lanes, sidewalks, enhanced wayfinding, and facility improvements to comply with the Americans with Disabilities Act. These are referred to in this document as "active transportation improvements."
- Variable-rate tolling, including signage and equipment, for motorists using the river crossing as a demand-management and financing tool.

In addition to the basic components described above, the Modified LPA includes five sets of design options. The design options are related to (1) the number of auxiliary lanes; (2) the bridge configuration; (3) the presence of the C Street ramps; (4) the I-5 alignment in downtown Vancouver; and (5) the park and rides. The Recommended Design Options are identified with bold text and an asterisk in Table 1-2.

- **Auxiliary Lanes.** Options for one or two auxiliary lanes. Auxiliary lanes are ramp-to-ramp connections on the highway that improve interchange safety by providing drivers with more space and time to merge, diverge, and weave at highway access points.

The one auxiliary lane design option would extend across the Columbia River bridges between the Marine Drive interchange and the Mill Plain Boulevard interchange.

[10] Each TPSS would be approximately 75 feet by 50 feet, including parking and access areas.

The two auxiliary lane design option would extend a second auxiliary lane in each direction of I-5 in addition to the one auxiliary lane included in the Modified LPA. The second auxiliary lane would also extend across the Columbia River bridges in addition to and in combination with the existing auxiliary lanes from approximately Interstate Avenue/Victory Boulevard to SR 500/39th Street.

- **Bridge Configurations.** Three bridge configurations are under consideration.

Double-deck fixed-span bridges: 116 feet of vertical navigation clearance over the primary navigation channel.

Single-level fixed-span bridges: 116 feet of vertical navigation clearance over the primary navigation channel.

Single-level movable-span bridges: with the movable spans over the primary navigation channel: 178 feet of vertical navigation clearance in the open position and 90 feet in the closed position (the north barge channel would have 99 feet of vertical navigation clearance and the south barge channel would have 90 feet of vertical navigation clearance).

- **C Street Ramps.** Options that retain or eliminate the existing C Street ramps in downtown Vancouver.
- **I-5 Alignment in Downtown Vancouver.** Options that maintain the I-5 mainline at its current location or shift the I-5 mainline up to 40 feet westward in downtown Vancouver between the SR 14 interchange and Mill Plain Boulevard interchange.
- **Park and Rides.** Options to provide parking capacity to accommodate 1,270 vehicles at designated park and rides near the Waterfront Station and Evergreen Station to serve LRT riders.

Table 1-2. Modified LPA Design Options

Modified LPA Component	Design Options
Auxiliary lanes	• **One auxiliary lane in each direction on the new Columbia River bridges and nearby sections of I-5*** • Two auxiliary lanes in each direction of I-5 would extend across the Columbia River bridges in addition to and in combination with existing auxiliary lanes from approximately Interstate Avenue/Victory Boulevard to SR 500/39th Street
Bridge configuration	• Double-deck fixed-span bridge configuration • **Single-level fixed-span bridge configuration*** • Single-level movable-span bridge configuration
C Street ramps	• **With C Street ramps*** • Without C Street ramps
I-5 Alignment in downtown Vancouver	• **Centered I-5 alignment*** • Westward shift of I-5 alignment
Park and Rides	• Provide parking capacity to accommodate 1,270 vehicles distributed across just two park and rides: one park and ride with 570 parking spaces near the Waterfront Station and one park and ride with 700 parking spaces near the Evergreen Station. The locations for park and rides that were evaluated included: ➢ Potential Waterfront Station park and rides ▪ Columbia Way (below I-5) ▪ Columbia Street/SR 14 ▪ Columbia Street/Phil Arnold Way ➢ Potential Evergreen Station park and rides ▪ Library Square ▪ Columbia Credit Union • **Provide parking capacity to accommodate 1,270 vehicles dispersed among five park and rides listed above *[a]**

Notes:

* Recommended Design Options are in bold.

a Depending on final design considerations, the decision may be made to use fewer than the five sites. The analysis assumes all five sites as it encompasses all physical impacts.

The transportation improvements proposed for the Modified LPA and the design options are shown in Figure 1-6. The Modified LPA includes all of the components listed above. If there are differences in environmental effects or benefits between the design options, they are identified in the sections below.

Section 1.5.1, Interstate 5 Mainline, describes the overall configuration of the I-5 mainline through the study area, and Sections 1.5.2, Portland Mainland and Hayden Island (Subarea A), through Section 1.5.5, Upper Vancouver (Subarea D), provide additional detail on four geographic subareas (A through D), which are shown on Figure 1-7. In each subarea, improvements to I-5, its interchanges, and the local roadways are described first, followed by transit and active transportation improvements. Design options are described under separate headings in the subareas in which they would be located. The description of the Modified LPA and design options are based on conceptual design and are subject to refinement as the design is finalized. The IBR Program will continue to consult with regulatory agencies, local agencies with jurisdiction, and tribes to seek opportunities for improvements and avoidance and minimization of impacts.

Figure 1-6. Modified LPA Components

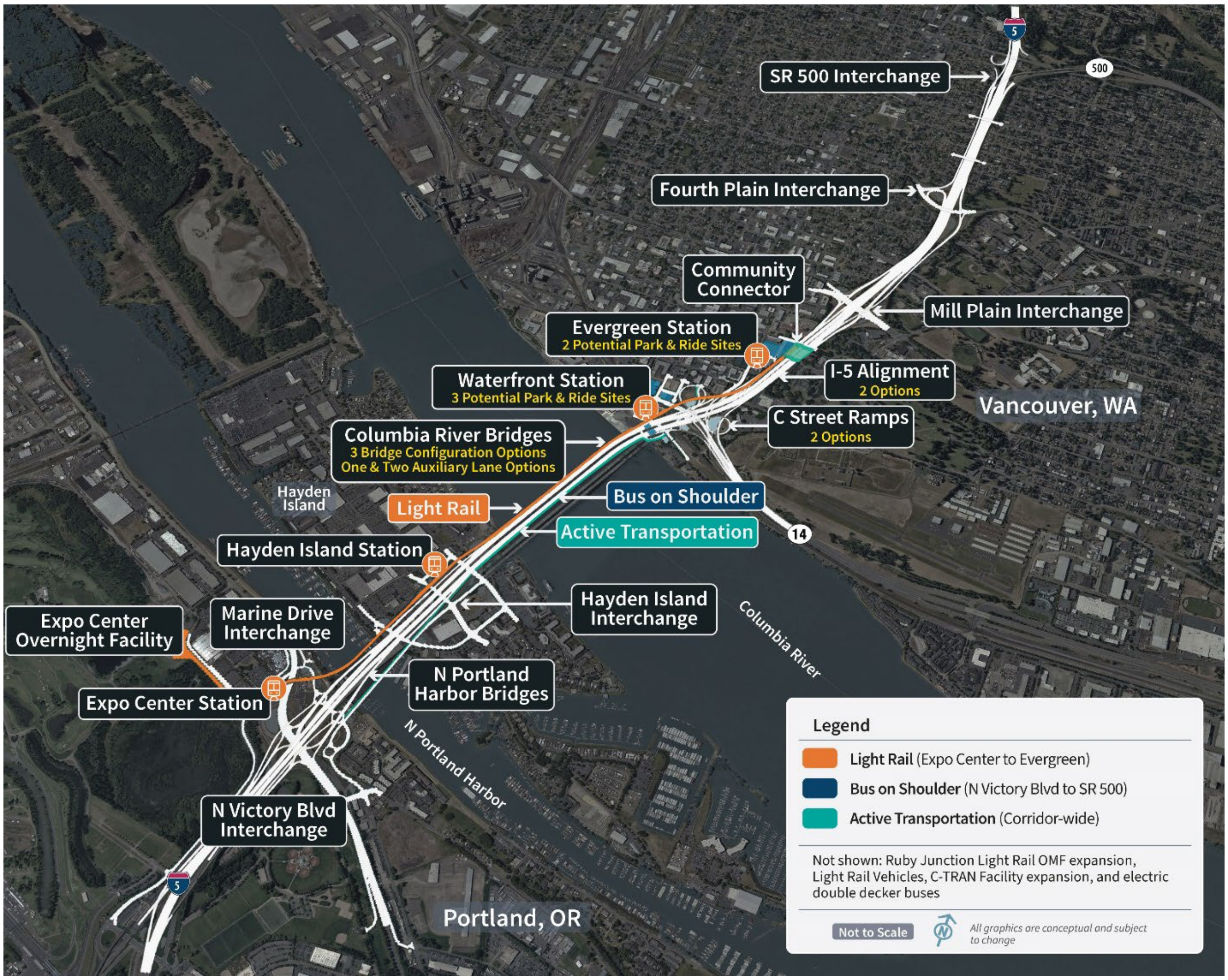


Figure 1-7. Modified LPA – Geographic Subareas

1.5.1 Interstate 5 Mainline

Today, within the 5-mile corridor, I-5 has three, typically 12-foot-wide, through lanes in each direction, an approximately 6- to 12-foot-wide inside shoulder, and an approximately 6- to 12-foot-wide outside shoulder, with the exception of the Interstate Bridge, which has approximately 1- to 2-foot-wide inside and outside shoulders. There are currently intermittent one and two auxiliary lane sections between the Victory Boulevard and Hayden Island interchanges in Oregon and between SR 14 and SR 500 in Washington.

The Modified LPA would include three 12-foot through lanes from Interstate Avenue/Victory Boulevard to SR 500/39th Street and one or two 12-foot auxiliary lanes, as detailed below and shown on Figure 1-8. Many of the existing auxiliary lanes on I-5 between the SR 14 and Main Street interchanges in Vancouver would remain, although they would be reconfigured. The existing auxiliary lanes between the Victory Boulevard and Hayden Island interchanges would be replaced with changes to on- and off-ramps and interchange reconfigurations. The existing Interstate Bridge over the Columbia River does not have auxiliary lanes; the Modified LPA would add one or two auxiliary lanes in each direction across the new Columbia River bridges.

The Modified LPA would also include shoulders (11- to 14-foot inside shoulders and 10- to 14-foot outside shoulders) to be consistent with the design standards of ODOT and WSDOT. The inside shoulder would be used by express bus service to bypass mainline congestion, known as “bus on shoulder” (refer to Section 1.5.7, Transit Operating Characteristics). The shoulder would be available for express bus service when general-purpose speeds are below 35 miles per hour.

1.5.1.1 Auxiliary Lane Design Options

The Modified LPA includes design options for one auxiliary lane in each direction or two auxiliary lanes in each direction across the Columbia River bridges in addition to and in combination with existing auxiliary lanes in the area. The one auxiliary lane design option would include an auxiliary lane in each direction across the Columbia River bridges between the Marine Drive interchange and the Mill Plain Boulevard interchange. The two auxiliary lane design option would include a second auxiliary lane from the Interstate Avenue/Victory Boulevard interchange and the SR 500/39th Street interchange, including on the Columbia River bridges (see Figure 1-8). This section provides an overview of the one auxiliary lane and the two auxiliary lane design options.

Figure 1-9, which shows a single-level fixed-span bridge configuration for comparison purposes, shows that the scale of the physical impacts (footprint, or the limits of permanent improvements) would be similar for the Modified LPA with one auxiliary lane design option and the Modified LPA with two auxiliary lanes design option, except over the Columbia River and in downtown Vancouver. For all bridge configuration design options, the two auxiliary lane design option would add a net of approximately 16 feet (8 feet in each direction) in total roadway width to the Columbia River bridges compared to the one auxiliary lane design option.

Figure 1-8. Auxiliary Lane Configurations

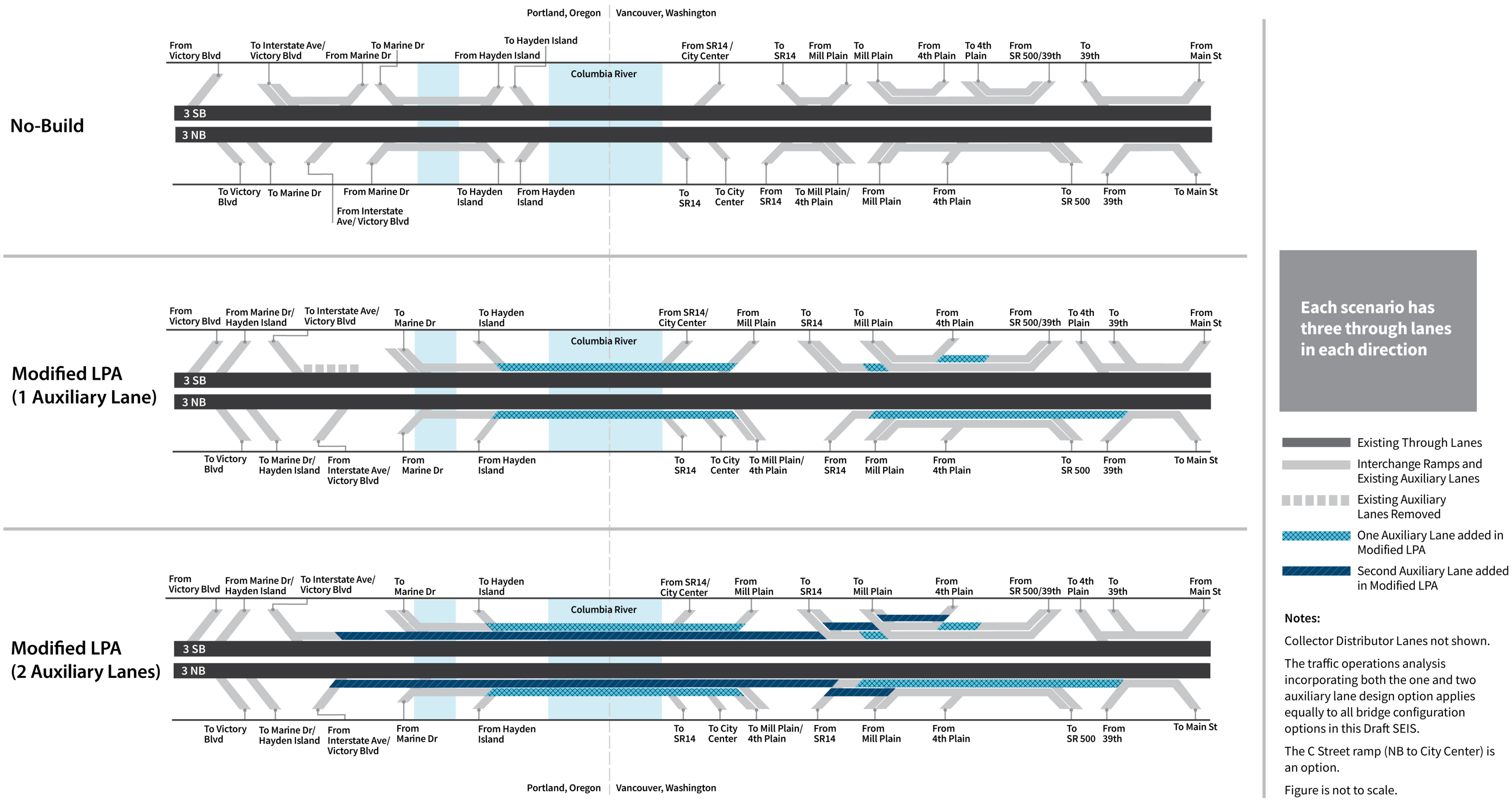
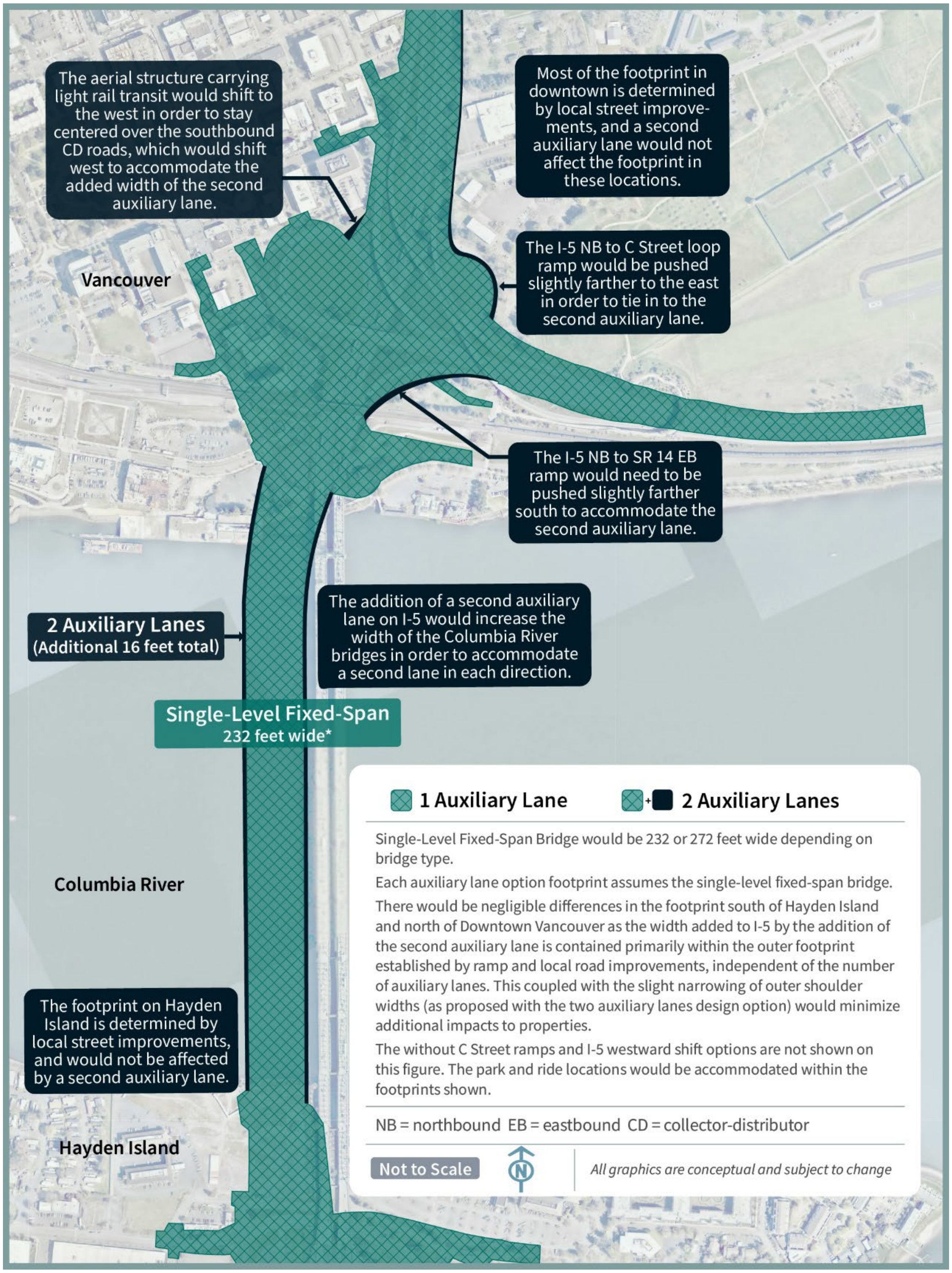


Figure 1-9. Auxiliary Lane Configuration Footprint Differences



Note: All dimensions are approximate.

ONE AUXILIARY LANE DESIGN OPTION – RECOMMENDED DESIGN OPTION

The IBR Program recommends advancing the one auxiliary lane in each direction of I-5 design option. The one and two auxiliary lane design options would provide important benefits to highway operations and safety. Both options received a mix of positive and negative feedback from the public. The one auxiliary lane design option is recommended because it would reduce overall environmental impacts while improving transportation operations and safety. The one auxiliary lane design option is also supported by local transportation agencies.

The one auxiliary lane design option would include a 12-foot-wide auxiliary lane in each direction across the Columbia River bridges between the Marine Drive interchange and the Mill Plain Boulevard interchange.

On northbound I-5, the auxiliary lane would extend the existing auxiliary from the Marine Drive on-ramp to the Hayden Island off-ramp to continue across the Columbia River bridge, and end at the combined off-ramp to Mill Plain/Fourth Plain Boulevard, north of SR 14 (see Figure 1-8). The existing auxiliary lane from the SR 14 on-ramp to the Mill Plain/Fourth Plain off-ramp would be extended to connect to the existing auxiliary lane from the 39th Street on-ramp to the Main Street off-ramp, creating an auxiliary lane beginning at the SR 14 on-ramp and ending at the Main Street off-ramp. The existing auxiliary lane located between the Mill Plain Boulevard on-ramp and the SR 500 off-ramp would remain.

On southbound I-5, the two existing auxiliary lanes between SR 500/39th Street and Mill Plain Boulevard would remain, with some reconfiguration due to the braided ramps between the SR 500/39th Street and Fourth Plain Boulevard interchanges. The new auxiliary lane across the Columbia River would begin at the Mill Plain Boulevard on-ramp and would continue across the Columbia River bridge, connecting to the existing auxiliary lane on Hayden Island and ending at the Marine Drive off-ramp. The existing southbound auxiliary lane between Marine Drive and Victory Boulevard/Interstate Avenue would be removed due to ramp reconfigurations as part of the Marine Drive braided ramp with the Victory Boulevard/Interstate Avenue off-ramp.

TWO AUXILIARY LANE DESIGN OPTION

The two auxiliary lane design option would include the same improvements as described under the one auxiliary lane design option and would add a second 12-foot-wide auxiliary lane in each direction of I-5 across the Columbia River bridges to further improve safety and operations in the corridor.

On northbound I-5, the inside auxiliary lane would extend from the combined Interstate Avenue/Victory Boulevard on-ramp, continue across the Columbia River bridge, and end at the SR 500/39th Street interchange, connecting to the existing auxiliary lane between the SR 14 on-ramp and Mill Plain on-ramp and the existing auxiliary lane between the 39th Street on-ramp and the Main Street off-ramp. The outside auxiliary lane would extend from the Marine Drive on-ramp across the Columbia River bridge and end at the Mill Plain/Fourth Plain Boulevard off-ramp. A new outside auxiliary lane would begin at the SR 14 on-ramp connecting to the existing auxiliary lane between the Mill Plain Boulevard on-ramp and the SR 500/39th Street off-ramp.

On southbound I-5, the two existing auxiliary lanes between SR 500/39th Street and Mill Plain Boulevard would remain, with some reconfiguration because of the braided ramps between the SR 500/39th Street and Fourth Plain Boulevard interchanges. In addition, there would be a third auxiliary lane between the Fourth Plain Boulevard on-ramp and the Mill Plain Boulevard off-ramp to improve operations and safety between these two closely spaced ramps. The existing auxiliary lane between the SR 500/39th Street on-ramp would extend to the SR 14 collector-distributor off-ramp. This auxiliary lane would then continue across the Columbia River bridge to the Interstate Avenue/Victory Boulevard off-ramp. The outside auxiliary lane would extend from the Mill Plain on-ramp across the Columbia River bridge to connect to the existing auxiliary lane between Hayden Island and the Marine Drive off-ramp.

1.5.2 Portland Mainland and Hayden Island (Subarea A)

This section discusses the geographic Subarea A (Figure 1-7 provides an overview of the geographic subareas). Figure 1-10 shows highway and interchange improvements in Subarea A, including the North Portland Harbor bridges.

1.5.2.1 Levee System Improvements

Within Subarea A, the IBR Program has the potential to alter three federally authorized levee systems:

- The Oregon Slough segment of the Peninsula Drainage District Number 1 levee (PEN 1).
- The Oregon Slough segment of the Peninsula Drainage District Number 2 levee (PEN 2).
- The PEN1/PEN2 Cross Levee segment of the PEN 1 levee (Cross Levee).

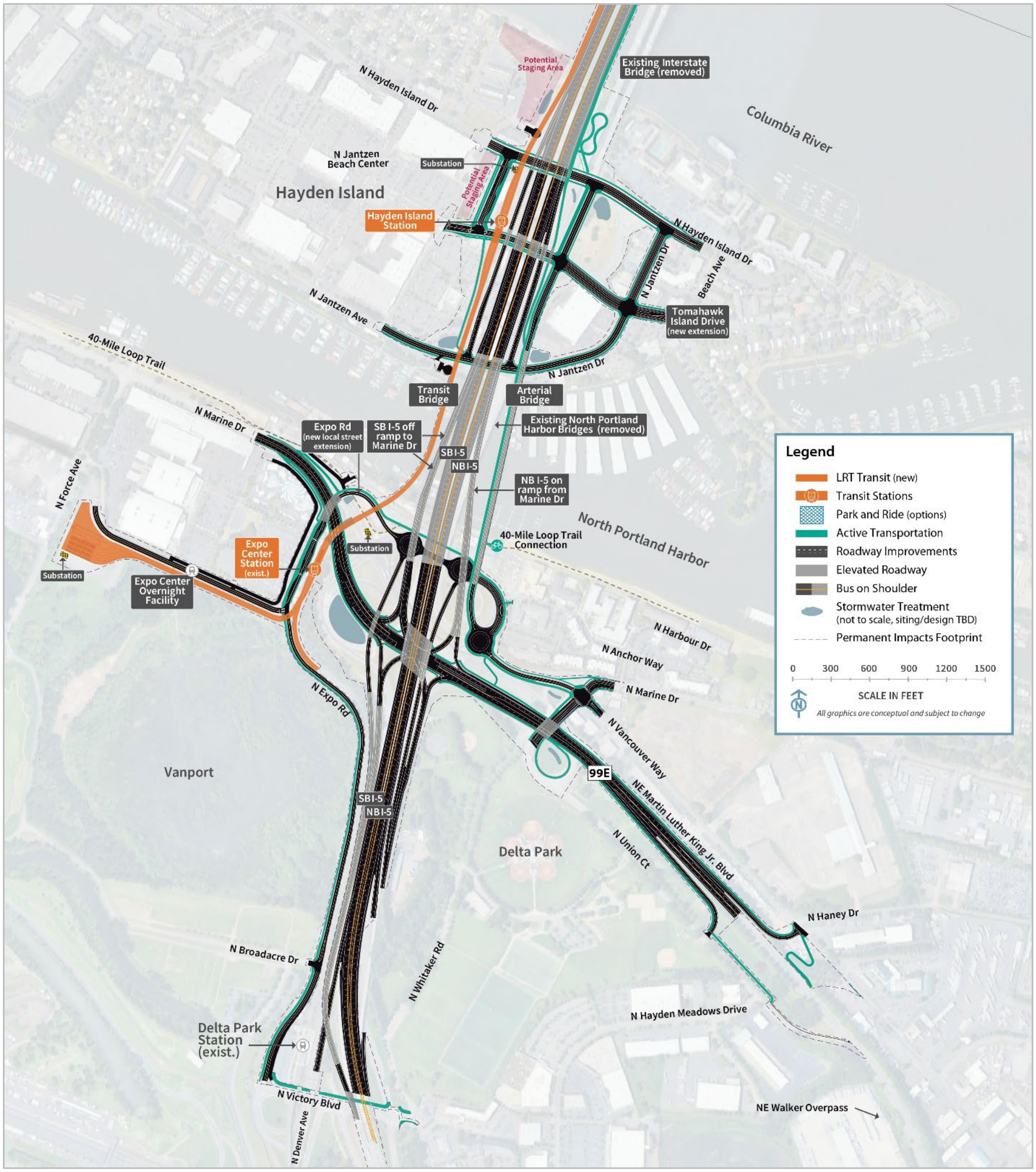
The levee systems are shown on Figure 1-11, and intersections with Modified LPA components are described throughout this section (Section 1.5.2, Portland Mainland and Hayden Island (Subarea A)), where appropriate. Within Subarea A, the IBR Program study area intersects with PEN 1 to the west of I-5 and with PEN 2 to the east of I-5. PEN 1 and PEN 2 include a main levee along the south side of North Portland Harbor and are part of a combination of levees and floodwalls. PEN 1 and PEN 2 are separated by the Cross Levee that is intended to isolate the two districts if one of them were to fail. The Cross Levee is located along the I-5 mainline embankment, except in the Marine Drive interchange area, where it is located on the west edge of the existing ramp from Marine Drive to southbound I-5.[11]

There are two concurrent projects underway that are planning improvements to PEN1, PEN2, and the Cross Levee to reduce flood risk:

- The U.S. Army Corps of Engineers (USACE) Portland Metro Levee System (PMLS) project.
- The Columbia Corridor Flood Safety (CCFS) projects (formerly known as “Flood Safe Columbia River” and “Levee Ready Columbia”).

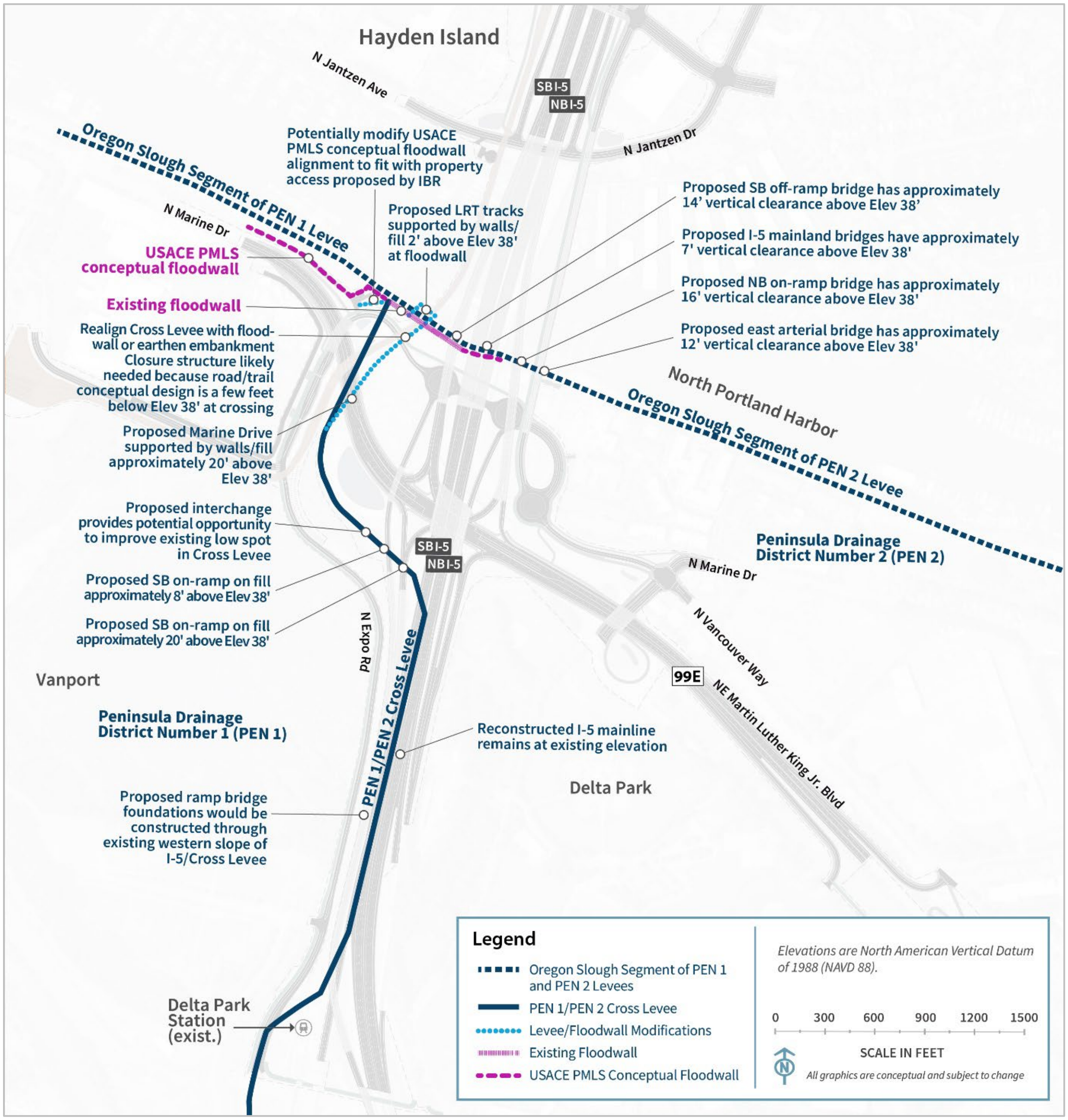
[11] The portion of the original Denver Avenue levee alignment within the Marine Drive interchange area is no longer considered part of the levee system by UFSWQD.

Figure 1-10. Portland Mainland and Hayden Island (Subarea A)



LRT = light-rail transit; NB = northbound; SB = southbound; TBD = to be determined

Figure 1-11. Levee Systems in Subarea A



USACE on the PMLS project, which includes improvements at PEN 1 and PEN 2 (e.g., raising these levees to elevation 38.2 feet for earthen levees and 39.2 feet for flood walls North American Vertical Datum of 1988 [NAVD 88]).[12] Additionally, as part of the CCFS projects, UFSWQD has identified the need to raise a low spot in the Cross Levee on the southwest side of the Marine Drive interchange.

The IBR Program is in close coordination with UFSWQD and the USACE to ensure that the IBR Program's design efforts consider the timing and scope of the PMLS project and the CCFS proposed modifications. The intersection of the IBR Program proposed actions to both the existing levee configuration and the anticipated future condition based on the proposed PMLS and CCFS projects are described below, where appropriate.

1.5.2.2 Highways, Interchanges, and Local Roadways

VICTORY BOULEVARD/INTERSTATE AVENUE INTERCHANGE AREA

The southern extent of the Modified LPA would improve two ramps at the Victory Boulevard/Interstate Avenue interchange (see Figure 1-10 and Figure 1-12). The first ramp improvement would be the southbound I-5 off-ramp to Victory Boulevard/Interstate Avenue; this off-ramp would be braided below (i.e., grade separated or pass below) the Marine Drive to the I-5 southbound on-ramp (see the Marine Drive Interchange Area section below). The other ramp improvement would lengthen the merging distance for northbound traffic entering I-5 from Victory Boulevard and from Interstate Avenue.

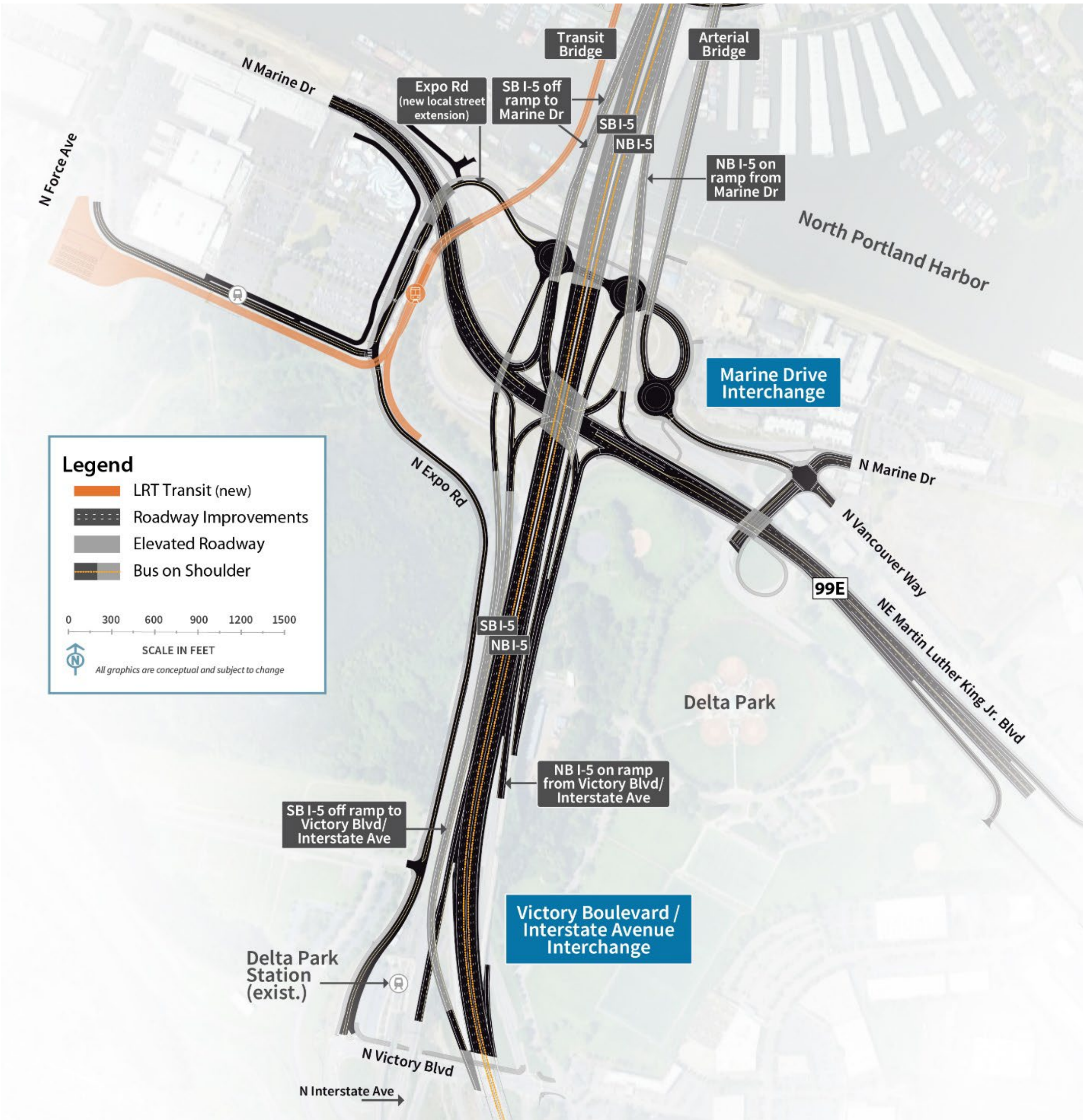
The existing I-5 mainline between Victory Boulevard/Interstate Avenue and Marine Drive is part of the Cross Levee (see Figure 1-11). The Modified LPA would require some pavement reconstruction of the mainline in this area; however, the improvements would mostly consist of pavement overlay, and the profile and footprint would be similar to existing conditions.

MARINE DRIVE INTERCHANGE AREA

The next interchange north of the Victory Boulevard/Interstate Avenue interchange is at Marine Drive. All movements within this interchange would be reconfigured to improve safety and operations for motorists entering and exiting I-5, and all active transportation users accessing areas in the vicinity of the interchange. In addition, Marine Drive would be raised over the proposed LRT extension to separate motorist and transit users. The proposed Marine Drive interchange configuration would be a single-point urban interchange. Figure 1-12 shows Marine Drive interchange's layout and construction footprint.

[12] NAVD 88 is a vertical control datum (reference point) used by federal agencies for surveying.

Figure 1-12. Transit and Roadway Improvements in North Portland



Martin Luther King Jr. Boulevard would have new more direct connections to I-5. The new interchange configuration would change the westbound Marine Drive and westbound Vancouver Way connections to Martin Luther King Jr. Boulevard. An improved connection farther east of the interchange (near Haney Drive) would provide access to westbound Martin Luther King Jr. Boulevard for these two streets. The existing access to westbound Martin Luther King Jr. Boulevard from Vancouver Way east of Haney Drive would be closed. For eastbound travelers on Martin Luther King Jr. Boulevard exiting to Union Court, the existing loop connection would be replaced with a new connection farther east (between the access to the East Delta Park Owens Sports Complex and N Hayden Meadows Drive).

Expo Road from Victory Boulevard to the Expo Center would be reconstructed with improved active transportation facilities. North of the Expo Center, Expo Road would be extended under Marine Drive and continue under I-5 to the east, connecting with Marine Drive and Vancouver Way through three new connected intersections. The westernmost intersection would connect the new local street extension to I-5 southbound. The middle intersection would connect the I-5 northbound off-ramp to the local street extension. The easternmost intersection would connect the new local street extension to an arterial bridge crossing North Portland Harbor to Hayden Island. This intersection would also connect the local street extension to Marine Drive and Vancouver Way.

To access Hayden Island using the arterial bridge from the east on Martin Luther King Jr. Boulevard, motorists would exit Martin Luther King Jr. Boulevard at the existing off-ramp to Vancouver Way just west of the Walker Street overpass. Then motorists would travel west on Vancouver Way, through the intersection with Marine Drive and straight through the intersection to the arterial bridge.

From Hayden Island, motorists traveling south to Portland via Martin Luther King Jr. Boulevard would turn onto the arterial bridge southbound and travel straight through the intersection onto Vancouver Way. At the intersection of Vancouver Way and Marine Drive, motorists would turn right onto Union Court and follow the existing road southeast to the existing on-ramp onto Martin Luther King Jr. Boulevard.

The conceptual floodwall alignment from the proposed USACE PMLS project is located on the north side of Marine Drive, near two industrial properties, with three proposed closure structures[13] for property access. The Modified LPA would realign Marine Drive to the south to maintain traffic on existing Marine Drive during construction. The Modified LPA would provide access to the two industrial properties via the new local road extension from Expo Road. Therefore, the change in access for the two industrial properties could require small modifications to the floodwall alignment (a potential shift of approximately 5 to 10 feet to the south) and closure structure locations. The IBR Program is coordinating with USACE PMLS and the UFSWQD on modifications to the floodwall alignment.

Marine Drive and the two southbound on-ramps would travel over the Cross Levee approximately 10 to 20 feet above the proposed elevation of the improved levee, and they would be supported by fill and retaining walls near an existing low spot in the Cross Levee.

The I-5 southbound on-ramp from Marine Drive would continue on a new bridge structure. Although the bridge's foundation locations have not been determined yet, they would be constructed through the western slope of the Cross Levee (between the existing I-5 mainline and the existing light-rail).

NORTH PORTLAND HARBOR BRIDGES

To the north of the Marine Drive interchange is the Hayden Island interchange area, which is shown in Figure 1-10. I-5 crosses over the North Portland Harbor when traveling between these two interchanges. The Modified LPA proposes to replace the existing I-5 bridge spanning North Portland Harbor to improve seismic resilience.

[13] Levee closure structures are put in place at openings along the embankment/floodwall to provide flood protection during high water conditions.

Six new parallel bridges would be built across the waterway under the Modified LPA: one on the east side of the existing I-5 North Portland Harbor bridge and five on the west side or overlapping the location of the existing bridge (which would be removed). From west to east, these bridges would carry:

- The LRT tracks.
- The southbound I-5 off-ramp to Marine Drive.
- The southbound I-5 mainline.
- The northbound I-5 mainline.
- The northbound I-5 on-ramp from Marine Drive.
- An arterial bridge between the Portland mainland and Hayden Island with a shared-use path for pedestrians and bicyclists.

All new structures would have at least as much vertical navigation clearance over North Portland Harbor as the existing North Portland Harbor bridge.

All of the six bridges would be designed and constructed to have sufficient clearance over the levees for access and maintenance. The foundation locations for the five roadway bridges have not been determined at this stage of design, but some foundations could be constructed through landward or riverward levee slopes.

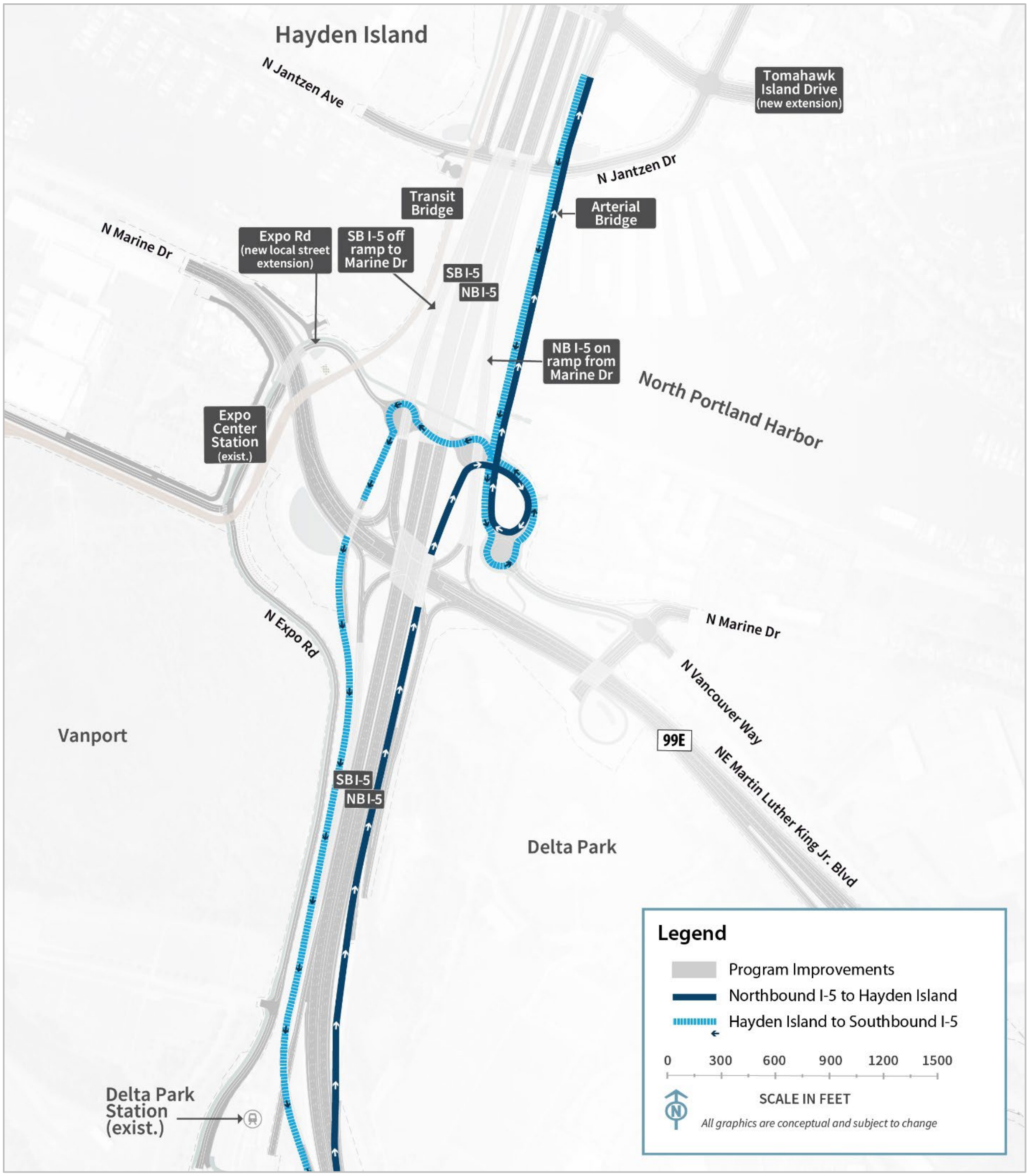
HAYDEN ISLAND INTERCHANGE AREA

All traffic movements for the Hayden Island interchange would be reconfigured. Figure 1-10 shows the layout and construction footprint of the Hayden Island interchange. A partial interchange would be built on Hayden Island with a northbound I-5 on-ramp from Jantzen Drive and a southbound I-5 off-ramp to Jantzen Drive. This would improve ramp lengths to provide sufficient merging/diverging areas compared to the existing substandard ramps that require acceleration and deceleration in a short distance. The I-5 mainline would be partially located on fill across the island and partially elevated to provide east–west connections on Hayden Island.

There would not be a southbound I-5 on-ramp or northbound I-5 off-ramp located on Hayden Island. Connections to Hayden Island for those movements would be via the local access (i.e., arterial) bridge connecting North Portland to Hayden Island (Figure 1-13). Vehicles traveling northbound on I-5 wanting to access Hayden Island would exit with traffic going to the Marine Drive interchange, cross under Martin Luther King Jr. Boulevard to the new intersection at the Expo Road local street extension, and use the arterial bridge to cross North Portland Harbor. Vehicles on Hayden Island looking to enter I-5 southbound would use the arterial bridge to cross North Portland Harbor, cross under I-5 using the new Expo Road local street extension to the westernmost intersection, cross under Marine Drive, merge with the Marine Drive southbound on-ramp, and merge with I-5 southbound south of Victory Boulevard.

Improvements to Jantzen Avenue may include additional left-turn and right-turn lanes at the interchange ramp terminals and active transportation facilities. Improvements to Hayden Island Drive would include new connections to the new arterial bridge over North Portland Harbor. The existing I-5 northbound and southbound access points from Hayden Island Drive would also be removed. A new extension of Tomahawk Island Drive would travel east–west through the middle of Hayden Island and under the I-5 interchange, thus improving connectivity across I-5 on the island.

Figure 1-13. Vehicle Circulation between Hayden Island and the Portland Mainland



NB = northbound; SB = southbound

1.5.2.3 Transit

A new light-rail alignment for northbound and southbound trains would be constructed within Subarea A (Figure 1-10) to extend from the existing Expo Center MAX Station over North Portland Harbor to a new station at Hayden Island. An overnight LRV facility would be constructed on the southwest corner of the Expo Center property (Figure 1-10) to provide storage for trains during hours when the MAX is not in service. This facility is described in Section 1.5.6, Transit Support Facilities. The existing Expo Center MAX Station would be modified to remove the westernmost track and platform. Other platform modifications, including track realignment and regrading the station, are anticipated to transition to the extension alignment. This could require reconstruction of the operator break facility, signal/communication buildings, and TPSSs. The existing TPSS at the end of TriMet's MAX Yellow Line would be decommissioned. A new TPSS would be constructed to the east of the LRT tracks and south of Expo Road, as well as at the overnight LRV facility, east of N Force Avenue. Immediately north of the Expo Center MAX Station, the LRT alignment would curve east toward I-5, pass beneath an elevated Marine Drive, cross the proposed Expo Road local street extension and the 40-Mile Loop Trail at grade, then rise over the existing levee onto a light-rail bridge to cross North Portland Harbor.

After crossing the new Expo Road extension, the new light-rail track would cross over the main levee (Figure 1-11). The light-rail profile is anticipated to provide sufficient clearance above the improved levees at the existing floodwall (and improved floodwall), and the tracks would be constructed on fill supported by retaining walls above the floodwall. North of the floodwall, the light-rail tracks would continue onto the new light-rail bridge over North Portland Harbor.

As the Modified LPA's light-rail extension would cross the north end of the existing Cross Levee, the IBR Program is proposing to realign the Cross Levee to the east of the light-rail alignment. This realigned Cross Levee would intersect the new Expo Road extension. A levee closure structure would be required because the proposed roadway is a few feet lower than the proposed elevation of the improved levee.

On Hayden Island, proposed transit components include northbound and southbound LRT tracks over Hayden Island; the tracks would be elevated at approximately the height of the new I-5 mainline. An elevated LRT station would also be built on the island immediately west of I-5. Active transportation facilities, described below, would connect to the new Hayden Island Station. A new TPSS would be constructed at the Hayden Island Station, north of the transit platform. If a single-level fixed-span or movable-span Columbia River bridge configuration were implemented, the light-rail alignment would extend north on Hayden Island along the western edge of I-5 before transitioning onto the outer (western) edge of the new western single-level bridge over the Columbia River. For the double-deck configuration, the light-rail alignment would transition to the lower level of the new double-deck southbound I-5 bridge over the Columbia River.

1.5.2.4 Active Transportation

In the Victory Boulevard interchange area (Figure 1-10), active transportation facilities would be provided on Victory Boulevard beneath I-5 and Interstate Avenue between Expo Road and the northbound on/off-ramp terminal east of I-5. Active transportation facilities would also be provided along Expo Road between Victory Boulevard and the Expo Center. These facilities would provide direct connections between the Victory Boulevard and Marine Drive interchange areas, as well as links to the Delta Park and Expo Center MAX Stations.

New shared-use path connections throughout the Marine Drive interchange area would provide access between the Bridgeton neighborhood (on the east side of I-5), Hayden Island, and the Expo Center MAX Station. There would also be connections to the existing portions of the 40-Mile Loop Trail, which runs north of Marine Drive under I-5 through the interchange area. The path would continue along the extension of Expo Road under the interchange to the intersection of Marine Drive and Vancouver Way, where it would connect under Martin Luther King Jr. Boulevard to Delta Park.

East of the Marine Drive interchange, active transportation facilities on Martin Luther King Jr. Boulevard and on the parallel street, Union Court, would connect travelers to Marine Drive and across the arterial bridge to Hayden Island. The active transportation facilities on Martin Luther King Jr. Boulevard would provide westbound and eastbound cyclists and pedestrians with off-street crossings of the interchange and would also provide connections to both the Expo Center MAX Station and the 40-Mile Loop Trail to the west.

The new arterial bridge over North Portland Harbor would include a shared-use path for pedestrians and bicyclists (Figure 1-10). On Hayden Island, active transportation facilities would be provided on Jantzen Avenue, Hayden Island Drive, and Tomahawk Island Drive and would connect to the Hayden Island Station. The shared-use path on the arterial bridge would continue along the arterial bridge to the south side of Tomahawk Island Drive. A parallel, elevated path from the arterial bridge would continue adjacent to I-5 across Hayden Island and cross above Tomahawk Island Drive and Hayden Island Drive to connect to the outer edge of the new single-level, or lower level of the double-deck eastern bridge over the Columbia River. A ramp down to the north side of Hayden Island Drive would be provided from the elevated path.

1.5.3 Columbia River Bridges (Subarea B)

This section discusses the geographic Subarea B (Figure 1-7 provides an overview of the geographic subareas). Figure 1-14 shows highway and interchange improvements in Subarea B.

Figure 1-14. Columbia River Bridges (Subarea B)

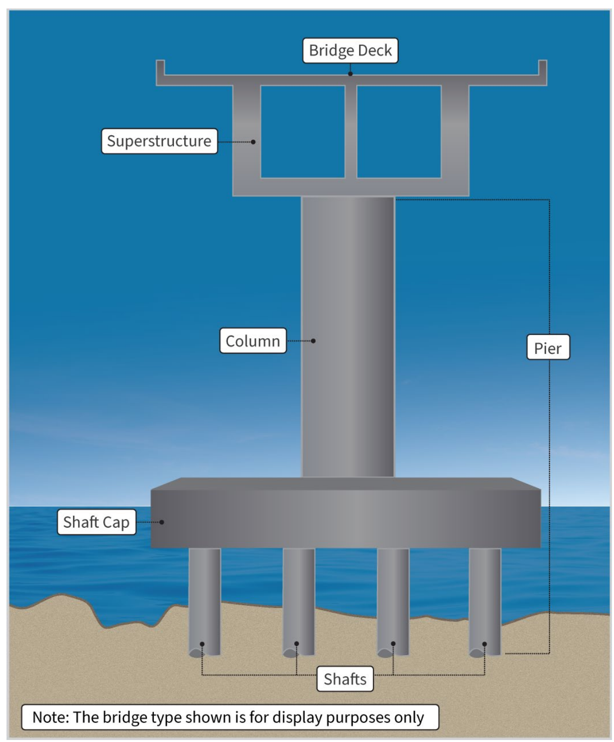
1.5.3.1 Highways, Interchanges, and Local Roadways

The two existing parallel northbound and southbound I-5 bridges that cross the Columbia River were constructed in 1917 and 1958, respectively. When the 1958 bridge was constructed, pier 5 of the 1917 bridge was removed and the profile was raised to match the new bridge. For the IBR Program, the two existing bridges would be replaced by two new parallel bridges, located west of the existing bridges (Figure 1-14). The new bridges would be designed to current American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design Bridge Design Specifications and AASHTO Seismic Guide Specifications and in compliance with ODOT and WSDOT design criteria. With all bridge configuration design options, the new eastern bridge would accommodate northbound highway traffic and a shared-use path. The new western bridge would carry southbound traffic and light-rail tracks. Whereas the existing bridges each have three lanes with no shoulders, each of the two new bridges would accommodate three through lanes, one or two auxiliary lanes, and shoulders on both sides of the highway. Lanes and shoulders would be built to full design standards.

As with the existing bridge (Figure 1-16), the new Columbia River bridges would provide three navigation channels: a primary navigation channel (Figure 1-17). The current location of the primary navigation channel is near the Vancouver shoreline where the existing lift spans are located. The IBR Program is coordinating with the USACE to obtain authorization to change the location of the primary navigation channel. Under the Modified LPA, the primary navigation channel would be shifted south approximately 500 feet (measured by channel centerlines), and the existing center barge channel would shift north and become the north barge channel. The new primary navigation channel would be 400 feet wide (this width includes a 300-foot USACE-authorized channel and a 50-foot channel maintenance buffer on each side of the authorized channel), and the two barge channels would also each be 400 feet wide.

The existing Interstate Bridge has nine in-water pier sets[14] and four pier sets on land (pier locations are shown on Figure 1-16). The new Columbia River bridges (any bridge configuration) would be built on six in-water pier sets, plus multiple piers on land (pier locations are shown on Figure 1-17). Each in-water pier set would be supported by a foundation of drilled shafts; each group of shafts would be tied together with a concrete shaft cap. Columns or pier walls would rise from the shaft caps and connect to the superstructures of the bridges (Figure 1-15).

Figure 1-15. Bridge Foundation Concept



BRIDGE CONFIGURATION OPTIONS

Three bridge configuration options are being considered: (1) double-deck fixed-span (with one bridge type); (2) a single-level fixed-span (with various potential bridge types); and (3) a single-level movable-span (with one bridge type). Both the double-deck and single-level fixed-span configurations would provide 116 feet of vertical navigation clearance at their respective highest spans, which was the vertical navigation clearance of the Columbia River Crossing (CRC) LPA. The CRC LPA included a double-deck fixed-span bridge

[14] A pier set consists of the pier supporting the northbound bridge and the pier supporting the southbound bridge at a given location.

configuration. The single-level fixed-span configuration was developed and is being considered as part of the IBR Program in response to the physical and contextual changes (e.g., design and operational considerations) since 2013 that allowed for opportunities to examine a refinement in the double-deck bridge configuration (e.g., ingress and egress of transit from the lower level of the double-deck fixed-span configuration on the north end of the southbound bridge).

Consideration of the single-level movable-span configuration as part the IBR Program was necessitated by the U.S. Coast Guard's (USCG) review of the Program's navigation impacts on the Columbia River and issuance of a Preliminary Navigation Clearance Determination (PNCD) (USCG 2022). The USCG PNCD set the preliminary vertical navigation clearance recommended for the issuance of a bridge permit at 178 feet; this is the current vertical navigation clearance of the Interstate Bridge. On January 16, 2026, the USCG issued a revised PNCD for the new Columbia River bridges and set the preliminary vertical navigation clearance at 116 feet or greater (USCG 2026).

The IBR Program is carrying forward the three bridge configurations, each of which meets the IBR Program's Purpose and Need, to address changed conditions to ensure a permittable bridge configuration is within the range of options considered in the Supplemental Environmental Impact Statement (SEIS). Each of the bridge configuration design options provides at least 116 feet of vertical navigation clearance and is consistent with the January 2026 PNCD issued by the USCG. Additional discussion on pending actions to obtain authorizations from USCG and USACE for the Columbia River bridges' primary navigation channel location are described in Section 2.6, Additional Compliance, of the Final SEIS.

Each of the bridge configurations assumes one auxiliary lane; two auxiliary lanes could be applied to any of the bridge configurations. All typical sections with one auxiliary lane would provide 14-foot shoulders to accommodate bus on shoulder and maintain traffic during construction of the Modified LPA and future maintenance.

Figure 1-16. Existing Navigation Clearances of the Interstate Bridge

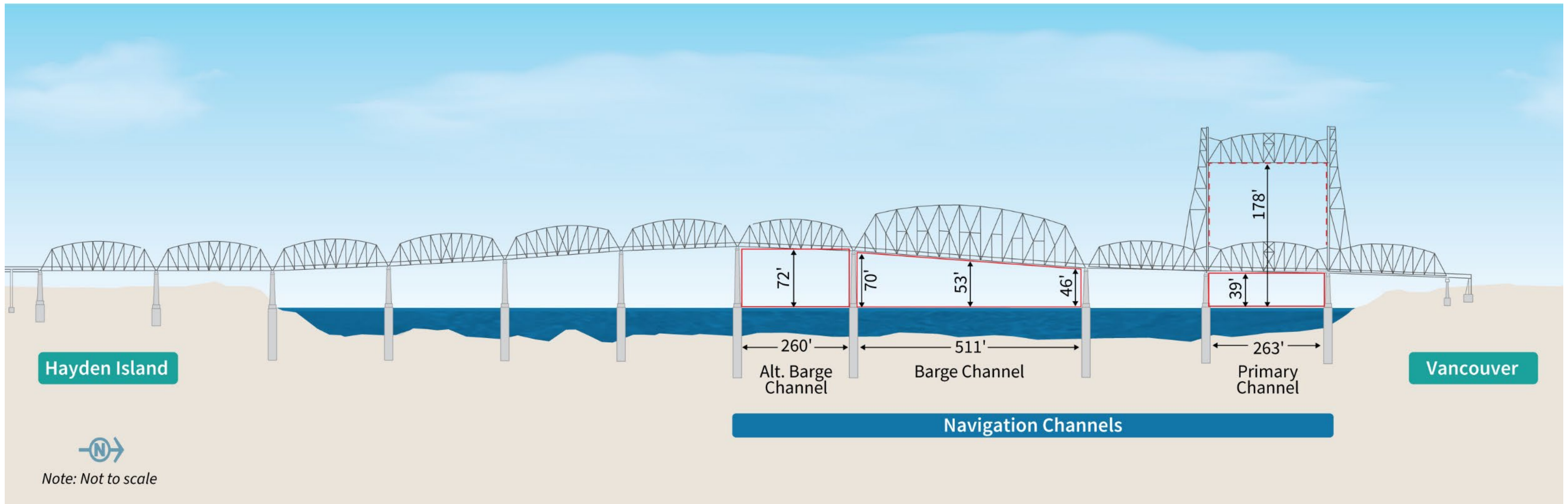
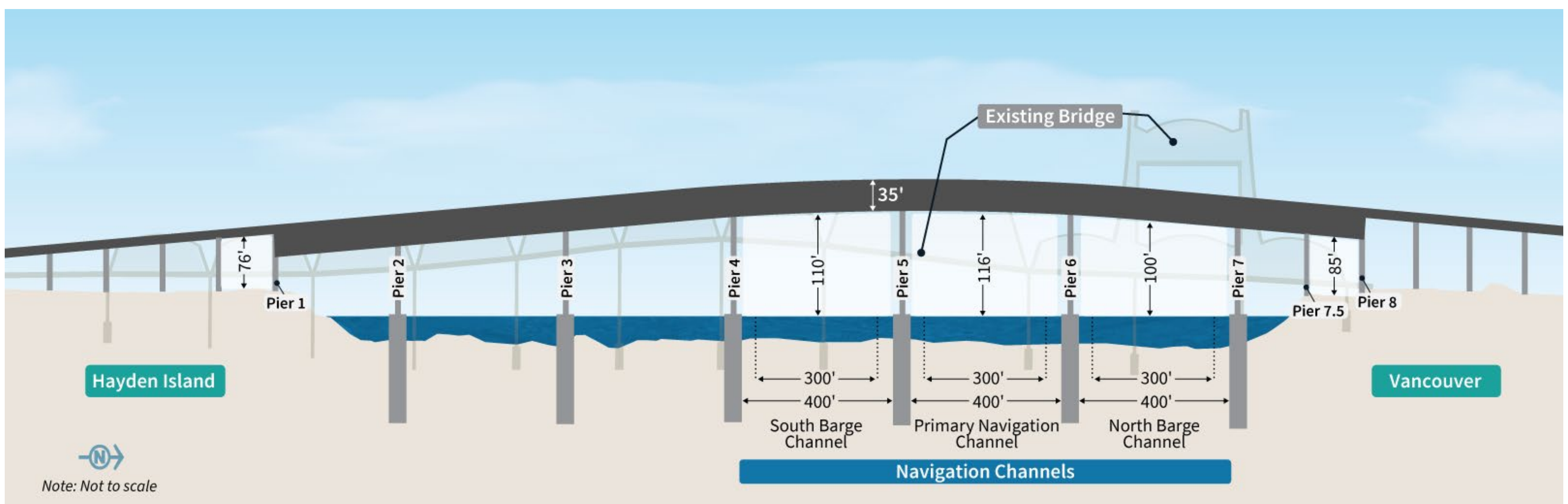


Figure 1-17. Navigation Clearances and Proposed Profile of the Modified LPA Columbia River Bridges with a Double-Deck Fixed-Span Configuration



Note: The location and widths of the proposed navigation channels would be same for all bridge configuration and bridge type options. The three navigation channels would each be 400 feet wide (this width includes a 300-foot USACE-authorized channel (shown in dotted lines) plus a 50-foot channel maintenance buffer on each side of the authorized channel). The vertical navigation clearance would vary, as described in the following sections.

Double-Deck Fixed-Span Configuration

The double-deck fixed-span configuration would be two side-by-side, double-deck, fixed-span steel truss bridges. Figure 1-18 shows an example of this configuration (this image is subject to change and is shown as a representative concept; it does not depict the final design). The double-deck fixed-span configuration would provide 116 feet of vertical navigation clearance for river traffic using the primary navigation channel and 400 feet of horizontal navigation clearance at the primary navigation channel, as well as barge channels.

The eastern bridge would accommodate northbound highway traffic on the upper level and the shared-use path and utilities on the lower level. The western bridge would carry southbound traffic on the upper level and one set of light-rail tracks (one northbound track and one southbound track) on the lower level. Each bridge deck would typically be 79 feet wide, with a total out-to-out width of approximately 173 feet.[15]

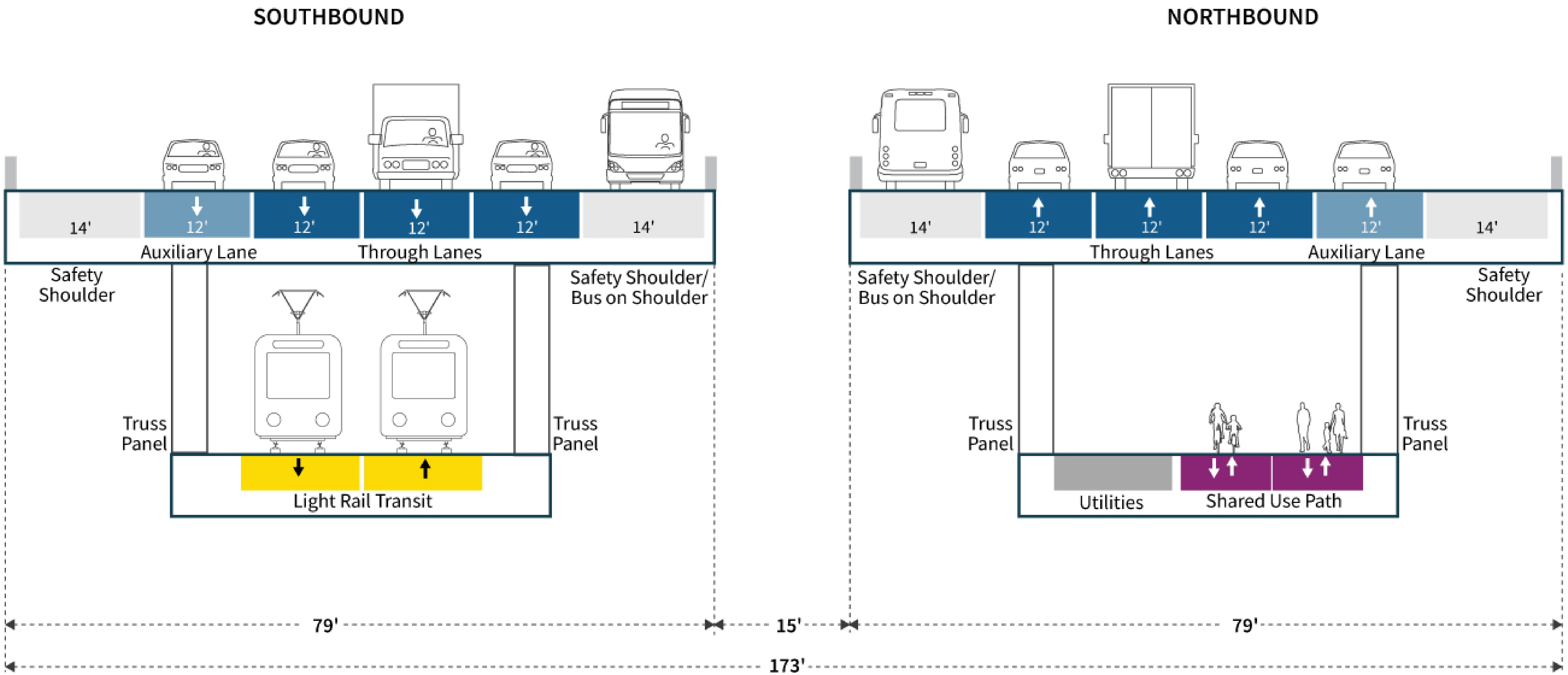
Figure 1-18. Conceptual Drawing of a Double-Deck Fixed-Span Configuration

Note: Visualization is looking southeast from Vancouver.

Figure 1-19 shows a typical cross section of the two parallel double-deck bridges. Like all bridge configuration design options under consideration, the double-deck fixed-span configuration would have six in-water pier sets. Each pier set would require 12 in-water drilled shafts, for a total of 72 in-water drilled shafts. Each individual shaft cap would be approximately 50 feet by 85 feet. This bridge configuration would have up to a 4% maximum grade on both the Oregon and Washington sides. All vertical profiles would follow AASHTO, WSDOT, and ODOT design standards.

[15] "Out-to-out width" is the measurement between the outside edges of the bridge across its width at the widest point.

Figure 1-19. Typical Cross Section of the Double-Deck Fixed-Span Configuration



Note: Design is not final and subject to change. Widths may vary with final design. The one auxiliary lane design option is used for illustration purposes. The two auxiliary lane design option would add approximately 8 feet to each bridge (i.e., 16 feet to the total width).

Single-Level Fixed-Span Configuration – Recommended Design Option

The single-level fixed-span configuration would have two side-by-side, single-level, fixed-span steel or concrete bridges. This report considers two single-level fixed-span bridge type options: a girder (steel or concrete segmental) bridge and an extradosed bridge.[16] The description in this section applies to both bridge types (unless otherwise indicated). Conceptual examples of both options are shown on Figure 1-20. These images are subject to change and do not represent final design.

This configuration would provide 116 feet of vertical navigation clearance for river traffic using the primary navigation channel and 400 feet of horizontal navigation clearance at the primary navigation channel, as well as barge channels, which is consistent with the January 2026 PNCD issued by the USCG.

The eastern bridge would accommodate northbound highway traffic and the shared-use path; the bridge deck would be approximately 104 feet wide. The western bridge would carry southbound traffic and light-rail tracks; the bridge deck would be approximately 113 feet wide. The I-5 highway, light-rail tracks, and the shared-use path would be on the same level across the two bridges, instead of being divided between two levels as with the double-deck configuration. The total out-to-out width of the single-level fixed-span configuration (extradosed option) would be approximately 272 feet at its widest point, approximately 99 feet wider than the double-deck configuration. The total out-to-out width of the single-level fixed-span configuration (girder option) would be approximately 232 feet at its widest point. Figure 1-21 shows a typical cross section of the single-level configuration with an extradosed bridge as shown by the 10-foot-wide bridge columns. Figure 1-22 shows a

The IBR Program recommends advancing the single-level fixed-span bridge configuration. All bridge configurations would provide important benefits to highway operations and safety and have similar impacts to many resources. The main differences between either of the fixed-span configurations and the movable-span configuration is that the latter would provide more vertical clearance to accommodate larger vessels and a lower grade for all land-based transportation modes (which would benefit freight and active transportation users in particular), but this configuration would also periodically disrupt all other land-based transportation modes (personal vehicles, freight, transit, and active transportation) with bridge openings. The main differences between the double-deck and single-level fixed-span configurations are that the slightly higher grade of the former would impact freight traffic and active transportation users, and the latter would have faster emergency response times (although there would also be more exposure to vehicles) and give users of the shared-use path a greater sense of security due to "eyes on the path." The fixed-span configurations received generally positive comments from the public, while there was mixed feedback on the movable-span because of the tradeoffs given above.

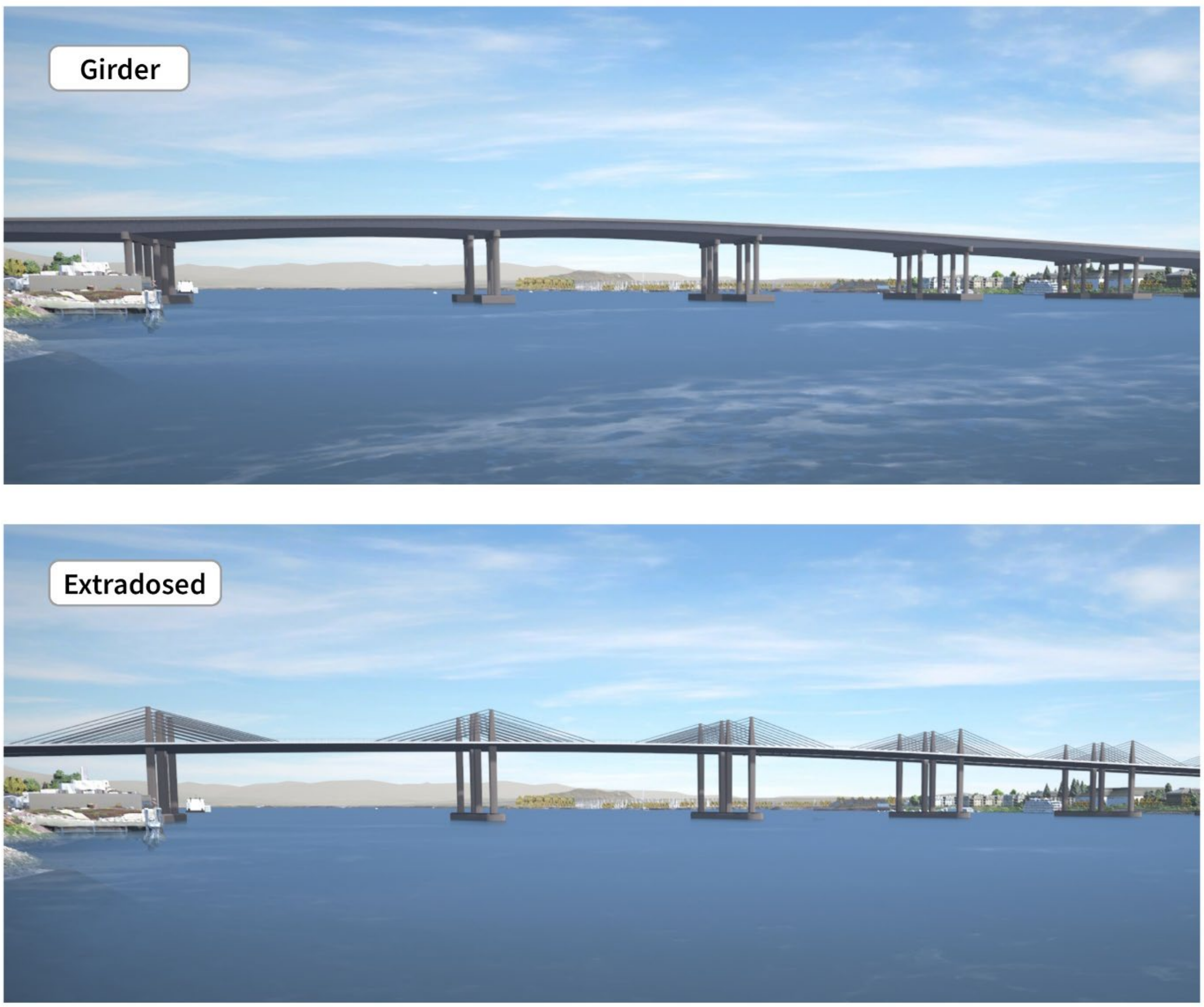
[16] The Draft SEIS also included a finback as a single-level fixed-span bridge type. As the design of the various bridge types progressed, it was determined that the finback would have higher risks associated with increased cost and construction schedule because this bridge type is less common and applying this bridge type to the scale of the new Columbia River bridges would introduce more design and construction challenges than the other bridge type options. Other bridge types, such as concrete or steel girder or extradosed, would have fewer risks and would be a more suitable for this location. As a result, the finback bridge type was dropped from further consideration.

typical cross section with a girder bridge, which would not have the 10-foot-wide bridge columns shown on Figure 1-21.

There would be six in-water pier sets with 16 in-water drilled shafts on each combined shaft cap, for a total of 96 in-water drilled shafts. The combined shaft caps for each pier set would be approximately 50 feet by 230 feet.

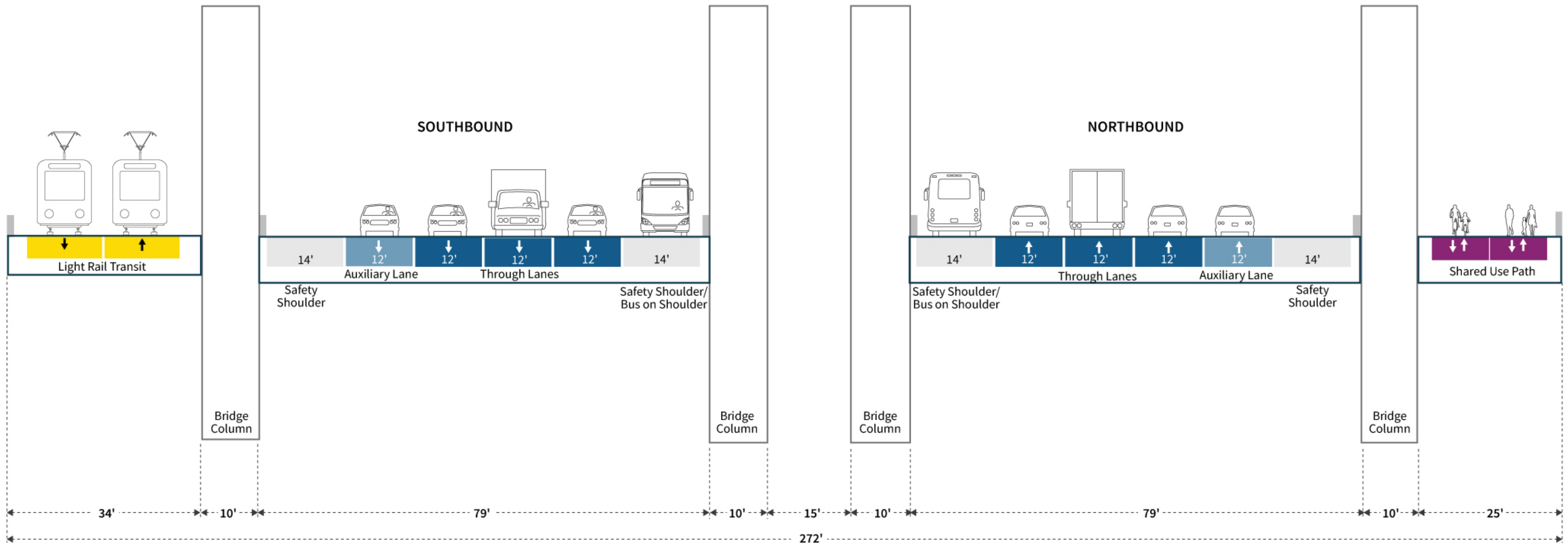
This bridge configuration would be expected to have an approximate grade of 3% on both the Oregon and Washington sides of the bridge. All vertical profiles would follow AASHTO, WSDOT, and ODOT design standards.

Figure 1-20. Conceptual Drawings of Single-Level Fixed-Span Bridge Types



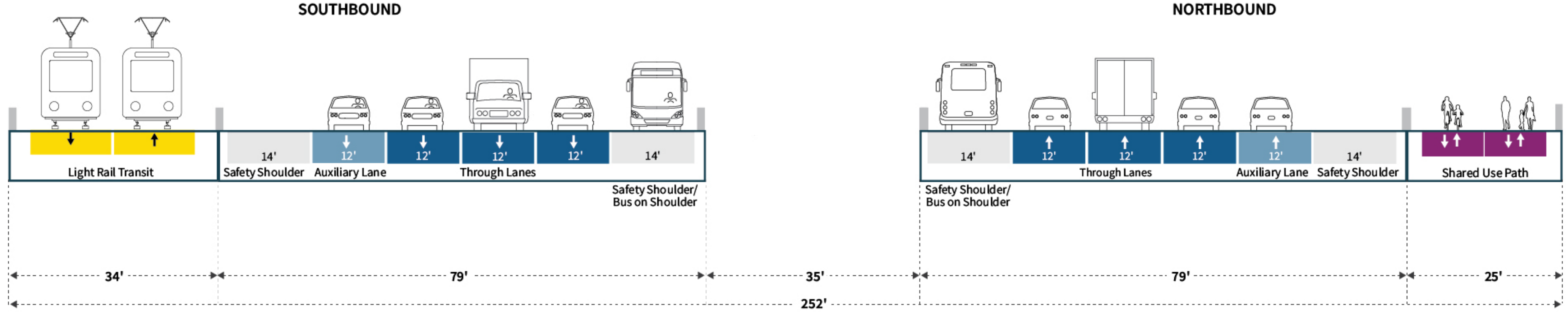
Note: Visualizations are for illustrative purposes only. They do not reflect property impacts or represent final design. Visualization is looking southeast from Vancouver.

Figure 1-21. Typical Cross Section of the Single-Level Fixed-Span Configuration (Extradosed Type)



Note: Design is not final and subject to change. Widths may vary with final design. The two auxiliary lane design option would add approximately 8 feet to each bridge (i.e., 16 feet to the total width).

Figure 1-22. Typical Cross Section of the Single-Level Fixed-Span Configuration (Girder Type)



Note: Design is not final and subject to change. Widths may vary with final design. The cross section for a girder bridge type would be the same as an extradosed bridge type except that it would not have the four 10-foot bridge columns. The distance between the two bridges could be reduced to 10 feet. The one auxiliary lane design option is used for illustration purposes. The two auxiliary lane design option would add approximately 8 feet to each bridge (i.e., 16 feet to the total width).

Single-Level Movable-Span Configuration

The single-level movable-span configuration would have two side-by-side, single-level steel girder bridges with movable spans between Piers 5 and 6. For the purpose of this report, the IBR Program assessed a vertical lift movable-span configuration with counterweights based on the analysis in the *River Crossing Bridge Clearance Assessment Report – Movable-Span Options,* included as part of Attachment C in Appendix D, Design Options Development, Screening, and Evaluation Technical Report to the Final SEIS. A conceptual example of a vertical lift-span bridge is shown in Figure 1-23. These images are subject to change and do not represent final design.

A movable span must be located on a straight and flat bridge section (i.e., without horizontal curvature and with minimal grade). To comply with these requirements, and for the bridge to maintain the highway, transit, and active transportation connections on Hayden Island and in Vancouver while minimizing property acquisitions and displacements, the movable span is proposed to be located approximately 500 feet south of the existing lift span, between Piers 5 and 6.

The single-level movable-span configuration would provide approximately 90 feet of vertical navigation clearance over the proposed relocated primary navigation channel when the movable spans are in the closed position, with 99 feet of vertical navigation clearance available over the north barge channel. It satisfies the requirement of a minimum of 72 feet of vertical navigation clearance (the existing Interstate Bridge's maximum clearance over the alternate [southernmost] over the barge channel when the existing lift span is in the closed position).

In the open position, the movable span would provide 178 feet of vertical navigation clearance over the proposed relocated primary navigation channel. Similar to the fixed-span configurations, the movable span would provide 400 feet of horizontal navigation clearance for the primary navigation channel and for each of the two barge channels. The vertical lift-span towers would be approximately 243 feet high, which would be slightly shorter than the existing lift-span towers, which are 247 feet high.

Similar to the single-level fixed-span configuration, the eastern bridge would accommodate northbound highway traffic and the shared-use path, and the western bridge would carry southbound traffic and light-rail tracks. The I-5 highway, light-rail tracks, and shared-use path would be on the same level across the bridges instead of on two levels as with the double-deck configuration. Typical cross sections of the single-level movable-span configuration are shown in Figure 1-24; the top section depicts the vertical lift spans (Piers 5 and 6), and the bottom section depicts the fixed spans (Piers 2, 3, 4, and 7). The movable and fixed cross sections are slightly different because the movable span requires lift towers, which are not required for the fixed spans of the bridges.

There would be six in-water pier sets and two piers on land per bridge. The vertical lift span would have 22 in-water drilled shafts each for Piers 5 and 6; the shaft caps for these piers would be approximately 50 feet by 312 feet to accommodate the vertical lift spans. Piers 2, 3, 4, and 7 would have 16 in-water drilled shafts each; the shaft caps for these piers would be the same as for the fixed-span options (approximately 50 feet by 230 feet). The single-level movable-span configuration (with a vertical lift span) would have a total of 108 in-water drilled shafts.

This single-level movable-span configuration would be expected to have an approximate grade of 3% on the Oregon side of the bridge and an approximate grade of 1.5% on the Washington side. All vertical profiles would follow AASHTO, WSDOT, and ODOT design standards.

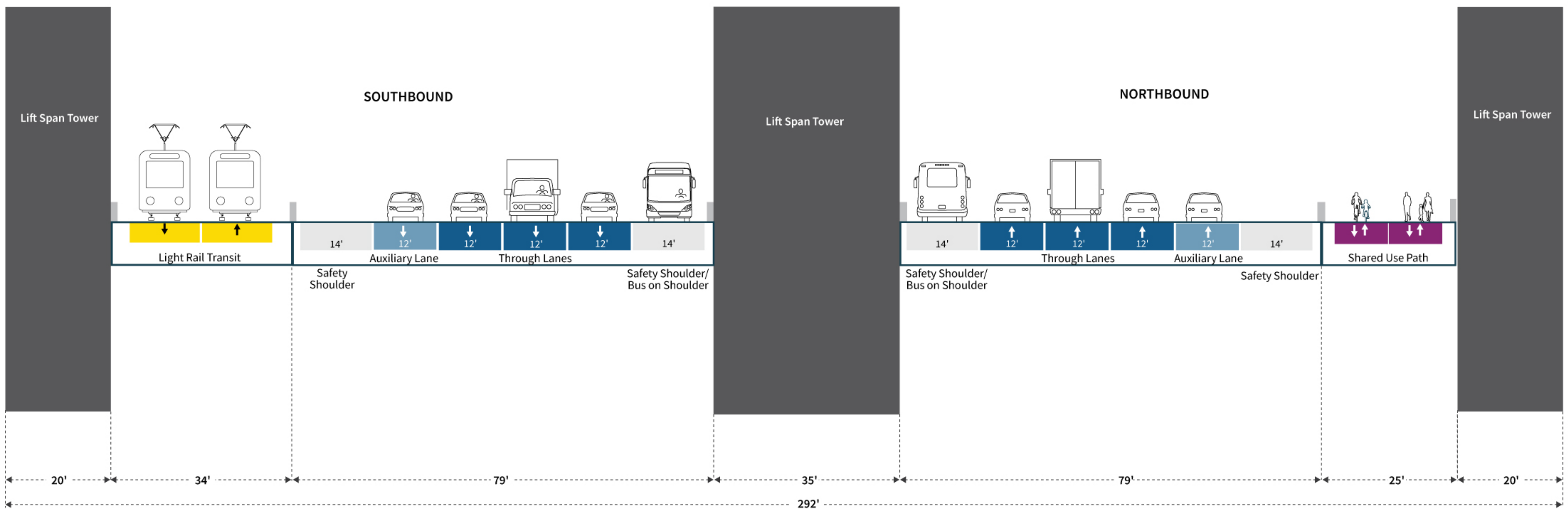
Figure 1-23. Conceptual Drawings of Single-Level Movable-Span Configurations in the Closed and Open Positions

Visualizations are for illustration purposes only. They do not reflect property impacts or represent final design.

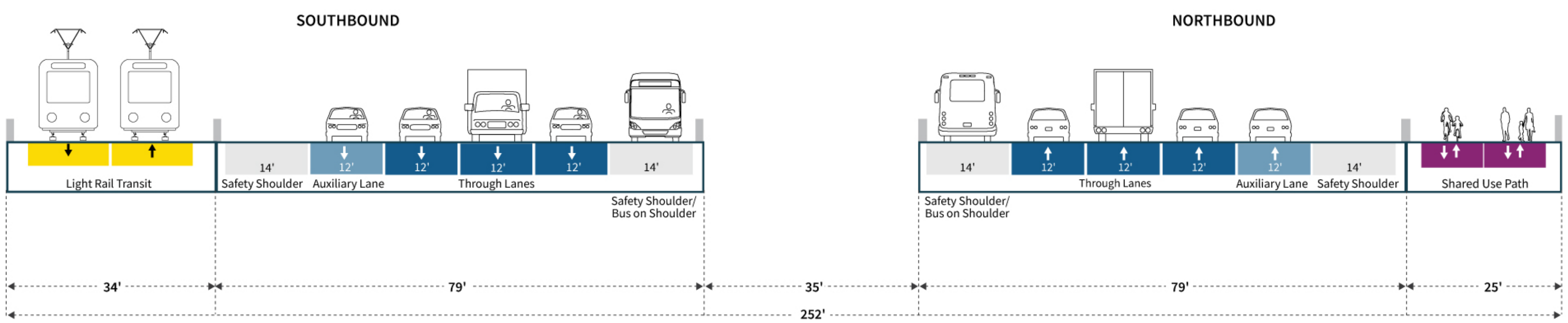
Note: Visualization is looking southeast (upstream) from Vancouver.

Figure 1-24. Typical Cross Section of the Single-Level Movable-Span Bridge Type

Single-level Bridge with Movable Span - Vertical Lift Span Cross-section (Piers 5 and 6)



Single-level Bridge with Movable Span - Fixed Spans Cross-section (Piers 2, 3, 4, and 7)



Note: Design is not final and subject to change. Widths may vary with final design. The one auxiliary lane design option is used for illustration purposes. The two auxiliary lane design option would add approximately 8 feet to each bridge (i.e., 16 feet to the total width).

Bridge Configuration Comparison

This section summarizes and compares each of the bridge configurations. Table 1-3 lists the key considerations for each bridge configuration. Figure 1-25 compares each of the three bridge configurations' footprints with the one auxiliary lane design option (refer to Figure 1-9 for a comparison of the one and two auxiliary lane design options footprints). The footprints of each configuration would differ in only three locations: over the Columbia River and at the bridge landings on Hayden Island and Vancouver. The rest of the I-5 corridor would have the same footprint. Over the Columbia River, the footprint of the double-deck fixed-span configuration would be approximately 173 feet wide. Comparatively, the extradosed bridge type of the single-level fixed-span configuration would be approximately 272 feet wide (approximately 99 feet wider), and the single-level fixed-span configuration with a girder bridge type would be approximately 232 feet wide (approximately 59 feet wider). The single-level movable-span configuration would be approximately 252 feet wide (approximately 79 feet wider than the double-deck fixed-span configuration), except at Piers 5 and 6, where larger bridge foundations would require an additional width of approximately 40 feet to support the movable span. The single-level configurations would have a wider footprint at the bridge landings on Hayden Island and Vancouver because transit and active transportation would be located adjacent to the highway, rather than below the highway in the double-deck option.

Figure 1-26 compares the basic profile and elevation of each configuration. The single-level fixed-span configuration and the lower deck of the double-deck fixed-span would have similar elevations, but the upper deck of the double-deck bridge would be approximately 35 feet higher. The single-level movable-span configuration would have a lower profile than the fixed-span configurations when the span is in the closed position.

Figure 1-25. Bridge Configuration Footprint Comparison

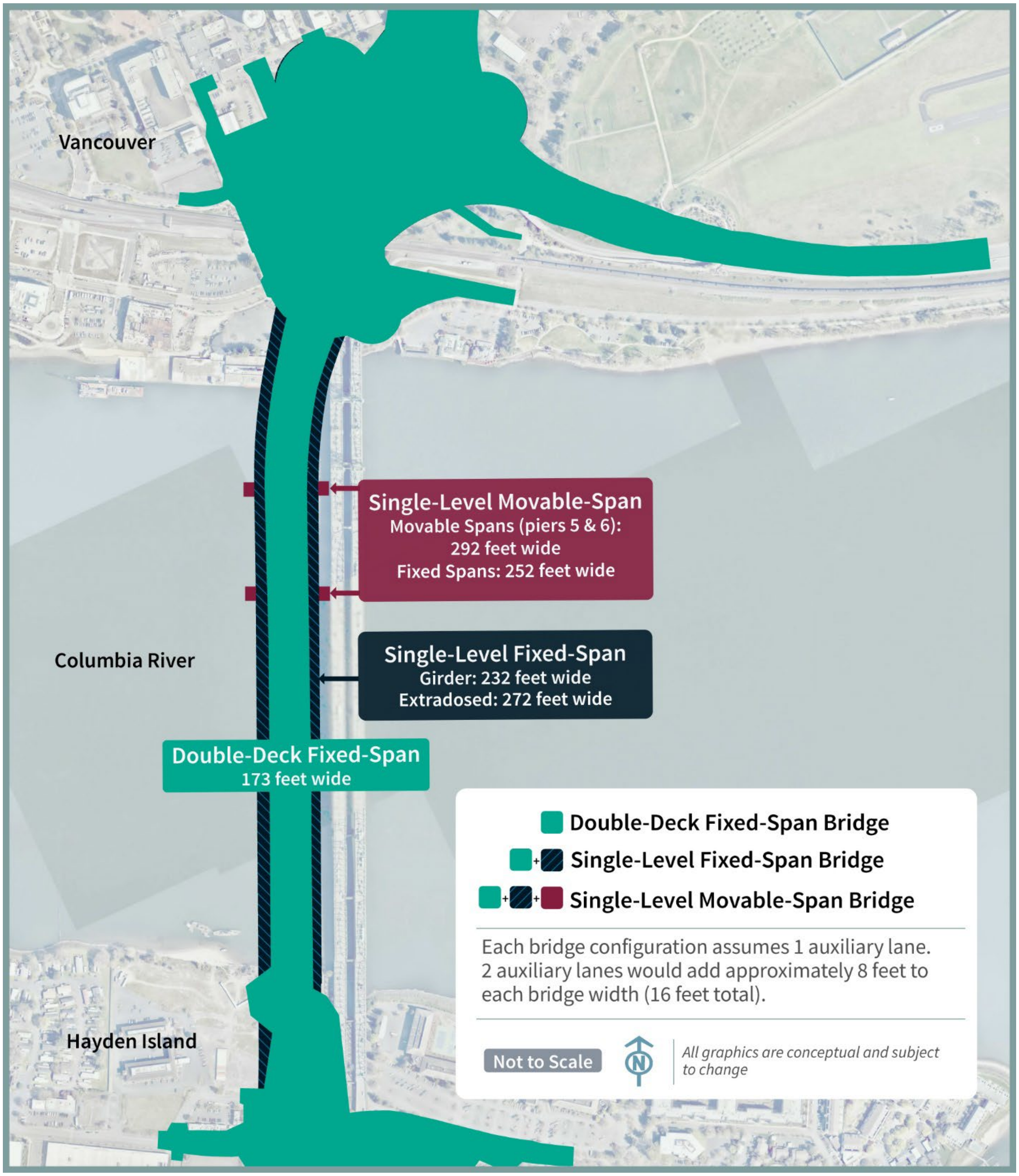
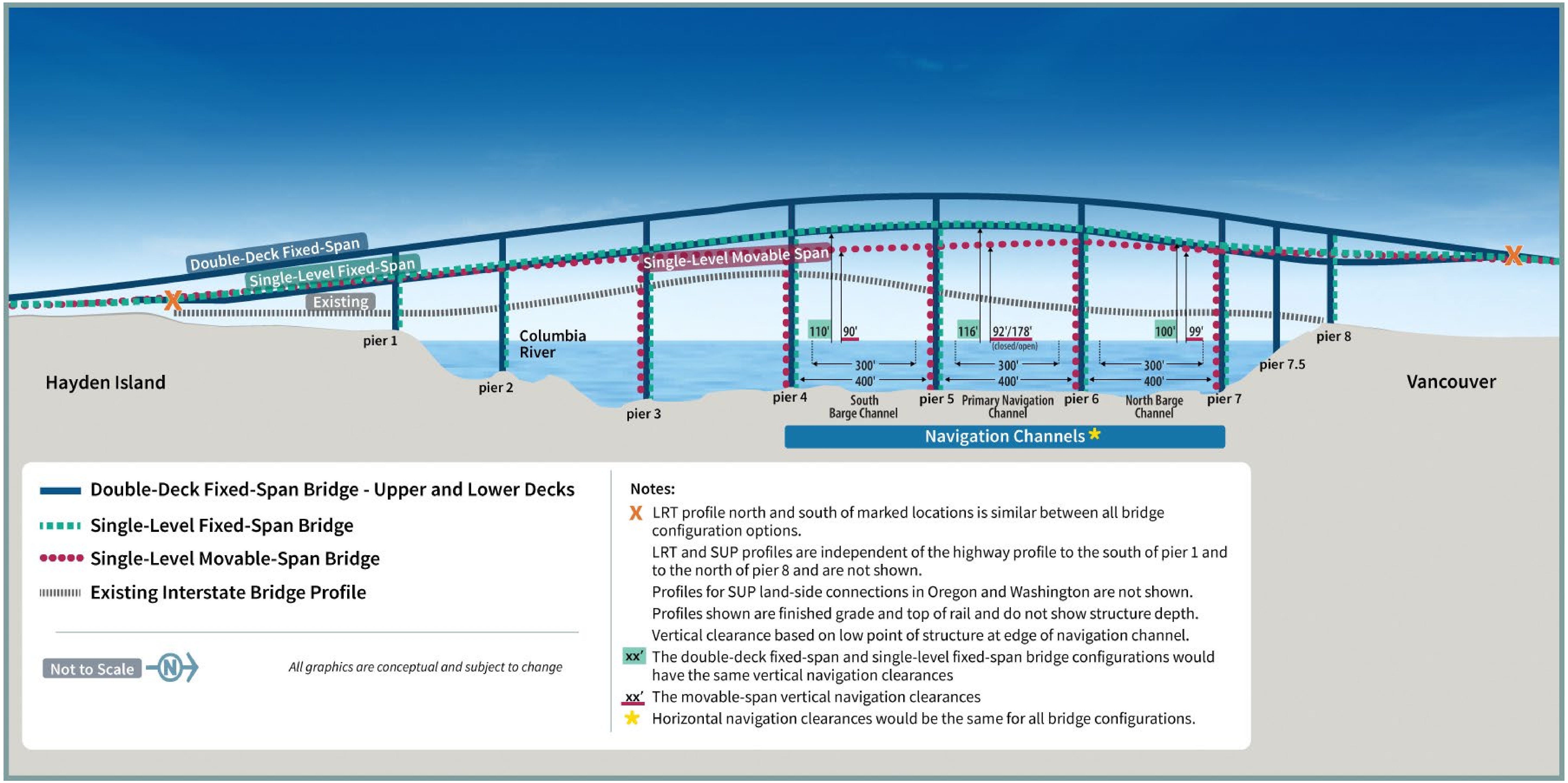


Figure 1-26. Bridge Configuration Profile Comparison



LRT = light-rail transit; SUP = shared-use path

Table 1-3. Summary of Bridge Configurations

Component	No-Build Alternative	Modified LPA with Double-Deck Fixed-Span Configuration	Modified LPA with Single-Level Fixed-Span Configuration [a]	Modified LPA with Single-Level Movable-Span Configuration
Bridge type	Steel through-truss spans	Double-deck steel truss	Single-level, concrete or steel girders, or extradosed	Single-level, steel girders with vertical lift span
Number of bridges	Two	Two	Two	Two
Movable-span type	Vertical lift span with counterweights.	N/A	N/A	Vertical lift span with counterweights
Movable-span location	Adjacent to Vancouver shoreline.	N/A	N/A	Between Piers 5 and 6 (approximately 500 feet south of the existing lift span)
Lift opening restrictions for vessels	Weekday peak AM and PM highway travel periods. [b] Typical bridge opening/gate closure durations are approximately 9 to 27 minutes depending on the purpose of the bridge lift (i.e., maintenance or vessel traffic) and lift elevation (i.e., partial lift or full lift). From 2007 to 2024, there was an average of 152 lifts per year (IBR 2025).	N/A	N/A	• Considering 2007–2024 trends in vessels transiting under the Interstate Bridge, there would be fewer bridge lifts compared to the No-Build Alternative due to increased vertical navigation clearance in the closed position (99 feet compared to 72 feet). • Additional restrictions to daytime bridge openings would be requested to consolidate fewer bridge

Component	No-Build Alternative	Modified LPA with Double-Deck Fixed-Span Configuration	Modified LPA with Single-Level Fixed-Span Configuration [a]	Modified LPA with Single-Level Movable-Span Configuration
				openings outside of morning, midday, and evening peak hours when vehicle and transit demand is high in order to improve LRT on-time performance and system reliability and reduce highway congestion. Changes to bridge opening restrictions would require future federal rulemaking process and authorization by USCG (beyond the assumed No-Build Alternative bridge restrictions for peak AM and PM highway travel periods). [b] • Typical opening durations are assumed to be 9 to 18 minutes [c] for the purposes of impact analysis but would ultimately depend on various operational considerations related to vessel traffic and river and weather conditions. Additional time would also be required to stop traffic

Component	No-Build Alternative	Modified LPA with Double-Deck Fixed-Span Configuration	Modified LPA with Single-Level Fixed-Span Configuration [a]	Modified LPA with Single-Level Movable-Span Configuration
				prior to opening and restart traffic after the bridge closes.
Out-to-out width [d]	138 feet total width	~173 feet total width	• Girder: ~232 feet total width • Extradosed: 272 feet total width	• ~292 feet at the movable span • ~252 feet at the fixed spans
Deck widths	• 52 feet (SB) • 52 feet (NB)	• ~79 feet (SB) • ~79 feet (NB)	Girder: • ~113 feet (SB) • ~104 feet (NB) Extradosed: • ~133 feet (SB) • ~124 feet (NB)	• ~113 feet (SB) • ~104 feet (NB)
Vertical navigation clearance	Primary navigation channel: • 39 feet when closed • 178 feet when open Barge channel: • 46 feet to 70 feet Alternate barge channel: • 72 feet	Primary navigation channel: • 116 feet maximum North barge channel: • 100 feet maximum South barge channel: • 110 feet maximum	Primary navigation channel: • 116 feet maximum North barge channel: • 100 feet maximum South barge channel: • 110 feet maximum	Primary navigation channel: • Closed position: ~90 feet • Open position: 178 feet North barge channel: • ~99 feet maximum South barge channel: • ~90 feet maximum
Horizontal navigation clearance	• 263 feet for primary navigation channel • 511 feet for barge channel • 260 feet for alternate barge channel	400 feet for all navigation channels (300-foot USACE authorized channel plus a 50-foot channel maintenance buffer on each side)	400 feet for all navigation channels (300-foot USACE authorized channel plus a 50-foot channel maintenance buffer on each side)	400 feet for all navigation channels (300-foot USACE authorized channel plus a 50-foot channel maintenance buffer on each side)

Component	No-Build Alternative	Modified LPA with Double-Deck Fixed-Span Configuration	Modified LPA with Single-Level Fixed-Span Configuration [a]	Modified LPA with Single-Level Movable-Span Configuration
Maximum height of bridge component (elevation relative to NAVD 88) [e]	247 feet at top of lift tower	~166 feet	• Girder: ~137 feet. • Extradosed: ~179 feet at top of pylons	~243 feet at top of lift tower
Movable span length (from center of pier to center of pier)	278 feet	N/A	N/A	450 feet
Number of in-water pier sets	Nine	Six	Six	Six
Number of in-water drilled shafts	N/A	72	96	108
Shaft cap sizes	N/A	50 feet by 85 feet	50 feet by 230 feet	• Piers 2, 3, 4, and 7: 50 feet by 230 feet • Piers 5 and 6: 50 feet by 312 feet (one combined footing at each location to house tower/equipment for the lift span)
Conceptual vertical grade [f]	4.8%	• ~4% on the Washington side • ~4% on the Oregon side	• ~3% on the Washington side • ~3% on the Oregon side	• ~1.5% on the Washington side. • ~3% on the Oregon side
LRT location	N/A	Below highway on SB bridge	West of highway on SB bridge	West of highway on SB bridge
Express bus	Shared roadway lanes	Inside shoulder of NB and SB (upper) bridges	Inside shoulder of NB and SB bridges	Inside shoulder of NB and SB bridges
Shared-use path location	Sidewalk adjacent to roadway in both directions	Below highway on NB bridge	East of highway on NB bridge	East of highway on NB bridge

All dimensions and quantities are approximate.

a When different bridge types are not mentioned, data apply to both bridge types under the single-level fixed-span bridge configuration.

b The No-Build Alternative assume existing conditions that restrict bridge openings during weekday peak periods (Monday through Friday 6:30 a.m. to 9 a.m.; 2:30 p.m. to 6 p.m., excluding federal holidays). For the Modified LPA with a single-level movable-span bridge configuration design option, additional timing restrictions, which would increase restrictions on the timing for and duration of bridge openings, except for emergencies, would be requested and coordinated with the USCG. Bridge openings would be required for vessels and/or cargo with heights greater than 72 feet under the No-Build Alternative; whereas, bridge openings for vessels and/or cargo requiring more than 99 feet of clearance would be required for the Modified LPA with the movable-span bridge configuration design option.

c For the purposes of the transportation analysis in the Final SEIS (Section 3.1, Transportation of the Final SEIS), the movable-span opening time is assumed to be an average of 13.2 minutes.

d "Out-to-out width" is the measurement between the outside edges of both northbound and southbound bridge across its width at the widest point and includes the space between the two bridges. The deck width is the measurement of the outer edges of either the northbound bridge or the southbound bridge.

e NAVD 88 is a vertical control datum (reference point) used by federal agencies for surveying.

f The maximum allowable vertical grade according to ODOT and WSDOT standards on the I-5 mainline is 4%.

I-5 = Interstate 5; LPA = Locally Preferred Alternative; LRT = light-rail transit; N/A = not applicable; NAVD 88 = North American Vertical Datum of 1988; NB = northbound; ODOT = Oregon Department of Transportation; SB = southbound; SEIS = Supplemental Environmental Impact Statement; USACE = U.S. Army Corps of Engineers; USCG = U.S. Coast Guard; WSDOT = Washington State Department of Transportation

1.5.4 Downtown Vancouver (Subarea C)

This section discusses the geographic Subarea C (Figure 1-7 shows an overview of the geographic subareas). Figure 1-27 shows all highway and interchange improvements in Subarea C.

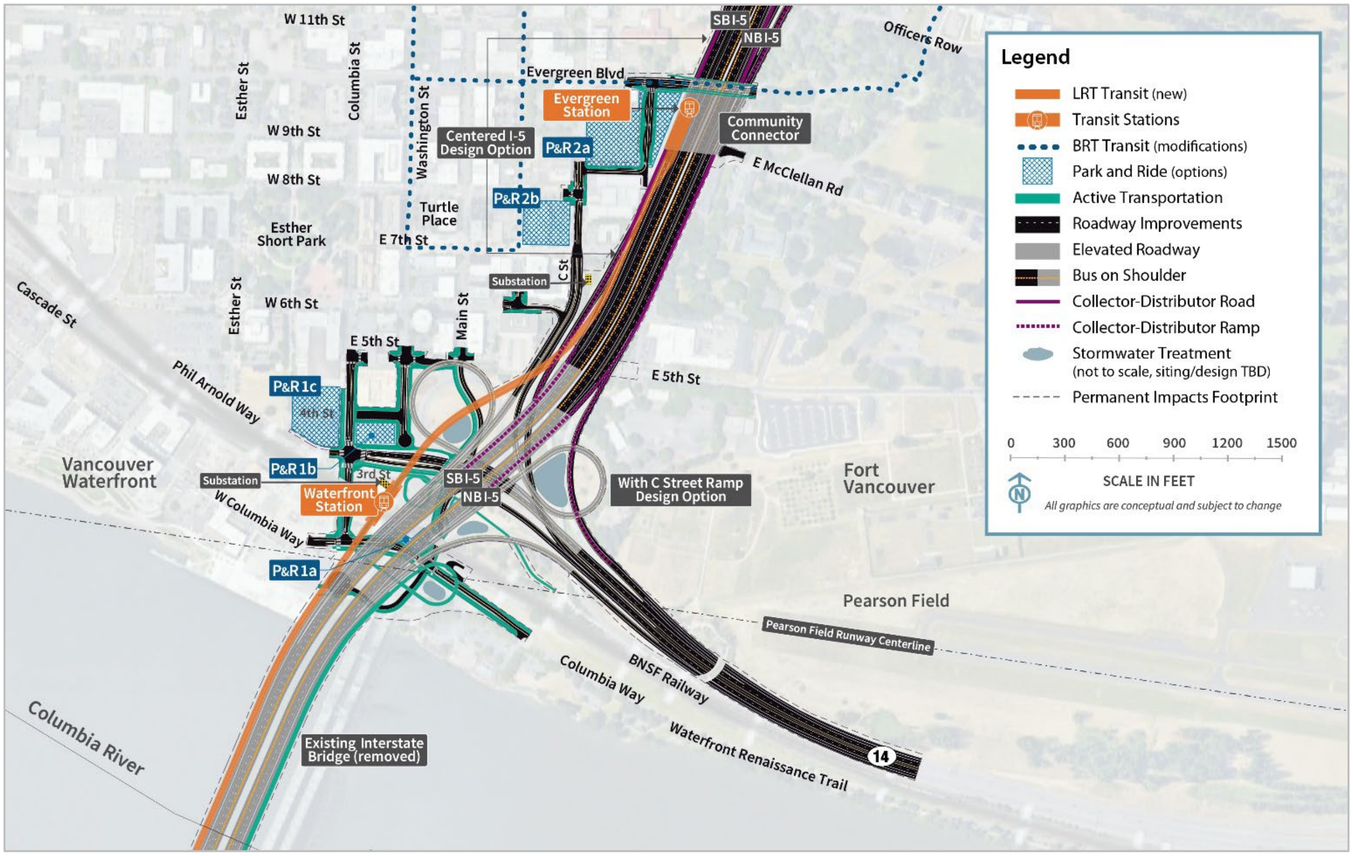
1.5.4.1 Highways, Interchanges, and Local Roadways

North of the Columbia River bridges in downtown Vancouver, improvements are proposed to the SR 14 interchange (Figure 1-27).

SR 14 INTERCHANGE/DOWNTOWN VANCOUVER

The new Columbia River bridges would touch down just north of the SR 14 interchange (Figure 1-27). The function of the SR 14 interchange configuration would remain essentially the same as it is now, but the interchange would be elevated to meet the new Columbia River bridges that cross over the BNSF Railway tracks. Direct connections between I-5 and SR 14 would be rebuilt. Access to and from downtown Vancouver would be provided as it is today, but the connection points would be relocated. Access from downtown Vancouver to eastbound SR 14 would be relocated from the Washington Street and W 5th Street intersection to a new intersection at Columbia Street and W 3rd Street. Access from westbound SR 14 would also be shifted from C Street to the new Columbia Street and W 3rd Street intersection. Access from downtown Vancouver to southbound I-5 would be relocated from the Washington Street and W 5th Street intersection to C Street. Access from northbound I-5 to downtown Vancouver would remain at C Street. Connections to downtown Vancouver would vary under the two design options under consideration for this area (with C Street ramps and without C Street ramps), as detailed below.

Figure 1-27. Downtown Vancouver (Subarea C)



BRT = bus rapid transit; LRT = light-rail transit; NB = northbound; P&R = park and ride; SB = southbound

Main Street would be extended between 5th Street and Columbia Way. Vehicles traveling from downtown Vancouver to access SR 14 eastbound would use the new extension of Main Street to the intersection underneath I-5. If coming from the west or south (waterfront) in downtown Vancouver, vehicles would use the Phil Arnold Way/3rd Street extension to the intersection, then continue to SR 14 eastbound. The existing Columbia Way roadway under I-5 would be realigned to the north of its existing location and would intersect both the new Main Street extension and Columbia Street with T intersections.

In addition, the existing overcrossing of I-5 at Evergreen Boulevard would be reconstructed.

C Street Ramp Design Options

With C Street Ramps – Recommended Design Option

The design option with C Street ramps would provide access to and from downtown Vancouver similar to existing conditions but with some of the connection points relocated. Access from northbound I-5 to downtown Vancouver would be rebuilt in the same location as the current connection. Downtown Vancouver I-5 access to and from the south would be consolidated at C Street with SR 14 connections to and from downtown at Columbia Street/
W 3rd Street (Figure 1-28).

Without C Street Ramps

Under this design option, downtown Vancouver I-5 access to and from the south would be through the Mill Plain interchange rather than C Street. There would be no eastside loop ramp from northbound I-5 to C Street and no directional ramp on the west side of I-5 from C Street to southbound I-5. The existing eastside loop ramp would be removed. This option would reduce the footprint of the Modified LPA in this area.

The IBR Program recommends advancing the with C Street ramps design option. Both C Street ramp design options would provide important benefits to highway operations and safety and have similar impacts to many other resources, particularly the natural environment. While there would be some short-term construction cost savings and reduced visual impacts without C Street ramps, there would be greater impacts to local traffic as traffic that would have used the C Street ramps would be routed to the Mill Plain interchange, thereby increasing traffic volumes on the local street network and requiring additional mitigation. Both design options received a mix of positive and negative feedback from the public; however, there were more comments in support of the with C Street ramps design option. The with C Street ramps design option also has more support from the local partner agencies.

I-5 Alignment Design Options

Centered I-5 – Recommended Design Option

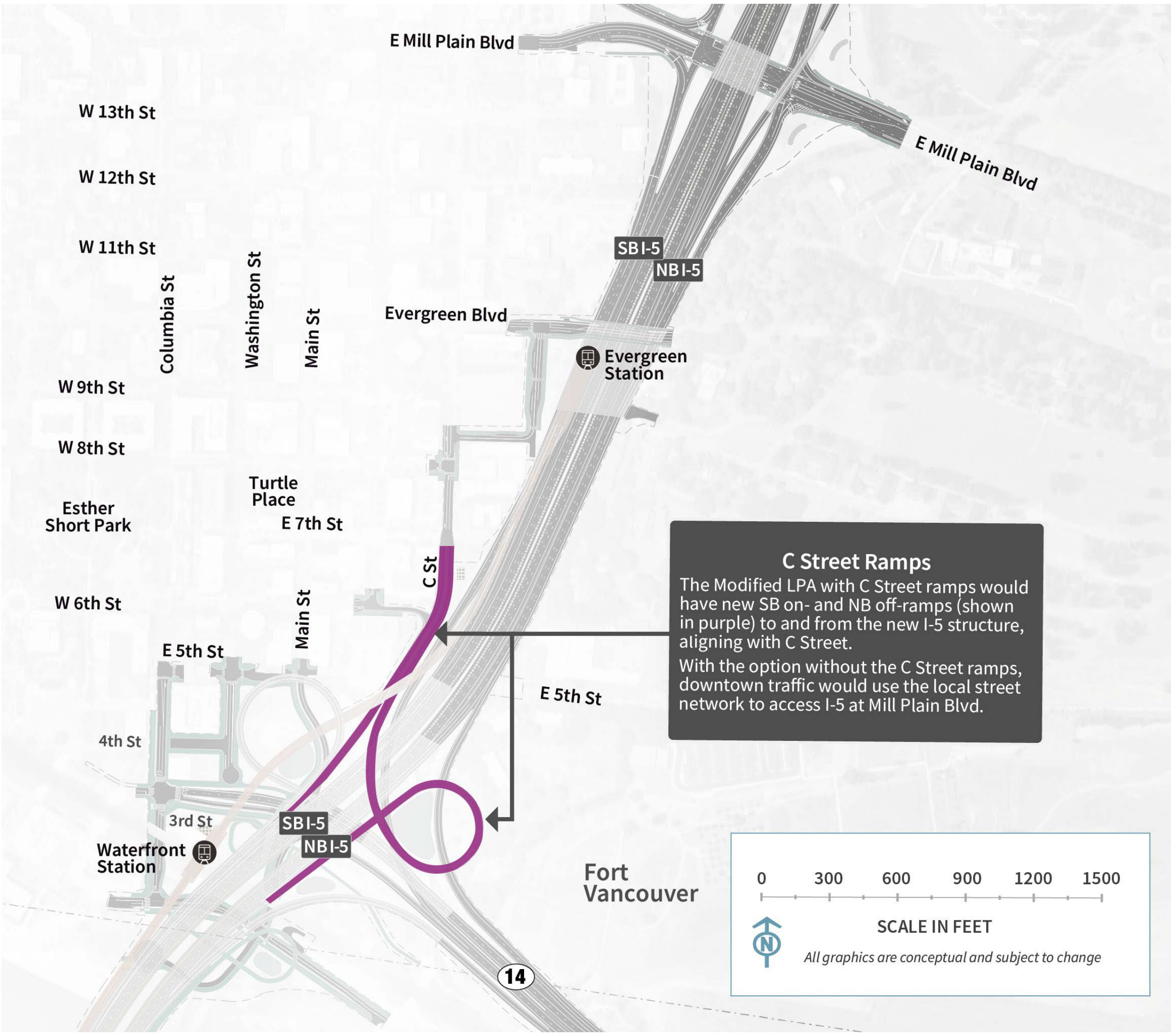
This design option would maintain the location of the existing I-5 mainline alignment through downtown Vancouver between the SR 14 interchange and the Mill Plain Boulevard interchange.

I-5 Shifted West

This design option would shift the I-5 mainline and ramps approximately 40 feet to the west between SR 14 and Mill Plain Boulevard.

The IBR Program recommends advancing the centered I-5 alignment design option. Both I-5 mainline alignments would provide important benefits to highway operations and safety and have similar impacts to many other resources, particularly the natural environment. The westward shift design option would notably increase acquisitions resulting in the displacement of an additional three businesses (with approximately 140 employees) and 33 residential units, and the physical removal of the historic Normandy Apartments. However, the westward shift would reduce the area of acquisition and other impacts to the Vancouver National Historic Reserve (VNHR) Historic District (which includes the Fort Vancouver National Historic Site). While some public comments noted the reduced impacts to the VNHR Historic District from the westward shift design option, others raised concerns about its effects on safety, congestion, and increased residential and business displacements.

Figure 1-28. Modified LPA with C Street Ramps



COLLECTOR-DISTRIBUTOR ROADWAYS

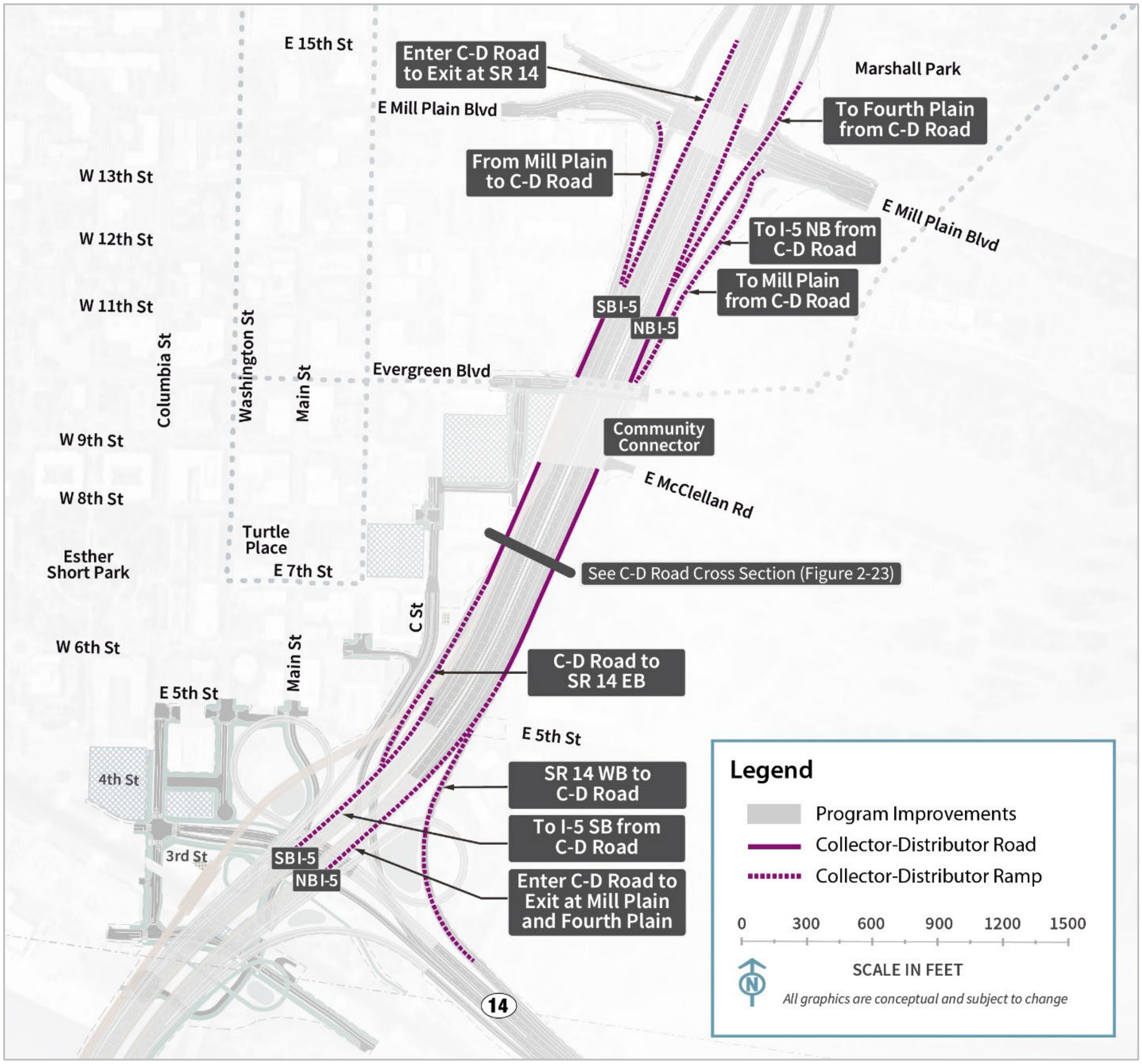
Figure 1-29 shows the location of the collector-distributor (C-D)[17] roadways in downtown Vancouver, and Figure 1-30 shows a typical cross section of the C-D roadways.

The on-ramp from SR 14 westbound would join the I-5 northbound off-ramp to Mill Plain/Fourth Plain Boulevard, forming the northbound C-D roadway between SR 14 and Fourth Plain Boulevard. The C-D roadway would provide access from northbound I-5 to the off-ramps at Mill Plain Boulevard and Fourth Plain Boulevard. The C-D roadway would also provide access from westbound SR 14 to the off-ramps at Mill Plain Boulevard and Fourth Plain Boulevard, and to the on-ramp to northbound I-5.

[17] A collector-distributor roadway parallels and connects the main travel lanes of a highway and frontage roads or entrance ramps.

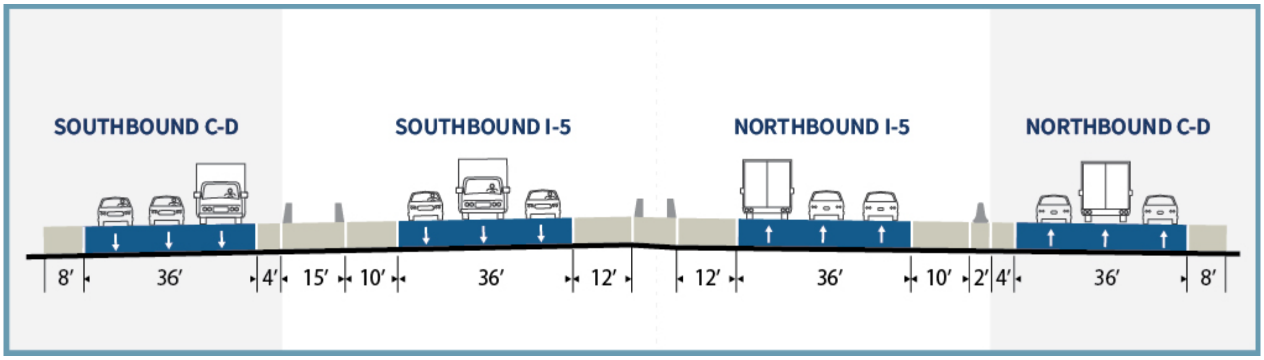
On southbound I-5, the off-ramp to SR 14 would join the southbound I-5 on-ramp from Mill Plain Boulevard to form a C-D roadway. The C-D roadway would provide access from southbound I-5 to the off-ramp to eastbound SR 14 and from Mill Plain Boulevard to the off-ramp to eastbound SR 14 and the on-ramp to southbound I-5.

Figure 1-29. Collector-Distributor Roadways



C-D = collector-distributor; EB = eastbound; NB = northbound; SB = southbound; WB = westbound

Figure 1-30. Typical Cross Section of the Collector-Distributor Roadways



The location of this cross section is shown on Figure 1-29.

1.5.4.2 Transit

LIGHT-RAIL ALIGNMENT AND STATIONS

Under the Modified LPA, the light-rail tracks would exit the highway bridge and be on their own bridge along the west side of the I-5 mainline after crossing the Columbia River (see Figure 1-27). The light-rail bridge would cross over the BNSF Railway tracks. An elevated light-rail station near the Vancouver waterfront (Waterfront Station) would be situated near the overcrossing of the BNSF tracks between Columbia Way and 3rd Street. Access to the elevated station would be primarily by elevator because the station would be situated approximately 90 feet above existing ground level. A stairwell(s) would be provided for emergency egress. The number of elevators and stairwells provided would be based on the ultimate platform configuration, station location relative to the BNSF trackway, projected ridership, and fire and life safety requirements. Passenger drop-off facilities would be located at ground level and would be coordinated with the C-TRAN bus service at this location. Active transportation facilities, described below, would connect to the new Waterfront Station. A new TPSS would be constructed north of the transit platform. The elevated light-rail tracks would continue north, cross over the westbound SR 14 on-ramp and the C Street/6th Street on-ramp to southbound I-5, and- then straddle the southbound I-5 C-D roadway. Transit components in the downtown Vancouver area would be similar between the C Street ramp and I-5 westward shift design options discussed above.

North of the Waterfront Station, the light-rail tracks would continue to the Evergreen Station, which would be the terminus of the light-rail extension (Figure 1-27). The light-rail tracks from downtown Vancouver to the terminus would be entirely on an elevated structure supported by single columns, where feasible, or by straddle bents[18] on either side of the roadway where needed. The Evergreen Station would be located at the same elevation as Evergreen Boulevard and the proposed Community Connector, and it would provide connections to the existing C-TRAN BRT system. Passenger drop-off facilities would be near the station and would be coordinated with the C-TRAN bus service at this location. Active transportation facilities, described below, would connect to the new Evergreen Station. A new TPSS would be located on the south side of 7th Street, approximately 750 feet south of Evergreen Station.

[18] A straddle bent is a type of bridge support structure that "straddles" vehicle lanes and supports a flyover ramp.

PARK AND RIDES

Park and rides can expand the catchment area of public transit systems (the geographic area from which a station draws ridership), making transit more accessible to people who live farther away from fixed-route transit service, and attracting new riders who might not have considered using public transit otherwise.

The Modified LPA would provide parking capacity to accommodate 1,270 vehicles at designated park and rides in Vancouver along the LRT alignment (Figure 1-27) located near the Waterfront and Evergreen LRT stations. Parking capacity would be provided for 570 vehicles near the Waterfront Station and for 700 vehicles near the Evergreen Station.

The park and rides would be designed to accomplish the following:

- Support transit ridership.
- Promote station access by walking, biking, rolling, and transit.
- Support City of Vancouver objectives to increase mobility and access for a vibrant downtown.
- Include existing parking facilities in downtown Vancouver to help meet the projected demand for park and rides in areas where City of Vancouver studies show surplus parking supply.

Additional information regarding the park and rides can be found in the Transportation Technical Report.

As presented in the Draft SEIS, the Modified LPA would provide parking capacity for LRT riders by locating a single park and ride near the Waterfront Station with approximately 570 parking spaces; three sites were considered for this facility. Similarly, a single park and ride near the Evergreen Station would provide approximately 700 parking spaces; two sites were considered. Based on further design analysis, public comment received on the Draft SEIS, and coordination with local agencies, the approach to providing parking capacity for LRT riders was adjusted to focus on dispersed parking across more facilities, including using all three sites previously identified near the Waterfront Station and both sites previously identified near the Evergreen Station. The approach to disperse parking capacity across more sites would correlate to smaller sites in terms of structure size above or below ground.

The sites under consideration are described below, and the evaluation of impacts and benefits to developing a single, large park and ride at each of the two LRT station or five smaller park and rides are evaluated in this report.

The IBR Program recommends advancing 1,270 park-and-ride spaces dispersed across five sites in Vancouver along the light-rail alignment, including three sites near the Waterfront Station and two sites near the Evergreen Station. All of the park and rides would provide similar benefits to the community by increasing the transit stations' catchment areas and making transit more accessible. There could be minor localized differences in traffic patterns and transit ridership depending on the location of spaces. Dispersing the 1,270 parking spaces across five park and rides rather than concentrating the spaces at a single location each near the Waterfront Station and Evergreen Station would promote compatibility with local planning goals and plans for multiuse development, multimodal access, and attractive public spaces. As the FTA's Capital Investment Grant process progresses, the IBR Program team will refine the Program's transit components, which will contribute to further information on parking needs to support transit ridership.

Studies (Appendix D to the Final SEIS) leading to the Modified LPA in 2022 evaluated a mix of light-rail station sites and park and rides and found that 1,270 spaces serving the Waterfront and Evergreen Stations, combined with bus and active transportation improvements, would attract the most riders.

Waterfront Station Park and Rides

Studies included in Appendix D to the Final SEIS have shown the need for park-and-ride capacity to accommodate 570 vehicles in the vicinity of the Waterfront Station. Three possible sites are analyzed (Figure 1-27):

- 1a. Columbia Way (below I-5). This 0.75-acre site could be developed as a new aboveground one-level parking structure. Access would be via Columbia Way. It could support approximately 70 parking spaces.
- 1b. Columbia Street/SR 14. This 0.50-acre site could be developed as a new aboveground six-level structure along the east side of Columbia Street and north of the SR 14 westbound off-ramp. Access would be via Washington Street. It could accommodate approximately 250 parking spaces. To provide all 570 parking spaces at this site, the structure would need to be 10 to 12 levels.
- 1c. Columbia Street/Phil Arnold Way (Waterfront Gateway Site). This 1.5-acre site could be developed as a new surface lot along the west side of Columbia Street, north of Phil Arnold Way. Access would be via Phil Arnold Way. A surface lot would provide approximately 250 parking spaces. To provide all 570 parking spaces at this site, a new four-level structure would be needed.

Evergreen Station Park and Rides

Studies included in Appendix D to the Final SEIS have shown the need for park and rides to accommodate 700 vehicles in the vicinity of the Evergreen Station. Two possible sites are analyzed in this technical report (see Figure 1-27):

- 2a. Library Square. This 3.2-acre site could be developed as a new underground three- to four-level structure east of C Street and south of Evergreen Boulevard. It could accommodate approximately 400 parking spaces. To provide all 700 parking spaces at this site, the structure would require seven or more levels below ground.[19] This site could be combined with Site 2b to provide a total of 700 spaces.

- 2b. Columbia Credit Union. This approximately 1-acre site is an existing parking structure/commercial building and provides an estimated 400 parking spaces to current users on four levels above ground. The parking capacity would not be exclusively available for transit users; however, up to 300 spaces could be used for transit riders. This site could be combined with Site 2a to provide a total of 700 spaces.

1.5.4.3 Active Transportation

Within the downtown Vancouver area, the shared-use path on the northbound (or eastern) bridge would exit the bridge at the SR 14 interchange, loop down on the east side of I-5 via a vertical helix path, cross back below I-5 to the west side of I-5, run beneath the elevated light-rail crossing over BNSF, and then loop down to connect to the Main Street extension at the intersection underneath I-5 with connections to the Waterfront Station from the active transportation facilities. Connections to the Waterfront Renaissance Trail would be made by facilities along Main Street and Columbia Way (Figure 1-27). Access would be provided across state right of way beneath the new bridges to provide a connection between the recreational areas along the city's Columbia River waterfront east of the bridges and existing and future waterfront uses west of the bridges.

Active transportation components in the downtown Vancouver area would be similar for all design options.

As part of the Modified LPA, a Community Connector is proposed to be built over I-5 just south of Evergreen Boulevard and east of the Evergreen Station (Figure 1-27). The structure is proposed to include off-street pathways for active transportation modes including pedestrians, bicyclists, and other micro-mobility modes, and public space and amenities to support the active transportation facilities with connections to the Evergreen Station from the active transportation facilities. The primary intent of the Community Connector is to improve connections between downtown Vancouver on the west side of I-5 and the Vancouver National Historic Reserve on the east side.

1.5.5 Upper Vancouver (Subarea D)

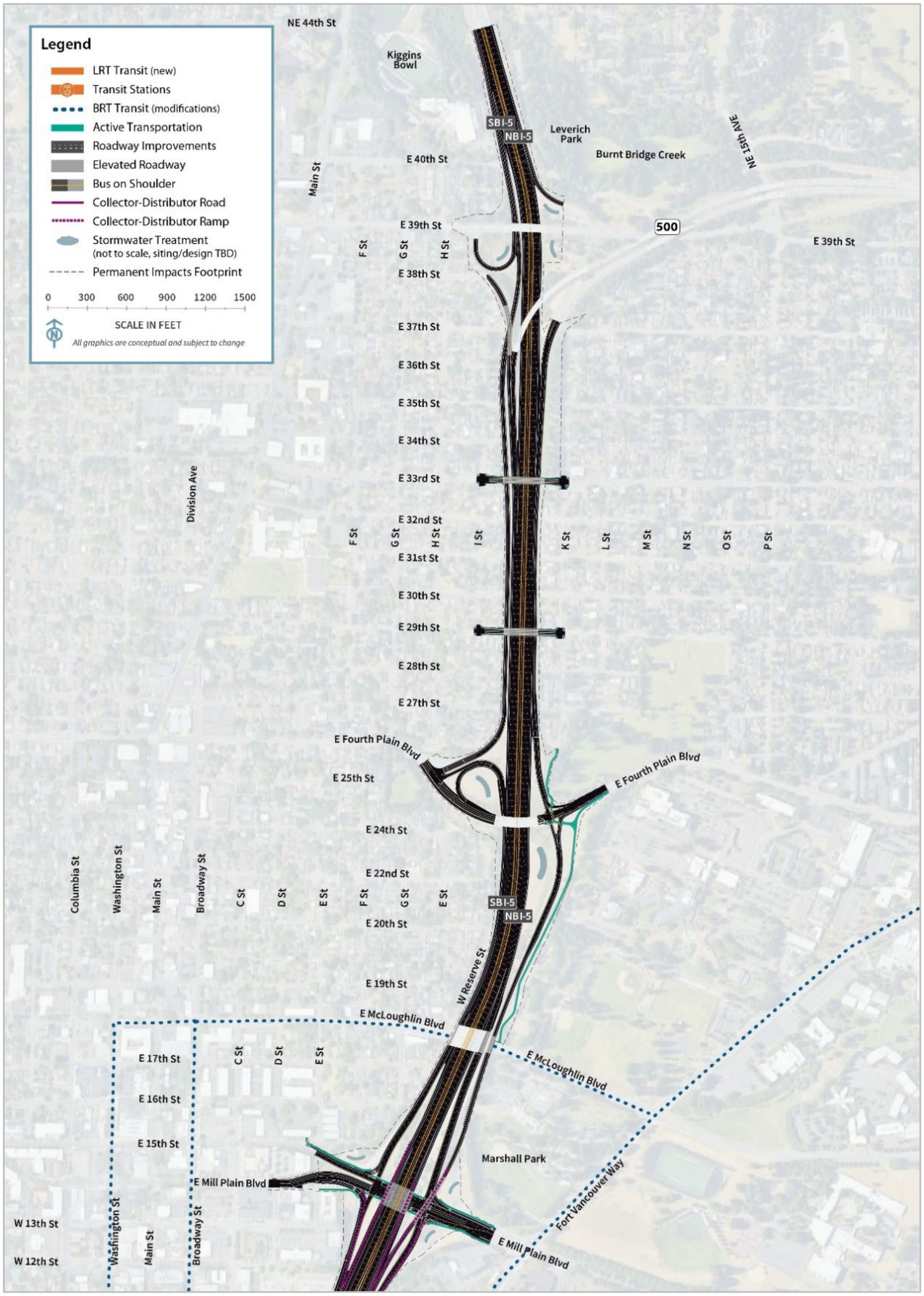
This section discusses the geographic Subarea D (Figure 1-7 shows an overview of the geographic subareas). Figure 1-31 shows all highway and interchange improvements in Subarea D.

1.5.5.1 Highways, Interchanges, and Local Roadways

Within the upper Vancouver area, the IBR Program proposes improvements to three interchanges—Mill Plain, Fourth Plain, and SR 500—as described below.

[19] The maximum depth of an underground parking structure at Library Square is provided for comparative purposes only. An underground parking structure would likely not exceed 3 or 4 levels because of engineering and environmental constraints.

Figure 1-31. Upper Vancouver (Subarea D)



BRT = bus rapid transit; LRT = light-rail transit; TBD = to be determined

MILL PLAIN BOULEVARD INTERCHANGE

The Mill Plain Boulevard interchange is north of the SR 14 interchange (Figure 1-31). This interchange would be reconstructed as a tight-diamond configuration but would otherwise remain similar in function and footprint to the existing interchange. The ramp terminal intersections would be sized to accommodate high, wide, heavy freight vehicles that travel between the Port of Vancouver and I-5. The off-ramp from I-5 northbound to Mill Plain Boulevard would diverge from the C-D road that would continue north, crossing over Mill Plain Boulevard, to provide access to Fourth Plain Boulevard via a C-D roadway. The off-ramp to Fourth Plain Boulevard would be reconstructed and would cross over Mill Plain Boulevard east of I-5, similar to the way it functions today.

FOURTH PLAIN BOULEVARD INTERCHANGE

At the Fourth Plain Boulevard interchange (Figure 1-31), improvements would include reconstruction of the I-5 ramp terminal intersections. The existing bridge for Fourth Plain Boulevard over I-5 would be retained. Northbound I-5 traffic exiting to Fourth Plain Boulevard would first exit to the northbound C-D roadway, which provides off-ramp access to Fourth Plain Boulevard and Mill Plain Boulevard. The westbound SR 14 to northbound I-5 on-ramp also joins the northbound C-D roadway before continuing north past the Fourth Plain Boulevard and Mill Plain Boulevard off-ramps as an auxiliary lane. The southbound I-5 off-ramp to Fourth Plain Boulevard would be braided below the 39th Street on-ramp to southbound I-5. This change would eliminate the existing nonstandard weave between the SR 500 interchange and the off-ramp to Fourth Plain Boulevard. It would also eliminate the existing westbound SR 500 to Fourth Plain Boulevard off-ramp connection. The existing overcrossing of I-5 at 29th Street would be reconstructed to accommodate a widened I-5, provide adequate vertical clearance over I-5, and provide pedestrian and bicycle facilities.

SR 500/39TH STREET INTERCHANGE AREA

The northern terminus of the I-5 improvements would be in the SR 500 interchange area (Figure 1-31). The improvements would primarily be to connect the Modified LPA to existing ramps. The off-ramp from I-5 southbound to 39th Street would be reconstructed to establish the beginning of the braided ramp to Fourth Plain Boulevard and restore the loop ramp to 39th Street. Ramps from existing I-5 northbound to SR 500 eastbound and from 39th Street to I-5 northbound would be partially reconstructed. The existing bridges for 39th Street over I-5 and SR 500 westbound to I-5 southbound would be retained. The 39th Street to I-5 southbound on-ramp would be reconstructed and braided over (i.e., grade separated or pass over) the new I-5 southbound off-ramp to Fourth Plain Boulevard.

The existing overcrossing of I-5 at 33rd Street would also be reconstructed to accommodate a widened I-5, provide adequate vertical clearance over I-5, and provide pedestrian and bicycle facilities.

1.5.5.2 Transit

There would be no LRT facilities in upper Vancouver. Proposed operational changes to bus service, including I-5 bus-on-shoulder service, are described in Section 1.5.7, Transit Operating Characteristics.

1.5.5.3 Active Transportation

Several active transportation improvements would be made in Subarea D consistent with City of Vancouver plans and policies. On the east side of I-5, a new shared-use path would connect E McLoughlin Boulevard to Fourth Plain Boulevard. At the Fourth Plain Boulevard interchange, there would be improvements to provide better bicycle and pedestrian mobility and accessibility; these include bicycle lanes, neighborhood connections, and a connection to the City of Vancouver's planned two-way cycle track on Fourth Plain Boulevard. The reconstructed overcrossings of I-5 at 29th Street and 33rd Street would provide pedestrian and bicycle facilities on those cross streets. No new active transportation facilities are proposed in the SR 500 interchange area. Active transportation improvements at the Mill Plain Boulevard interchange include buffered bicycle lanes and sidewalks, pavement markings, lighting, and signing.

1.5.6 Transit Support Facilities

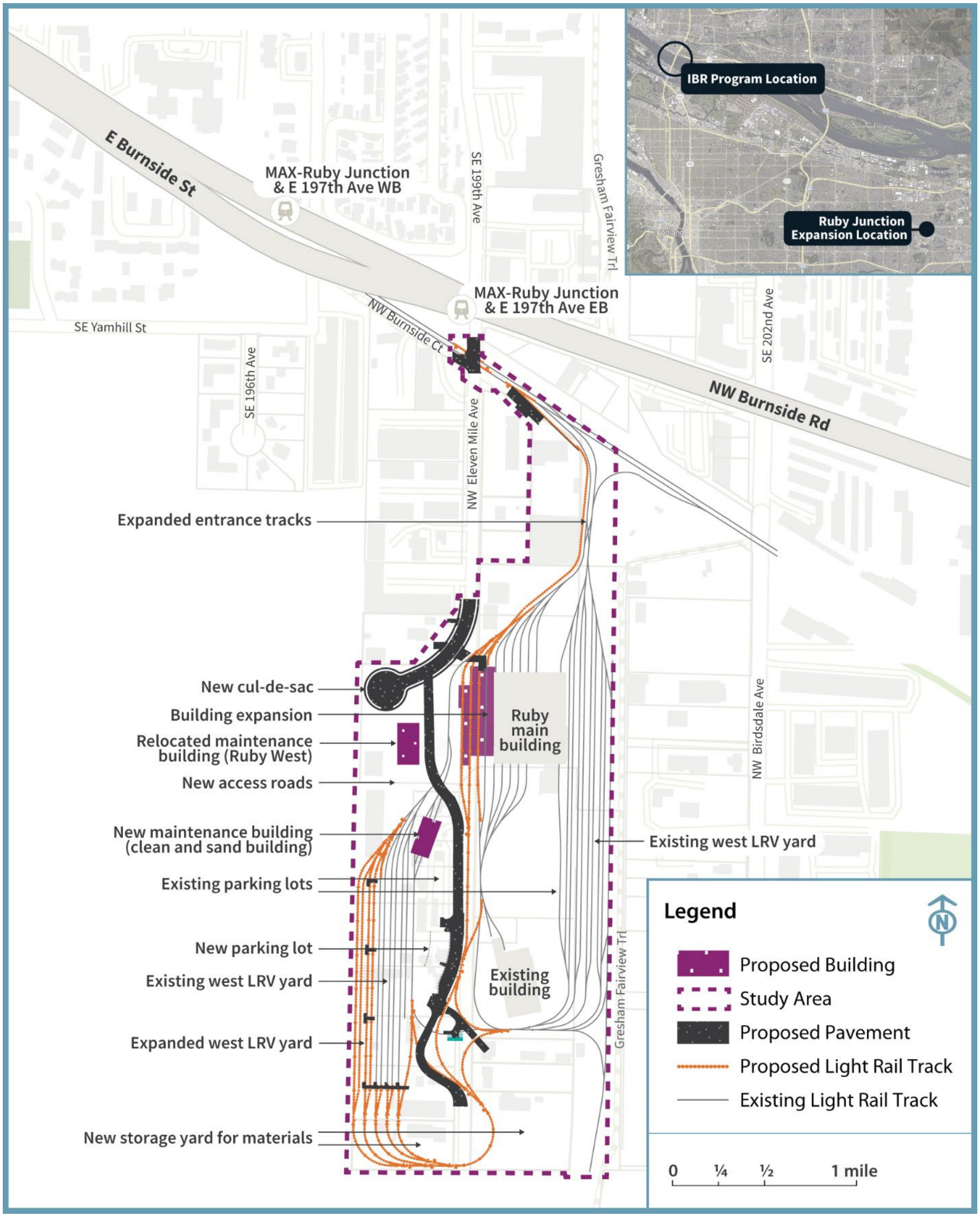
1.5.6.1 Ruby Junction Light-Rail Operations and Maintenance Facility Expansion

The TriMet Ruby Junction Light-Rail OMF in Gresham, Oregon, would be expanded to accommodate the additional LRVs associated with the Modified LPA's LRT service (the Ruby Junction location relative to the study area is shown in Figure 1-32). Improvements would include additional storage tracks for LRVs and maintenance materials and supplies; expanded LRV maintenance bays; expanded parking and employee support areas for additional personnel; an additional maintenance building for daily cleaning and periodic weather-dependent treatments for LRV maintenance, demolition, and relocation of a maintenance building (Ruby West); tenant improvements and new structures for affected operations; and a third lead track at the northern entrance to the Ruby Junction Light-Rail OMF. Adjacent parcels would be acquired to accommodate maintenance and storage needs required for or impacted by the Modified LPA. Figure 1-32 shows the proposed footprint of the expansion.

The existing main building would be expanded west to provide additional maintenance bays. Today, Eleven Mile Avenue extends from NW Burnside Road and dead ends at the southern limits of the existing OMF. To make space for the building expansion, the existing Eleven Mile Avenue public right of way would be vacated and would terminate in a new cul-de-sac west of the main building. A new cul-de-sac would be required to meet City of Gresham code requirements for fire access and turnaround. New internal/nonpublic access roads would be constructed to maintain access to TriMet buildings south of the cul-de-sac; these would impact an existing maintenance building (Ruby West), which would be demolished and rebuilt within Ruby Junction Light-Rail OMF.

The existing western LRV storage yard, west of Eleven Mile Avenue, would be expanded to the west to accommodate additional storage tracks and a runaround track (a track constructed to bypass congestion in the maintenance yard). This expansion would require partial demolition of an existing TriMet building (just north of the LRV storage) and would require relocating the material storage yard to the southeastern corner of the campus. Immediately east of the storage yard, a double track LRV maintenance building would be constructed impacting existing parking. Various other surface parking areas in the west yard would also be relocated north of the cul-de-sac.

Figure 1-32. Ruby Junction Light-Rail Operations and Maintenance Facility Study Area



EB = eastbound; LRV = light-rail vehicle; WB = westbound

All tracks in the west LRV storage yard would also be extended southward to connect to the proposed runaround track. The runaround track would connect to existing and proposed tracks adjacent to the existing Ruby Junction building located to the south. The connections to the runaround track would require partial demolition of an existing TriMet building and, full demolition of one existing building and partial demolition of another building on the adjacent private property to the south. These affected functions would be housed in a new replacement building on site.

A third track would be needed at the north entrance to the Ruby Junction Light-Rail OMF to accommodate increased train volumes without decreasing service. The additional track would also reduce operational impacts during construction and maintenance outages for the yard. Constructing the third track would require reconstruction of Burnside Court east of Eleven Mile Avenue. An additional crossover would also be needed on the mainline track where it crosses Eleven Mile Avenue; it would require reconstruction of the existing track crossings for vehicles, bicycles, and pedestrians.

1.5.6.2 Expo Center Overnight Light-Rail Vehicle Facility

An overnight facility for LRVs would be constructed on the southwest corner of the Expo Center property (as shown on Figure 1-33). The inclusion of the Expo Overnight Facility allows TriMet the ability to maintain current service and maintenance operations on their Blue Line system and reduce deadheading between Ruby Junction and the northern terminus of the MAX Yellow Line extension. Deadheading occurs when LRVs travel without paying passengers to move the vehicles to and from service. Currently, Blue Line is maintained through a limited nighttime work window. With the inclusion of the Expo Overnight Facility, trains originating service at Evergreen have substantially less deadhead time, reducing Yellow Line operating costs, and Blue Line maintenance windows are retained.

The facility would provide a yard access track, storage tracks for approximately 13 LRVs, one building for light LRV maintenance and operator facilities, a TPSS, a sand silo, a parking lot for operators and facility staff, space for security personnel, and other associated facilities. This facility and the lead tracks connecting to it would necessitate relocation and reconstruction of the internal circulation road from the Expo Road entrance to approximately 100 feet west of Building E of the Expo Center (including southern areas of the parking lot, including gates and booths). However, it would not affect existing Expo Center buildings.

The overnight facility lead track would connect to the mainline tracks by crossing Expo Road just south of the existing Expo Center MAX Station. The connection tracks would require relocation of one or two existing LRT facilities, including a TPSS building and potentially the existing signals/communication building, which are both just south of the Expo Center MAX Station. Existing artwork at the station may require relocation.

1.5.6.3 Additional Bus Bays at the C-TRAN Operations and Maintenance Facility

Three bus bays would be added to the existing C-TRAN OMF located at 2425 NE 65th Avenue in Vancouver. These additional bus bays, which would not require the acquisition of any new property, would provide maintenance capacity for the additional express bus service on I-5 (Section 1.5.7, Transit Operating Characteristics). Modifications to the facility would accommodate new vehicles as well as maintenance equipment.

Figure 1-33. Expo Center Overnight LRV Facility

1.5.7 Transit Operating Characteristics

1.5.7.1 Light-Rail Transit Operations

Nineteen new LRVs would be purchased to operate the extension of the MAX Yellow Line. These vehicles would be similar to those currently used for the TriMet MAX system. With the Modified LPA including all design options, LRT service in the new and existing portions of the Yellow Line in 2045 would operate with 6.7-minute average headways[20] during the 2-hour morning peak period. Midday and evening headways would be 15 minutes, and late-night headways would be 30 minutes. LRT service would operate between the hours of approximately 5 a.m. (first southbound train leaving Evergreen Station) and 1 a.m. (last northbound train arriving at the station), which is consistent with current service on the Yellow Line. LRVs would be deadheaded at Evergreen Station before beginning service each day. A third track at this northern terminus would accommodate layovers.

1.5.7.2 Express Bus Service and Bus on Shoulder

C-TRAN provides bus service that connects to LRT and augments travel between Washington and Oregon with express bus service to key employment centers in Oregon. Beginning in 2022, the main express route providing service in the I-5 corridor, Route 105, had two service variations. One pattern provides service between Salmon Creek and downtown Portland with a single intermediate stop at the 99th Street Transit Center, and one provides service between Salmon Creek and downtown Portland with two intermediate stops: the 99th Street Transit Center and downtown Vancouver. This route currently provides weekday service with 20-minute peak and 60-minute off-peak headways.

In 2045, for both the No-Build Alternative and Modified LPA, C-TRAN Route 105 would be revised to only provide direct service from the Salmon Creek Park and Ride and 99th Street Transit Center to downtown Portland with no intermediate stops in downtown Vancouver. Under the Modified LPA with all design options, this route would operate at 5-minute peak headways with no service in the off-peak, compared to 10-minute peak headways under the No-Build Alternative. Under both the No-Build Alternative and the Modified LPA, C-TRAN Route 105 intermediate stop service through downtown Vancouver would be replaced with C-TRAN Route 101, which would provide direct service from downtown Vancouver to downtown Portland and would operate at 15-minute peak and 30-minute off-peak headways and 10-minute peak and 30-minute off-peak headways, respectively.

Two other existing C-TRAN express bus service routes would remain unchanged after completion of the Modified LPA. C-TRAN Route 190 would continue to provide service from the Andresen Park and Ride in Vancouver to Marquam Hill in Portland. This route would continue to operate on SR 500 and I-5 within the study area. Route headways would be 10 minutes in the peak periods with no off-peak service. C-TRAN Route 164 would continue to provide service from the Fisher's Landing Transit Center to downtown Portland. This route would continue to operate within the study area only in the northbound direction during PM service to use the I-5 northbound high-occupancy vehicle lane in Oregon before exiting to eastbound SR 14 in Washington. Route headways would be 10 minutes during the peak and 30 minutes during the off-peak. These two routes provide the same routing and frequencies in both the No-Build Alternative and the proposed Modified LPA.

C-TRAN express bus Routes 105 and 190 are currently permitted to use the existing southbound inside shoulder of I-5 from 99th Street to the Interstate Bridge in Vancouver. However, the existing shoulders are too narrow for bus-on-shoulder use in the rest of the I-5 corridor in the study area. The Modified LPA would include inside shoulders on I-5 that would be wide enough (approximately 14 feet on the Columbia River bridges and 11.5 to 12 feet elsewhere on I-5) to allow northbound and southbound buses to operate on the shoulder, except where I-5 would have to taper to match existing inside

[20] Headways are defined as gaps between arriving transit vehicles.

shoulder widths at the north and south ends of the corridor. Figure 1-10, Figure 1-14, Figure 1-27, and Figure 1-31 show the potential bus-on-shoulder use over the Columbia River bridges. Bus on shoulder could operate on any of the Modified LPA bridge configurations and bridge types. Additional approvals (including a continuing control agreement), in coordination with ODOT, may be needed for buses to operate on the shoulder on the Oregon portion of I-5.

After completion of the Modified LPA, two C-TRAN express bus routes operating on I-5 through the study area would be able to use bus-on-shoulder operations to bypass congestion in the general-purpose lanes. C-TRAN Route 105 would operate on the shoulder for the full length of the study area. C-TRAN Route 190 would operate on the shoulder for the full length of the corridor except for the distance required to merge into and out of the shoulder as the route exits from and to SR 500. These two express bus routes (105 and 190) would have a combined frequency of every 3 minutes during the 2045 AM and PM peak periods. To support the increased frequency of express bus service, eight double-decker or articulated buses would be purchased.

With the C Street ramps design option, C-TRAN Route 101 would use bus on shoulder south of the SR 14 interchange but would not use the full extent of bus-on-shoulder lanes that would be included in the Modified LPA because the route would need to begin merging over early to use the C Street off-ramp to access downtown Vancouver. Without the C Street ramps design option, C-TRAN Route 101 would be rerouted to use the Mill Plain interchange to access downtown Vancouver. Under this design option, the Route 101 would also not use the full extent of bus-on-shoulder lanes that would be included in the Modified LPA but would use the bus on shoulder south of Mill Plain Boulevard and begin merging over early to use the Mill Plain off-ramp.

C-TRAN Route 164 would not be anticipated to use bus-on-shoulder operations because of the need to exit to SR 14 from northbound I-5.

1.5.7.3 Local Bus Route Changes

Two TriMet bus routes would be adjusted to accommodate the transit improvements associated with the Modified LPA. TriMet Line 6 bus route would be changed to terminate at the Expo Center MAX Station instead of Hayden Island, where it terminates currently and in the No-Build Alternative. The new Line 6 route would require passengers to transfer to the new LRT connection to access Hayden Island. TriMet Line 6 is anticipated to travel from Delta Park MAX Station north along Expo Road to the Expo Center MAX Station. Table 1-4 shows the existing service and anticipated future changes to TriMet Line 6. In addition to Line 6, TriMet Route 11 could require slight modifications to maintain transfers to the Expo Center MAX Station, depending on the final design of the station and surrounding area.

As part of the Modified LPA, several local C-TRAN bus routes would be changed to better complement the new light-rail extension. Most of these changes would reroute existing bus lines to provide a transfer opportunity at the proposed new Evergreen Station. Table 1-4 shows existing service and anticipated future changes to C-TRAN bus routes. In addition to the changes noted in Table 1-4, other local bus route modifications may move service from Broadway to C Street.

For both TriMet and C-TRAN detailed service planning analysis, including obtaining public feedback for service changes associated with the Modified LPA, would be conducted prior to the start of revenue service.

Table 1-4. Proposed TriMet and C-TRAN Bus Route Changes

Bus Route	Existing Route	Changes with Modified LPA
TriMet Line 6	Connects Goose Hollow, Portland City Center, N/NE Portland, Jantzen Beach, and Hayden Island. Within the study area, service currently runs between Delta Park MAX Station and Hayden Island via I-5.	Route would be revised to terminate at the Expo Center MAX Station. Route is anticipated to travel from the Delta Park MAX Station, north along Expo Road to connect via facilities on the west side of I-5 with the Expo Center MAX Station.
TriMet Line 11	Connects East Columbia, Expo Center, Smith/Bybee lakes, Rivergate and St. Johns via Marine Drive, Lombard, Columbia, Fessenden, and Ivanhoe.	Stops along Marine Drive would be relocated or the line would be rerouted slightly to connect via facilities on the west side of I-5 with the Expo Center MAX Station.
C-TRAN Fourth Plain and Mill Plain bus rapid transit (The Vine)	Runs between downtown Vancouver and the Vancouver Mall Transit Center via Fourth Plain Boulevard, with a second line along Mill Plain Boulevard. In the study area, service currently runs along Washington and Broadway Streets through downtown Vancouver.	Route would be revised to begin/end near the Evergreen Station in downtown Vancouver and provide service along Evergreen Boulevard to Fort Vancouver Way, where it would travel to or from Mill Plain Boulevard or Fourth Plain Boulevard depending on clockwise/counterclockwise operations. The Fourth Plain Boulevard route would continue to serve existing Vine stations beyond Evergreen Boulevard.
C-TRAN #2 Lincoln	Connects the 99th Street Transit Center to downtown Vancouver via Lincoln and Kaufman Avenues. Within the study area, service currently runs along Washington and Broadway Streets between 7th and 15th Streets in downtown Vancouver.	Route would be modified to begin/end near C Street and 9th Street in downtown Vancouver.
C-TRAN #25 St. Johns	Connects the 99th Street Transit Center to downtown Vancouver via St. Johns Boulevard and Fort Vancouver Way. Within the study area, service currently runs along Evergreen Boulevard, Jefferson Street/Kaufman Avenue, 15th Street, and Franklin Street in downtown Vancouver.	Route would be modified to begin/end near C Street and 9th Street in downtown Vancouver.

Bus Route	Existing Route	Changes with Modified LPA
C-TRAN #30 Burton	Connects the Fisher's Landing Transit Center with downtown Vancouver via 164th/162nd Avenues and 18th, 25th, 28th, and 39th Streets. Within the study area, service currently runs along McLoughlin Boulevard and on Washington and Broadway Streets between 8th and 15th Streets.	Route would be modified to begin/end near C Street and 9th Street in downtown Vancouver.
C-TRAN #60 Delta Park Regional	Connects the Delta Park MAX Station in Portland with downtown Vancouver via I-5. Within the study area, service currently runs along I-5, Mill Plain Boulevard, and Broadway Street.	Route would be discontinued.

1.5.8 Tolling

Consistent with the CRC LPA, tolling cars and trucks that would use the new Columbia River bridges is proposed as a method to help fund the bridge construction and future maintenance, as well as to provide different mode, time, and destination choices for trips across the Columbia River. The sections below describe the tolling authority and tolling operations.

1.5.8.1 Tolling Authority

Federal and state laws provide authority to toll the I-5 crossing. The IBR Program plans to toll the new Columbia River bridges under the federal tolling authorization program codified in 23 U.S. Code § 129 (Section 129). Section 129 allows public agencies to impose new tolls on federal-aid interstate highways for the reconstruction or replacement of toll-free bridges or tunnels. In 2023, the Washington State Legislature authorized tolling on the Interstate Bridge, with toll rates and policies to be set by the Washington State Transportation Commission (WSTC). In Oregon, the legislature authorized tolling on the Interstate Bridge in 2013 and gave the Oregon Transportation Commission (OTC) the authority to set toll rates and policies. Subsequently, in January 2025, the OTC reviewed and approved the I-5 tollway project application that designated the IBR Program as a "tollway project" and the facility (the I-5 bridge) as a tollway for construction as defined in Oregon Revised Statutes (ORS) 383.003(8) and pursuant to ORS 383.015.

At the beginning of 2024, the OTC and the WSTC entered into a bi-state tolling agreement to establish a cooperative process for setting toll rates and policies. This included the formation of the I-5 Bi-State Tolling Subcommittee, which consists of two commissioners each from the OTC and WSTC, and tasked the subcommittee with developing toll rate and policy recommendations for joint consideration and adoption by each state's commission. At the direction of the commissions, all toll scenarios being analyzed in the next round of tolling analysis (referred to as a level 3 toll traffic and revenue study) for the IBR Program assume a low-income discount. Formal action is still needed by the commissions to implement rates and policies, including discounts and exemptions.

In December 2024, a memorandum of understanding was executed by both states that outlined their shared understanding of tolling operations, including cooperation between the state Departments of Transportation and roles and responsibilities for the IBR Program. Toll collection would be managed by WSDOT, including drivers' option to use *Good To Go!* accounts for paying tolls. In addition to the memorandum, the two states plan to enter into a separate agreement guiding the sharing and uses of toll revenues, including the order of uses (flow of funds) for bridge construction, debt service, and other required expenditures. WSDOT and ODOT also plan to enter into one or more agreements addressing implementation logistics, toll collection, and operations and maintenance for tolling the bi-state facility.

1.5.8.2 Tolling Operations

The Modified LPA includes a proposal to apply variable tolls on vehicles using the Columbia River bridges with the toll collected electronically in both directions. Tolls would vary by time of day with higher rates during peak travel periods and lower rates during off-peak periods. The IBR Program evaluated multiple toll scenarios with two different variable toll schedules by time of day. For purposes of this NEPA analysis, the lowest toll schedule was analyzed, with tolls assumed to range between $1.50 and $3.15 (state fiscal year 2026 dollars) for passenger vehicles and light trucks (i.e., vehicles with two axels) with a *Good To Go!* account. The assumed toll range and other assumptions are documented in the IBR Program Level 2 Toll Traffic and Revenue Study (IBR 2023). Medium and heavy trucks (i.e., vehicles with more than two axels) would be charged a higher toll than passenger vehicles and light trucks. Passenger vehicles and light trucks without a *Good To Go!* account would pay an additional $2.00 per trip to cover the cost of identifying the vehicle owner from the license plate and invoicing the toll by mail.

It is assumed that tolling would begin on the existing Interstate Bridge, referred to as "pre-completion tolling," in 2027, allowing time after receiving a Record of Decision to hire a contractor, install tolling equipment, and conduct the rate-setting process. The purpose of pre-completion tolling would be to generate initial capital construction funding on a pay-as-you-go basis. Later, toll revenue would be used to secure a portion of Program financing to pay back bonds or loans. Pre-completion tolling would also help pay current interest on the debt to minimize interest costs. Once the new Columbia River bridges are completed, the traffic and tolling operations would shift

Tolling Equipment

Below are the key types of equipment used to collect data for billing purposes.

Transponders: Small tags affixed to vehicles that communicate with tolling equipment as the vehicle passes.

Antenna/Readers: As a vehicle with a transponder enters a toll zone, an antenna transmits a signal between the transponder and the reader. The reader then transmits pertinent information to the toll zone controller.

Automatic Vehicle Classification: Various roadway devices installed overhead and/or in pavement to detect and identify the vehicle type (e.g., truck, bus, personal vehicle, etc.).

License Plate Image Capture Cameras: Cameras and software that capture images of license plates as vehicles pass.

Digital Video Audit System: Various types of cameras monitor traffic flow and equipment locations.

from the existing Interstate Bridge over to the new bridges, and 24-hour tolls would be implemented; this is referred to as "post-completion tolling."

The start dates for pre-completion tolling would be determined based on the IBR Program environmental and construction timelines; placeholders for tolling start dates were used in this NEPA analysis. This NEPA analysis assumed that pre-completion tolling on the existing Interstate Bridge would be toll-free overnight between 11 p.m. and 5 a.m. (IBR 2023). The OTC and WSTC are also considering this as an option during the level 3 toll traffic and revenue study; however, a decision has not been made on whether these toll-free hours would be implemented. This toll-free period could help avoid situations where users would be charged during lane or partial bridge closures when construction delays may occur.

Tolls would be collected using an all-electronic toll collection system using transponder pass readers and license plate cameras mounted to structures over the roadway. Each traffic lane and shoulder would have a pass reader and license plate camera to ensure accurate detection of vehicles. Toll collection booths would not be required. Instead, motorists could obtain a pass and set up a *Good To Go!* account that would automatically bill the account holder associated with the pass each time the vehicle crossed the bridge. Customers without passes would be tolled by a license plate recognition system that would bill the address of the owner registered to that vehicle's license plate.

There would be two separate "toll zones," which are the area in which the tolling system would detect and classify passing vehicles and then transmit pertinent information to the toll zone controller (Figure 1-3430). There would be one zone for northbound traffic and one zone for southbound traffic. During pre-completion tolling, the toll zones would be located on I-5 in Vancouver, between the Interstate Bridge and the BNSF Railway. The location of the post-completion toll zones would be determined at a later date, but it is anticipated that both toll zones would remain in Vancouver.

Figure 1-34. Toll Zone

One gantry (i.e., overheard structure) would be located in each toll zone (Figure 1-3430). Generators and equipment cabinets would be located nearby, which would house various equipment needed to support toll operations. Additional equipment cabinets would be placed throughout the Program area to support tolling operations, such as near the toll rate signage (see below).

As previously noted, a key element of tolling would be variable-rate pricing, where toll rates would differ based on the time of day a vehicle uses the bridge. To accomplish this, toll rate signs would be installed at route decision points on local roads, I-5 on-ramps, and on I-5, including locations north and south of the bridges where drivers make informed route decisions (e.g., I-5/Interstate 205 junction and I-5/Interstate 84 junction). The intent of the toll rate signs is to provide both static and variable pricing information. The static sign would contain details such as direction, wayfinding, or other information. These signs would also include a variable message sign panel that would show toll rate(s) in effect at that time.

1.5.9 Transportation System- and Demand-Management Measures

Many well-coordinated transportation demand-management and system-management programs are already in place in the Portland-Vancouver metropolitan region. In most cases, the impetus for the programs comes from state regulations: Oregon's Employee Commute Options rule and Washington's Commute Trip Reduction law (described in the sidebar).

> **State Laws to Reduce Commute Trips**
>
> Oregon and Washington have both adopted regulations intended to reduce the number of people commuting in single-occupancy vehicles (SOVs). Oregon's Employee Commute Options Program, created under Oregon Administrative Rule 340-242-0010, requires employers with over 100 employees in the greater Portland area to provide commute options that encourage employees to reduce auto trips to the work site. Washington's 1991 Commute Trip Reduction (CTR) Law, updated as the 2006 CTR Efficiency Act (Revised Code of Washington §70.94.521) addresses traffic congestion, air pollution, and petroleum fuel consumption. The law requires counties and cities with the greatest traffic congestion and air pollution to implement plans to reduce SOV demand. An additional provision mandates "major employers" and "employers at major worksites" to implement programs to reduce SOV use.

The physical and operational elements of the Modified LPA provide the greatest transportation demand-management opportunities by promoting other modes to fulfill more of the travel needs in the corridor. These include:

- Major new light-rail line in exclusive right of way, as well as express bus routes and bus routes that connect to new light-rail stations.
- I-5 inside shoulders that accommodate express buses.
- Modern bicycle and pedestrian facilities that accommodate more bicyclists and pedestrians and improve connectivity, safety, and travel time.
- Park and rides.
- A variable-rate toll on the new Columbia River bridges.

In addition to these fundamental elements of the Modified LPA, facilities and equipment would be implemented that could help existing or expanded transportation system–management measures maximize the capacity and efficiency of the system. These include:

- Replacement or expanded variable message signs in the primary study area. These signs alert drivers to incidents and events, allowing them to seek alternate routes or plan to limit travel during periods of congestion.
- Replacement or expanded traveler information systems with additional traffic monitoring equipment and cameras.
- Expanded incident response capabilities, which help traffic congestion to clear more quickly following accidents, spills, or other incidents.

- Queue jumps or bypass lanes for transit vehicles where multilane approaches are provided at ramp signals for on-ramps. Locations for these features will be determined during the detailed design phase.
- Active traffic management strategies including ramp metering and dynamic speed limits. These strategies are intended to manage congestion by controlling traffic flow.

1.5.10 Off-Site Mitigation Sites

The IBR Program will provide off-site mitigation for unavoidable impacts to natural resources, including fish and wildlife species and their habitats, wetlands, surface waters, floodplains, and other regulated habitat features (refer to the Final SEIS, Sections 3.14, Water Quality and Hydrology; 3.15, Wetlands; and 3.16, Ecosystems).[21] Applicable federal, state, and local regulatory frameworks require mitigation sequencing that includes avoidance and minimization of impacts, and compensatory mitigation to achieve “no net loss” of the resource or its functions. Mitigation must fully offset the impacts of the Modified LPA and achieve this “no net loss” standard. The Modified LPA would result in unavoidable impacts to natural resources, which would require mitigation under one or more regulatory frameworks. Mitigation plans and mitigation bank use plans will be prepared to provide compensation for any such unavoidable impacts to regulated resources (wetlands, waters, floodplain, sensitive habitats) and to demonstrate that the IBR Program will achieve “no net loss” of function of these resources. The IBR Program is preparing functional assessments and coordinating with regulatory agencies to quantify the amount and type of compensatory mitigation required to offset Program impacts and achieve “no net loss.”

It is anticipated that compensatory mitigation for unavoidable impacts to aquatic and terrestrial habitats and species in Washington will be provided through the purchase of credits from the proposed Wapato Valley Mitigation and Conservation Bank (Figure 1-35). The bank is approximately 876 acres and is located in the Columbia River floodplain at the mouth of the Lewis River, approximately 19 river miles downstream of the Interstate Bridge. Approval of the bank is expected in 2026.

It is anticipated that compensatory mitigation for unavoidable impacts to wetlands, and aquatic and terrestrial habitats and species in Oregon will be provided partially through the purchase of advance mitigation credits at ODOT’s proposed Columbia Bottomlands Advance Mitigation/Conservation Site, and partially through the purchase and protection under conservation easement of a site on West Hayden Island (shown on Figure 1-35). The Columbia Bottomlands Advanced Mitigation/Conservation site is located in Scappoose Bay, a slough of Multnomah Channel, in Columbia County, Oregon. The site is located approximately 1 mile upstream of where the Multnomah Channel meets the Columbia River and approximately 20 river miles downstream of the Interstate Bridge. The site has been designed to provide advance mitigation credits for impacts to wetlands and aquatic and terrestrial habitats and species for future ODOT projects. All impacted wetlands and other water features would be mitigated in accordance with current USACE mitigation policies, and the conditions of the Section 404 Permit. All compensatory mitigation plans would be developed in coordination with the USACE and other appropriate agencies as part of the Section 404 permitting process. The USACE and other

[21] On-site mitigation is identified and analyzed in relevant subsections of Chapter 3, Existing Conditions and Environmental Consequences of the Final SEIS.

appropriate agencies would determine the appropriate level of mitigation based upon the functions lost or adversely affected as a result of impacts to aquatic resources.

The proposed site on West Hayden Island is approximately 65 acres in size and is located approximately 2.5 river miles downstream of the Interstate Bridge, on the south side of the island adjacent to North Portland Harbor. The site is currently owned by the Oregon Department of State Lands, but ODOT has proposed to purchase this site and place it under a conservation easement. One or more compensatory mitigation projects may also be conducted on the site. The specific activities to be conducted at this site would be developed in coordination with the applicable regulatory agencies for each of the various permit applications.

In addition to the compensatory wetland and habitat mitigation described above, the IBR Program may need to excavate material from within the 100-year floodplain to address the compensatory excavation requirements of the City of Portland's recently updated floodplain ordinance. If such activity is required, it is anticipated that this material would be removed from upland portions of the 65-acre parcel on West Hayden Island described above or from aquatic areas adjacent to this parcel. If such excavation activities are conducted, excavated materials will be disposed of at a location approved to receive that type of material.

Figure 1-35. Potential Compensatory Mitigation Sites

1.6 Modified LPA Construction

Construction of the IBR Program would be sequenced in accordance with many factors, such as the scale of improvements, different types of infrastructure and associated construction specialties required, timing of funding received, maintenance of traffic on I-5, navigation on the Columbia River, seasonal and weather constraints, permit conditions, and other considerations. Multiple construction packages are anticipated to be developed and delivered by different agencies—WSDOT, ODOT, TriMet, and C-TRAN—that will use various delivery methods (e.g., design-bid-build, design-build, progressive design-build, construction manager/general contractor).

The first construction packages are anticipated to be the new Columbia River bridges and approaches. Subsequent construction packages would be sequenced throughout the Program area. Early construction activities may occur in the Program area to prepare for the bridge replacement work. Demolition of the existing Interstate Bridge would take place after the new Columbia River bridges were opened to traffic. Construction of other components of the Modified LPA would be sequenced during and after the construction of the new Columbia River bridges begins.

Electronic tolling infrastructure for the existing Interstate Bridge would be constructed and operational near the start of construction on the new Columbia River bridges and would be constructed and operational for the new Columbia River bridges in time for their opening. The toll rates and policies for tolling (including pre-completion tolling) would be determined by the OTC and WSTC (refer to Section 1.5.8, Tolling).

1.6.1 Construction Components, Packaging Plan, and Duration

Table 1-5 lists the main construction components of the Modified LPA along with the estimated construction durations and descriptions of the associated work. Construction packages are also listed in Table 1-5 and illustrated in Figure 1-36. These main construction components would be defined by some functional improvement to the Program corridor; for example, construction of the new bridges would be coordinated with the construction of the connections to the existing I-5, enabling use of the new bridges while other components of the Program are constructed. Each listed component would require multiple construction packages—small and large, general and specialty. As construction progresses, interim connections may be in place while subsequent components are built and final connections and finishes are completed. This preliminary construction plan may change as the Program advances toward construction. Construction packages may further be combined or separated throughout delivery of the Program. Construction of all components identified in the Program could last more than 10 years.

The estimated durations are shown as ranges to reflect the potential for Program funding to be sequenced over time. In addition to funding, contractor schedules, regulatory restrictions on in-water work, river navigation considerations, permits and approvals, weather, materials, and equipment could all influence construction duration and overlap of construction of certain components. Certain work below the ordinary high-water mark of the Columbia River and North Portland Harbor would be restricted to minimize impacts to species listed under the Endangered Species Act and their designated critical habitat.

Throughout most periods of construction, three travel lanes in each direction on I-5 (accommodating personal vehicles, freight, and buses) would remain open during peak hours. Off-peak and weekend restrictions and closures could be required during construction. Active transportation connections would be maintained throughout construction. Advanced coordination and public notice would be given for restrictions, intermittent or longer-term closures, and detours for highway, local roadway, transit, and active transportation users via accessible facilities and wayfinding (refer to the Final SEIS, Section 3.1, Transportation, for additional information, including for local street and ramp or interstate access closures). At least one Columbia River navigation channel would remain open to shipping throughout construction. Advanced coordination and notice would be given for restrictions or intermittent closures to navigation channels as required (refer to the Final SEIS Section 3.2, Navigation, for additional information).

Table 1-5. Preliminary Construction Packaging Plan

Component and General Location	Estimated Duration	Description	Construction Packages
Columbia River bridges, approaches, and demolition of Interstate Bridge *Hayden Island to Evergreen Boulevard*	6 to 8 years	• General sequence for new bridges would include initial preparation and installation of foundation piles, shaft caps, pier columns, superstructure, and deck elements, followed by systems and finish work. • SR 14 interchange would be constructed in a separate construction package and must be completed before all traffic could be transferred to the new Columbia River bridges. • Demolition of the existing Interstate Bridge could begin only after traffic is transferred to the new Columbia River bridges.	• Columbia River Bridges [a] • Approaches [a] • Pre-completion Tolling Signage and Equipment Installation • SR 14 A • Evergreen Bridge • Interstate Bridge Demolition
Light-rail and bus-on-shoulder transit *Expo Station to Evergreen Station; Ruby Junction*	4 to 7 years	• The light-rail alignment would be partially supported by the southbound Columbia River bridge and approach structure guideways. • Light-rail construction would include all infrastructure associated with light-rail elements of the Transit Packages construction package (e.g., overhead catenary system, tracks, stations, and park and rides). • Bus on shoulder would include corresponding bus elements of the Transit Packages construction package.	• North Portland Harbor Transit Bridge • Marine Drive A (supports transit improvements) • Hayden Island A (supports transit improvements) • Light-rail Overnight Facility • Transit Packages • Ruby Junction
Marine Drive and Hayden Island interchanges and	4 to 10 years	• Hayden Island interchange construction duration would not necessarily entail continuous active construction.	• Hayden Island Surface Streets

Component and General Location	Estimated Duration	Description	Construction Packages
North Portland Harbor bridges *Marine Drive to Hayden Island*		• The North Portland Harbor bridges could include sequenced construction of southbound bridges, northbound bridges, and demolition of the existing North Portland Harbor bridge to maintain traffic mobility during construction. • Hayden Island and Marine Drive interchanges could be broken into several contracts, which could spread work over a longer duration.	• Hayden Island Interchange • North Portland Harbor Bridges • Oregon I-5 Southbound • Oregon I-5 Northbound • North Portland Harbor Bridge Removal • Marine Drive Interchange • North Expo Road
Mill Plain Boulevard, Fourth Plain Boulevard, and SR 500/39th Street interchanges *Mill Plain Boulevard to SR 500*	3 to 4 years	• Construction of these interchanges could be independent from each other.	• Mill Plain Boulevard Interchange • Washington North

a The Columbia River Bridges and Approaches construction packages include light-rail guideway from the Hayden Island Bridge Approach, the Columbia River bridges, north to Evergreen Boulevard.

Figure 1-36. Preliminary Construction Packages

1.6.2 Potential Staging Sites and Casting Yards

Equipment and materials would be staged in the primary study area throughout construction generally within existing or newly purchased right of way, on land vacated by existing transportation facilities (e.g., I-5 on Hayden Island), or on nearby parcels. However, at least one large site could be required for construction offices, equipment maintenance and storage, maintenance of traffic equipment, employee parking, and construction material storage and other needs. Criteria for suitable sites include large, open areas for heavy machinery and material storage, waterfront access for barges (either a slip or a dock capable of handling heavy equipment and material) to convey material to the construction zone, and roadway or rail access for landside transportation of materials by truck or train.

Two potential major staging sites have been identified (see Figure 1-10). Both sites are located on Hayden Island on the west side of I-5. A large portion of both parcels would be required for new right of way for the Modified LPA. Other staging sites may be identified during the design process or by the contractor. Following construction of the Modified LPA, the staging sites could be converted to other uses.

In addition to on-land sites, some staging activities for construction of the new Columbia River and North Portland Harbor bridges would take place on the river itself. Temporary work structures, barges, barge-mounted cranes, derricks, and other construction vessels and equipment would be present on the river during most or all of the bridges' construction period. The IBR Program is working with USACE, USCG, and the Federal Aviation Administration to obtain necessary clearances for these activities.

A casting or staging yard could also be required for construction of the overwater bridges if a precast concrete segmental bridge design is used. A casting yard would require access to the river for barges, a slip or a dock capable of handling heavy equipment and material, a large area suitable for a concrete batch plant and associated heavy machinery and equipment, and access to a highway or railway for delivery of materials. Such a site would likely be between approximately 50 and 100 acres. As with the staging sites, casting yards would be identified during the design process or by the contractor and would be subject to the same contract and permit requirements to implement the best management practices (BMPs) described in Appendix M to the Final SEIS unless more stringent permitting requirements and conditions are required at the time of identification.

All material staging, equipment staging areas, equipment fueling areas, and casting yards would be contained and located outside of environmentally and culturally sensitive areas. To the extent practicable, these sites would be located in upland locations, on areas that are already or have been previously disturbed. These activities would be conducted consistent with the impact minimization BMPs described in Appendix M to the Final SEIS. Construction of the Modified LPA would also include revegetating temporarily disturbed areas consistent with federal, state, and local regulations, and the net result would be no net loss of habitat function in the long term. As with the staging sites, casting or staging yard sites may be identified as the design progresses or by the contractor and would be evaluated via a NEPA re-evaluation or supplemental NEPA document for potential environmental impacts at that time.

1.7 No-Build Alternative

The No-Build Alternative illustrates how transportation and environmental conditions would likely change by the year 2045 if the Modified LPA is not built. This alternative makes the same assumptions as the Modified LPA regarding population and employment growth through 2045, and it assumes that the same transportation and land use projects in the region would occur as planned.

Regional transportation projects included in the No-Build Alternative are those in the financially constrained 2018 *Regional Transportation Plan* (RTP) adopted in December 2018 by the Metro Council (Metro 2018) and in March 2019 (RTC 2019) by the Southwest Washington Regional Transportation Council (RTC) Board of Directors (referred to collectively as the 2018 RTP in this report).[22] The 2018 RTP has a planning horizon year of 2040 and includes projects from state and local plans necessary to meet transportation needs over this time period; financially constrained means these projects have identified funding sources. The Transportation Technical Report lists the projects included in the financially constrained 2018 RTP.

The implementation of regional and local land use plans is also assumed as part of the No-Build Alternative. For the IBR Program analysis, population and employment assumptions used in the 2018 RTP were updated to 2045 in a manner consistent with regional comprehensive and land use planning. In addition to accounting for added growth, adjustments were made within Portland to reallocate the households and employment based on the most current update to Portland's comprehensive plan, which was not complete in time for inclusion in the 2018 RTP.

Other projects assumed as part of the No-Build Alternative include major development and infrastructure projects that are in the planning stage, permitting stage, or partway through phased development. They include the Waterfront Vancouver project, Terminal 1 development, the Renaissance Boardwalk, the Waterfront Gateway project, improvements to the levee system, several restoration and habitat projects, and the Portland Expo Center.

In addition to population and employment growth and the implementation of local and regional plans and projects, the No-Build Alternative assumes that the existing Interstate Bridge would continue to operate as it does today. As the bridge ages, needs for repair and maintenance would potentially increase, and the bridge would continue to be at risk of mechanical failure or damage from a seismic event.

[22] The 2018 RTP was the adopted regional transportation plan available when the IBR Program initiated the SEIS. In 2023, Oregon Metro and RTC updated their respective RTPs as part of their five-year update cycle, as required under 23 CFR § 450.324. The 2023 RTP was adopted by Oregon Metro in 2023 and RTC in 2024, several years after the IBR Program Draft SEIS analysis was initiated in early 2021. To use the regional travel demand model supporting the 2023 RTP, additional refinement and coordination would be necessary for it to be ready for use in a facility-specific study, such as the IBR Program. This refinement and coordination process is lengthy and can take up to a year and a half for a complex project with numerous partner agencies, like the IBR Program. Therefore, the NEPA lead agencies exercised their discretion and determined, based on their technical expertise, that the 2018 RTP and Travel Demand Model continued to be the most appropriate base tool for the purposes of comparing the No-Build Alternative to the Modified LPA and design options in the Final SEIS.

2. METHODS

2.1 Study Area

The evaluation presented in Chapter 5, Modified LPA Analysis – Climate Impacts, focuses on the Modified LPA. It considers benefits and impacts on two geographic levels:

1. **The Metropolitan Regional Model Boundary Area:** This is defined as the area included in the transportation model used in the Program analysis. This area is shown in Figure 2-1. The traffic analysis subarea is shown in Figure 2-2.
2. **The regional level:** GHG emissions are calculated at the regional level to provide a meaningful comparison of alternatives. In a national or global context, the differences in emissions among alternatives would be imperceptible. However, addressing global climate change will require cumulative progress from many such projects whose individual contributions are small. Therefore, the relevance of regional impacts to national and global climate change is noted where appropriate.

Figure 2-1. Metropolitan Regional Model Boundary

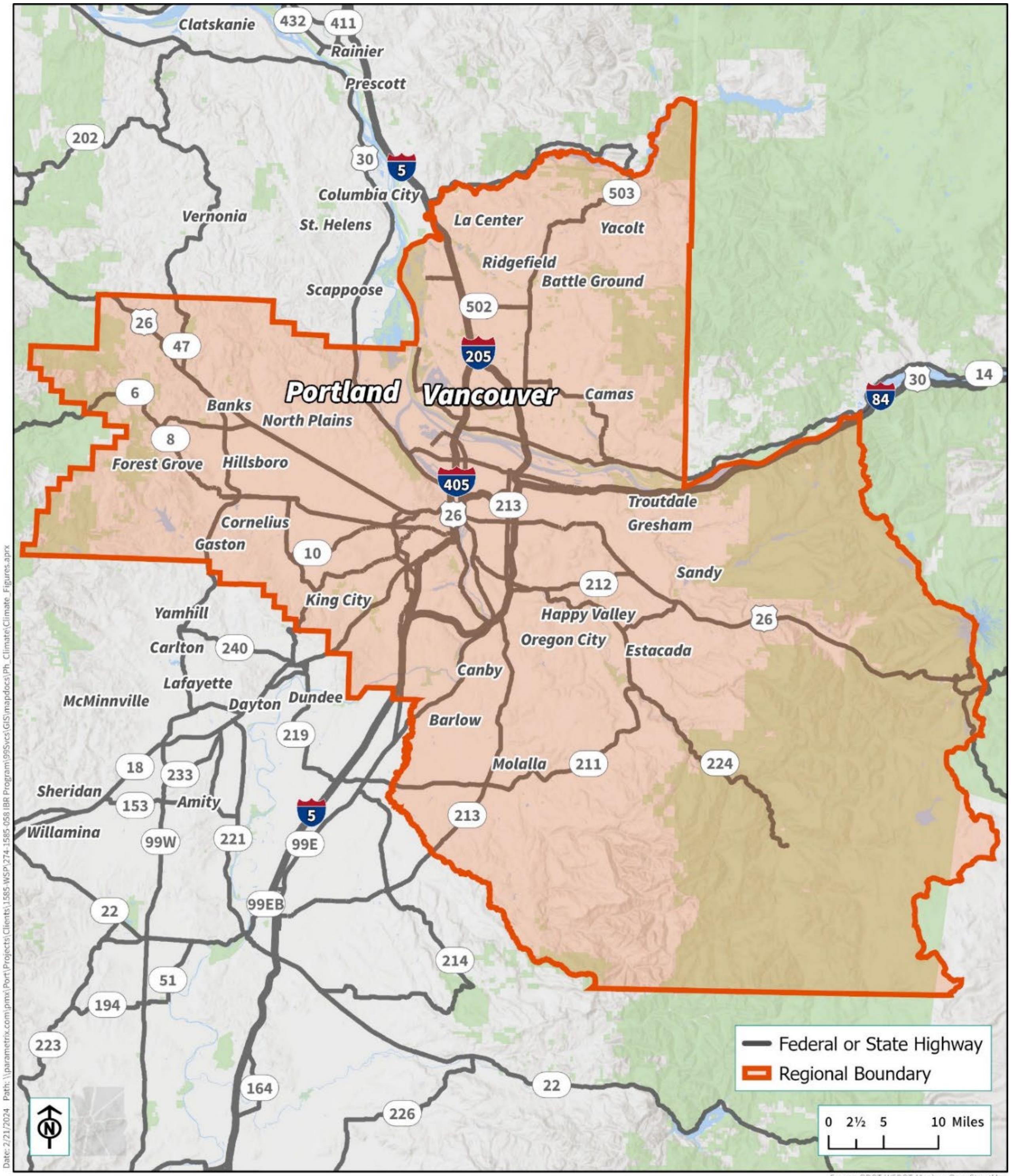
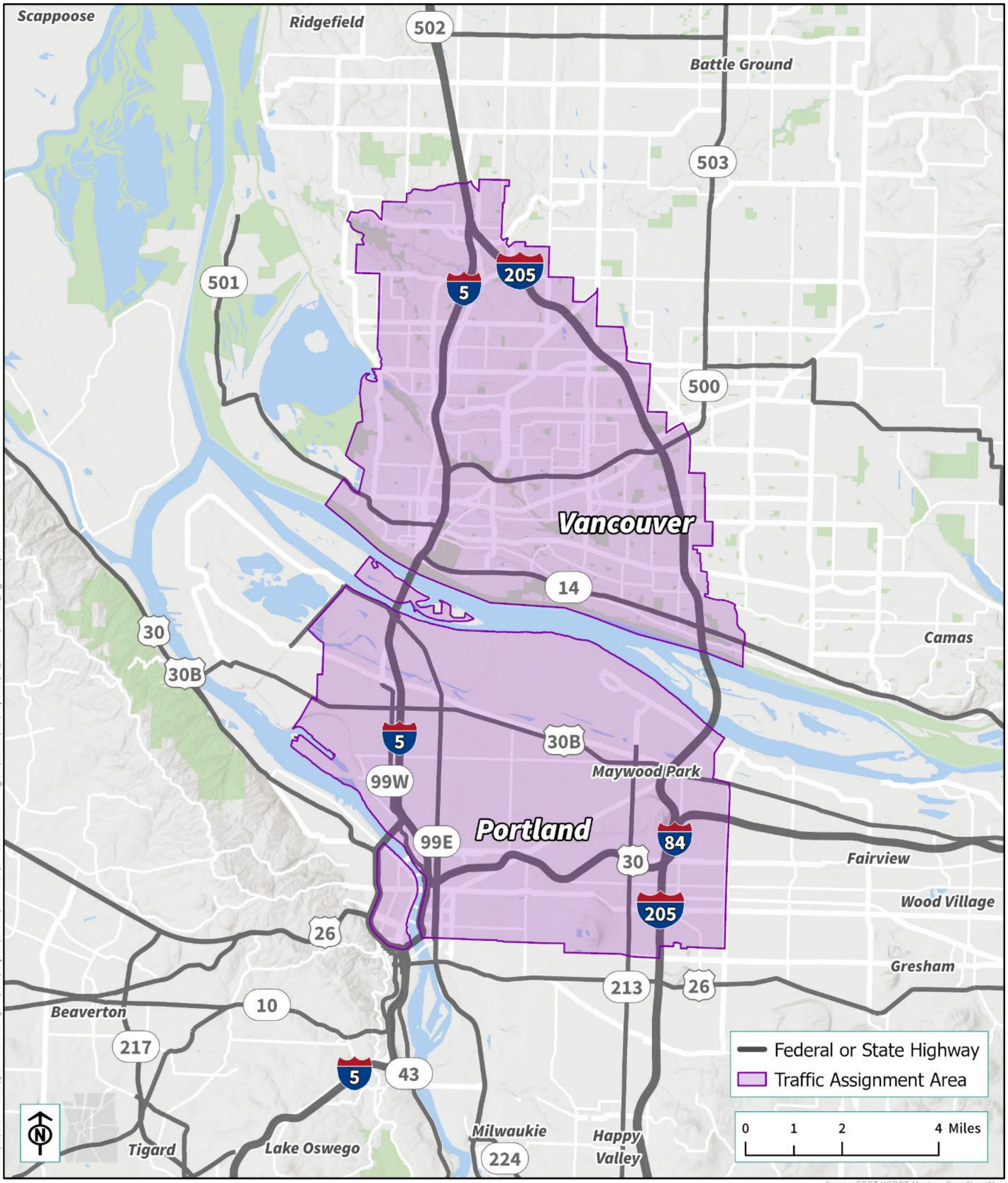


Figure 2-2. IBR Program Traffic Analysis Subarea



2.2 Regulatory and Policy Context for Climate

Washington State agencies must conduct climate-related analysis under SEPA, which requires environmental reviews that account for GHG impacts from specific projects. Accordingly, this Climate Change Technical Report, developed initially in support of the IBR Program's NEPA/SEPA Draft SEIS, has been updated in support of this technical report.

On August 1, 2016, the CEQ released the *Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews* (CEQ 2016). This guidance, as updated in January 2023 with the *CEQ Interim Guidance on Greenhouse Gas Emissions and Climate Change,* was used to inform the climate analysis published with the Draft SEIS (CEQ 2023). The guidance was rescinded by CEQ on May 28, 2025. It provided federal agencies a common approach for assessing their proposed actions while recognizing each agency's unique circumstances and authorities. The guidance explained how agencies should apply NEPA principles and existing best practices to their analysis. Its recommendations included leveraging early planning processes to:

- Consider GHG emissions in the identification of proposed actions and alternatives.
- Quantify a proposed action's projected GHG emissions or reductions for the expected lifetime of the action.
- Place GHG emissions in context and disclose relevant GHG emissions and climate impacts.
- Identify alternatives and mitigation measures to avoid or reduce GHG emissions.
- Provide additional context for GHG emissions to allow decision-makers and the public to understand tradeoffs associated with an action, including through the use of the best available social cost of GHG (SC-GHG) estimates.
- Incorporate environmental justice considerations into their analysis of climate-related effects.
- Use the information developed during the NEPA review to consider reasonable alternatives that would make the actions and affected communities more resilient to the effects of a changing climate.

As noted in Chapter 1, Introduction, although the CEQ guidance has been withdrawn, this report follows that guidance and outlines a strategy for addressing climate change in the planning, design, construction, and operation of the IBR Program Modified LPA, as well as an initial baseline for measuring potential GHG effects. The IBR Program has limited modifications to the methodology and analysis that was published in the NEPA/SEPA Draft SEIS for public review as much as possible, while continuing to comply with SEPA legislative requirements.

Multiple state, regional, and local regulations and policies guide the development and evaluation of transportation projects and local communities' management of GHG emissions. Section 5.1, Consistency with Goals, Policies, and Plans, presents an evaluation of the consistency of the IBR Program with these state, regional, and local plans, programs, and policies.

2.2.1 Federal

NEPA (42 U.S. Code 4332) requires that federal agencies consider environmental effects before taking actions that could substantially affect the human environment. There is no current federal guidance directing the analysis of climate change in NEPA documents.

2.2.2 State

Washington and Oregon requirements (legislation, executive orders) and plans related to sustainability, GHGs, and energy transition plans are organized by agency below.

2.2.2.1 Washington and WSDOT

- SEPA Rules, Washington Administrative Code (WAC) 197-11: Climate is identified in WAC 197-11-444(b)(iii) as one of the elements of the environment to be evaluated as part of SEPA analysis.
- Revised Code of Washington (RCW) 70A.45.020: GHG emissions reductions, Reporting 13 requirements – Establishes limits for anthropogenic emissions of GHG emissions for Washington State. The law commits Washington to limits of 45% below 1990 levels by 2030, 70% below 1990 levels by 2040, and 95% below 1990 levels with net zero emissions by 2050.
- RCW 47.01.440 – Statewide goals to reduce annual per capita VMT by 2050.
- State Energy Strategy (Commerce 2021) – Provides a roadmap for meeting Washington's GHG emission limits established in RCW 70A.45.020. Provides a multi-pronged strategy addressing transportation, buildings, electricity, and industry.
- WSDOT Strategic Plan (WSDOT n.d.) – Resilience Goal: Resilience is among the agency's three key areas of work and includes building a more resilient transportation system and taking a lead role in development of transportation that combats climate change and enhances healthy communities for all.

WSDOT Agency Greenhouse Gas Emissions Reduction Strategy – Lead by example by reducing agency GHG emissions.

Transportation Sector Greenhouse Gas Emissions Reduction Strategy – Reduce transportation sector GHG emissions by promoting and investing in efficient, equitable, and healthy transportation choices.

- State Efficiency and Environmental Performance Executive Order 20-01 – Directs state agencies with the largest carbon emissions (including WSDOT) to achieve reductions in GHG emissions and eliminate toxic materials from state agency operations.
- Incorporation of current and future climate change impacts by state agencies (RCW 70A.05.040) – Requires state agencies to incorporate climate resilience and adaptation actions and priority activities when designing, planning, and funding infrastructure projects.
- WSDOT Secretary's Executive Order 1113: Sustainability – Directs employees to take actions that sustain economic, environmental, and societal prosperity for current and future generations through a focus on energy efficiency, pollution reduction, and enhanced resilience.

- Washington Governor's Executive Order 21-04: State Efficiency and Environmental Performance - Zero Emission Vehicles: Builds on EO 20-01 (State Efficiency and Environmental Performance) to establish targets, processes and systems for the electrification of Washington State's fleet.

2.2.2.2 Oregon and ODOT

- Executive Order 25-29: On Reducing Greenhouse Gas Emissions and Advancing Oregon's Clean Energy Future (Oregon 2025) – Directs state agencies to foster the transition to a clean energy economy by prioritizing implementation of Oregon Energy Strategy Pathways, get clean energy projects built, and build a resilient clean energy economy. The executive order also requires state agencies to demonstrate accountability, coordination, and progress of implementation.
- Oregon Transportation Plan (ODOT 2023) – Long-range policy plan establishes vision and foundation to guide transportation system development and investment. Includes policies and strategies to increase the resiliency of the transportation system to better withstand and recover from the anticipated impacts of climate change, extreme weather, seismic and other natural disasters, and adapt to changing needs.
- Strategic Action Plan (ODOT 2024) – Three-year plan includes strategic outcomes to reduce ODOT's carbon footprint, increase fleet efficiency, and electrify Oregon's transportation system. Also includes plans to address resilience of transportation system.
- Climate Adaptation & Resilience Roadmap (ODOT 2022) – Policy and strategies to help ODOT institutionalize adaptation and resilience practices. Outlines a path forward for integrating climate change considerations into ways the agency plans for, invests in, builds, manages, maintains, and supports the multimodal transportation system.
- Climate Action Plan (ODOT 2021) – Five-year plan includes actions ODOT is taking between 2021 and 2026 to reduce GHG emissions from transportation, improve climate justice and make the transportation system more resilient to extreme weather events.
- Statewide Transportation Strategy (ODOT 2013) – The Statewide Transportation Strategy: A 2050 Vision for Greenhouse Gas Reduction is Oregon's carbon-reduction roadmap for transportation and includes strategies for substantially reducing GHG emissions from the transportation sector.
- Governor's Executive Order 20-04 – Directs State of Oregon agencies to take action to reduce and regulate GHG emissions and increases the state GHG reduction goals to at least 45% below 1990 emissions levels by 2035 and at least 80% below 1990 levels by 2050.
- Oregon Department of Land Conservation and Development – Climate-Friendly and Equitable Communities (CFEC) Adopted Amendments to Division 12 (Transportation Planning Rules): These updated rules require local governments in metropolitan areas to plan for greater development in transit corridors and downtowns; prioritize system performance measures that achieve community livability goals; prioritize investments for reaching destinations by walking, bicycling, and transit; plan for and manage parking to meet demonstrated demand; plan for needed infrastructure for electric vehicle charging; and regularly monitor and report progress. CFEC rules also require local governments to conduct Enhanced Review of Select Roadway Projects for the change in VMT resulting from induced or latent demand using best

available science. Oregon Revised Statutes 468A.205 – Sets state GHG reduction goals: by 2010 arrest the growth of Oregon's GHG emissions and begin to reduce GHG emissions, by 2020 achieve GHG levels that are 10% below 1990 levels, and by 2050 achieve GHG levels that are at least 75% below 1990 levels.

2.2.2.3 Washington and Oregon Transportation Transition Policies

Washington and Oregon have additional policies that are intended to promote a shift away from GHG emissions in the transportation sector. These are listed in Table 2-1.

Table 2-1. Washington and Oregon Transportation Transition Policies

Policy	Policy Directives
WSDOT Strategic Plan: Resilience Goal – Washington State Department of Transportation (WSDOT n.d.)	• WSDOT will plan and/or invest resources to improve the ability to mitigate, prepare for, and respond to emergencies; combat climate change; and build a transportation system that provides equitable services, improves multimodal access, and supports Washington's long-term resilience. • This includes improving the resilience of the transportation system and leading the development of transportation that combats climate change and enhances healthy communities for all.
Executive Order 21-04: Zero Emission Vehicles	• Builds on EO 20-01 (State Efficiency and Environmental Performance) to establish targets, processes, and systems for the electrification of Washington State's fleet
Washington Governor's Executive Order 20-01: State Efficiency and Environmental Performance (2020)	• When making purchasing, construction, leasing, and other decisions that affect state government's emissions of GHGs or other toxic substances, agencies shall explicitly consider the benefits and costs (including the social costs of carbon) of available options to avoid those emissions. Where cost-effective and workable solutions are available that will reduce or eliminate emissions, decision makers shall select the lower-emissions options.
Revised Code of Washington (RCW) 70A.45.020: GHG emissions reductions, Reporting 13 requirements	• Establishes limits for anthropogenic emissions of GHG emissions for Washington State. The law commits Washington to limits of 45% below 1990 levels by 2030, 70% below 1990 levels by 2040, and 95% below 1990 levels with net zero emissions by 2050.
RCW 70A.45.050: GHG emissions limits for state agencies	• Sets GHG limits for state agencies and establishes reporting requirements. By 2050, state agencies shall reduce overall emissions of greenhouse gases to forty-seven thousand metric tons, or ninety-five percent below 2005 levels and achieve net zero greenhouse gas emissions by state government as a whole.

Policy	Policy Directives
Climate Commitment Act – Washington State Department of Ecology (Ecology n.d.)	• Directed by Washington State Legislature to design and implement a cap-and-invest program to reduce statewide GHG emissions. This program works by setting an emissions limit, or cap, and then lowering that cap over time to ensure Washington meets the GHG reduction commitments set in state law (95% reduction of GHGs by 2050). The State Legislature invests funds from credit sales in projects and programs to reduce emissions. For transportation, these include public transportation, active transportation, and low-carbon energy/fuels programs.
Washington Clean Vehicles Program (Chapter 173-423 WAC)	• Adopt California's Heavy-Duty Engine and Vehicle Omnibus rules. • 100% of sales of light-duty vehicles sold in Washington will be electric by 2035. • Requires increasing the number of new ZEVs sold in Washington until all new vehicles meet the ZEV standard starting in 2035.
Washington Clean Fuels Program (RCW 70A.535)	• Requires fuel suppliers to reduce the carbon intensity of transportation fuels to 20% below 2017 levels by 2038.
Washington Clean Energy Transition Act (UTC n.d.)	• 100% of electricity sold in Washington will be renewable by 2045.
Oregon Climate Protection Program (DEQ 2021a)	• 50% reduction by 2035 and 90% reduction by 2050 in emissions for covered fossil fuel suppliers (from 2017–2019 average emissions).
Oregon Clean Fuels Program (DEQ 2022)	• 10% reduction by 2025. • In March 2020, Governor Brown issued Executive Order 20-04 to amend low-carbon fuel standards and schedule to phase in implementation with the goal of 20% below 2015 levels by 2030, 25% below 2015 levels by 2035. (The Oregon Clean Fuels Program Expansion was adopted by the Environmental Quality Commission in October 2022 and is effective as of January 1, 2023.)
Oregon Clean Energy Targets (DEQ n.d.[a])	• Targets for reducing GHG emission from electricity in Oregon from baseline (average annual emissions for 2010, 2011, and 2012): 80% below baseline emissions by 2030. 90% below baseline emissions by 2035. 100% below baseline emissions by 2040.
Oregon Zero Emission Vehicle (Senate Bill 1044) (ODOE n.d.)	• At least 250,000 registered motor vehicles will be ZEV by 2025. • At least 25% of registered motor vehicles, and at least 50% of new motor vehicles sold annually, will be ZEV by 2030. • At least 90% of new motor vehicles sold annually will be ZEV by 2035.
Oregon Clean Car Standards (DEQ n.d.[b]) and Advanced Clean Cars II (DEQ n.d.[c])	• The DEQ is beginning a rule-making process to adopt California's Advanced Clean Cars II rule, which would require all light-duty vehicle sales in Oregon to be zero emission by 2035.

Policy	Policy Directives
Oregon Clean Truck Rules 2021 (DEQ n.d.[d]) and Advanced Clean Trucks (DEQ 2025b)	• Requires manufacturers of medium- and heavy-duty vehicles to sell a certain percentage of ZEVs beginning with 2027 vehicle model year: ➢ 75% zero-emission sales for Class 4-8 rigid trucks by 2035. ➢ 55% zero-emission sales for Class 2b-3 pickup trucks and vans by 2035. ➢ 40% zero-emission sales for Class 7-8 tractor trucks by 2035.

DEQ = Oregon Department of Environmental Quality; EO = executive order; GHG = greenhouse gas; RCW = Revised Code of Washington; WSDOT = Washington State Department of Transportation; ZEV = zero-emission vehicle

2.2.3 Local

This section lists local guidance, policies, and plans related to climate. Section 5.1, Consistency with Goals, Policies, and Plans, describes key aspects and evaluates the IBR Program's consistency with these documents and directives.

2.2.3.1 City of Portland

- Climate Emergency Declaration (City of Portland 2020a).
- Climate Emergency Workplan 2022–2025 (City of Portland 2022).
- Climate Action Plan Final Progress Report (City of Portland n.d.[a]).
- Climate Emergency Declaration, Ordinance No. 37494, as amended.
- Transportation System Plan Chapter 2, Goals and Policies (City of Portland 2020b).
- Pricing Options for Equitable Mobility (City of Portland n.d.[b]).

2.2.3.2 Oregon Metro

- Regional Transportation Plan and Regional Transportation Plan Appendix J: Climate Smart Strategy Implementation and Monitoring (Metro 2023).
- Climate Smart Strategy for the Portland Metropolitan Region (Metro 2015).

2.2.3.3 TriMet

- Making Transit Better: Cleaner Environment (website) (TriMet n.d.).

2.2.3.4 Port of Portland

- Our Environment: Climate Change Strategy (Port of Portland n.d.[b]).
- Environmental Objectives and Targets 2016–2017 (Port of Portland n.d.[a]).

2.2.3.5 City of Vancouver

- Climate Priority Resolution (City of Vancouver 2022a).

- Climate Action Plan (City of Vancouver 2022a).
- Climate Action Framework (City of Vancouver 2022a).

2.2.3.6 C-TRAN

- C-TRAN Mission and Vision (C-TRAN 2018).

2.2.3.7 Port of Vancouver

- Climate Action Plan (Port of Vancouver 2021).

2.2.3.8 Southwest Washington Regional Transportation Council

- The Unified Work Program for Fiscal Year 2023 (2022) directs the RTC to pursue state strategies to reduce VMT per capita and to help reduce GHG emissions.

2.2.3.9 Multnomah County

- Climate Action Plan Final Progress Report 2020 (Multnomah County 2020).

2.2.4 Corporate and Private Commitments

In the private sector, entrepreneurial strategies, international market forces, shareholder pressure, and technological advances for vehicles are all expediting the electrification of transportation beyond what is driven by federal policies and programs. California's steady advancement of regulation has further driven the transition of the world's largest auto manufacturers to electric vehicles, affecting the national and international markets. Parallel to the change in vehicle powertrains is the shift away from carbon-based electricity sources, which will result in decarbonization of the transportation sector over time. Examples of electric vehicle production timelines and commitments by major manufacturers are shown in Table 2-2. These are in addition to manufacturers that are solely serving the electric vehicle market (e.g., Tesla, Rivian, Lucid).

Table 2-2. Corporate and Private Commitments to Transportation Transition

Manufacturer	Goal	Metrics and Tactics
Hyundai (Genesis, Kia, Ioniq)	**Carbon neutral across all stages by 2045 (including parts procurement, production, and vehicle operation) (Hyundai Motor Company n.d.).**	• 60% renewable energy in factories by 2045, 90% by 2040, 100% by 2045. • 100% electrification (through battery-electric vehicles and fuel-cell electric vehicles) in European market by 2035 and major markets by 2040. • Genesis: Electrification across all new models starting in 2025 with 100% electrification by 2030.
GM (Chevrolet, Buick)	Carbon neutral in global products and operations by 2040 (General Motors 2022).	• More than 1 million units of EV capacity in North America and more than 2 million globally by 2025. • Eliminate tailpipe emissions from new light-duty vehicles by 2035.

Manufacturer	Goal	Metrics and Tactics
Ford	Carbon neutrality globally across vehicles, operations and supply chain no later than 2050 (Ford Media Center 2022).	• Science-based interim targets by 2035. • Sales of all new cars and vans will be zero emissions by 2040 globally, no later than 2035 in leading markets. • Zero emissions for all vehicle sales in Europe and carbon neutrality across Ford's European footprint of facilities, logistics and suppliers by 2035. • Five new Ford electrified cars by 2024 and 40% of global car volume all-electric by 2030 (Chalmers Ford 2022).
Stellantis (Fiat, Chrysler)	Carbon neutral by 2038 (Stellantis 2022).	• Reducing emissions by half by 2030. • 100% battery-electric vehicle sales in Europe and 50% in the U.S. by 2030.
Honda	Carbon neutral for all products and corporate activities by 2050 (Honda Motor Company 2022).	• Launch 30 EV models globally by 2030.
Toyota and Lexus (Toyota n.d.)	Zero emissions from new vehicles by 2050.	• Offer electrified versions of Toyota and Lexus models by 2025. • 40% of new vehicle sales in the U.S. will be EVs by 2025. • 70% of new vehicle sales in the U.S. will be EVs by 2030. • Carbon neutral in all manufacturing plants by 2035, eliminating emissions from energy use at facilities by 2050. • Zero life-cycle emissions by 2050.
Nissan	Carbon neutral across company's operation and life cycle of products by 2050 (Nissan Motor Corporation 2021).	• 100% of all new vehicle offerings electrified in key markets by the early 2030s.
Volkswagen	40% reduction in emissions in Europe by 2030 (Volkswagen A.G. 2021).	• Invest 14 billion euros in decarbonization by 2025. • Net carbon neutral for production, supply chain, and vehicles by 2050. • 70% of unit sales in Europe will be all- EVs by 2030, 50% in North America and China.

Manufacturer	Goal	Metrics and Tactics
Volvo	Reducing emission across value chain to become a climate-neutral company by 2040 (Volvo Car Corporation n.d.).	• Reduce life cycle emissions per car by 40% by 2025. • Reduce tailpipe emissions by 50% per car by 2025 (2018 baseline). • Climate-neutral global manufacturing operations by 2025. • Fully electric car company by 2030 (sell only fully electric cars) (Volvo Car Corporation 2021).
Mercedes-Benz Group	Carbon neutral by 2039 (across automotive value chain) (Mercedes-Benz Group n.d.).	• All new vehicle architectures will be electric-only from 2025 onward.

EV = electric vehicle

2.3 Data Collection Methods

Data used to support the climate analyses were derived from the analysis in the Transportation Technical Report (for VMT and mode shift estimates) and the September 2024 Energy Technical Report published with the Draft SEIS for estimates of energy use and GHG emissions associated with construction and operation of the Modified LPA.

Climate data were collected to understand existing conditions and forecasts of extreme weather and other changes in future climatic conditions. The analysis also draws on quantitative data and findings from other relevant discipline reports, including physical impacts from construction and long-term operation. The report presents GHG emission estimates for both construction and operational impacts. Qualitative data draw from multiple government and academic sources. The following sections summarize the specific data sources that are used to assess benefits and adverse impacts.

The quantitative analysis draws from sources including:

- The Climate Mapping for Resilience and Adaptation portal (NOAA n.d.) developed by federal partners with support from Esri.
- University of Washington Climate Impacts Group.
- Data to identify sensitive populations, including:
  - 2020 U.S. Census.
  - 2016–2020 American Community Survey.
  - Metro Regional Land Information System.
  - 2022 Point in Time Counts (Multnomah and Clark Counties).

The analysis also incorporates qualitative data derived from the IBR Program's community and agency engagement activities, which include listening sessions, partnerships with local agencies, and others.

2.4 Analysis Methods

This Climate Change Technical Report evaluates both the potential benefits and the anticipated adverse impacts to climate resulting from the Modified LPA. VMT and mode shift estimates are described in the Transportation Technical Report. Estimates of the resulting GHG emissions associated with operation and the estimated energy use and GHG emissions associated with construction were described in the September 2024 Energy Technical Report published with the Draft SEIS. This report references these data and provides additional context and description of next steps. The impacts analysis also includes a discussion of how climate change would compound adverse impacts to affected resources. Specifically, it addresses resources that would be more vulnerable to the impacts of the Modified LPA due to the effects of climate change (e.g., flooding, ecosystem resources, and vulnerable communities).

2.4.1 Benefits Analysis

One of the objectives of the IBR Program is to provide expanded transit and multimodal transportation options. The benefits analysis examines the extent to which the Modified LPA furthers this objective across improvements by infrastructure type (high-capacity transit, bicycle/pedestrian, and highway). Mode shift and reduction of VMT would result in lower GHG emissions for the Modified LPA as compared to the No-Build Alternative. The results of the Transportation Technical Report were used to inform the benefits analysis, developed in the September 2024 Energy Technical Report, and summarized in the Climate Report. The benefits analysis also includes a review of climate resiliency and adaptation approaches pursued by the Program.

2.4.2 Adverse Impacts Analysis

2.4.2.1 Direct Impacts

This report relies on quantities calculated in the September 2024 Energy Technical Report to present potential emissions of GHGs. These include emissions associated with construction and the future year transportation operations. The September 2024 Energy Technical Report includes a detailed description of the methods used to develop the estimates. The Final SEIS developed for NEPA did not update the MOVES model, and thus the GHG estimates used in this report are the same as those presented in the September 2024 document. Updates to the calculations for energy use associated with construction identified a minor decrease in anticipated energy use from the Modified LPA (approximately 0.16% less than presented in the Draft SEIS analysis), which would correspond to a similar estimated reduction in the GHG analysis. However, because the September 2024 document included a range of estimates for different design options, those numbers are retained in this report.

2.4.2.2 Indirect Impacts

Indirect impacts are growth-inducing effects and other effects related to induced changes in patterns of land use, population density, or population growth rate. The Land Use Technical Report evaluates the potential for induced land use growth associated with the IBR Program.

2.4.2.3 Cumulative Impacts

Cumulative impacts may occur when the Program's effects are combined with those from past, present, and reasonably foreseeable future projects or programs. They can also result from individually small but collectively significant actions that occur over a long period of time. The analysis in this report addresses long-term effects and defines how the Program will provide opportunities for developing resilient infrastructure and minimizing the contribution of the transportation sector to climate change. It also considers the compounded effects on resources due to their vulnerability to the effects of climate change. The Cumulative Effects Technical Report addresses other potential cumulative impacts.

The cumulative impacts section also includes an estimate of the social cost of carbon (SCC). The climate damages from the combination of construction emissions, transit operations, and benefits accruing from decrease in roadway use compared to No-Build were monetized using estimated SCC from 2024 federal sources and Washington and Oregon 2025 estimates. The calculations are described in more detail in Section 5.7, Cumulative Greenhouse Gas Changes and the Social Cost of Carbon .

2.4.3 Mitigation

State legislation and policy support reducing emissions from transportation to help mitigate the impacts of climate change; however, there are no specific requirements for mitigation actions in federal, state, or local regulations. A number of measures can be implemented to reduce GHG emissions from construction and transportation operations and otherwise protect infrastructure, communities, and ecosystems against the escalating climate crisis.

Measures to reduce operational GHG emissions are assumed to be those that reduce private vehicle travel demand, increase transit and nonmotorized mode shares, use transit technology that eliminates or reduces the use of fossil fuels (e.g., battery-electric buses, light-rail), and improve traffic flow along I-5 between Vancouver and Portland. Measures that are integrated into the IBR Program will be qualitatively evaluated.

Measures taken to reduce the energy consumed by the construction of the Modified LPA would encompass conservation of construction materials, fuels used during construction, and best management practices. The September 2024 Energy Technical Report includes a discussion of potential best management practices and their expected benefits.

Further best management practices and mitigation measures will be considered in coordination with project partners and subject to developing regulations and standards for transportation projects. For example, the City of Vancouver, in a comment submitted in response to the Draft SEIS, requested that the Program "consider and incorporate into the mitigation the following CBAG [Community Benefit Advisory Group] recommendation: use material options that are sustainable and environmentally friendly (balancing decisions to use low carbon materials, costs, and life of materials) into the program design, including local elements (examples include ash and shells). Consider other emissions as well." The IBR Program is working on recommendations for sustainable solutions and is using the Envision rating system to document impacts and shape improved outcomes. A sustainability rating system allows projects and programs to systematically score and rate their efforts, and the external system provides accountability and comparisons to other national and international projects. The

Envision system includes ratings for five categories: Quality of Life, Leadership, Resource Allocation, Natural World, and Climate and Resilience.

3. IBR PROGRAM CLIMATE OVERVIEW

The IBR Program aims to build resilient infrastructure that contributes to the reduction of GHG emissions in accordance with local, regional, and state goals. The Program supports these goals by providing safe, efficient, and accessible multimodal solutions for people traveling across the Columbia River and North Portland Harbor. The Program's climate framework, introduced in Section 1.4, IBR Program Climate Framework, guides Program-related work, including desired outcomes, screening criteria, Program-level performance measures, intergovernmental and community benefits agreements, and construction specifications and procurement strategies.

Current climate challenges within the Program area include limited capacity for low-emissions travel modes (e.g., walking, biking, and rolling), constrained/limited transit options, and significant congestion, which results in idling vehicles that contribute to GHG emissions. The IBR Program is committed to seeking outcomes that reduce GHG emissions within the Program area, minimize operational and construction emissions, produce structures resilient to climate disruptions, and limit environmental impacts that exacerbate the effects of climate change.

3.1 Climate Considerations in Planning and Design

Climate considerations guide planning for all areas of work on the IBR Program, including design, construction, operation, and maintenance. The effort falls into three broad categories of actions: reducing GHG emissions, managing risks, and building for resiliency. Approaches to these efforts are outlined below.

- Reduce GHG impacts by implementing Program components:

Improved transportation options (to facilitate mode shift).

Implementation of demand management (e.g., variable-rate tolling).

Optimized construction approaches.

Operations and maintenance efficiencies (e.g., auxiliary lanes, ramp meters).

- Evaluate risks to determine the consequences of climate hazards in the following categories: social (people, community); environmental (contamination, destruction); and economic (cost of repair, financial losses).
- Optimize the resiliency of the infrastructure by addressing vulnerability from natural hazards.

Local partners can support further acceleration toward GHG reductions by implementing complementary services and policies, such as:

- Providing higher frequency mass transit and deeper investments in transit.
- Approving and encouraging land uses that reduce single-occupant vehicle trips.
- Providing mobility hub options.

Questions the IBR Program will continue to address in ongoing design include:

- How will future climate affect our natural systems and our infrastructure?

- How will historically vulnerable people be affected by climate change?
- How can the IBR Program lessen the climate impacts for equity priority communities?
- How can we design resilient infrastructure?

3.2 Climate Strategies and Partnerships

Oregon and Washington have laws, guidance, and policies that are requiring the transition to near-zero use of GHG fuels and energy sources by 2050; the transition is underway in both the vehicle fleet and the electricity grid. The transition will not be complete until after the 2045 future year evaluated in the SEIS, and thus some GHG emissions from the Program will be unavoidable. For example, for the construction of the Modified LPA, GHG emissions are unavoidable, but the Program is committing to GHG-reducing practices to minimize fuel and embodied emissions from construction materials to the extent that it is practical.

Project partners have expressed interest in tangible measured outcomes related to climate change and the IBR Program. There are multiple ways to decrease GHG emissions associated with transportation:

- Reduce the carbon in fuels or electricity used to move people and goods (e.g., electric vehicles powered from renewable power sources, renewable diesel, green hydrogen, renewable natural gas, greater fuel efficiency, land use changes that reduce vehicular travel).
- Change how and how far we travel and transport goods using gasoline and diesel-powered vehicles (e.g., shift to transit and more efficient freight modes).
- Increase the efficiency of the miles traveled (e.g., shift modes, reduce congestion).

The IBR Program seeks to move people and goods more efficiently by providing improved multimodal options (supporting mode shift), implementing tolling (reducing demand and congestion), improving safety and traffic flow (reducing congestion and improving reliability), and modernizing a crucial link of our regional infrastructure, thereby enabling shifts to a cleaner future.

In addition to the types of measures noted above, policy direction is an important component of planning for GHG reduction and climate resiliency. Table 3-1 describes how ODOT and WSDOT can lead, partner in, or support policies and programs that reduce GHG emissions or support resiliency for future conditions. Such programs and policies at all levels of government and in the private sector have been successful in maintaining accountability for groups ranging from manufacturers to individual consumers in reducing the transportation sector's contribution to global GHG emissions.

The alignment of the IBR Program with regard to local, regional, and state goals, policies, and plans is evaluated in Section 5.1, Consistency with Goals, Policies, and Plans. Specific climate-supporting strategies are considered in Chapter 6, Designing for Resiliency.

Table 3-1. ODOT and WSDOT Roles in Policies, Plans, and Programs to Reduce Greenhouse Gases and Support Resiliency

Role	Description
Lead	ODOT and WSDOT will be in lead roles for issues related to ODOT- or WSDOT-owned and/or operated roads/highways and ODOT- or WSDOT-led policies and programs. These issues and programs are the primary and traditional mission of ODOT and WSDOT ODOT. Examples include the design, permitting, and construction of bridges, interchanges, and multimodal facilities, along with financing, tolling, and highway maintenance.
Partner	This role applies to situations where ODOT and WSDOT policies, plans, programs, and funding impact local governments and other agencies, but the DOT is not the lead (e.g., transit service providers,[a] electricity grid improvements, and charging stations).
Support	This role applies to situations where the DOT does not have decision-making authority or investments to contribute, but ODOT and WSDOT can support other agencies or private entities (e.g., land use planning, employer and industry location decisions).

a As the lead transit agencies for the IBR Program, TriMet and C-TRAN will be responsible for owning, operating, and maintaining the expanded transit service constructed as part of the Program.

3.3 Climate and Equity Considerations

Large transportation infrastructure projects have historically harmed many low-income communities and communities of color. The IBR Program is committed to centering equity in all aspects of work, not only to avoid further harm to equity priority communities, but also to ensure they have a voice in helping shape Program work and are able to realize economic and transportation benefits. As the Program progresses, designing for resilience and plans for mitigation will incorporate an equity lens in an effort to build toward climate justice and equitable resilience. The IBR Program's community and partner engagement efforts seek to understand and address the needs of equity priority communities.

Engagement with tribes, particularly in consideration of impacts and changes to tribal lands and traditional cultural practices associated with the Columbia River and surrounding area, supports the IBR Program's equity work. The Equity Technical Report contains more information about the IBR Program's efforts to engage with these communities and address their needs.

The following additional equity-focused measures are being taken or considered by the Program:

- Equitable tolling approaches, including the potential for sliding scales for different types or workers (e.g., working people who bring equipment with them to the job, income thresholds, and shift workers).
- Design that is safe and comfortable for all users to walk, bike, and roll on the active transportation facility.
- Design that accommodates users of all abilities (e.g., sight-impaired community members) to reduce barriers to using transit and active transportation modes.

- Provision of tree canopy, vegetation, or bridge structure to create shaded areas for respite during heat waves.
- Open spaces, pathways, and other facilities built to withstand increased flooding.
- Mitigation of heat island effects with primary focus on areas where data has shown disproportionate impacts on low-income or disadvantaged populations.
- Transportation demand management program assistance for workers to access job sites (e.g., providing supplemental transit, carpool, or other low-carbon transportation options for workers) during the Program's construction phase.

Additional approaches could be considered by partners, including:

- First- and last-mile solutions and transit network improvements to ensure that people can get to and from destinations on time.
- Changes in land use and development to better support mobility and social health.
- Reduced or free transit fares to reduce barriers to use.
- Subsidies or other incentives for electric vehicles, bicycles, or other low- or no-carbon modes.

The Equity Technical Report and the Environmental Justice Technical Report describe these efforts and provide an evaluation of Modified LPA impacts to equity priority communities, efforts to minimize or mitigate those impacts, and efforts to progress toward equity in engagement processes and Program outcomes. The IBR Program has established six equity objectives:

1. Mobility and accessibility – Improve mobility, accessibility, and connectivity, especially for lower income travelers, people with disabilities, and historically underserved communities who experience transportation barriers.
2. Physical design – Integrate equity, area history, and culture into the physical design elements of the Program, including bridge aesthetics, artwork, amenities, and impacts to adjacent land uses.
3. Community benefits – Find opportunities for and implement local community improvements in addition to required mitigations.
4. Workforce equity and economic opportunity – Ensure that economic opportunities generated by the Program benefit minority and women owned firms, Black, Indigenous, and People of Color (BIPOC) workers, workers with disabilities, and young people. The Program will engage with both federally recognized Indian tribes with Tribal Employment Rights Offices and those without.
5. Decision-making processes – Prioritize access, influence, and decision-making power for Equity Priority Communities throughout the Program in establishing objectives, design, implementation, and evaluation of success.
6. Avoid further harm – Actively seek out options with a harm-reduction priority rather than simply mitigate disproportionate impacts on historically impacted and underserved communities and populations.

4. PLANNING FOR ADAPTATION AND RESILIENCY

The effects of climate change are already underway,[23] and more changes are predicted in the years ahead. Future-ready infrastructure design must anticipate a range of potential climate scenarios that accommodate future climate uncertainty. Thus, the IBR Program is working to understand, anticipate, and design improvements to address the effects of climate changes on the region and for the Program. For example, under extreme heat, concrete and asphalt roads can buckle and distort, steel train tracks and cables can warp and sag, and bridge joints can expand. Increased storms and precipitation could affect stormwater systems, and changes in summer precipitation could affect planting choices and drive maintenance needs. This chapter explores these topics.

The IBR Program is using the best available information from Oregon and Washington and their supporting climate research centers (University of Washington and Oregon State University), as well as other information from relevant agencies, such as Bonneville Power Administration, the U.S. Army Corps of Engineers, Federal Emergency Management Agency (FEMA), National Oceanic and Atmospheric Administration, and the U.S. Coast Guard, to determine the likely range of conditions the bridge will experience through during its expected design life. Climate considerations include:

- Temperature increases – Longer and more frequent heat waves in summer months; higher average temperatures year round.
- Precipitation changes – Increased ice and snow, heavy precipitation and stormwater management; changes in seasonal flows.
- Stormwater and flooding – Increased flooding and landslides (especially adjacent to access points).
- Fire risk – Increased wildfires, smoke intrusion.
- Additional concerns – Increased storm and wind intensity, landslides.

4.1 Climate Models and Greenhouse Gas Concentrations

Globally, GHG concentrations have risen substantially because of human activities and are changing life on our planet. To make projections of future climate, scientists use “what if” scenarios of plausible future GHG emissions to drive computer model simulations of the earth’s climate. There are numerous global climate models (each constructed slightly differently), and multiple techniques for “downscaling” coarse global model projections to local scales. Scientists apply a range of GHG scenarios to understand the breadth of possible future outcomes, which depend heavily on our global actions in the years ahead. The range reflects some of the important unknowns regarding future understanding of the climate system.

Regional modeling is conducted by area-specific modeling centers such as the Northwest Climate Resilience Collaborative hosted by the University of Washington, which includes 10 research, community-based, and non-profit organizations across the Northwest (University of Washington n.d.).

[23] The EPA reports indicators of observed effects across a multitude of factors (EPA 2025)

The Climate Toolbox created and maintained by the Climate Impacts Research Consortium is the source of the climate projections (Climate Impacts Research Consortium n.d.).

Climate change impacts are often assessed by first downscaling coarse-resolution global model projections to local scales. Global climate models simulate changes at coarse spatial scales (50 to 100 miles from one grid cell to the next). Therefore, they do not adequately represent local-scale weather and climate patterns. Downscaled climate projections translate these coarse-resolution global model projections to a level of detail that is more relevant to management and decision-making. This increased resolution (usually about 5 to 10 miles from one grid cell to the next) often provides a better representation of local climate, but it also entails additional assumptions, which means that different approaches can give different results.

There are two different approaches to downscaling global climate projections to local climate projections:

1. "Statistical downscaling" uses observed relationships between weather observations and coarse-scale global climate model weather patterns. An advantage of statistical downscaling is that it is inexpensive to implement. A disadvantage is that it does not capture the local-scale processes that can alter the response to warming at any given location.
2. "Dynamical downscaling" uses a physical model, such as a regional climate model, that is driven by coarse-resolution global climate model weather patterns. An advantage of dynamical downscaling is that the model can capture important local-scale changes that cannot be represented with a statistical approach. A disadvantage is that it is expensive to implement, although regional climate model simulations are becoming increasingly feasible.

To bracket the potential range of future climates, the scientific community has defined a set of four different climate scenarios called Representative Concentration Pathways (RCPs), all considered possible depending on the volume of GHG emitted in the years to come. These scenarios, which are used in modeling global and regional climate impacts, represent differing concentrations of GHGs in the atmosphere.[24] The four scenarios are:

- Very low emissions, high mitigation – RCP 2.6
- Low emissions – RCP 4.5
- Moderate emissions – RCP 6.0
- High emissions – RCP 8.5

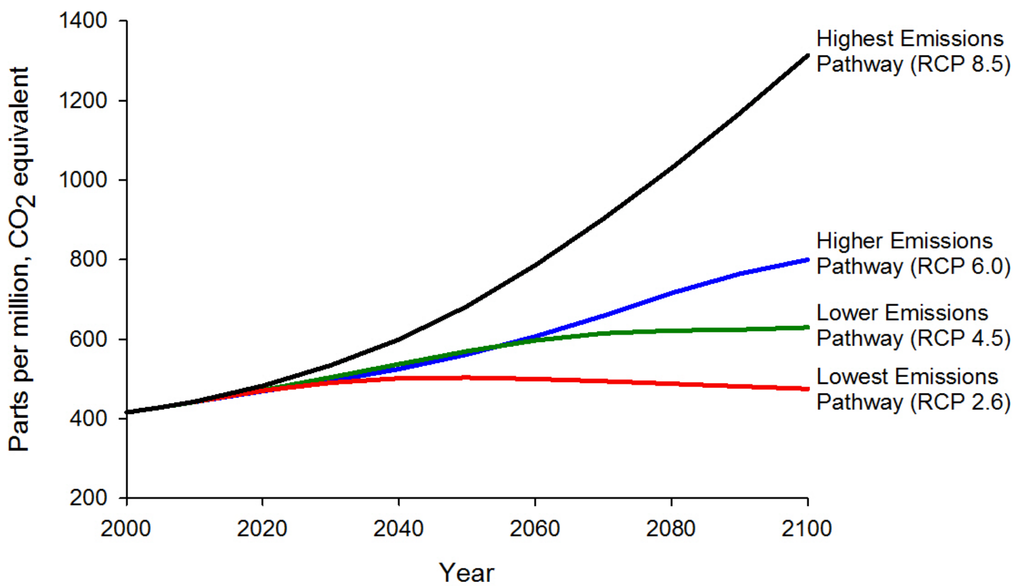
These scenarios are associated with a broad range of potential future effects and were selected to represent a range of possible future climate conditions to plan for the resilience of IBR Program investments. RCP 2.6, a lower-emissions scenario, was not used because it assumes that global GHG emissions would have peaked by 2020, which did not occur. Planning for the higher-emissions scenarios (e.g., RCP 4.5 or RCP 8.5) as a conservative measure means that the IBR Program would be

[24] Although the more recent CMIP6 modeling experiment is underway, this technical analysis used the range of potential future climates provided by the CMIP5 modeling experiment. The Intergovernmental Panel on Climate Change has accepted the RPCs. The emissions scenarios and models used in CMIP6 were not available at the scale and applicability that was needed for this analysis. As the new models are used to adjust downscaled forecasts for the study area, the IBR Program analysis will be updated as appropriate.

resilient in a range of future conditions and would accommodate a lower-emissions scenario should global policies and emissions accelerate reductions. Thus, this report focuses on RCP 4.5 and RCP 8.5 to bracket the data presented.

The scenario descriptors are based on cumulative emissions by 2100 for each scenario. In all RCPs, atmospheric carbon dioxide (CO_2) concentrations are higher in 2100 than at the present day because of further increase in cumulative emissions of CO_2 to the atmosphere during the 21st century. Because the climate system responds slowly to changes in GHG concentrations, the differences among the RCPs in GHG concentrations do not become pronounced until after the middle of the 21st century, as shown in Figure 4-1. For analyses after mid-century, it is important to distinguish between different RCPs. RCP 8.5 predicts a much more rapid warming than other scenarios and more pronounced changes in important indicators such as river flow, water temperature, and precipitation.

Figure 4-1. Projected Atmospheric Greenhouse Gas Concentrations



Source: EPA n.d.

Figure 4-1 shows projected GHG concentrations for the four different emissions pathways. The highest (top) pathway (RCP 8.5) assumes that GHG emissions will continue to rise throughout the current century. The lowest (bottom) pathway (RCP 2.6) assumes that emissions reach a peak between 2010 and 2020, declining thereafter.

Because there are many variables involved in climate, it is not possible to predict exactly how climate change will play out into the future. As a result, modeling of future climate change must account for uncertainty. Sources of uncertainty in climate forecasting include:

- Uncertainty in levels of anthropogenic forcing due to different emission paths (“scenario uncertainty”).
- Uncertainty due to natural variability, encompassing internal chaotic climate variability and externally driven (e.g., solar, volcanic) natural climate change (“natural variability”).

- Uncertainty in the climate system's response to external forcing due to incomplete knowledge of feedback and timescales in the system ("response uncertainty").

Acknowledging uncertainty allows for a range of actions beyond the present or near-term future. Ultimately, uncertainties in climate projections are unknowable since they can only be verified in the future.

4.2 Expected Future Conditions Resulting from Climate Change

In the next century, the Portland-Vancouver region is projected to experience an increase in average temperature and in the number of extremely hot days. Additionally, changes to patterns of heavy precipitation are expected. While the region is projected to experience roughly the same annual volume of rain, it is expected to arrive as more severe storm events (for example, atmospheric rivers). Increasing global temperatures may yield more precipitation falling as rain rather than snow, including in the Cascade Mountains and Columbia River Basin. Rain falling on snow can further reduce accumulated snowpack, which would result in higher river flows during the rainy season and longer flows during the summer. Increased winter river flows and the prevalence of severe storms result in a higher chance of flooding, which could impact low-lying land in the IBR Program study area. Paradoxically, although the mean temperature will increase, there is still expected to be up to a week of freezing nights through the end of the century. Therefore, an overall increase in winter storms will likely also create an increase in storms bringing ice and snow, especially since temperatures need not be below freezing to produce snow and ice. These effects have implications for both the construction and operation of the Modified LPA. Chapter 6, Designing for Resiliency presents design considerations related to these future effects.

4.2.1 Temperature Increases

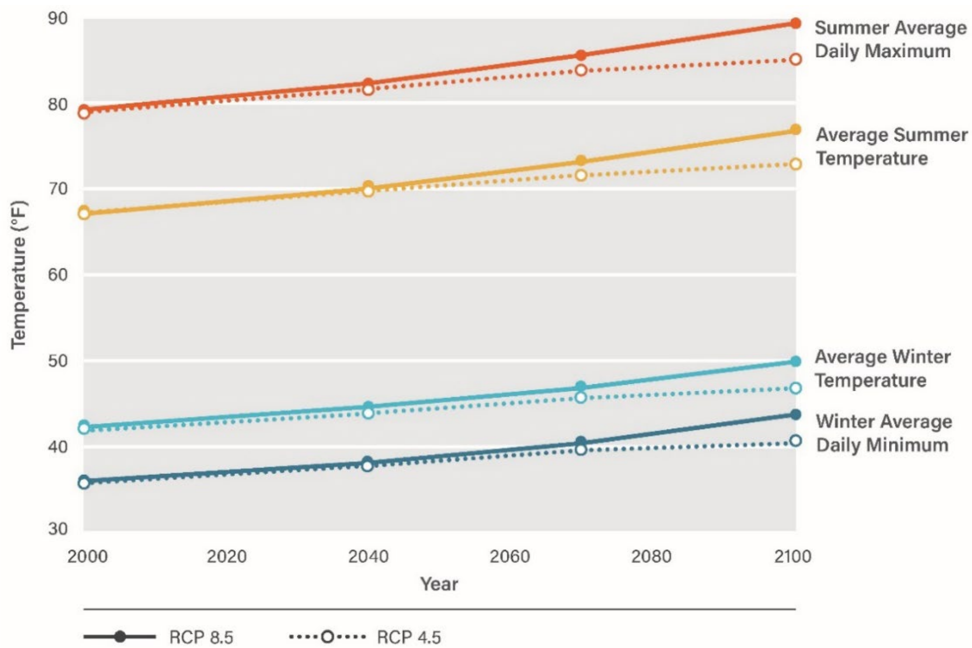
In each of the RCP scenarios, the average temperatures will increase. Figure 4-2 shows future temperature predictions for the study area for the RCP 4.5 (lower) and 8.5 (highest) scenarios. The earth has already exceeded a global average of 1 degree Celsius (°C) (1.8 degrees Fahrenheit [°F]) of warming and is expected to reach 1.5°C (2.7°F) of warming in the next decade. The most optimistic emissions targets cap warming at 1.5°C (2.7°F); however, if current emissions rates are maintained, warming is predicted to exceed 4°C (7.2°F) globally by 2100.

Using the Climate Toolbox developed by Climate Impacts Research Consortium,[25] climate projections are available for user-defined geographies. The following projections are reported using a point on the Interstate Bridge. Thus, with the current pace of emissions reductions or better, the average temperatures in the Program area are expected to climb 5°F to 8°F by the end of the century. The increase in temperature will be most evident in the summer months, where the average temperature will climb 5.5°F to 9.5°F, with an increase in average daily maximum temperatures of 6°F to 10°F (Figure 4-2).

[25] The Climate Impacts Research Consortium is a multi-agency group; the University of California at Merced developed the climate toolbox, available at https://climatetoolbox.org/.

The increase in average temperatures may seem relatively small, but it is in the temperature extremes where the danger lies. Currently, the Portland metropolitan area experiences mild summer weather, where only 5 to 6 days per year have a heat index over 90°F and a heat index over 100 may happen once per year. Heat waves lasting more than a day or two have been significant public health crises. In the future, 30 to 60 days each year are predicted to have temperatures over 90°F in the RCP 4.5 and RCP 8.5 scenarios. Likewise, days over 100°F are likely to become at least as common as days over 90°F are now (Figure 4-3). In addition, days with heat indices over 105°F will go from a once-in-a-decade phenomenon to up to 10 days every year (Merced n.d.).[26]

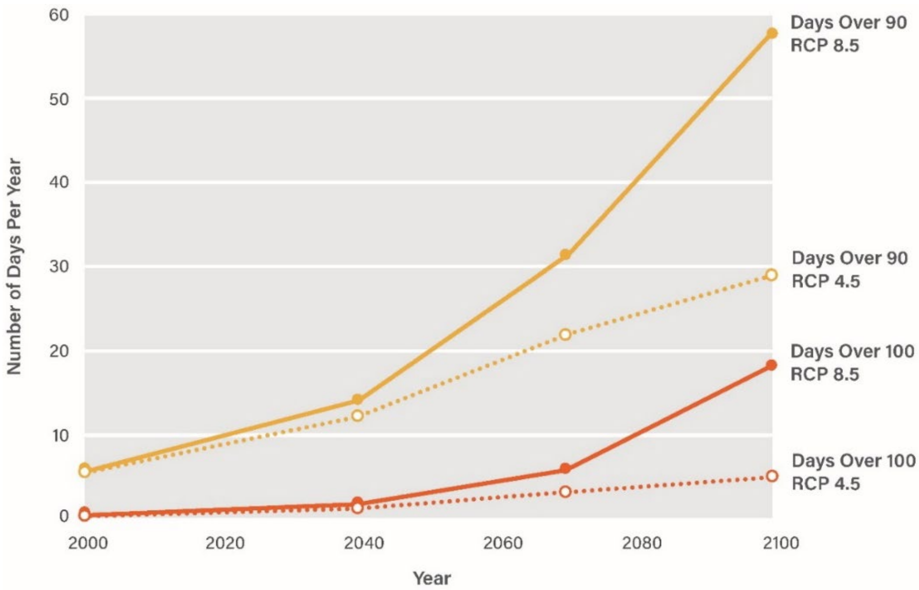
Figure 4-2. Projected Average Temperature (°F) Changes in the IBR Program Study Area, 2000–2100



Source: Merced n.d.

[26] All temperature predictions are from the online Climate Toolbox, using the southern ramps of the existing Interstate Bridge as a location. (Merced n.d.)

Figure 4-3. Changes in Extreme Temperatures (°F), 2000–2100



Source: Merced n.d.

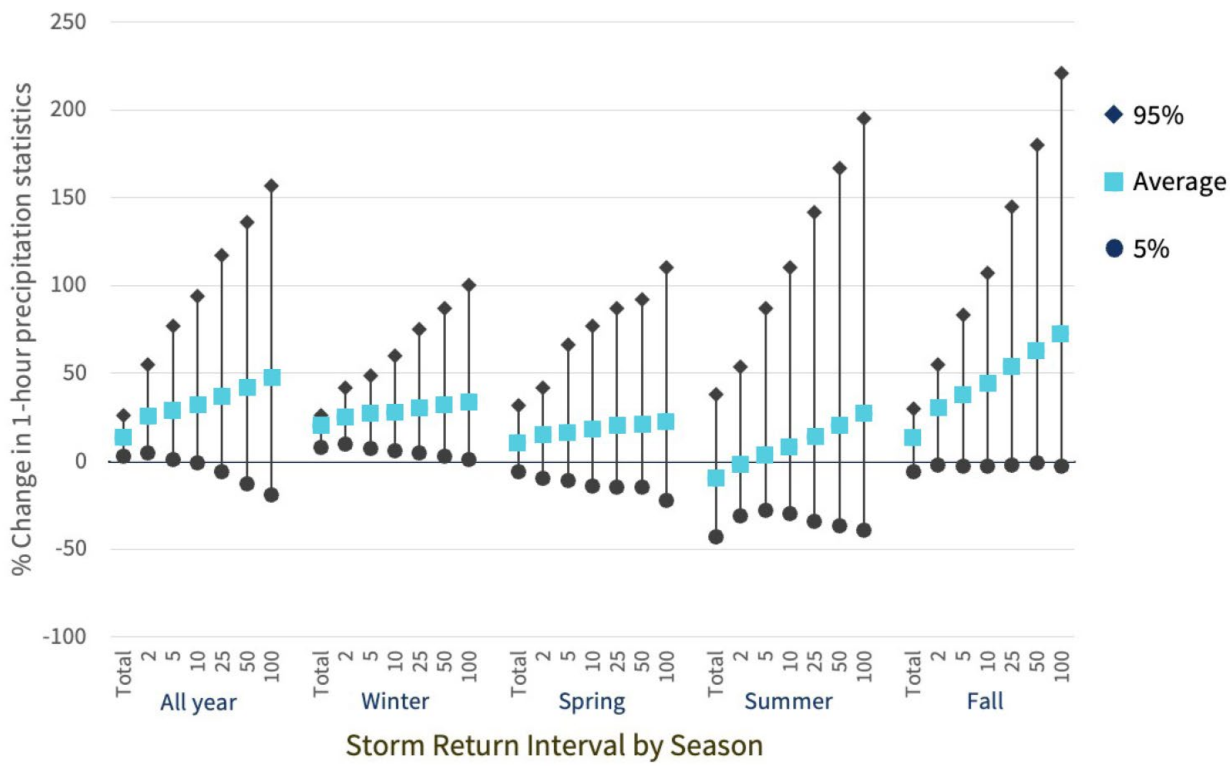
The increase in temperatures will have implications for Program design. Under extreme temperatures, concrete and asphalt roads can buckle and distort, steel train tracks and cables can warp and sag, and bridge joints can expand. Under excessive heat, the performance of light-rail transit rails and road surfaces are known to decrease. To address long-term temperature increases, infrastructure designs should withstand regular air temperatures well over 100°F during the summer months. Temperature increases will also affect the usability of the structure into the future, especially by active modes. This means considering ways to cool the structure (especially on long access ramps) to ensure the safety of pedestrians and bicyclists. Such measures could include special treatments to keep surfaces from getting too hot, shade structures and plantings, misters, rest stops, and potable water fountains.

Finally, the increase in temperature will have an implication for restoration and landscaping around the structures. Planting plans will need to consider the changing conditions and include species that are likely to thrive in a more extreme climate as well as to provide shade and regulate temperature.

4.2.2 Precipitation Changes

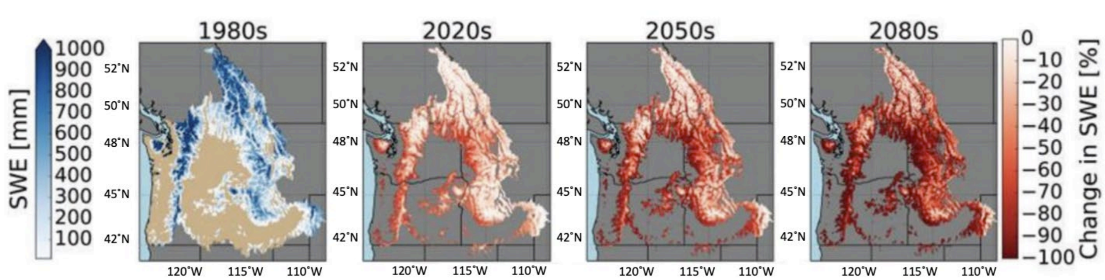
As temperatures rise, more evaporation transpiration occurs, which in turn alters the intensity, duration, and frequency of precipitation in the region. Decreases in the snowpack will affect the timing of the annual freshet (increased stream flows associated with winter melt and runoff). Increased atmospheric energy in the form of heat can also increase the intensity of storms and strengthen winds. Although the IBR Program study area is not predicted to see a significant increase in overall precipitation, climate models predict an increase in the intensity of precipitation, specifically during the winter months. The models also project less snowpack across the Columbia River Basin. Figure 4-4 shows the predicted change in the 1-hour precipitation in 2080 compared to averages in 1980 through 2010. The models predict a decrease in snowpack and an increase in winter precipitation falling as rain rather than snow (Figure 4-5). These factors will all contribute to increased volumes of stormwater and, in turn, will exacerbate risks for urban flooding, landslides, public safety hazards, and degradation of water quality. There is a very slight decrease in summer precipitation expected overall, but the decrease in snowpack will also lead to a decrease in summer stream flows.

Figure 4-4. Projected Changes in 1-Hour Precipitation for the 2080s (WY 2060 thru 2089) Compared to 1980–2010 Averages for the Portland Metropolitan Area



Source: Modified from Morgan et al. (2021)

Figure 4-5. Broad-Scale Decreases in Snow Water Equivalent across the Columbia River Basin over the Next Century



Source: RMJOC 2018

Notes: shading indicates where snowpack is expected to decrease with winter precipitation falling as rain instead of snow.

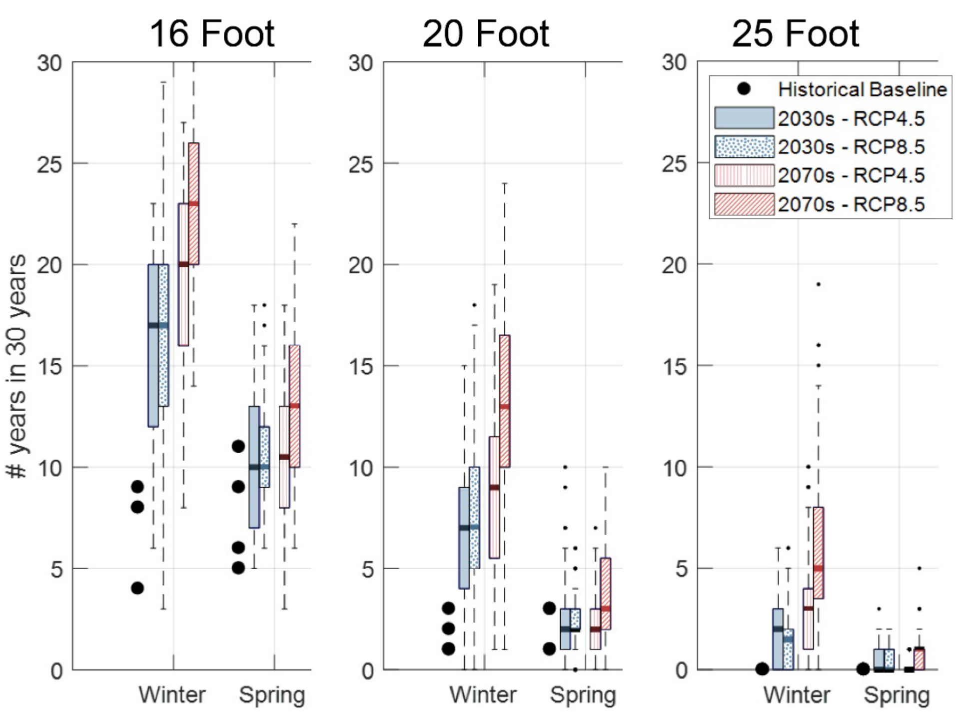
SWE = snow water equivalent

4.2.3 Stormwater and Flooding

The implications of these shifts in precipitation for the IBR Program lie mainly in stormwater and flood management. Because the proportion of rain to snow precipitation is expected to increase, infrastructure design should plan for a wider range of water volumes and the possibility of higher and more frequent floods. Stormwater facilities should be sized to accommodate anticipated future storm frequencies and volumes. In addition, since winters are likely to continue to fall below freezing at least some of the time, the risk of significant snow and ice events will also increase. The shift from snow to rain at higher elevations will also increase the chance of flooding during the wet season (Figure 4-6). Several parts of the study area are already designated by FEMA as having a 1% annual flood risk (portions of Hayden Island, along the Columbia River shoreline in Vancouver, and west of I-5 in Portland; see Section 6.2.3, FEMA Floodplain Regulations, and the Water Quality and Hydrology Technical Report for more information).

FEMA risk maps have not yet been updated for climate change or even current conditions, so it is reasonable to expect that more of the study area will be subject to flood risk in the coming century.

Figure 4-6. Increased Risk of Exceedance for the 16-, 20-, and 25-Foot Action Stage at Vancouver, WA



Source: RMJOC 2020

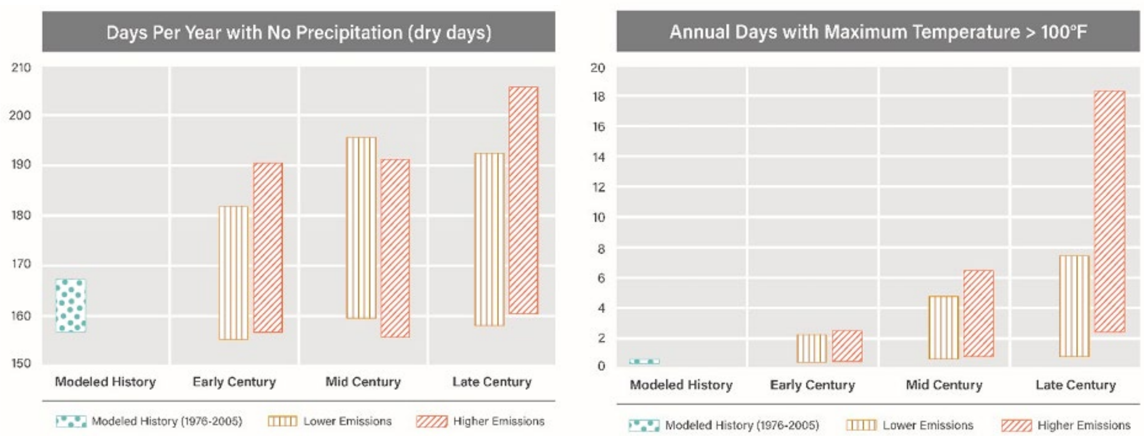
Note: Black dots indicate reference points from four simulated historical baseline scenarios. These are presented to contextualize the projections.

In addition to stormwater and flooding, higher winter flows will increase the speed that vessels need to achieve to navigate through the river, although expected river flows are still expected to be generally safe for navigation (IBR 2025).

4.2.4 Fire and Smoke Risk

Increasing summer temperatures will combine with increased number of consecutive dry days to increase the regional fire risk (see Figure 4-7).

Figure 4-7. Increased Drought and Heat Increase Fire Risk



Source: Merced n.d.

There is little risk of large-scale fires in the study area because it is in a developed space. The risk of small-scale roadside fires ignited by sparks from traffic is likely to increase. The risk of fires in the surrounding areas will not directly impact the bridge's infrastructure, but the fires could create traffic problems that divert motorists from other areas.

No matter where fires are located, all regions across the western U.S. will see an increase in severe smoke events. Severe smoke can impact visibility, causing traffic hazards and sometimes causing roads to shut down. Exposure to wildfire smoke is a health threat, particularly to people directly exposed to the elements such as active transportation users, transit passengers, or construction workers. Severe smoke could affect active Modified LPA construction. The Occupational Safety and Health Administration has instituted new smoke hazard rules that dictate whether workers are required to wear protective gear, as well as rules about working in excessively hot conditions. Both Oregon and Washington have passed rules to protect workers in smoke and in heat.

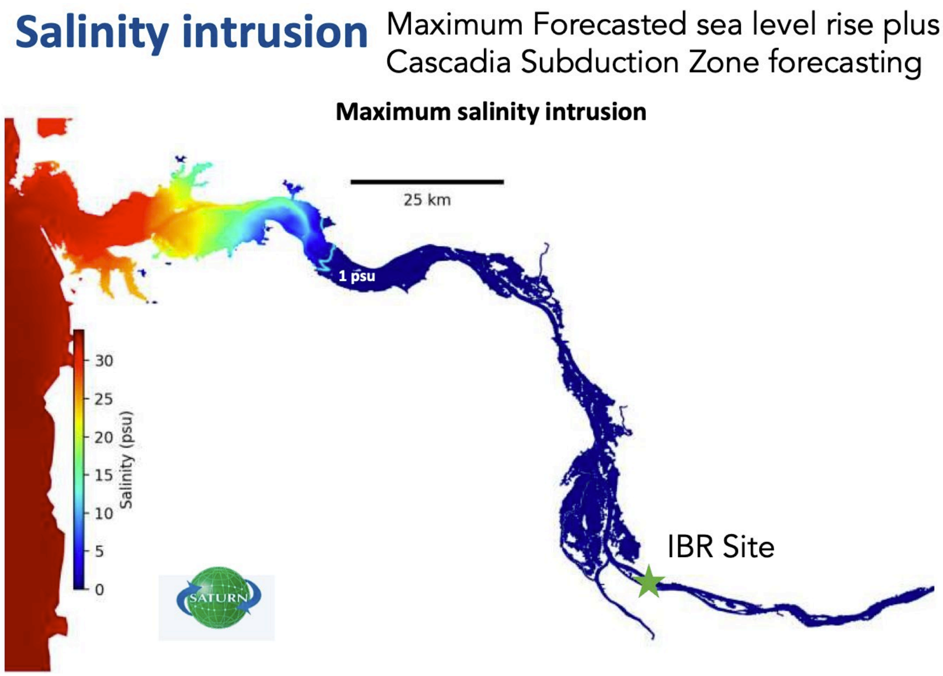
For bridge operations, smoke could limit active use for multiple days each year. Conversely, winds coming off the Columbia Gorge could blow away the smoke to provide a refuge for outdoor recreation during smoke events.

4.2.5 Additional Concerns

4.2.5.1 Saltwater Intrusion

Saltwater intrusion is not a cause for concern according to the latest modeling from the Oregon Health and Science University Center for Coastal Margin Observation and Prediction (Baptista 2018). The models from the Center for Coastal Margin Observation & Prediction have since been revised and show saltwater intrusion ending roughly 100 kilometers downstream of the bridge site, even with low flows and king tides (Baptista 2018). Figure 4-8 presents these data.

Figure 4-8. Maximum Salinity Intrusion in the Columbia River



Source: Baptista 2018

4.2.5.2 Wind

Initial research on wind speeds showed no average increase predicted in future years as a result of climate change. It is possible, however, that the increase in storms will be accompanied by an increase in gusty winds. This factor will continue to be researched and evaluated to understand and address any implications for the IBR Program.

4.2.5.3 Landslides

The risk of landslides increases under heavy rain conditions. While there are no recorded landslides in the study area, steep slopes are present near Burnt Bridge Creek in the northern part of the study area, and any cuts should be carefully protected during construction.

4.2.5.4 Population Growth

There is uncertainty about future population migration due to pressures from a changing climate. Higher population growth in the study area would influence VMT, and thus energy and carbon emissions, for both the Modified LPA and the No-Build Alternative.

5. MODIFIED LPA ANALYSIS – CLIMATE IMPACTS

This section includes an evaluation of the consistency of the IBR Program with local, regional, and state goals, policies, and plans, and summarizes anticipated impacts from the Modified LPA on GHGs. This section also presents an analysis of Program impacts to resources that are either more vulnerable to the effects of climate change, or that would be made more vulnerable to the effects of climate change resulting from the Program. Finally, this section presents an estimate of the costs and benefits implied by the GHG impacts using the U.S. EPA's SCC, with supplemental calculations to show the Washington and Oregon values used for the SCC in their climate programs.

As outlined in Chapter 2, Methods, the basis of the quantitative GHG estimates draws findings from the Transportation Technical Report and the September 2024 Energy Technical Report. Chapter 6, Designing for Resiliency, includes additional considerations for further improved outcomes to GHG emissions, including discussion of measures to reduce construction-related GHG, emissions associated with operations and maintenance, and user emissions.

Three of the design options for the Modified LPA (SR 14 interchange without C Street ramps, westward shift of I-5 mainline, and downtown Vancouver park-and-ride locations) would have no or negligible effects on GHG emissions and are therefore not discussed separately in this report.

The single-level fixed-span bridge configuration would have effects similar to those of the double-deck fixed-span configuration, except there would be fewer operational emissions due to the reduced profile grade of the new Columbia River bridges (approximately 29 feet lower height); the shallower grade could also attract more active transportation users. The single-level movable-span configuration would have effects similar to those of the single-level fixed-span configuration, except there would be increased air pollutant and GHG emissions due to vehicle idling during bridge openings. The single-level movable-span configuration would be similar to the No-Build Alternative due to the electricity required to raise and lower the bridge.

Analysis of the long-term effects of two auxiliary lanes using the regional travel demand model shows no statistical difference in GHG emissions compared to one auxiliary lane. An additional analysis using operational model outputs for changes in speed and congestion in the traffic subarea shows that GHG emissions reduction could be up to 0.4% lower for the two-auxiliary-lanes option than for the option with one auxiliary lane.

5.1 Consistency with Goals, Policies, and Plans

The six local Joint Lead agencies (ODOT, WSDOT, RTC, TriMet, and C-TRAN), as well as the Cities and Ports of Portland and Vancouver, have numerous climate-related goals, policies, and plans. Through an interagency working group, these agencies have been engaged with the IBR Program throughout the planning efforts to date. Working together, the IBR Program staff and local agency partners developed a comprehensive database of local plans and climate initiatives, including specific climate commitments and emissions reduction goals. Appendix B presents a summary of the partners' climate policies, plans, and goals and shows where and how the IBR Program climate framework and desired outcomes (as well as other Program initiatives, efforts, and goals such as equity and public engagement) are aligned.

The IBR Program is consistently aligned with the climate aims of partner agencies. Highlights are included below.

- **Reducing emissions from the transportation system** – The Modified LPA would shift travel demand to lower GHG–emitting modes of travel and improve transportation efficiency. The Modified LPA would reduce vehicle-based GHG emissions by expanding transportation options for non-auto trips, which is one of the most significant methods of reducing driving trips. New and improved transportation options include high-capacity transit and safe, comfortable bicycle and pedestrian infrastructure.
- **Construction and operations** – Construction goals for the IBR Program center on reducing construction-based emissions. The Program aims to reduce emissions associated with maintenance and operations by using an electric vehicle maintenance fleet.
- **Community resiliency** – The IBR Program includes climate resiliency goals such as designing for performance in a range of environmental conditions resulting from climate change.

There are several areas in which the IBR Program is partially aligned with partner goals, plans, and policies. One example is Portland's modal hierarchy, which places priority on walking, bicycling, and transit in all transportation decisions and investments. Because the Modified LPA would primarily improve mobility and access for I-5—part of the interstate highway system—the modal prioritization is not aligned. Even so, the Modified LPA would improve and expand safe, direct travel options for people walking, biking, rolling, and taking transit within the study area.

A second example of where the IBR Program is partially aligned with partner goals is in variable-rate tolling. Equity and equitable access to travel is a shared priority. For the IBR Program, variable pricing is expected and is an important tool to manage vehicle travel demand. The IBR Program is committed to evaluating equitable tolling structures, but the decision to use variable-rate tolling rests with the state transportation commissions who would make determinations on the tolling program for the Modified LPA, including toll rates, participation, and setting subsidies or exemptions.

The following sections provide a high-level summary of the climate policies and goals of IBR Program partner agencies.

5.1.1 State Level – WSDOT and ODOT

Both Oregon and Washington have an array of climate policies, strategies, and executive orders that guide state agencies' efforts to reduce emissions and increase resilience of the transportation system.

- Washington has established statewide GHG reduction targets with benchmarks at 2030 (45% below 1990 levels), 2040 (70% below 1990 levels), and 2050 (95% below 1990 levels) (Revised Code of Washington (RCW) 70A.45.020).
- Washington's Integrated Climate Change Response Strategy: Requires state agencies to incorporate climate resilience and adaptation actions and priority activities when designing, planning, and funding infrastructure projects (Ecology 2012). Supported by RCW 70A.05.040: Incorporation of current and future climate change impacts by state agencies.

- WSDOT Strategic Plan: Resilience Goal: Directs WSDOT to plan and/or invest in a transportation system that supports long-term resilience (WSDOT n.d.).
- WSDOT Secretary's Executive Order 1113: Sustainability – Directs employees to take actions that sustain economic, environmental, and societal prosperity for current and future generations through a focus on energy efficiency, pollution reduction, and enhanced resilience.
- Executive Order 21-04: Zero Emission Vehicles (2021)- Builds on EO 20-01 (State Efficiency and Environmental Performance) to establish targets, processes, and systems for the electrification of Washington State's fleet.
- The ODOT Climate Action Plan guides ODOT to reduce emissions from the transportation system and improve resilience to extreme weather events (ODOT 2021).
- Oregon has established statewide GHG reduction targets with benchmarks at 2035 (45% below 1990 levels) and 2050 (80% below 1990 levels).
- Oregon's updated statewide planning rules require jurisdictions in metropolitan areas and Metro to take steps to reduce VMT and GHG emissions: plan for increased transit service to the key corridors and centers; prioritize investments that make it easier to travel without reliance on a personal vehicle; plan and manage parking to avoid oversupply; plan for electric vehicle charging; and increase monitoring of VMT and GHG emissions.

5.1.2 Regional Government – Oregon Metro and the Southwest Washington Regional Transportation Council

- Oregon Metro's (Metro's) Regional Transportation System Plan establishes a GHG reduction target with specific benchmarks for 2035 (20% below 2005 levels) and 2050 (35% below 2005 levels) (Metro 2018, 2023). The plan also establishes specific performance monitoring targets for the region.
- Metro's Comprehensive Climate Action Plan for the Portland–Vancouver region lays out a plan to dramatically reduce emissions in the area while saving people money and creating healthier communities (Metro 2025). The plan includes 10 transportation-related actions.
- Metro's Climate Smart Strategy outlines a variety of best practices to make the region's transportation system more efficient and supportive of active and low-carbon modes of travel (Metro 2015).
- Metro's Regional Congestion Pricing Study provides best practices guidance for implementing equitable congestion pricing programs: variable pricing, targeted exemptions, focus on transit, and focus on vulnerable communities (Metro 2021).
- The Unified Work Program for Fiscal Year 2023 directs RTC to pursue state strategies to reduce VMT per capita and to help reduce GHG emissions (RCW 70.235.020, RCW 47.01.440 and Governor's Executive Order 14-04) and to coordinate with Metro, ODOT, and the Oregon Department of Environmental Quality on performance-based planning, air quality, and climate change planning issues (RTC 2022).

5.1.3 Cities – Portland and Vancouver

Both Portland and Vancouver have strong political support for climate action and have established citywide policies to address the impacts of climate change for their communities.

- Portland's Climate Emergency Declaration establishes emission reductions targets with benchmarks at 2030 (50% below 1990 levels) and 2050 (reach net zero) (City of Portland 2020a).
- Portland's Transportation System Plan aims to implement projects that shift travel behavior to increase trips to active and low-carbon modes of travel and projects that reduce VMT to meet emissions reduction targets (City of Portland 2020b).
- Portland's Pricing Options for Equitable Mobility Strategy provides specific guidance for making mobility in the city more equitable using community engagement, pricing strategies, and reinvestment of revenues generated toward equity and climate goals (City of Portland n.d.[b]).
- The City of Vancouver's Climate Action Framework supports a just and equitable transition to 80% reduction in community-wide emissions by 2030 and carbon neutrality by 2040, with support for low-income residents and communities of color. It establishes four near-term next steps: (1) ongoing engagement, (2) climate risk assessment, (3) continued focus on high-priority areas, and (4) increasing capacity for implementation and evaluation (City of Vancouver 2022b).
- The City of Vancouver's 2024–2044 Transportation System Plan (City of Vancouver 2024) and 2023–2029 Vancouver Strategic Plan (City of Vancouver 2023).

5.1.4 Transit Agencies – TriMet and C-TRAN

TriMet and C-TRAN support climate action and have established policies to address the impacts of climate change.

- TriMet's sustainability commitments include converting the MAX light-rail to 100% renewable power, converting to a greener bus fleet, improving facilities, and investing in MAX regenerative braking and other sustainable elements in transit projects.
- C-TRAN aims to contribute to the region's sustainability, livability, and economic vitality by helping to reduce traffic congestion, lower emissions, enable more dense urban land development, and provide essential transportation to people who depend on public transit (C-TRAN 2018).

5.1.5 Ports – Portland and Vancouver

The Port or Portland and Port of Vancouver support climate action and have established policies to address the impacts of climate change.

- The Port of Portland's Climate Change Strategy establishes an emissions reduction target for 2020 of 15% below 1990 levels (Port of Portland n.d.[b]).

- The Port of Vancouver's Climate Action Plan establishes emissions reduction targets of 45% to 50% below 2005 levels by 2030, and carbon neutrality by 2050. The plan outlines a long list of specific strategies to guide the Port's activities and investments to reduce emissions and support partners in reducing emissions (Port of Vancouver 2021).

5.2 Summary of Modified LPA Transportation Impacts

Transportation is a major contributor to GHG emissions. The IBR Program is proposing changes to the regional transportation system with the Modified LPA that would expand transit, institute tolling, and reconfigure highway and local connections. Therefore, it is important to understand how the Modified LPA is likely to affect VMT, congestion, and travel choices. This section presents relevant findings from the Transportation Technical Report and outlines plans for additional evaluation. Section 5.3, Operational Greenhouse Gas Impacts, describes how these changes in transportation metrics relate to changes in GHG emissions.

5.2.1 Vehicle Miles Traveled, Transit, and Multimodal Trips

The IBR Program has evaluated potential changes in travel behavior and VMT using the regional travel demand model that was jointly developed by Metro and RTC for use in the 2018 RTP,[27] adopted by Metro in 2018 and RTC in 2019. The model considers planned transportation projects (transportation supply) and land use (trip generation), as well as the cost of travel (both time and money for all available modes of travel) to estimate trip origins, destinations, and modes of travel. Trips are then assigned to the network (roadways and transit routes). With these inputs, VMT, travel speeds, and congestion can be predicted for future conditions.

This section provides summary tables of the modeled transportation results for the Modified LPA and the No-Build Alternative. For more information and a description of the methods used to develop these estimates, see the Transportation Technical Report.

The Modified LPA would reduce regional VMT, vehicle hours traveled (VHT), and vehicle hours of delay (VHD) compared to the No-Build Alternative. While the decreases are not significant on a regional basis for VMT and VHT, the reductions, especially in VHD, represent a larger share in the smaller traffic study subarea where the Modified LPA effects would be most felt. Total reductions in VHD compared to the No-Build Alternative are more significant both regionally and in the study area at 11% and 29%, respectively. This highlights the improvement in congestion reduction resulting from the Modified LPA and the level of impact the I-5 corridor has on overall delay in the region.

Table 5-1 presents modeled weekday results of VMT, VHT, and VHD. Together with vehicle types and fuel sources, these traffic measures are used to estimate GHG emissions from travel behavior. Each of these is a measure of traffic performance, and the model shows that in each case, the Modified LPA has better performance (lower VMT, lower VHT, and lower VHD) compared to the No-Build Alternative.

[27] The transportation analysis for the No-Build Alternative and Modified LPA is based on the anticipated regional highway and transit networks and service levels for 2045 as informed by the regional transportation plans for both Metro (Metro 2018) and RTC (RTC 2019). The traffic model applied to this analysis reflects pre-COVID conditions. New surveys and model development efforts that include post-COVID travel behavior are planned to be incorporated in the 2028 RTP update.

Daily VMT would decrease by nearly 100,000 miles in the region as a result of the Modified LPA; this reduction is due to people switching modes of travel, choosing to make shorter trips, or otherwise adjusting their travel patterns. Results are presented for the Modified LPA with one auxiliary lane and with two auxiliary lanes. None of the other Modified LPA design options would result in a measurable difference in VMT, VHT, or VHD.

Table 5-1. 2045 Weekday Daily Vehicle Miles of Travel, Vehicle Hours of Travel, and Vehicle Hours of Delay

Alternative	VMT	VHT	VHD
No-Build Alternative			
Portland Metropolitan Region	59,042,000	1,803,600	65,500
Traffic Subarea [a]	14,349,500	439,600	24,900
Modified LPA			
Portland Metropolitan Region	58,950,700	1,792,300	58,300
Traffic Subarea [a]	14,270,500	428,000	17,400
Modified LPA with Two Auxiliary Lanes			
Portland Metropolitan Region	58,960,800	1,791,900	58,000
Traffic Subarea [a]	14,279,300	427,400	17,000
Change between No-Build and Modified LPA			
Regional Difference	-91,300(<-1%)	-12,100 (<-1%)	-7,300 (-11%)
Subarea Difference	-79,000 (<-1%)	-11,600 (-3%)	-7,500 (-30%)
Change between No-Build and Modified LPA with Two Auxiliary Lanes			
Regional Difference	-83,300(<-1%)	-12,600 (-1%)	-7,600 (-11%)
Subarea Difference	-70,900 (<-1%)	-12,200 (-3%)	-7,900 (-32%)
Change between Modified LPA and Modified LPA with Two Auxiliary Lanes			
Regional Difference	10,100 (<-1%)	-400 (<-1%)	-300 (<-1%)
Subarea Difference	8,800 (<-1%)	-600 (<-1%)	-400 (-2%)

Source: 2018 Metro/RTC Regional Travel Demand Model (RTDM) and Regional Transportation Plan (RTP). Model area includes Portland-Vancouver metropolitan area.

a The traffic subarea is a subset of the region used to capture potential impacts and diversion of trips related to the IBR Program. This subarea includes an extent between the I-5 and I-205 split in Vancouver, south of I-84 in Portland, west of I-5 and east of I-205 in both Portland and Vancouver. See the Transportation Technical Report for more information.

LPA = Locally Preferred Alternative; VHD = vehicle hours of delay; VHT = vehicle hours traveled; VMT = vehicle miles traveled

Table 5-2 presents data on daily trips through the I-5 corridor in the study area as estimated by the regional travel demand model. These are traffic measures that affect GHG emissions; they are inputs to the MOVES modeling presented in Section 5.3, Operational Greenhouse Gas Impacts. Though the number of regional person trips is the same for the Modified LPA and the No-Build Alternative, the models predict shifts between modes and destinations. The results show that, for all design options, the regional transit mode share would increase slightly, and the IBR Program would generate approximately 12,500 daily new transit trips. These new riders would be due, in part, to a shift to transit as a result of variable-rate tolling on the Columbia River bridges, as well as the extension of light-rail transit between the Expo Center and Evergreen, new park-and-ride lots, and improvements to the speed and frequency of express buses crossing the river.

A more detailed analysis of trip generation and distribution is presented in the Transportation Technical Report.

Table 5-2. 2045 Weekday Daily Corridor and Systemwide Transit Trips

Measure	No-Build Alternative	Modified LPA (1 auxiliary lane)	Modified LPA (2 auxiliary lanes)
Regional Person Trips (all modes)	11,905,000	Same as No-Build	Same as No-Build
Work Trips (all modes)	2,165,500	Same as No-Build	Same as No-Build
Non-Work Trips (all modes)	9,739,500	Same as No-Build	Same as No-Build
Total Regional Transit Trips [a]	626,300	638,800	638,700
Regional Transit Mode Share	5.26%	5.37%	5.36%
Regional New Transit Trips	N/A	12,500	12,400
Percentage Change from No-Build	N/A	+2.00%	+1.98%

Source: 2018 Metro/RTC RTDM RTP and IBR Program analysis

a Transit trips count each passenger only once between the origin and destination of their trip. Transit trips include all trips on any transit mode.

Metro = Oregon Metro; C-TRAN = Clark County Public Transit Benefit Area Authority; IBR = Interstate Bridge Replacement; RTC = Regional Transportation Council; TriMet = Tri County Metropolitan Transportation District of Oregon

In addition to shifting trips to transit, the Modified LPA includes bicycle and pedestrian improvements on the Columbia River bridges, as well as facilities to access these bridges, which are expected to increase bicycle and pedestrian trips. The proposed shared-use path on the I-5 northbound bridge would range from 16 to 24 feet wide and would be designed to optimize user experience, safety, and comfort. It would be buffered from vehicle traffic, street debris, and stormwater to provide an attractive and comfortable environment for all users. On each end of the bridge, the path would include improved connections to existing and proposed active transportation facilities. These improvements are expected to draw more bicycle and pedestrian trips to the bridge and the broader Program area. In 2022, approximately 410 daily bicycle and pedestrian trips were estimated to use the existing path to cross the Columbia River; Program improvements are expected to increase this total to between 740 and 1,600 trips per day in 2045.[28]

Considering the increasingly hot conditions expected in the future, active transportation users could experience discomfort (and potentially health risks), which could discourage the use of the facilities. The different bridge configurations for the main bridge crossing could produce different user experiences. If active transportation paths were on the lower deck of a double-deck bridge, that

[28] The Transportation Technical Report includes more description of these counts and forecast volumes with the Modified LPA improvements.

would provide cover for users, which would be beneficial for shading during summer heat events and providing protection from the rain in other months. Opportunities to provide shade or rain protection would not be exclusive to a double-deck configuration, as measures to provide shade (e.g., canopies, shade panels) could be incorporated on the single-level bridge configurations.

5.2.2 Changes in Travel Behavior

Travel needs and behaviors are influenced by societal factors such as development density, household types, income levels, economic activity (e.g., employment and business production), and the availability of transit and active transportation facilities. Patterns in urban development and housing affordability have a strong influence on how often and how far people typically drive. Oregon and Washington have some of the strongest land use laws in the country, which help to limit the extent of housing sprawl that could otherwise be "induced" by roadway improvements. Reducing transportation demand requires affordable housing across the region, jobs near housing and transit-served areas, and substantial increases in transit and active transportation systems. Partner agencies in the Portland-Vancouver metropolitan region that control land use and transportation policy are engaged in efforts to mitigate the climate impacts of driving by encouraging more compact development and expanding transportation options.

Transportation projects can make travel quicker, easier, or more reliable, which lowers the perceived "cost" of travel. A lower perceived cost (in time, convenience or money) may result in people choosing to drive more often, drive farther, choose driving over another mode (e.g., walking/rolling, biking, or public transit), or change the destination or route for their trips.

The IBR Program is an investment to create a modern, seismically resilient multimodal bridge and to increase the attractiveness of climate-friendly transit, biking, and walking trips. Key components of the IBR Program that are expected to balance any potential increase in driving include:

- The addition of reliable, high-capacity transit with dedicated space between Portland and Vancouver, along with three new light-rail stations.
- Improved active transportation facilities across the bridge and in the study area.
- Demand management measures such as variable-rate tolling where tolls are higher during peak periods to manage demand and encourage other travel choices.

In addition, other travel demand tools, such as intelligent transportation systems that make use of communications and smart technology to better manage congestion, would be implemented as part of the Modified LPA.

Finally, the IBR Program is designing infrastructure that accommodates land use changes that support development of more dense, walkable, transit-served communities, which would further reduce the need for driving and associated GHG emissions.

5.3 Operational Greenhouse Gas Impacts

GHG emissions by gas- and diesel-powered passenger and freight vehicles are directly related to VMT, the age and type of vehicle, and the time spent traveling (e.g., travel efficiency, or speed, and congestion). Other factors, such as the amount of time vehicles spend idling in traffic congestion, also influence their GHG emissions. When people switch to more efficient modes of transportation—such as transit, carpooling, walking, or biking—GHG emissions are reduced. GHG reductions will also be realized as people switch to electric vehicles.

The September 2024 Energy Technical Report describes potential GHG emissions associated with VMT and transit trips. These estimates are summarized below.

5.3.1 Emissions from Roadway Users

Energy consumption and GHG emissions in 2045 are expected to be substantially lower than existing values for the region if requirements in regulations and voluntary low-emission vehicle commitments by the private sector are realized. These effects are independent of the IBR Program. These system changes mean that even though the population and VMT are expected to increase over the coming decades in the region, the increase of approximately 40% VMT in the study area by 2045 compared to existing conditions will generate substantially fewer GHG emissions over that same time period because of new regulations and a shift toward electric vehicles.

Comparing future conditions under the No-Build Alternative and the Modified LPA shows that the Modified LPA would result in additional reductions in VMT and a mode shift to transit and active transportation. These shifts are described above in Section 5.1, Consistency with Goals, Policies, and Plans.

On a regional basis, these shifts would likely result in small reductions in energy consumption and GHG emissions with the Modified LPA. The September 2024 Energy Technical Report details the differences calculated using EPA's MOVES model. The model results compare 2045 emissions for the No-Build Alternative and the Modified LPA. In 2045, the modeled total energy consumption and several measures of CO_2 emissions differ by approximately 0.25% between the No-Build Alternative and the Modified LPA with electric vehicle assumptions. Those estimates are at the regional level; estimates for a smaller study area defined in the Transportation Technical Report as the "traffic assignment area," or the area in which vehicle travel would be affected by the project, would result in similar decreases in VMT and energy use and a reduction of approximately 1.01% in GHG emissions with electric vehicle assumptions. See the September 2024 Energy Technical Report for additional analysis.

There are no thresholds to determine the significance of energy consumption or GHG emissions. Table 5-3 summarizes the estimates at the regional level using assumptions that electric vehicles increase in the fleet over time, following existing state requirements and manufacturer commitments for production. The September 2024 Energy Technical Report presents this analysis and also shows GHG emissions for 2045 with a vehicle fleet that does not include electric vehicles; future GHGs would be higher in that scenario.

As shown in Table 5-3, the Modified LPA is expected to reduce GHG emissions by 45 metric tons per day compared to the No-Build Alternative. A reduction of 45 metric tons of GHG per day in the region is equivalent to the carbon sequestered by 744 tree seedlings grown for 10 years, 5,064 gallons of gasoline not burned, or 10.7 gasoline-powered passenger vehicles driven for an entire year. Section 5.6, Indirect Effects, sums up these benefits over multiple years of the Program's operation.[29]

Table 5-3. Daily Regional Energy Consumption and CO_2e Emissions (with Electric Vehicle Assumptions)

Pollutant	Existing (2015)	No-Build (2045) (with EV Assumptions)	Modified LPA (2045) (with EV Assumptions)	Modified LPA Difference from No-Build (with EV Assumptions)
Total Energy Consumption (MMBtu/day)	290,732	190,771	190,302	-0.25%
CO_2e Exhaust Emissions (MT CO_2e/day)	22,273	11,440	11,409	-31 MT/day -0.26%
CO_2e Fuel Cycle Emissions (MT CO_2e/day)	6,014	6,668	6,653	-15 MT/day -0.22%
Total CO_2e Emissions (MT CO_2e/day)	28,286	18,108	18,063	-45 MT/day -0.25%

Table sourced from the September 2024 Energy Technical Report; Emissions estimates produced using EPA MOVES model. Fleet assumptions listed in the September 2024 Energy Technical Report. Fuel cycle emissions are from production and transport of fuels.

CO_2e = carbon dioxide equivalent; MMBtu/year = million British thermal units per year; MT = metric tons

DESIGN OPTIONS

This section describes potential long-term effects on climate with the design options where they would differ from the Modified LPA.

The I-5 mainline westward shift and the park-and-ride site options would have the same general effects for GHG emissions as the Modified LPA because they would not change the anticipated transportation outcomes. Therefore, these options are not described below.

Two Auxiliary Lanes

Analysis of the long-term effects of two auxiliary lanes using the regional travel demand model shows a minimal difference in GHG emissions compared to one auxiliary lane, as shown in Table 5-4.

[29] Calculations developed using the EPA Greenhouse Gas Equivalences Calculator, accessed May 24, 2024: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Table 5-4. Comparison of Energy Consumption and CO_2e Emissions between Auxiliary Lane Options Using Regional Demand Model, Traffic Analysis Subarea

Parameter	Existing (2015)	No-Build (2045)	Modified LPA with One Auxiliary Lane (2045)	Modified LPA with Two Auxiliary Lanes (2045)	One Auxiliary Lane Difference from No-Build	Two Auxiliary Lanes Difference from No-Build
Daily Vehicle Miles Traveled	11,267,296	14,349,500	14,270,500	14,279,300	-0.55%	-0.49%
Total Energy Consumption (MMBtu/day)	76,557	47,863	47,380	47,371	-1.01%	-1.03%
CO_2e Exhaust Emissions (MT CO_2e/day)	5,864	2,886	2,854	2,853	-1.01%	-1.14%
CO_2e Fuel Cycle Emissions (MT CO_2e/day)	1,583	1,644	1,630	1,630	-0.85%	-0.84%
Total CO_2e Emissions (MT CO_2e/day)	7,447	4,530	4,484	4,483	-1.01%	-1.03%

Note: Values in this table represent emissions and energy consumption within the traffic assignment area. CO_2e emissions are calculated assuming an electric vehicle adoption rate consistent with Oregon and Washington State goals. If the adoption rates are less than the rates assumed in this analysis (52% electric vehicles by 2045), GHG from both No-Build and the Modified LPA would be proportionately higher.

CO_2e = carbon dioxide equivalent; MMBtu = million British thermal units; MT = metric tons

Operational analysis (modeling that provides more sensitivity to changes in speed and congestion) was conducted for the I-5 system to better understand the effects of the Program improvements on congestion, traffic speed, and throughput. Because these factors influence GHG production from vehicles (e.g., congestion tends to decrease fuel economy and therefore would increase GHG production), the operational model was used to assess potential effects of the one- and two-auxiliary lane options of the Modified LPA compared to the No-Build Alternative. An additional analysis using operational model outputs for changes in speed and congestion on the I-5 corridor shows that reductions in user GHG emissions associated with the Modified LPA could be approximately 2.5% lower than the No-Build, and the Modified LPA with two auxiliary lanes could be approximately 2.9% lower than the No-Build, as shown in Table 5-5. This analysis shows that improving traffic speeds (i.e., reducing congestion) through the addition of a second auxiliary lane would have an effect on I-5 that translates into lower GHG in the traffic analysis subarea (see Section 5.7, Cumulative Greenhouse Gas Changes and the Social Cost of Carbon for an evaluation of the cumulative GHG emissions associated with the Program, which includes construction emissions).

Table 5-5. Comparison of Energy Consumption and CO_2e Emissions between Auxiliary Lane Options Using Operational Model, Traffic Analysis Subarea

Parameter	No-Build Alternative (2045)	Modified LPA with One Auxiliary Lane (2045)	Modified LPA with Two Auxiliary Lanes (2045)	Modified LPA with One Auxiliary Lane Difference from No-Build Alternative	Modified LPA with Two Auxiliary Lane Difference from No-Build Alternative
Daily Vehicle Miles Traveled	14,349,500	14,270,500	14,279,300	-0.55%	-0.49%
Total Energy Consumption (mmBtu/day)	48,969	47,744	47,545	-2.50%	-2.91%
CO_2e Exhaust Emissions ($MT\ CO_2e$/day)	2,966	2,880	2,866	-2.89%	-3.38%
CO_2e Fuel Cycle Emissions ($MT\ CO_2e$/day)	1,666	1,637	1,634	-1.72%	-1.92%
Total CO_2e Emissions ($MT\ CO_2e$/day)	4,632	4,517	4,499	-2.47%	-2.86%

Source: MOVES model output

CO_2e = carbon dioxide equivalent; LPA = Locally Preferred Alternative; mmBtu/year = million British thermal units per year; MT = metric tons; VMT = vehicle miles traveled

Table 5-6 summarizes the key differences in climate impacts and benefits among the No-Build Alternative, the Modified LPA with one auxiliary lane, and the Modified LPA with two auxiliary lanes.

Table 5-6. Comparison of Climate Impacts and Benefits for Auxiliary Lane Scenarios (2045)

No-Build Alternative	Modified LPA with One Auxiliary Lane	Modified LPA with Two Auxiliary Lanes
No additional GHG emissions related to construction activities (e.g., GHGs from the manufacture and transport of construction materials).	Lower GHG emissions from traffic operations associated with improved traffic flow and reduced VMT. Regional GHG emissions would decrease by just over 1% using data from the regional travel demand model and just over 3% using traffic data with refined assumptions for vehicle speeds.	Same as the Modified LPA with one auxiliary lane. Differences in GHG emissions as compared to the one auxiliary lane option are not statistically significant (see Table 5-4 and Table 5-5).

CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; mmBtu = million British thermal units; MT = metric tons; VMT = vehicle miles traveled

Bridge Configurations

Single-Level Fixed-Span Configuration

The long-term effects of the single-level fixed-span configuration would be similar to those of the double-deck fixed-span configuration, but would slightly reduce operational emissions due to the reduced profile grade (approximately 29 feet lower than the double-deck configuration). See Table 5-7.

Single-Level Movable-Span Configuration

The long-term effects of the single-level movable-span configuration would be similar to those of the single-level fixed-span configuration, except that this option would increase energy consumption because of the longer construction duration, additional materials required for the larger bridge foundations, electricity required to raise and lower the bridge, and longer idling periods for queued vehicles on the freeway during bridge openings. These emission differences were not quantified because they are too small to be measurable at the scale of the region or the analysis area. See Table 5-7.

Table 5-7. Comparison of Climate Impacts and Benefits for Bridge Configuration Options

No-Build Alternative	Double-Deck Fixed-Span Configuration	Single-Level Fixed-Span Configuration	Single-Level Movable-Span Configuration
• The frequency and duration of bridge openings is expected to be similar to	• Greenhouse gas emissions would be reduced due to the elimination of bridge	• Similar to the double-deck fixed-	• Similar to the single-level fixed-span

No-Build Alternative	Double-Deck Fixed-Span Configuration	Single-Level Fixed-Span Configuration	Single-Level Movable-Span Configuration
existing conditions, resulting in similar levels of air quality pollutant and GHG emissions due to vehicles idling during bridge openings. • Increased GHG emissions due to the electricity required to raise and lower the bridge. • No GHG emissions related to manufacture and transport of construction materials.	openings, which would reduce the amount of idling. • Bridge construction is material-intensive, resulting in GHG emissions from the manufacture and transport of construction materials, as well as from construction equipment and vehicles. • Steeper grade than the No-Build Alternative would increase localized operational emissions due to engines requiring more power to propel the vehicle uphill. Emissions are not affected at the regional scale due to modeling assumptions.	span configuration, except: • Fewer operational emissions than the double-deck fixed-span configuration because of the reduced profile grade (approximately 29 feet lower height). • Shallower grade may attract more active transportation users.	configuration, except: • Increased air quality pollutant and greenhouse gas emissions due to idling during bridge openings, similar to the No-Build Alternative. • Increased GHG emissions due to the electricity required to raise and lower the bridge, similar to the No-Build Alternative.

SR 14 Interchange Without C Street Ramps

This design option would result in additional congestion on local streets, which in turn would result in failing operations at 14 intersections, compared to eight intersections for the Modified LPA. This additional congestion and idling would decrease vehicle efficiency, resulting in greater GHG emissions than the Modified LPA. Additionally, VMT and GHG would increase for trips with an origin or destination in downtown Vancouver south of Mill Plain Boulevard with the removal of the C Street ramps. As with the bridge configuration options, these emissions differences were not quantified because they are too small to be measurable at the scale of the region or the traffic analysis area.

5.3.2 Emissions from Transit Operations

The energy consumption and GHG emissions for the extension of light-rail transit were estimated from the electricity needs of the light-rail elements of the Modified LPA. While no GHGs would be emitted at the point of use, there would be GHG emissions associated with the production of electricity to power light-rail vehicles and stations. (Electricity would also be needed for lighting at park-and-ride facilities, but the model used to calculate electricity use does not include these emissions.) Energy needs for bus operations are accounted for in the roadway calculations above. Table 5-8 summarizes energy and GHG emissions due to increased transit and new transit facilities under the Modified LPA. The values presented below would decrease over time as energy suppliers in Washington and Oregon are required by law to move to carbon neutral energy production by 2040.

Table 5-8. Energy Consumption and Greenhouse Gas Emissions from Modified LPA Light-Rail Transit Operations

Transit Element	Energy Consumption (MMBtu/year)	CO_2e Emissions (MT/year)	CO_2e Emissions (MT/day)
Light-Rail Vehicles	2,638	2,524	6.9
Transit Stations	1,146	129	0.35

Note: Energy assumptions are drawn from the September 2024 Energy Technical Report (Federal Transit Administration Greenhouse Gas Emissions Estimator output available in Appendix B of the September 2024 Energy Technical Report).

CO_2e = carbon dioxide equivalent; MMBtu = million British thermal units; MT = metric tons.

5.3.3 Emissions from Operations and Maintenance

The impacts of routine maintenance for roadways, transit vehicles, and light-rail tracks were estimated for the Modified LPA. Roadway maintenance includes the emissions from vehicles performing routine maintenance activities such as sweeping, restriping, and landscaping. Table 5-9 summarizes the energy and GHG emissions from maintenance activities under the Modified LPA. These would be similar to or lower than the annual maintenance activities with the No-Build Alternative because the facilities built for the Modified LPA would be new. There would also be several years where only light to minimal maintenance activity would be needed after construction is complete. Based on current experience with the existing lift span compared to other bridges in the system, maintenance needs for a lift span would be higher than for the other bridge options because of the need for regular inspections and maintenance of the lift mechanism and other moving parts. If the Modified LPA is not implemented, a major rehabilitation of the existing bridges would likely be required in the future. Those activities would result in higher emissions for a number of years while that work is completed.

Table 5-9. Modified LPA Annualized Energy Consumption and CO_2e Emissions from Maintenance Activities

Project Element	Energy Consumption (mmBtu/year)	CO_2e Emissions (MT/year)
Annualized Value [a]	11,078	1,088

Source: Infrastructure Carbon Estimator (ICE) spreadsheet tool output (available in Appendix A of the September 2024 Energy Technical Report).

a Annualized value assumes a 30-year project life.

CO_2e = carbon dioxide equivalent; LPA = Locally Preferred Alternative; mmBtu = million British thermal units; MT = metric tons

5.4 Construction Effects

5.4.1 Modified LPA

Emissions from construction activities are considered in this section. GHG emissions would be produced from construction equipment and upstream emissions resulting from the production of construction materials, such as raw material mining/extraction, transportation to the production facility, and material production (i.e., embodied in construction materials). Traffic delays caused by construction would result in increased GHG emissions associated with idling. Although construction activity would be temporary, impacts would be long-lasting, as additional GHG emissions are added to the atmosphere. The Federal Highway Administration's (FHWA's) Infrastructure Carbon Estimator (ICE) spreadsheet tool provided the basis for construction emission estimates (ICF 2020). The ICE spreadsheet tool incorporates project features and construction traffic delays to calculate energy consumption from construction equipment, materials, and routine maintenance. The ICE spreadsheet tool was used for all elements of the Modified LPA except the main Columbia River bridge crossing, which was evaluated using a material-based approach. [30]

Construction impacts to energy consumption and GHG emissions from all elements of the Modified LPA except for the Columbia River bridge crossing are provided in Table 5-10. Impacts during construction were calculated using FHWA's ICE spreadsheet tool, which incorporates project features and construction traffic delays to calculate energy consumption from construction equipment, materials, and routine maintenance (ICF 2020). These values represent the sum of the total impacts over the construction period.

[30] The ICE spreadsheet tool is not recommended for use in estimating emissions associated with bridges longer than 1,000 feet with high or deep spans. Therefore, the construction emissions associated with the large bridge structure over the Columbia River were estimated using a materials-based approach. For more information, see the September 2024 Energy Technical Report published with the Draft SEIS.

Table 5-10. Modified LPA Energy Consumption and CO_2e Emissions from Construction Activities – Excluding Columbia River Bridge Structures

Project Element	Total CO_2e Emissions [a] (MT)
Materials (e.g., embodied emissions in construction materials)	299,098
Transportation (e.g., transport of materials to the project site)	10,034
Construction (e.g., operation of equipment on site)	18,318
Total	**327,450**

Source: ICE spreadsheet tool output (available in Appendix A)

Note: See Section 5.4.3, Potential Measures to Reduce Construction Emissions, for discussion of potential additional ways to reduce construction-related GHG emissions.

a Values calculated from the Federal Highway Administration's Infrastructure Carbon Estimator Model

CO_2e = carbon dioxide equivalent; LPA = Locally Preferred Alternative; MT = metric tons

Construction impacts to energy consumption and GHG emissions specific to the Columbia River bridges are provided in Table 5-11. These values represent the sum of the total impacts over the construction period. High and low ranges of total emissions are provided to disclose the uncertainty associated with final bridge design and specific construction materials, as described in the methodology section of the September 2024 Energy Technical Report.

Table 5-11. Modified LPA Energy Consumption and CO_2e Emissions from Construction Activities – Columbia River Bridge Structures Only

Project Element	Total CO_2e Emissions – Low Estimate [a] (MT)	Total CO_2e Emissions – High Estimate [a] (MT)
Materials	70,100	121,373
Transportation	2,351	4,070
Construction	12,190	16,015
Total	**84,641**	**141,459**

Source: ICE spreadsheet tool output and material quantity calculations (available in Appendix C of the September 2024 Energy Technical Report)

a Materials and construction values calculated based on material quantity estimates, environmental product declarations, and fuel usage factors.

CO_2e = carbon dioxide equivalent; LPA = Locally Preferred Alternative; MT = metric tons

Using the estimates presented above, the total GHG emissions anticipated from construction of the Modified LPA would range between 412,091 and 468,910 metric tons. Table 5-12 presents the total estimated construction emissions from the Modified LPA using the "high" estimate presented above.

Table 5-12. Modified LPA Energy Consumption and GHG Emissions from Construction Activities

Construction Element	Modified LPA, Excluding Columbia River Bridge Structure GHG Emissions [a] (MT CO_2e)	Columbia River Bridge Structure GHG Emissions, [b] High Estimate (MT CO_2e)	Modified LPA, Total GHG Emissions, High Estimate (MT CO_2e)
Materials (e.g., embodied emissions in construction materials)	299,098	121,373	420,471
Transportation (e.g., transport of materials to the project site)	10,034	4,070	14,106
Construction (e.g., operation of equipment on site)	18,318	16,015	34,333
Total	**327,450**	**141,459**	**468,910**

Source: ICE spreadsheet tool output (available in Appendix A of the September 2024 Energy Technical Report)

a Values calculated from the Federal Highway Administration's Infrastructure Carbon Estimator Model

b Values calculated using a material quantity-based estimate for materials using environmental product declarations and scaled factors for transportation and construction fuel usage.

CO_2e = carbon dioxide equivalent; LPA = Locally Preferred Alternative; MT = metric tons

5.4.1.1 Traffic Delay Due to Construction

Construction of the Modified LPA is anticipated to last 9 to 14+ years, impacting all modes of transportation within the study area as well as adjacent corridors.[31] The Modified LPA could require nighttime closure of regional roadways, interchanges, and local roads during construction. Construction-related truck traffic for delivery of materials, equipment and for removal of materials/debris from demolition could also increase congestion and delays, particularly during periods of major construction. Closures during construction of the Modified LPA could temporarily affect transit operations and/or access to transit within the study area, sidewalks, bicycle facilities, and/or shared-use paths. Increased congestion due to temporary closures of roadways, transit facilities, and active transportation facilities could result in elevated vehicle emissions of CO_2e. Closures would be limited to off-peak hours to minimize impacts to regional travel during peak travel periods, which would also help minimize emissions due to construction-related congestion.

5.4.2 Design Options

While it is expected that certain design options would require a greater volume of materials, leading to a greater contribution of GHG emissions, design data to determine those volumes will not be available until the final design process. GHG emissions from construction of the Modified LPA are presented in Table 5-12, above, as a range to reflect the uncertainty associated with construction

[31] Funding, as well as contractor schedules, regulatory restrictions on in-water work and river navigation considerations, permits and approvals, weather, materials, and equipment could all influence construction duration.

material quantities for the main river crossing.[32] The double-deck fixed-span or single-level movable-span configuration and the two-auxiliary-lane option would require a greater volume of materials, which would contribute more GHG emissions than the same type of bridge in the single-span configuration with one auxiliary lane. The single-level movable-span configuration would require a greater volume of materials, which would contribute more GHG emissions.

Emissions and energy consumption were estimated for the Modified LPA using the ICE spreadsheet tool, which does not have the granularity to differentiate between the design options associated with roadway configurations. Estimates could be refined by using material quantity data similar to the bridge construction analysis, but this information would not be available until final design is underway.

For more information, including a description of the methods used to develop the estimates in Table 5-11, see the September 2024 Energy Technical Report.

5.4.3 Potential Measures to Reduce Construction Emissions

The IBR Program is considering certification through a sustainability rating system (e.g., Envision) to evaluate the sustainability of construction-related choices and activities. As the Program progresses into final design and construction contracting, the sustainability rating system assessment would be able to provide increasingly detailed analysis of the potential benefits and costs of such choices, with the intent of identifying feasible ways to reduce GHG emissions associated with construction materials, means, and methods.

Oregon and Washington have standard specifications that would reduce GHG emissions during construction. These include:

- ODOT Standard Specifications Section 290, which has requirements for environmental protection and includes air pollution control measures. These control measures include vehicle and equipment idling limitations, which would also reduce energy usage and GHG emissions.
- Oregon Clean Diesel policy to retrofit or require Tier 4 motors (OAR 731-005-0800).
- Many of WSDOT’s standards specifications to minimize air quality impacts would also reduce energy use and GHG emissions, including:

Minimizing delays to traffic during peak travel times.

Minimizing unnecessary idling of on-site diesel construction equipment.

Educating vehicle operators to shut off equipment when not in active use to reduce emissions from idling.

Preparing a traffic control plan with detours and strategic construction timing (such as night work) to continue moving traffic through the area and reduce backups and delays to the traveling public, to the extent possible.

[32] For more information on the methods used to create this range, see the September 2024 Energy Technical Report.

As construction packages and plans are developed, the IBR Program will evaluate the potential to further reduce GHGs associated with construction. This could be implemented through construction bid document specifications or performance requirements, and could include the following:

- Construction materials.

Design specifications for materials to reduce embodied emissions; use Environmental Product Declarations to evaluate various material choices and options.

Minimize lengthy supply chains for materials by using local sources where possible while still maintaining acceptable quality levels for materials.

Use cleaner production methods for cement and concrete (e.g., consider different mixes, fuel specifications for kiln and manufacture), and if found viable, incorporate into material specifications.

Warm-mix asphalt technologies.

Maximize inclusion of recycled material to reduce virgin material production and inclusion. This would include recycling existing concrete and asphalt pavements within Program limits to be used as aggregate base, subbase, backfill materials, etc.

Consider prioritizing suppliers that document accountability to their sustainable practices, such as by participating and reporting to EPA's EnergyStar Challenge for Industry.

- Fuel and energy use.

Encourage use of renewable fuels and/or electric equipment.

Specify improved diesel emissions standards for construction and vehicles.

Use renewable diesel, renewable propane or other lower-carbon fuels in construction equipment.

Require on-site renewable diesel use in heavy equipment and transport of materials.

Select specified electrical equipment (e.g., lighting) to maximize for energy efficiency, as long as the equipment meets safety and other project needs and requirements.

Seek to prioritize the use of battery-powered equipment and limit the use of diesel equipment operating under less stringent emissions standards than EPA's Tier 4.[33]

Supply power during construction (e.g., electric equipment, power for lighting) from 100% renewables (e.g., electric equipment, power for lighting).

- Waste reduction.

Minimize construction waste and consider adopting or establishing a zero-waste demolition plan including a recycling plan to maximize the recycling or reuse of old bridge components.

Reuse working bridge parts, recycle all possible materials.

Perform in-place recycling of asphalt surfaces.

Use other innovative methods that encourage use of recycled materials.

[33] The EPA has adopted a comprehensive national program to reduce emissions from nonroad (construction equipment) diesel engines by integrating engine and fuel controls as a system to gain the greatest emission reductions. To meet these Tier 4 emission standards, engine manufacturers will produce new engines with advanced emission control technologies.

- Traffic management during construction.[34]

Minimize detour times.

Support construction personnel in reduced commute impacts.

Consider transit subsidies or elimination of fares during the construction period.

- Support for non-driving modes.

Consider construction-phase or ongoing travel demand management programs with education/incentives to encourage people to try non-driving modes. This would be particularly effective with the delays expected during construction.

- Other approaches as suggested by interested parties, agencies, and the public.

5.5 Environmental Impacts Exacerbated by Climate Change

Any transportation project will have direct impacts, positive and negative, to communities, natural resources, and the built environment. These impacts are disclosed and described in resource-specific technical reports developed for the IBR Program and are summarized in the SEIS. The cumulative effects analysis addresses the compounding and interrelated effects from Program activities, combined with other past, present, and reasonably foreseeable future projects. The environmental justice analysis addresses impacts to minority and low-income populations to determine if there would be disproportionately high and adverse effects on those communities. The Equity Technical Report describes IBR Program efforts to pursue equity in processes and outcomes.

An additional important consideration is to understand how climate change would compound identified impacts due to vulnerability of people, communities, or natural systems. The EPA has found that certain communities—communities of color, low-income communities, Tribal Nations and Indigenous communities—are especially vulnerable to climate-related effects.[35] The Climate and Economic Justice Screening Tool developed by the federal government but discontinued in 2025 indicates that there are three census tracts identified as disadvantaged in the study area; all are located in Vancouver. The Equity Technical Report presents demographic data and analysis. Climate change also is likely to increase a community's vulnerability to other environmental impacts, further exacerbating environmental justice concerns. The effects of climate change observed to date and projected to occur in the future include more frequent and intense heat waves, longer fire seasons and more severe wildfires, degraded air quality, increased drought, greater sea-level rise, an increase

[34] Measures for minimizing the effects of construction-related traffic congestion (and thus emissions) are described in the Transportation Technical Report.

[35] See EPA, Final Rule for Carbon Pollution Emission Guidelines for Existing Stationary Sources Electric Utility Generating Units, 80 Federal Register 64661, 64647 (October 23, 2015), https://www.federalregister.gov/d/2015-22842 ("[c]ertain groups, including children, the elderly, and the poor, are most vulnerable to climate-related effects." Recent studies also find that certain communities, including low-income communities and some communities of color. . . are disproportionately affected by certain climate change related impacts—including heat waves, degraded air quality, and extreme weather events—which are associated with increased deaths, illnesses, and economic challenges. Studies also find that climate change poses particular threats to the health, well-being, and ways of life of indigenous peoples in the U.S.); see also EPA, EPA 430-R-21-003, Climate Change and Social Vulnerability in the United States: A Focus on Six Impacts ("Six Impacts") (September 2021).

in the intensity and frequency of extreme weather events, harm to water resources, harm to agriculture, ocean acidification, and harm to wildlife and ecosystems.

The increased area of impervious surface associated with the Modified LPA and design options may exacerbate heat island effects. To the extent that these areas are close to sensitive populations and land uses, means to provide reflective surfaces, shading, or vegetation, or to otherwise minimize or mitigate the heat island effects, would benefit the community.

5.6 Indirect Effects

In the context of climate change, indirect impacts include potential growth-inducing effects and other effects related to project-induced changes in patterns of land use, population density, or population growth rate. The Land Use Technical Report addresses these potential impacts.

Indirect impacts could also occur on the federal navigational channel of the Columbia River; climate change–induced sea level change could have effects on the channel in two circumstances:

- Below Water – Increased water depth due to sea level change within the federal navigation channel could impose a residual future benefit for the federal navigation channel future operations and maintenance and utility (less dredging required).
- Above Water – Increased river stage along the federal navigation channel could reduce the vertical clearance available for vessels to transit under the new Columbia River bridges.

See Section 6.4.1, U.S. Coast Guard Permit: Bridge Locations and Clearances, for more discussion of changes in river flows and navigation.

5.7 Cumulative Greenhouse Gas Changes and the Social Cost of Carbon

The IBR Program would result in GHG emissions from construction, roadway users, and ongoing operations and maintenance activity. GHG emissions from construction and operations and maintenance would be unavoidable impacts. The GHG emissions associated with roadway users are expected to be lower than they would be with the No-Build Alternative. This section evaluates how the GHG emissions reduced by implementation of the IBR Program would be balanced by the unavoidable construction-related emissions. Although there would be small differences in emissions between the Modified LPA design options, those differences are not included in the tables below because at the scale and time frame of the analysis, they would not substantially change the conclusions described.

Table 5-13 presents the basis for the SCC assessment. The construction, operations and maintenance, and transit operations emissions would result in new GHGs from the project. A balancing factor is the reduced roadway operational emissions due to the reduced VMT and improved traffic performance associated with the Modified LPA and all design options. The operations and maintenance emissions disclosed in Section 5.3.3, Emissions from Operations and Maintenance, were not included in this cumulative analysis because they would occur with or without the IBR Program; the IBR Program would have lower operations and maintenance emissions during the evaluation period than the No-

Build Alternative due to the condition of the existing bridges and infrastructure requiring more maintenance, especially in the near-term years.

Table 5-3 in Section 5.3.1, Emissions from Roadway Users, summarizes GHG reduction estimates at the regional level and shows a reduction of 45 metric tons of GHG per day for the Modified LPA compared to the No-Build Alternative.

To calculate annual emissions for the Modified LPA and the No-Build Alternative, the IBR Program used the assumption that weekend bridge crossings occur at 90% of the level of weekday crossings. As shown in 5.3, Operational Greenhouse Gas Impacts, the Modified LPA would result in fewer regional VMT and corresponding GHG emissions than the No-Build Alternative. To determine the cumulative GHG changes between opening year and the future year (2035 through 2045), this reduction of 45 metric tons per day was annualized over the 11-year period used for operational evaluation.[36]

The estimates in Table 5-13 reflect the difference between the Modified LPA and the No-Build Alternative. Implementation of the IBR Program could result in an increase of almost 338,000 metric tons of GHG through 2045. Given that savings from roadway users would occur in each year once the Program becomes operational, over 158,000 metric tons of GHG emissions could be avoided between the 2035 opening year and 2045. These numbers account for reductions between opening year and future forecast year; additional reductions from roadway users would continue to accrue after 2045.

Table 5-13. Cumulative GHG Emissions Estimates

Parameter	Annual Difference Between Modified LPA and No-Build (MT CO_2e)	Years	Total Over Evaluation Period (MT CO_2e)	Note
Construction Emissions	+46,891	2025–2034	468,910	A range of emissions was estimated; see note. [a]
Operations and Maintenance Emissions	0	2040–2045	0	Annual emissions of 1,088 MT CO_2e would be lower or similar to the No-Build Alternative.
Transit Operational Emissions	+2,524	2035–2045	25,240	Emissions reflect expanded transit system.
Roadway User Emissions [b]	-15,802	2035–2045	- 158,017	Estimate based on daily reduction of 45 MT CO_2e/day in the region.

a A range of emissions was estimated and presented in Section 5.4,Construction Effects. The value presented in this table is the “high” value, which assumes higher carbon intensity bridge design and materials for the main river crossing under the single-level bridge with one auxiliary lane. The construction period is assumed to last 10 years.

[36] The daily estimate of 45 metric tons per day is based on an average weekday; based on a comparison of current bridge crossings between weekdays and weekend days, the average savings on a weekend day was estimated to be 90% of the weekday average (40.5 MT). These GHG reduction values were annualized using a year with 260 weekdays and 105 weekend days. The annual estimates were summed over 11 years, from opening year in 2035 through the end of the transportation forecast year in 2045.

b Roadway user emissions were assumed to be constant over each year between 2035 and 2045. Due to shifts in the share of electric vehicles in the fleet over time, the 2035–2045 benefits may be underestimated (i.e., those years have more gasoline vehicles than expected in 2045). Changes to travel demand based on population, employment and land use after 2045 are not forecast at this time. Benefits from the Modified LPA would extend well beyond 2045.

CO_2e = carbon dioxide equivalent; LPA = Locally Preferred Alternative; MT = metric tons

The climate impacts from the combination of construction emissions, transit operations, and benefits accruing from decrease in roadway use compared to No-Build were monetized using the updated SC-GHG values published by the EPA in the *Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances* (EPA 2023).[37] Table 5-14 shows the present value in 2024 of the monetized climate costs for the 2025–2045 period under each discount rate.[38] The present value of the monetized impacts (damages) of the GHG emissions from the IBR Program ranges from $41 to $115 million in 2020 dollars.[39] The equivalent annualized costs of the emissions over the 20-year period range between $2.55 and $6.42 million. The estimates presented in Table 5-14 reflect emissions through 2045, the end of the traffic forecast period. However, benefits from the Modified LPA would extend well beyond 2045 because the transit, active transportation, and roadway improvements are expected to last for many years.

Table 5-14. Social Cost of All Greenhouse Gas Emission Changes Associated with IBR Program Cumulative Emissions (2025–2045)

Value	Discount Rate 2.5%	Discount Rate 2.0%	Discount Rate 1.5%
Present Value in 2024 (millions 2020$)	$41.24	$67.29	$114.96
Annualized Value (20 years; millions 2020$)	$2.55	$3.96	$6.42

Source: EPA 2024. Appendix C contains outputs from the EPA model.

[37] All files used for the analysis were available on the EPA's webpage in 2024 and were used in this analysis. The model used to calculate the social cost of carbon is a Microsoft Excel based document titled: "Workbook for Applying SC-GHG Estimates" developed by the EPA to assist analysts in applying the updated SC-GHG estimates in policy analysis, such as to monetize project SC-GHG emissions in an environmental impact statement.

[38] A discount rate is a way to account for changes in the value of a dollar over time, and using different discount rates can adjust for the value of benefits or costs today than in the future. The social cost of carbon (SCC) discount rate determines how much future climate damages are valued today, with lower rates placing higher value on future generations and resulting in a higher SCC.

[39] The EPA's social cost of carbon tool published in 2024 provided values for CO_2, CH_4 and N_2O. However, the construction, maintenance, and user emissions are presented above in CO_2e. Appendix C of this report contains additional details about how the CO_2e estimates were disaggregated into specific speciation of constituent chemicals (e.g., CO_2, CH_4, and N_2O) for vehicle operations, fuel cycle emissions, and fuel used during construction and transportation of construction materials. Data were not available to disaggregate embodied CO_2e from construction materials or transit operations, and CO_2e was input as CO_2. Using CO_2e in place of CO_2, CH_4, and N_2O to estimate the social cost of carbon for transit operations and construction materials may result in an overestimate of the social cost of the construction-related emissions.

Oregon and Washington both publish estimated SCC as part of their regulatory and pricing programs. Using either state value would result in lower cost estimates of the emissions than using the EPA value.

Washington has formally adopted the SCC for use in utility planning under the Clean Energy Transformation Act. The Washington Utilities and Transportation Commission publishes annually adjusted SCC values based on the federal Interagency Working Group's estimates using a 2.5% discount rate. These values, listed below, are updated each year and required for use in resource planning and cost-effectiveness analysis:

- 2025 SCC: ~$99/ton (2024 dollars)
- 2030 SCC: ~$106/ton
- 2050 SCC: ~$138/ton

Oregon

Oregon does not have a universally adopted SCC across state agencies. However, the Oregon Department of Environmental Quality uses the SCC in its Climate Protection Program to set Covered Compliance Instrument credit values. The current approach is as follows:

- Starting Value: $81/ton (2021 dollars)
- Updated Value: $107/ton (2023 dollars)
- After 2023: Increases $1/year and adjusts for inflation (for each dollar year)

This value is used to determine alternative compliance contributions when regulated entities choose not to directly reduce emissions.

6. DESIGNING FOR RESILIENCY

Chapter 4, Planning for Adaptation and Resiliency, outlines the future climate conditions that are being considered in design and permitting for the IBR Program. The Program will consider a range of possible future outcomes, including the highest (worst-case) scenarios modeled for climate change (e.g., RCP 8.5 as discussed in Section 4.1, Climate Models and Greenhouse Gas Concentrations).[40] Design decisions to address potential future conditions will be made with consideration of the range of potential outcomes and using a risk-based approach for this critical infrastructure. The following goals would be addressed as the Program advances work on climate resilience and adaptation:

[40] American Society of Civil Engineers standard practice is to use the 90th percentile of the Representative Concentration Pathways (RCPs) 8.5 and 4.5. RCP 4.5 is described by the Intergovernmental Panel on Climate Change as a moderate scenario in which emissions peak around 2040 and then decline. RCP 8.5 is the highest baseline emissions scenario in which emissions continue to rise throughout the 21st century. Therefore, climate change projected under RCP 8.5 will typically be more severe than under RCP 4.5. See the IPCC for more description of these models: https://www.ipcc.ch/.

- The bridges, roadway, paths, and transit system will withstand and can be used under acute events, such as flooding of the highway approaches from atmospheric rivers and the loss of snowpack.
- The bridges and other infrastructure can be used during chronic events, such as extended heat periods or smoke events from forest fires.
- Transit can maintain operations in a range of future temperature and climate conditions.
- The bridge approaches on either bank can provide heat refuge and greenspace.
- The bridges and transit system will be resilient to the failure of other infrastructure, such as power sourcing.
- The bridges will help to mitigate urban heat island effects (e.g., by using materials that keep the surface temperatures cooler or are reflective).
- The bridges will mitigate elevated temperatures of stormwater runoff before discharging into the river.

6.1 Design Considerations

The Modified LPA will be designed either to accommodate future climate conditions or not to preclude the development of design refinements to better accommodate future fluctuations in climate conditions. Below is an initial list of environmental conditions that could require design for adaptation or accommodation. These considerations will be evaluated further as design progresses.

- Heat – Design for sustained air temperatures above 100°F, with surface temperatures far exceeding 100°F.

All plantings should consider future temperature projections to understand plant suitability and life cycle expectations (e.g., for long-lived trees, this is a more important consideration for resiliency. Planting grasses or short-lived plants is of lesser sensitivity to selecting tree species).

Infrastructure for active users should assume the need to cool people down in the summer, provision of shade, rest areas, etc., with special sensitivity to areas with active use (transit stations, bicycle and pedestrian paths, etc.). These considerations for increased heat events will be addressed by specifying material specifications (e.g., temperature tolerance, reflective materials).

Strategies should be implemented to minimize high-temperature runoff entering waterways where it can harm wildlife. These strategies could include infiltration ponds or other methods to sequester runoff from roadways. The Columbia River and Fairview Creek have established requirements for temperature that will be addressed through the state permitting process (see Water Quality and Hydrology Technical Report for more information).

Consider mitigation for other environmental impacts that have co-benefit to climate factors (e.g., reducing heat islands, adding shading).

- Water flow, volume, hydraulics – Design for significantly larger water volumes from winter storms. Design for more frequent snow and ice storms. Consider designs to accommodate drier, hotter summers.

Consider water treatment options that hold water well into the dry season to reduce the need for irrigation.

Consider the need for rain protection at transit stations and on active transportation facilities.

Evaluate ramps/access in flood-prone areas or other areas with drainage challenges.

- Fire – Plan for increased drought in the area, leading to increased risk of small local fires ignited by traffic.

Plant drought-tolerant plants; consider plantings that retain water in summer.

- Smoke – Effects from smoke (visibility, particulate deposits) are generally considered temporary and, thus, are not anticipated to dictate design. However, smoke could affect the need for intermittent closures or detours.

Plan for smoke-caused disruption to active transportation facilities. If the bridges, with their windy position, are less smoky than the surrounding areas, they could be a recreation refuge during periods of intense smoke.

Consider the possibility of traffic issues due to fire- and smoke-closed roads at other points along the I-5 corridor and nearby crossings.

6.2 Emissions During Program Operation and Maintenance

The GHG emissions from the long-term operation and maintenance of Program improvements (as opposed to user emissions) are anticipated to be relatively minor. However, they represent an additional opportunity to improve climate outcomes and progress toward shared GHG reduction goals. As Program design and planning continue, ODOT and WSDOT will work together to develop plans for long-term operation and maintenance of the infrastructure.

The following are options for reducing GHGs through infrastructure maintenance. ODOT, WSDOT, TriMet and C-TRAN will consider these approaches to further improve climate performance of the IBR Program:

- Minimizing energy use on the bridges (e.g., LED lights) and using green energy sources.
- Providing energy storage on the bridges for operations if power is interrupted. These features could offer multiple benefits (e.g., wind turbines as entry sentinels, solar panels as potential screens for wind and rain for active transportation facilities).
- Maximizing the renewable electricity supply for operations (lights, signs, transit) toward 100% as soon as practical.

Update evaluation of the potential for installing wind generation on the bridges (any turbines or equipment would have to be designed to avoid conflict with Federal Aviation Administration–regulated surfaces, approximately 20 feet above the bridge decks).

Install solar panels for energy needs on the bridges.

Explore the use of piezoelectric energy harvesters to generate energy from vibration energy of traffic.

- Using an all-electric or hydrogen state department of transportation maintenance fleet (anticipated by 2045).
- Establishing guidelines for replacement equipment, alternative fuel use, and materials standards.

- Providing a zero-carbon source for energy use for collecting tolls (e.g., ensure the office space used to oversee and operate tolls on the bridges is carbon neutral or negative).
- Using energy-efficient electrical systems for toll gantries and technical shelters.

6.3 Further Reductions in User Emissions and Monitoring User Experience

Options to enhance the design of Program components to support emerging technologies and transitions from gasoline vehicles could include the following:

- Providing electric vehicle charging stations at park-and-ride or other project locations.
- Using wind-powered energy for MAX trains and battery-electric buses.
- Designing active transportation facilities to serve a range of mobility devices and speeds; providing flexible space for emerging types of low-emission vehicles (e-bikes, e-trikes); designing for speed differential/flexibility for future technologies (and pedestrians).
- Using shading, including the potential use of solar panels, and vegetation to reduce urban heat along bicycle and pedestrian facilities (thus reducing the disincentive to use these facilities during heat events).
- Including monitoring stations along bike/pedestrian facilities to track heat, noise, and air quality to alert vulnerable road users to local conditions.

Other efforts that could be pursued by project partners to complement the IBR Program are explored in Chapter 8, Next Steps.

6.4 Permitting Requirements

This section describes permits and other regulatory requirements that are related to factors considered in this report. They include requirements related to the USCG bridge permit; water quality regulations under the Clean Water Act; and floodplain management requirements established by FEMA.

6.4.1 U.S. Coast Guard Permit: Bridge Locations and Clearances

The Modified LPA will require a USCG permit. The Program considered the impacts of climate change in the permit application. This section provides an overview of work completed to date, and next steps.

The Columbia River is deemed a navigable water of the U.S. The Code of Federal Regulations, specifically 33 CFR 115, provides the requirements for applying for a permit to construct or modify bridges crossing navigable waters of the U.S. It also sets forth the procedures the USCG follows to process the application. Rising sea levels and changes in rainfall patterns associated with climate change could result in rising river levels and, therefore, the design of higher bridge elevations.[41] Bridge designs generally consider high-water scenarios that incorporate current scientific understanding of rising river levels and flood levels for bridge clearances.

Climate change could affect future Columbia River water levels. The impacts of climate change in the IBR Program area that could be relevant to future Columbia River water levels and vessel clearance are projected as follows:

- Relative sea level rise in the Pacific Northwest will vary regionally based on uplift and subsistence of continental plates. Some areas will experience less sea level rise because their ground is rising due to tectonic forces. For 2100, the projected absolute sea level rise is 1.0 to 2.2 feet in the low scenario and 1.4 to 2.8 feet in a high scenario. For 2150, the projected ranges are 1.5 to 3.8 in the low scenario and 2.3 to 4.9 feet in a high scenario (Miller et al. 2018). These projections are for the mouth of the Columbia River, not at the bridge site.
- Findings from the Levee Ready Columbia study indicate that rising sea levels may only impact the Columbia as far inland as Rainier, Oregon (Wherry et al. 2019).
- Evaluation of the latest climate change data indicates that sea level change at the mouth of the Columbia River would likely have little effect on water surface elevations around the new Columbia River bridges. Based on the most likely future scenario, the 50% probability projection for 2150, a water surface elevation change of less than 8 inches could occur at the bridges, but this would only occur during high tide events that coincide with atmospheric river storm events in November, December, and January (USACE 2022). Therefore, the effects of climate-induced sea level change on the federal navigation channel operations and maintenance are expected to be minor.

More likely to have a direct impact on the levee system in the study area is the anticipated increase in precipitation in the Cascades and the Willamette Valley, which will create higher wintertime flows. The study also indicates the need to prepare for earlier snowmelt and more wintertime rain-on-snow events, quickly melting the snowpack, which also lead to higher river flows.

- Warmer winter temperatures in the Columbia River Basin will result in lower snowpack and higher winter base flows. Lower base flows are expected in the spring and summer months, and an increased likelihood of more intense storms may increase the chance of flooding. Average annual precipitation is likely to stay within the range of 20th century variability; however, there will be a shift in the amount and timing of seasonal precipitation, with a trend toward more winter precipitation.
- Seasonal shifts in temperature and precipitation will likely impact base and peak flows and river water levels. Warmer, wetter winters will likely lead to higher winter base flows and river stages, while lower base flows and river stages will likely occur in spring and summer months.

There is uncertainty associated with these predictions, and the best available science does not provide specific predictions for how climate change impacts would change the daily or monthly average highs and lows at the bridge crossing.

[41] Higher bridge elevations will require longer structures due to Americans with Disabilities Act and other design standards.

As noted, future higher winter base flows will affect water depth and river speed. While the river could have higher peak flows, according to the Columbia River Pilot's Vessel Movement Guidelines (Columbia River Pilots 2023), river flow is not as much of a navigation issue on the Columbia River as river height. However, it is possible that during future high flow events, navigation of certain vessels could be affected due to increased river flow regardless of the navigational clearances. Depending on the final design and approved navigational clearances, it is possible that ship navigation for some of the largest vessels could be affected during high river levels.

The Navigational Impact Report prepared for the IBR Program includes information on the size of vessels historically operating in this stretch of the river, as well as an analysis of how river navigation would be affected with the new bridge in place (IBR 2025).

6.4.2 Water Quality

As design and permitting advance, stormwater and water quality evaluation will be conducted with sensitivity to future climate change scenarios. For example, the Water Quality and Hydrology Technical Report evaluates the water quality concerns in the study area and addresses the Program's impacts. Water temperature is a concern for the Columbia River and lower Snake River, as formally identified by the EPA in May 2020. The total maximum daily load applies a 20°C (68°F) summer maximum criterion for salmon and steelhead migration to the lower 397 miles of the Columbia, which includes the project area. Year-round water temperatures in the vicinity of the primary study area exceed the standard for salmon and steelhead migration corridors of a 20°C average 7-day maximum. Since the 1960s, summer water temperatures in the Columbia have increased by approximately 1.5°C due to climate change (EPA 2021).

The Water Quality and Hydrology Technical Report provides more information on effects associated with floodplains, water quality, and stormwater flows and treatment requirements.

6.4.3 FEMA Floodplain Regulations

As design and permitting of the Modified LPA advance, floodplain evaluation will be conducted with sensitivity to future climate change scenarios. Results may indicate areas that warrant protection or action in exceedance of current requirements. Additionally, local or state requirements may shift in the coming years; the IBR Program needs to be prepared to meet future permitting requirements.

FEMA maps floodplains associated with surface waters throughout the U.S. Floodplains are designated in terms of floods with 100-year or 500-year recurrence intervals, or a 1% chance or 0.2% chance, respectively, of occurring in any given year. The maps also identify floodways, which include the stream channel and adjacent areas where water is actively flowing during a flood. Design standards for buildings and infrastructure are typically established by state or local jurisdictions based on their location with respect to FEMA-mapped floodplains. Floodplains mapped by FEMA within the IBR Program primary study area include the Columbia Slough, the Columbia River, and Burnt Bridge Creek. These floodplains are confined to the immediate vicinity of project streams due to levees or, in the case of Burnt Bridge Creek, steep slopes. See Figure 6-1).

As part of the Modified LPA, new in-water pier complexes would be built for the Columbia River bridges, and the original pier complexes would be removed. New piers would also be built for the

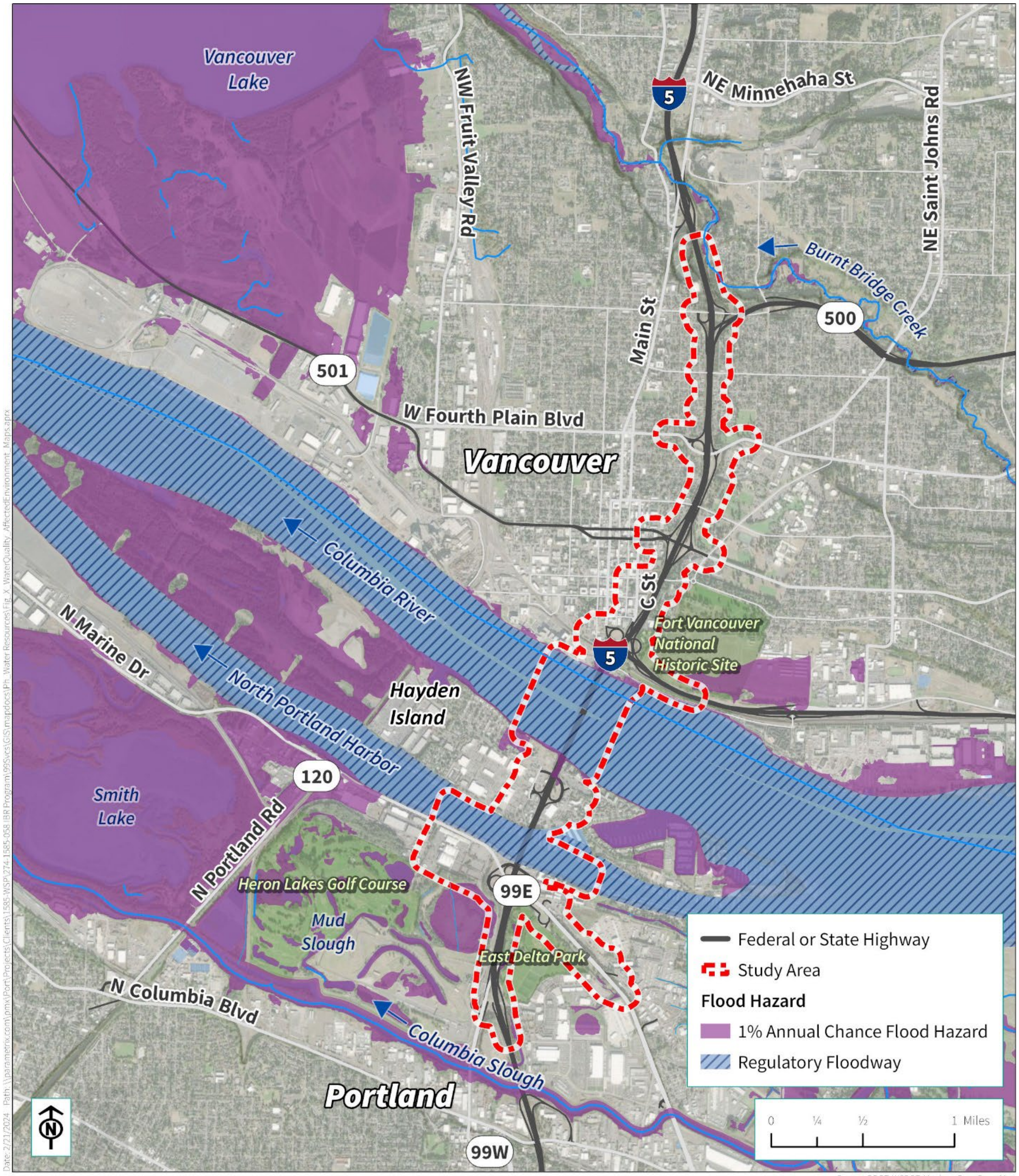
North Portland Harbor bridges. The new structures would likely require a floodplain permit from the local jurisdictions. Floodplain permits require modeling studies to evaluate the impact of the proposed bridges on flood flows; these studies would be conducted prior to applying for the permit and based on the design information available at that time. If results of the final modeling show the project would impede flood flows to a degree that exceeds local standards, the likely solution would be to excavate additional space within the floodplain to provide storage of flood waters.

As the Program moves forward, the design of facilities within floodplains and floodways will be consistent with current regulations and guidance. Requirements and anticipated changes are outlined below:

- A floodplain permit will be required. A technical "no-rise" analysis stamped by a registered professional engineer licensed in the State of Oregon will be required to show that encroachments in the floodway will not result in a rise in the base flood elevation If the analysis shows there will be a rise, then an application must be made to FEMA for a Conditional Letter of Map Revision per CFR 44.60.3(d)(4).
- Fill compensation (or compensatory excavation) is required under Portland City Code 24.50.060.F.8. These requirements are independent from the "no-rise" requirements. Any fill placed below the FEMA base flood elevation or the 1996 Flood Inundation Elevation must be balanced by an equal volume of soil removal. In order to qualify as removal, the excavation may not be filled with water during non-storm winter conditions. The "no-rise" analysis does not satisfy the fill compensation requirements.
- The requirements for fill compensation (or compensatory excavation) are expected to change in the coming year(s) as fill and structure compensation requirements from the FEMA Biological Opinion in Oregon are adopted.

FEMA floodplain mapping in the study area does not account for the future effects of climate change. The IBR Program will therefore conduct hydraulic modeling using a range of scenarios, including one that includes anticipated future flows.

Figure 6-1. Federal Emergency Management Agency Floodplain Boundaries in the Study Area



7. AVOIDANCE, MINIMIZATION, AND MITIGATION MEASURES

To prevent or minimize contributions to climate change, the following long-term and temporary avoidance and minimization measures are identified in Table 7-1. The table also describes IBR Program commitments to monitor and report GHG emissions. No specific temporary or long-term mitigation measures within control of the IBR program for climate change were identified; however, avoidance, minimization, and mitigation measures for transportation, air quality, and energy that could potentially affect climate change are described in the Transportation Technical Report, Air Quality Technical Report, and Energy Technical Report of the NEPA/SEPA Final SEIS and are not included in the table below. Refer to Appendix B of the SEPA Addendum to review the measures.

Table 7-1. Avoidance and Minimization Measures and Program Commitments

Temporary or Long-Term	Impact Type	Avoidance and Minimization Measure
Temporary	Construction phase GHG emissions resulting from construction materials	ODOT, WSDOT, TriMet, and C-TRAN will use design specifications for materials to reduce embodied emissions as feasible. They will also request Environmental Product Declarations from construction contractors to quantify and monitor construction GHG from materials.
Temporary	GHG emissions from construction fuel and energy use	ODOT, WSDOT, TriMet, and C-TRAN construction specifications will encourage on-site renewable diesel use; seek to prioritize the use of battery-powered equipment and encourage limiting the use of diesel equipment operating under less stringent emissions standards than EPA's Tier 4; supply power during construction (e.g., electric equipment, power for lighting) from 100% renewables (e.g., electric equipment, power for lighting), as feasible.
Long-Term	GHG emissions from maintenance equipment	ODOT and WSDOT will use an all-electric or hydrogen state DOT maintenance fleet (anticipated by 2045) and establish guidelines for replacement equipment, alternative fuel use, and materials standards, as feasible.
Long-Term	Changes in climate performance and impacts resulting from design decisions and construction activity	ODOT and WSDOT will pursue certification through the Envision sustainability rating system to evaluate and document the sustainability of Program design and construction.
Long-Term	Changes in climate performance of transportation system due to infrastructure changes by the IBR Program	IBR Program will monitor transportation trips across the Columbia River by mode throughout the life of the IBR Program and will establish plan for long-term monitoring and reporting with local agency partners, as feasible.

DOT = Department of Transportation; EPA = U.S. Environmental Protection Agency; GHG = greenhouse gas; ODOT = Oregon Department of Transportation; WSDOT = Washington State Department of Transportation

8. NEXT STEPS

In addition to the measures outlined in previous sections, this section outlines the potential for additional partnerships with local and regional partners in the service of shared climate goals. Addressing the climate crisis requires collective action. As the stewards of the state and interstate highway system, ODOT and WSDOT have the ability to shape projects to promote alternative modes, introduce demand management, and improve system management and operations. However, there are many other strategies to decrease VMT and GHG emissions associated with transportation (e.g., higher frequency mass transit, land use patterns that reduce trip distances and support active modes, and mobility hub options). Many of these are outside of the responsibility or control of ODOT and WSDOT.

The IBR Program invited climate and planning staff from each of the partner agencies to join ODOT and WSDOT climate specialists in a climate technical work group, which discusses strategies to support shared climate goals. The work group meetings cover topics such as methods to assess Program-related GHG emissions, GHG reduction goals and targets, and the need for mutually supportive policies and programs to support shared climate goals. Future meetings will address design refinements, the environmental analysis, construction means and methods, and potential mitigation or offsets. Table 8-1 presents a range of potential additional strategies and considerations to address GHG emissions and VMT. The table is not a list of IBR Program, agency, or private commitments, but rather a tool to outline and understand the various means to reduce GHG emissions from transportation in our region. The table includes a list of potential strategies, along with the likely responsible party, and considerations for further evaluation or exploration of the strategy as it relates to the implementation of the IBR Program.

Table 8-1. Extending Transportation Climate Strategies Beyond the IBR Program

Category	Climate Strategy	Responsible Entity	Considerations and Notes
Travel Options	Increase telecommuting and remote work.	Employers	Employer-supported programs: Reduce travel demand for commute trips. Reduce peak-period “rush hour” travel demand.
	Employer transit – van pool or small buses.	Employers	Employer-supported programs: Reduce travel demand for commute trips. Reduce peak-period “rush hour” travel demand. Alternative to fixed-transit routes.
	TDM/employer programs to encourage employee travel behavior changes (e.g., Oregon DEQ’s ECO program).	Employers Cities	Programs could also be designed for residents.

Category	Climate Strategy	Responsible Entity	Considerations and Notes
Design Choices	Park-and-ride facilities.	IBR Program TriMet C-TRAN	Encourages shift to transit, especially for residents who live far from high-frequency routes. However, parking is not an ideal land use adjacent to high-capacity transit.
	Active transportation facilities serve all types of vehicles and speeds: electric bikes and future technologies.	IBR Program Cities on own networks	Design active transportation facilities for speed differential. Flexibility for future technologies. Design is safe and comfortable for all active transportation users.
	Managed/bypass lanes (e.g., HOV, transit, or freight).	ODOT and WSDOT Transit providers	Incentive for carpooling. Transit or freight bypass lanes to improve travel times and reduce air quality impacts. Addresses localized air quality impacts from diesel trucks idling in congestion; increased efficiency supports freight ability to use alternative fuels.
	First- and last-mile solutions and transit network improvements.	IBR Program Cities on own networks Transit providers MPOs	Improve access, quality, and frequency of connections.
Financial Incentives	Reduce or eliminate transit fares.	TriMet/C-TRAN MPOs ODOT and WSDOT	Incentivizes transit.
	Increase parking charges.	Cities Private	Increasing hourly or daily parking fees can result in reduction of trips or mode change.
	Increase bridge toll rates per trip.	OTC/WSTC	Equity considerations The OTC and WSTC set toll rates in each state and would need to collaborate to set the toll for the IBR Program.

Category	Climate Strategy	Responsible Entity	Considerations and Notes
	Increase local or state gas tax or introduce road user charge.	OR/WA Counties Cities	Equity considerations. In the Pacific Northwest, some movement toward a road user charge as more sustainable mechanism for revenue. Oregon has conducted a pilot program. Both states are considering this for the future for revenue stability.
	Reduced toll for EVs.	OTC/WSTC	Could incentivize EV switch; with reduced toll for EVs, this should be paired with equity considerations and programs to support making EVs more accessible for low-income community members.
	Reduced toll for low-emission medium-duty and heavy-duty vehicles.	OTC/WSTC	Eventually the fleet will be EV, but this could accelerate transition.
Technology Choices	Alternative fuels (e.g., charging stations, hydrogen fueling, clean source electricity).	Private	Existing layover/fueling site near Delta Park.
	Switch from gas-powered to electric vehicles.	Auto manufacturer commitments Federal requirements Individuals Fleet: local agencies, states	Laws/regulations in place to make this happen, along with corporate commitments. Equity considerations and programs to support making EVs more accessible for low-income community members.
	Increase e-bike and e-cargo bike use (e.g., subsidize purchase).	States Cities Employers/private	Example: Denver e-bike rebate program demonstrates there is strong and increasing demand for e-bikes; Oregon considering program at state level.
Land Use Choices	Increase density of housing and employment.	Cities Counties Metro RTC	Encourage a mix of uses and “complete communities” or “20-min neighborhoods” to reduce long trips.
	New branch/office locations in Vancouver near housing.	Employers	Reduce need for long commute trips.

Category	Climate Strategy	Responsible Entity	Considerations and Notes
	Increase bike parking and micromobility parking.	Employers Cities Private developers	Incentive for bike commuting. Most important at destinations.
	Reduce urban heat islands.	Cities Private developers	Create design standards and requirements to reduce heat island effects with development (reduce pavement, use reflective colors, strategize plantings, etc.).
Other	Housing weatherization for low-income households.	Cities Counties State	Reduces risk to health related to excessive heat (or cold).

C-TRAN = Clark County Public Transit Benefit Area Authority; DEQ = Department of Environmental Quality; ECO = Employee Commute Options; EV = electric vehicle; HOV = high occupancy vehicle; IBR = Interstate Bridge Replacement; MPO = Metropolitan Planning Organization; OTC = Oregon Transportation Commission; TDM = transportation demand management; Tri-Met = Tri County Metropolitan Transportation District of Oregon; WSDOT = Washington State Department of Transportation; WSTC = Washington State Transportation Commission

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Appendix A: Climate Framework

Considering the importance of our natural environment

IBR Program Climate Framework

May 2024

IBR Program Climate Framework

CONTENTS

FIGURE

1. INTRODUCTION

This document outlines the IBR Program Climate Framework and working concepts for implementation. The IBR Climate Framework has two main objectives: reduce climate impacts and improve climate adaptation and resilience. The framework will be applied to all Program phases including design, construction, and long-term operation and maintenance. The goal of this work is to account for environmental impacts throughout the life cycle of the bridge and associated facilities. In collaboration with local agency partners, the public, and the Program's community and equity advisory groups, the IBR Program developed the following desired outcomes associated with climate change and resiliency. Desired outcomes are observable and measurable accomplishments that the IBR Program aspires to achieve at a program level. The following desired outcomes align with the Program's Purpose and Need statement, as well as with the community priorities and values adopted by the Community Advisory Group and the equity objectives adopted by the Equity Advisory Group.[1]

- Reduce greenhouse gas emissions in support of state climate goals.
- Minimize operational and embodied carbon during construction.
- Design all structures to be resilient to and operable following anticipated climate disruptions (e.g., heat events, flooding, sea level rise).
- Limit other Program-related environmental impacts that exacerbate effects of climate change (e.g., heat island, runoff).

These desired outcomes are translated into the climate framework. Figure 1 illustrates the operational goals that will be developed and demonstrated during each stage of the IBR Program. The equity nexus indicates the connection between climate resilience and equity objectives of the IBR Program.[2] Because traditionally marginalized and underserved communities can be more vulnerable to the effects of climate change, treatments to mitigate the impact of climate change will be considered with sensitivity to those communities.

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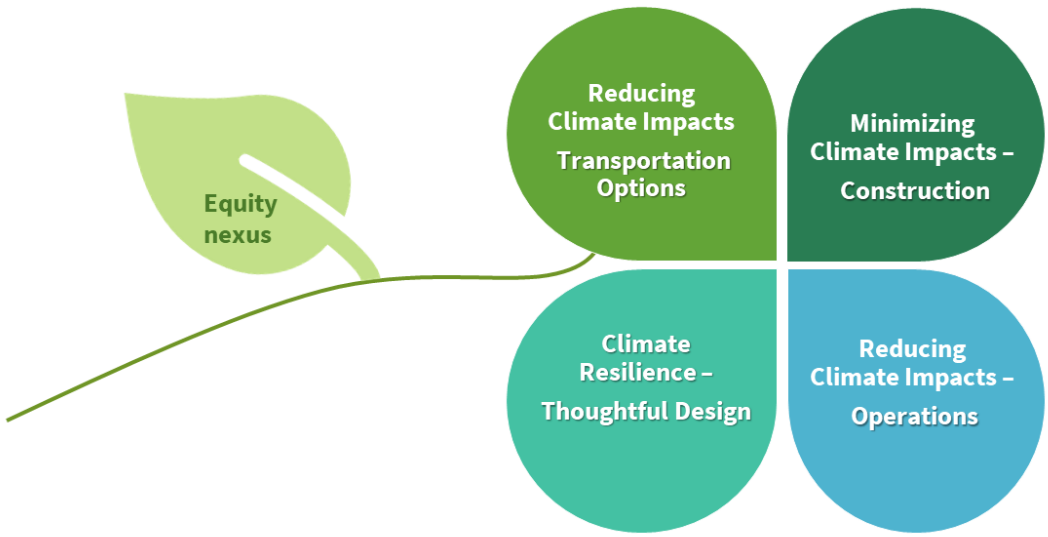
[1] For more information on the advisory groups associated with the IBR Program, see https://www.interstatebridge.org/advisory-groups.

[2] For more information on the equity objectives of the IBR program see https://www.interstatebridge.org/equity

Figure 1. IBR Climate Framework



Implementing the Climate Framework will require collaboration and diligence from the Program team, partners, and other interested parties. Using the Climate Framework and tangible measures, the IBR Program intends to monitor performance during construction and of future operations of the highway, transit, active transportation, and local facilities. The specifics of targets and data to monitor will be developed in collaboration with local agency partners.

The next four sections of the document describe how the framework elements are aligned with Program development and future operations.

2. IMPROVE CLIMATE RESILIENCE THROUGH THOUGHTFUL DESIGN CHOICES

This Program has an opportunity to create a transportation system that will support our region's resilience in a future with more extreme weather events. Climate modeling predicts the type and frequency of extreme events, and the IBR Climate Framework directs Program staff to design for performance in a range of environmental conditions. Actions the Program will take include the following:

- Manage stormwater within the project area to account for **increased storm intensities** and prevent flooding.
- Design bridge footings and boat and barge clearances to anticipate **increased river elevations** due to changes in precipitation and river flow patterns.
- Design bridge footings to anticipate **lower low-water levels in summer months**.

- Select material for and design road surfaces to account for **increased temperature extremes.**
- Use native and other resilient species to ensure **plant survival and resiliency.**
- Incorporate **renewable energy–harnessing technology** such as solar panels or wind turbines that can help to support the local electricity grid and offset emissions directly from bridge operations.
- Design pedestrian and active transportation environments that **anticipate extreme weather and take advantage of opportunities to mitigate or manage exposure;** for example, provide shade and use reflective or light-colored materials.

The Program is also thinking broadly about what might happen globally as extreme weather and sea level rise displaces communities close to the coast and equator. Impacts to seasonal jobs may result as harvest seasons shift and wildfires or flooding ruin soils. As climate becomes more unpredictable, the following may result and impact the Pacific Northwest:

- Climate refugees may lead to an influx of residents.
- Changing work patterns may lead people to shift to earlier, later, or cooler hours or even to telecommute.
- Shift of seasonal work and transport of seasonal products, agriculture especially.

Creating a resilient bridge to withstand the unpredictability of the next 100 years is critical to ensuring that the Oregon Department of Transportation and the Washington State Department of Transportation can continue to manage travel demands as they change with future population growth and extreme weather.

3. REDUCE CLIMATE IMPACTS VIA TRANSPORTATION OPTIONS

One of the best ways to eliminate emissions from transportation in the long term is to shift demand away from single-occupancy vehicles to other modes such as transit, carpooling, and bicycle and pedestrian trips. Not only would this move more people in fewer vehicles, but it also would reduce congestion and improve travel times and reliability. The Program will take the following actions to shift travel demand to low emission modes:

- Increase access and connections to high-capacity transit.
- Increase and improve accessibility for people who walk, bike, roll.
- Design infrastructure to better accommodate high efficiency vehicles by creating charging opportunities.
- Design infrastructure that supports communities with high access to multimodal opportunities and transit (e.g., complete communities).
- Implement pricing strategies such as tolls.

The Program will take the following actions to improve transportation efficiency:

- Reduce congestion through mode shift and changes to time of day travel.
- Design to reduce stop-and-go traffic patterns.
- Target moderate speeds for lower emissions.
- Incorporate transportation system management such as intelligent transportation systems.

4. MINIMIZE CLIMATE IMPACTS FROM CONSTRUCTION

Construction methods can be harmful to the surrounding environment by emitting greenhouse gases and generating construction noise and material waste. The Program will investigate and engage in the best and most climate friendly construction materials, equipment, and practices in an attempt to reduce embedded carbon in materials, reduce the use of carbon-intensive fuels, maximize recycling, and reduce and mitigate greenhouse gas emissions. Lifecycle emissions will be considered when making recommendations and choices.

The following are potential concepts to reduce climate impacts from construction:

- Optimize project elements to use the minimum amount of construction material to achieve their function.
- Design for prefabrication and/or modular components to reduce waste (e.g., use columns of the same size to allow reuse of concrete forms).
- Use warm-mix asphalt in lieu of hot-mix asphalt to reduce energy consumption and associated GHGs.
- Research clean production methods for cement and concrete, and if found viable, incorporate into material specifications.
- Maximize the use of recycled material to reduce virgin material production and use. This would include recycling existing concrete and asphalt pavements to be used as aggregate base, subbase, backfill materials, etc.
- Minimize lengthy supply chains for materials by using local sources where possible while still maintaining acceptable quality levels for materials.
- Use battery-powered equipment as feasible, and where not, use equipment that exceeds Tier 4 emission regulations established by the U.S. Environmental Protection Agency.
- Establish a demolition and recycling plan to maximize the recycling or reuse of old bridge and roadway components.

5. REDUCE CLIMATE IMPACTS FROM OPERATIONS AND MAINTENANCE

Operation and maintenance of the infrastructure built for the IBR Program would result in long-term environmental impacts. Impacts mitigated from operations and maintenance do not include the impacts from roadway users, but rather how the bridge, highway, transit and associated facilities are run and maintained. Within this element of the framework, the Program is focused on areas under direct control of the Oregon and Washington departments of transportation and TriMet and C-TRAN as opposed to the vehicle impacts from bridge users.

Vehicles (e.g., light-rail vehicles and maintenance vehicles), road surfaces (both on structures and on the ground), lighting, and the structures themselves will all need regular maintenance and repair and, at some point, replacement. A configuration with a bridge lift would add to operation and maintenance and energy needs. The infrastructure design choices made for the Program will determine the maintenance and operation requirements. The following factors may be considered in mitigating impacts from operations:

- Electrify the maintenance fleet.
- Establish replacement equipment and material standards.
- Use green energy for administrative services to oversee and operate the tolling system.

Appendix B: Consistency with Goals, Policies, and Plans

Table B-1 through Table B-9 summarize the IBR Program partners' climate planning, policies, and goals and show where and how the IBR program climate framework and desired outcomes (as well as other program initiatives, efforts, and goals such as equity and public engagement) are aligned. Alignment is indicated as follows:

- Aligned – IBR Program goals are in alignment with, and in some cases directly contribute to achieving, this partner goal.
- Partial – IBR Program goals may not directly relate to this partner goal, but are not in conflict.
- No – IBR Program goals are not aligned with this partner goal.
- Not Applicable (N/A) – Partner goal does not apply to the IBR Program; however, the IBR Program is not in conflict with this goal.
- To Be Determined (TBD) – The IBR Program has not arrived at a decision, commitment, or goal for this topic yet. Timing of a decision is indicated in the table.

Table B-1. Alignment of IBR Program and Washington/WSDOT Climate Goals and Policies

Policy	Specific Goal	Alignment with IBR Program Goals
WSDOT Secretary's Executive Order 1113: Sustainability	**GHG Reduction Target.** By 2030, reduce overall emissions of GHGs in the state to 50 million metric tons, or 45% below 1990 levels.	**Yes – Aligned.** IBR Program would shift travel demand to lower-GHG modes and improve transportation efficiency. Construction goals center around reducing construction-based emissions, and goals for maintenance and operations are all aiming to reduce GHGs.
	GHG Reduction Target. By 2040, reduce overall emissions of GHGs in the state to 27 million metric tons, or 70% below 1990 levels.	**Yes – Aligned.** Construction would be complete and the Program would be operational. ODOT and WSDOT are working to minimize future GHGs associated with maintenance by planning for a renewable power supply and high-efficiency lighting.
	GHG Reduction Target. By 2050, reduce overall emissions of GHGs in the state to 5 million metric tons, or 95% below 1990 levels.	**Yes – Aligned.** Construction would be complete and the Program would be operational.
	Energy efficiency.	**Yes – Aligned.** IBR Program climate efforts include planning for a renewable power supply, high-efficiency lighting, and energy-efficient construction practices and considerations for contractor requirements, all of which contribute to the IBR Program's energy efficiency.
	Reducing pollution.	**Yes – Aligned.** IBR Program would reduce GHG emissions compared to the No-Build Alternative over a 40-year analysis period.
	Enhanced resilience.	**Yes – Aligned.** IBR Program includes climate resiliency goals, such as designing for performance in a range of environmental conditions resulting from climate change.

Policy	Specific Goal	Alignment with IBR Program Goals
WSDOT Strategic Plan: Resilience Goal (WSDOT n.d.)	Improve resilience of the transportation system: • Seismic resilience: prioritize and strengthen the elements of the transportation system most critical to emergency response after a seismic event, such as an earthquake or tsunami. • Asset management: build resilience and reduce vulnerabilities while proactively managing the preservation and maintenance of WSDOT's assets necessary to achieve and sustain a state of good repair. • Operational resilience: support and enhance security for all WSDOT staff and properties and improve WSDOT's Emergency Preparedness for response and recovery from natural and manmade incidents (including cyber).	**Yes – Aligned.** The IBR Program includes climate resiliency goals, such as designing for performance in a range of environmental conditions resulting from climate change, as well as seismic resilience.
	Lead in the development of transportation that combats climate change and enhances healthy communities for all: • WSDOT Agency Greenhouse Gas Emissions Reduction Strategy – Lead by example by reducing agency GHG emissions. • **Transportation Sector Greenhouse Gas Emissions Reduction Strategy** – Reduce transportation sector GHG emissions by promoting and investing in efficient, equitable and healthy transportation choices.	**Yes – Aligned.** The IBR Program would shift travel demand to lower-GHG modes and improve transportation efficiency. Construction goals center around reducing construction-based emissions, and goals for maintenance and operations are all aiming to reduce GHGs.
Governor's Executive Order 20-01	State Efficiency and Environmental Performance. • When making purchasing, construction, leasing, and other decisions that affect state government's emissions of GHGs or other toxic substances, agencies shall explicitly consider the benefits and costs (including the social costs of carbon) of available options to avoid those emissions.	**Yes – Aligned.** The IBR Program would shift travel demand to lower-GHG modes and improve transportation efficiency. Construction goals center around reducing construction-based emissions, and goals for maintenance and operations are all aiming to reduce GHGs.

GHG = greenhouse gas; IBR = Interstate Bridge Replacement; ODOT = Oregon Department of Transportation; WSDOT = Washington State Department of Transportation

Table B-2. Alignment of IBR Program and Oregon/ODOT Climate Goals and Policies

Policy	Specific Goal	Alignment with IBR Program Goals
Oregon Transportation Plan (ODOT 2023)	Reduce passenger VMT per capita by 20% by 2050. Transition to cleaner vehicles and fuels, reducing CO_2e per mile by 77% by 2050.	**Yes – Aligned.** The IBR Program would shift travel demand to lower-GHG modes and improve transportation efficiency. Construction goals center around reducing construction-based emissions, and goals for maintenance and operations are all aiming to reduce GHGs.
ODOT Strategic Action Plan (ODOT 2024)	Secure Sufficient and Reliable Funding – Seek sufficient and reliable funding to support a modern transportation system and a fiscally sound ODOT.	**Yes – Aligned.** The IBR Program seeks sufficient and reliable funding. The IBR Program would identify equitable tolling and pricing strategies supporting multimodal construction costs and improved operations and access in coordination with a statewide tolling program and in support of each state's climate goals.
	Preserve Transportation Assets – Protect initial investments by working to maintain transportation assets long term, keeping facilities open and operational as much as possible.	**Yes – Aligned.** The purpose of the IBR Program directly corresponds to this goal. The Program will improve traffic operations and safety, improve transit connectivity and reliability, improve interstate freight mobility, and improve the structural and seismic integrity of the I-5 bridge.
	Improve Equitable Outcomes – continue to build and equip a diverse workforce that reflects the communities we serve and utilizes equitable processes that ensure decisions lead to more equitable outcomes. .	**Yes – Aligned.** The IBR Program's prioritization of equity concerns would assist in advancing this goal. The IBR Program established eight equity priority communities including Black, Indigenous, and People of Color and members of Indian tribes; people with low incomes, disabilities, or limited English proficiency; houseless individuals; immigrants and refugees; young people; and older adults. (See the Equity Technical Report for more information.)
	Improve Access to Active and Public Transportation - provide increased transportation choices for people to reach their destinations by means other than driving.	**Yes – Aligned.** The purpose of the IBR Program directly corresponds to this goal. By shifting travel demands to lower-GHG modes and improving transportation efficiency, the replacement bridges would fit into this goal.

Policy	Specific Goal	Alignment with IBR Program Goals
ODOT Climate Adaptation & Resilience Roadmap (ODOT 2022)	Applicable guiding principles for the state's practical approach to adaptation and resilience: • Climate Equity • Economic Sustainability	**Yes – Aligned.** The IBR Program includes climate resiliency goals, such as designing for performance in a range of environmental conditions resulting from climate change. Equity in processes and outcomes for the community is prioritized by the IBR Program. (See the Equity Technical Report for more information.)
ODOT Climate Action Plan (ODOT 2021)	Reduce emissions from the transportation system.	**Yes – Aligned.** IBR Program elements would reduce GHG emissions as compared to the No-Build Alternative.
	Make the transportation system more resilient to extreme weather events.	**Yes – Aligned.** IBR Program design would consider changes in environmental conditions resulting from climate change, with goals to address the effects of increased weather extremes on the road surface and expansion of the bridges.
Oregon Statewide Transportation Strategy (ODOT 2013)	The Statewide Transportation Strategy: A 2050 Vision for Greenhouse Gas Reduction (STS) is Oregon's carbon-reduction roadmap for transportation and includes strategies for substantially reducing GHG emissions from the transportation sector.	**Yes – Aligned.** IBR Program elements would reduce GHG emissions, which would contribute to the goal of lowering overall state emissions as compared to the No-Build Alternative.
Governor's Executive Order 20-04: State GHG Reduction Goals	**GHG Reduction Target.** Per Executive Order 20-04, achieve state GHG emission reduction goals to at least 45% below 1990 emissions levels by 2035, and at least 80% below 1990 levels by 2050.	**Yes – Aligned.** IBR Program elements would reduce GHG emissions, which would accelerate the state's progress toward these goals as compared to the No-Build Alternative. The IBR Program would expand transportation options with an aim to shift travel demand to lower emissions travel modes. IBR Program construction goals aim to reduce construction-based emissions.
Executive Order 25-29 On Reducing Greenhouse Gas Emissions and Advancing Oregon's Clean Energy Future	This executive order directs state agencies to foster the transition to a clean energy economy by prioritizing implementation of Oregon Energy Strategy Pathways, get clean energy projects built, and build a resilient clean energy economy. The Executive Order also requires state agencies to demonstrate accountability, coordination, and progress of implementation.	**N/A;** no conflict.

Policy	Specific Goal	Alignment with IBR Program Goals
Oregon Department of Land Conservation Updated Transportation Planning Rules	Oregon Dept. of Land Conservation and Development updates to the statewide Transportation Planning Rules aimed at reducing transportation emissions. The rules require local governments in metropolitan areas to: • Plan for greater development in transit corridors and downtowns, where services are located and less driving is necessary. • Prioritize system performance measures that achieve community livability goals. • Prioritize investments for reaching destinations without dependency on single-occupancy vehicles, including in walking, bicycling, and transit. • Plan for and manage parking to meet demonstrated demand, and avoid over building parking in areas that need housing and other services. • Plan for needed infrastructure for electric vehicle charging. • Regularly monitor and report progress.	**Yes – Aligned.** The IBR Program aims to reduce vehicle-based GHG emissions by expanding transportation options for non-auto trips. This aim includes high-capacity transit and safe, comfortable bike and pedestrian infrastructure.

Policy	Specific Goal	Alignment with IBR Program Goals
	GHG Emissions Reduction Target for the Portland Metropolitan Area (OAR 660-044-0020) • Metro shall use the greenhouse gas emissions reduction targets in this rule as it develops, reviews, and updates a land use and transportation scenario that accommodates planned population and employment growth while achieving a reduction in greenhouse gas emissions from light vehicle travel in the metropolitan area. • The greenhouse gas emissions reduction target is a 20 percent reduction in the year 2035. • The greenhouse gas emissions reduction target is a 35 percent reduction in the year 2050.	**Yes – Aligned.** The IBR Program aims to reduce vehicle-based GHG emissions by expanding transportation options for non-auto trips. This aim includes high-capacity transit and safe, comfortable bike and pedestrian infrastructure.

CO_2e = carbon dioxide equivalent; IBR = interstate Bridge Replacement Program; OAR = Oregon Administrative Rules; ODOT = Oregon Department of Transportation; VMT = vehicle miles traveled

Table B-3. Alignment of IBR Program and TriMet Climate Goals and Policies

Policy	Specific Goal	Alignment with IBR Program Goals
TriMet Sustainability	100% renewable energy: MAX, our electric buses and all of our facilities are 100% powered by renewable electricity. This reduces our greenhouse gas emissions by nearly 24%. All electricity we purchase now comes from natural resources such as the sun and wind.	**Yes – Aligned.** TriMet trains operating on IBR Program structures will be powered by 100% renewable energy.
	Converting to a greener bus fleet: Our goal is to transition to a zero-emissions bus fleet by 2040. Right now, we're testing three types of battery-electric buses. They include short-range electric buses that charge periodically throughout the day and long-range electrics that are meant to go all day before needing to charge. The third type of electric buses being tested were originally diesel buses that have been converted to all electric. To reduce our carbon footprint while we make that transition, we're running our fixed-route diesel buses on renewable diesel. The cleaner-burning fuel lowered the greenhouse gas emissions from our bus fleet by about 61% compared to the biodiesel blend we had been using. As Oregon's largest consumer of diesel, we're leading the state's transportation industry toward a cleaner air future.	**Yes – Partial.** IBR Program climate goals include goals to use low-emissions vehicles and to reduce emissions during operations and maintenance activities. The construction goal aims to use low-emissions construction equipment and vehicles, and the maintenance and operations goal aims to have an electric fleet of vehicles for maintenance. These goals support this conversion goal by setting an example of an agency using low-impact vehicles.

Policy	Specific Goal	Alignment with IBR Program Goals
	Making transit more sustainable: For more than a decade, we've been building sustainable elements into our transit projects, like bioswales to filter and slow stormwater runoff. At the SW Lincoln/3rd Ave MAX Station, our innovative eco-track provides a vegetated trackway that reduces runoff and flooding. The solar panel array near Portland State University — the largest in Downtown Portland — generates 64,000 kilowatt hours of electricity and saves tons of CO_2 every year. We've also installed solar panels on Orange Line shelters.	**Yes – Partial.** IBR Program climate goals include goals to minimize construction emissions and embodied carbon, including maintaining options to use innovative approaches in construction equipment and materials.
	Improving our facilities: Recycling and materials management are a key part of our environmental program. This program, and our dedicated employees, ensure that we handle our waste disposal safely and responsibly. In addition to recycling all office materials, our operations and maintenance facilities recycle.	**N/A;** no conflict.
	MAX regenerative braking: The energy created as MAX Orange Line trains brake — which would otherwise be lost as heat — is stored in supercapacitors and put back into the MAX system to keep voltage stable, reducing power outages that can cause service disruptions.	**N/A;** no conflict.

CO_2 = carbon dioxide; GHG = greenhouse gas; IBR = Interstate Bridge Replacement; MAX = Metropolitan Area Express; N/A = not applicable

Table B-4. Alignment of IBR Program and C-TRAN Climate Goals and Policies

Policy	Specific Goal	Alignment with IBR Program Goals
C-TRAN Mission and Vision (C-TRAN 2018)	C-TRAN services contribute positively to the region's sustainability, livability, and economic vitality by helping manage traffic congestion, reduce dependence on foreign oil, lower-carbon emissions, contain transportation costs for employers and employees, enable denser land use and development of urban areas, and provide essential transport to persons with no other means of travel.	**Yes – Aligned.** IBR Program climate goals aim to shift travel demand to low GHG modes. This aim includes increasing access and connection to high-capacity transit, supporting this goal.

GHG = greenhouse gas; IBR = Interstate Bridge Replacement

Table B-5. Alignment of IBR Program and Metro Climate Goals and Policies

Policy	Specific Goal	Alignment with IBR Program Goals
Metro Climate Smart Strategy (Metro 2015)	Implement adopted local and regional land use plans.	**Yes – Aligned.** The IBR Program does not have land use authority. However, the Program would be designed to align with current land use plans and solutions would be forward compatible with denser, transit-oriented communities. Additionally, IBR Program climate goals support finding design solutions that foster complete and walkable communities.
	Make transit convenient, frequent, accessible, and affordable.	**Yes – Aligned.** The IBR Program includes goals to shift travel demand to low GHG modes, including high-capacity transit, which would contribute to Metro's goal.
	Make biking and walking safe and convenient.	**Yes – Aligned.** IBR Program elements would increase and improve accessibility for people who walk, bike, and roll. The IBR Program solution would include major improvements to active transportation options.
	Make streets and highways safe, reliable, and connected.	**Yes – Aligned.** The IBR Program would improve transportation efficiency, which aims to reduce congestion, design for traffic smoothing, and target moderate speeds. In addition to reducing emissions, it would also improve road safety.
	Use technology to actively manage the transportation system.	**Yes – Aligned.** The IBR Program includes goals to improve transportation efficiency, which includes the use of transportation management systems and intelligent transportation systems.
	Provide information and incentives to expand the use of travel options.	**Yes – Aligned.** IBR Program climate goals include transportation demand management strategies and increasing range of transportation options.
	Make efficient use of vehicle parking and land dedicated to parking.	**Yes – Aligned.** The size and configuration of park-and-ride facilities associated with the Modified LPA are being designed to address this goal.

Policy	Specific Goal	Alignment with IBR Program Goals
	Support transition to cleaner, low-carbon fuels and more fuel-efficient vehicles.	**Yes – Aligned.** IBR Program climate recommendations include developing an electric vehicle maintenance fleet for ongoing facility maintenance and operations and adoption of targets for construction equipment and fuels.
	Secure adequate funding for transportation investments.	**Yes – Aligned.** The IBR Program aims to pursue and leverage any and all federal, state, and other funding sources that support all modes and address long-term needs.
Regional Transportation Plan (Metro 2023)	**GHG Reduction Target.** Consistent with Oregon Governor's Executive Order 20-04, reduce transportation-related GHG emissions to at least 45% below 1990 emissions levels by 2035 and 80% below 1990 levels by 2050.	**Yes – Aligned.** The IBR Program has a goal to contribute to reducing GHG emissions. The goals associated with transportation options aim to shift travel demand to low GHG modes; construction goals center around reducing construction-based emissions; and goals for maintenance and operations are all aiming to reduce GHGs.
	Climate Leadership Policy 1: Implement adopted local and regional land use plans.	**Yes – Aligned.** The IBR Program recognizes the importance of local and regional land use planning and its influence on travel patterns and climate outcomes.
	Climate Leadership Policy 2: Make transit convenient, frequent, accessible, and affordable.	**Yes – Aligned.** Existing transit options are limited. The IBR Program would provide high-capacity transit that improves transit service frequency and reliability.
	Climate Leadership Policy 3: Make biking and walking safe, accessible, and convenient.	**Yes – Aligned.** Existing active transportation facilities are inadequate; the IBR Program would improve the active transportation network and make it easier for people to walk, roll, and bike.
	Climate Leadership Policy 4: Make streets and highways safe, efficient, reliable, and connected.	**Yes – Aligned.** The IBR Program would improve safety, connectivity, and reliability for I-5 and connecting streets. The Program would address seismic vulnerability, safety concerns with the existing roadway design, congestion and travel time reliability, limited public transit, impaired freight movement, and inadequate active transportation facilities.

Policy	Specific Goal	Alignment with IBR Program Goals
	Climate Leadership Policy 5: Use technology to actively manage the transportation system and ensure that new and emerging technology affecting the region's transportation system supports shared trips and other Climate Smart Strategy policies and strategies.	**Yes – Aligned.** The IBR Program would incorporate intelligent transportation systems and demand management tools to actively manage the roadway network.
	Climate Leadership Policy 6: Provide information and financial incentives to expand the use of travel options and reduce vehicle miles traveled.	**Yes – Aligned**. Expanding transportation options is a key component of the IBR Program climate framework, and there is no conflict. Transportation Demand Management and Transportation System Management are elements of the proposed IBR Program.
	Climate Leadership Policy 7: Manage parking in mixed-use centers and corridors to reduce the amount of land dedicated to parking, encourage parking turnover, increase shared trips, biking, walking and transit use, reduce vehicle miles traveled, increase housing and job production and generate revenue.	**Yes – Aligned**. The IBR Program is evaluating two park-and-ride facilities associated with the transit system; the size of each facility is being planned to optimize ridership and minimize land use impacts.
	Climate Leadership Policy 8: Support Oregon's transition to cleaner fuels and more fuel-efficient and electric vehicles in recognition of the external impacts of carbon and other vehicle emissions.	**Yes – Aligned.** The IBR Program supports the transition to zero-emission vehicles. The IBR Program's climate program would explore ways to electrify the fleet used for construction and ongoing operations and maintenance.
	Climate Leadership Policy 9: Secure adequate funding for transportation investments necessary to implement the Climate Smart Strategy and increase the region's preparedness for and resilience to climate change and natural hazard impact.	**Yes – Aligned.** The IBR Program is a transportation investment that supports the Regional Transportation Plan.

Policy	Specific Goal	Alignment with IBR Program Goals
Regional Transportation Plan Appendix J: 2023 Regional Transportation Plan Climate Smart Strategy Implementation and Monitoring (Metro 2023)	The full list of RTP Climate Smart Strategy **performance monitoring targets** are shown on page 22 of the document.	**Yes - Aligned.** The goals associated with transportation options aim to shift travel demand to low GHG modes; construction goals center around reducing construction-based emissions; and goals for maintenance and operations are all aiming to reduce GHGs. The IBR Program includes elements to improve the performance of the targets identified in the Climate Smart Strategy.
Comprehensive Climate Action Plan for the Portland-Vancouver metropolitan area (Metro 2025)	The Comprehensive Climate Action Plan lays out a plan to dramatically reduce emissions in the Portland-Vancouver metropolitan area while saving people money and creating healthier communities. **Transportation: The plan includes 10 transportation actions:** • Creating complete communities where people don't need to travel far. • Making it easier to take transit, bike, walk, roll and work from home. • Pricing roads, both to fund new transit and active transportation options and to encourage people to use them. Other action areas include Building energy and Food, goods and services. Actions in these areas are not relevant to the IBR Program.	**Yes - Aligned.** The transportation action areas listed below align with the IBR Program transportation investments. Specifically: 1. Complete communities: The IBR Program supports the implementation of local and regional land use plans; and incorporates transit-oriented development planning. 2. Transit: The IBR Program transit element is implementing planned transit service. 3. Bike/Ped/Other: The IBR Program will build new bicycle and pedestrian facilities. 4. Transportation pricing: The IBR Program will implement tolling.

Policy	Specific Goal	Alignment with IBR Program Goals
Regional Congestion Pricing Study (Metro 2021)	Best Practices for Implementing Congestion Pricing Programs in an Equitable Manner. Pricing program design impact on equity outcomes: A more equitable pricing and investment strategy would include the following components: **variable pricing; targeted exemption; focus on transit; focus on vulnerable communities.** A less equitable pricing and investment strategy would include: 24-hr flat rate pricing; no supportive investments in transit; no focus on vulnerable communities Congestion pricing programs and projects can improve equity outcomes by reducing harm and increasing benefits if agencies are willing to **focus engagement on historically impacted residents and other community partners traditionally at a disadvantage** and ensure they have a role in decision-making at every step in the process.	**TBD.** Variable pricing would be used and is a key component to manage demand. The IBR Program is committed to evaluating equitable tolling structures. The state transportation commissions would make determinations on the tolling program. The IBR Program would continue to uphold its commitment to meaningfully engage priority equity communities in decision-making. Equity and equitable access to transportation is a shared priority, and the IBR Program is committed to evaluating equitable tolling structures.
	Congestion pricing programs and projects can improve equity outcomes by **committing to targeted investments** of net toll revenues for locally supported improvements such as improved transit infrastructure and services and traffic safety improvements.	**TBD.** Variable pricing would be used and is a key component to manage demand. The IBR Program is committed to evaluating equitable tolling structures. The state transportation commissions would make determinations on the tolling program. Transit investment would be key to the overall Program. The IBR Program is currently considering a range of high-capacity transit options, all of which would greatly improve transit frequency and reliability compared to today.

Policy	Specific Goal	Alignment with IBR Program Goals
	Congestion pricing programs and projects can improve equity outcomes by exploring who pays and to what degree**, and considering a suite of affordability programs such as rebates or exemptions for low-income drivers, a "transportation wallet," or other investments that address affordability.**	**TBD.** Variable pricing would be used and is a key component to manage demand. The IBR Program is committed to evaluating equitable tolling structures. The state transportation commissions would make determinations on the tolling program. Equity and equitable access to transportation is a shared priority, and the IBR Program is committed to evaluating equitable tolling structures.

GHG = greenhouse gas; I-5 = Interstate 5; IBR = Interstate Bridge Replacement Program; LPA = Locally Preferred Alternative; TBD = to be determined

Table B-6. Alignment of IBR Program and City of Portland Climate Goals and Policies

Policy	Specific Goal	Alignment with IBR Program Goals
The City of Portland's 2022–2025 Climate Emergency Workplan (City of Portland 2022)	GHG Emissions Reduction Target. By 2030, cut Portland's carbon emissions 50% or more, compared to 1990 levels, and to net zero by 2050.	**Yes – Aligned.** The IBR Program has a goal to contribute to reducing GHG emissions. The goals associated with transportation options aim to shift travel demand to low GHG modes; construction goals center around reducing construction-based emissions; and goals for maintenance and operations are all aiming to reduce GHGs.
Climate Emergency Declaration (City of Portland 2020a)	Portland's Climate Emergency Declaration establishes emission reductions targets with benchmarks at 2030 (50% below 1990 levels) and 2050 (reach net zero). **GHG Reduction Target.** Be it further resolved that the City of Portland adopts a new target of achieving **at least a 50% reduction in carbon emissions below 1990 levels by 2030** and net-zero carbon emissions before 2050. These targets will be carried forward into future Climate Action Plan updates and workplans.	**Yes – Aligned.** The IBR Program has a goal to contribute to reducing GHG emissions. The goals associated with transportation options aim to shift travel demand to low GHG modes; construction goals center around reducing construction-based emissions; and goals for maintenance and operations are all aiming to reduce GHGs.

Policy	Specific Goal	Alignment with IBR Program Goals
	GHG Reduction Target. To inform future Climate Action Plan updates and workplans, the City of Portland will analyze decarbonization pathways to achieve **carbon neutrality by 2050** with clear interim goals, including a commitment to monitoring any remaining emission sources and implementing policies or mechanisms to reduce those emissions, including but not limited to the role of urban sequestration and negative carbon technologies.	**Yes – Aligned.** The IBR Program has a goal to contribute to reducing GHG emissions. The goals associated with transportation options aim to shift travel demand to low GHG modes; construction goals center around reducing construction-based emissions; goals for maintenance and operations are all aiming to reduce GHGs.
Transportation System Plan: Policies (City of Portland 2020b)	**Transportation Policy –** Mode share goals and VMT reduction. Increase the share of trips made using active and low-carbon transportation modes. Reduce VMT to achieve targets set in the most current Climate Action Plan and Transportation System Plan and meet or exceed Metro's mode share and VMT targets.	**Yes – Aligned.** The IBR Program has a goal to contribute to reducing GHG emissions as compared to a No-Build scenario. The goals associated with transportation options aim to shift travel demand to low GHG modes; construction goals center around reducing construction-based emissions; and goals for maintenance and operations are all aiming to reduce GHGs.
	Transportation Policy – Transportation strategy for people movement. Implement a prioritization of modes for people movement by making transportation system decisions according to the following ordered list: • Walking • Bicycling • Transit • Fleets of electric, fully automated, multiple passenger vehicles • Other shared vehicles	**Yes – Partial.** The IBR Program serves primarily to improve mobility and access for I-5, part of the interstate highway system, so the modal prioritization is not aligned. Even so, the IBR Program would improve and expand safe, direct travel options for people walking, biking/rolling, and taking transit within the Program area.

Policy	Specific Goal	Alignment with IBR Program Goals
	• Low- or no-occupancy vehicles, fossil-fueled non-transit vehicles • When implementing this prioritization, ensure that: • The needs and safety of each group of users are considered, and changes do not make existing conditions worse for the most vulnerable users higher on the ordered list. • All users' needs are balanced with the intent of optimizing the right-of-way for multiple modes on the same street. • When necessary to ensure safety, accommodate some users on parallel streets as part of a multi-street corridor. • Land use and system plans, network functionality for all modes, other street functions, and complete street policies, are maintained. • Policy-based rationale is provided if modes lower in the ordered list are prioritized.	
	Transportation Policy – GHG Reduction Target. By 2035, reduce Portland's transportation-related carbon emissions to 50% below 1990 levels, at approximately 934,000 metric tons.	**Yes – Aligned.** The IBR Program has a goal to contribute to reducing GHG emissions. The goals associated with transportation options aim to shift travel demand to low GHG modes; construction goals center around reducing construction-based emissions; goals for maintenance and operations are all aiming to reduce GHGs.

Policy	Specific Goal	Alignment with IBR Program Goals
Pricing Options for Equitable Mobility (City of Portland n.d.[b])	**We are in a climate crisis.** The transportation sector contributes more than 40% of GHG emissions in the Portland region. Reducing transportation emissions will take a three-pronged approach: 1. Reducing driving by making other options safer and more attractive. 2. Shifting the trips that remain on the road to zero-emission vehicles (including cars, buses and freight). 3. Planning and building connected, inclusive, and complete neighborhoods to reduce the need for long trips.	**Yes – Partial.** The IBR Program is centering climate and equity outcomes that influence all stages of decision-making. Expanding transportation options is one of the most significant means that the IBR Program has to reduce driving trips. The IBR Program supports the transition to zero-emission vehicles. The Program's climate program would explore ways to electrify the fleet used for construction and ongoing operations and maintenance. The IBR Program is contributing to building connected and complete communities in the Program area.
	The City should utilize the Equitable Mobility Framework to guide pricing policy deliberations and commit to evaluating equitable mobility impacts of the existing system and any future proposed transportation policy. This includes impacts to moving people and goods, safety, climate and health, and the economy.	**TBD.** Variable pricing would be used and is a key component to manage demand. The IBR Program is committed to evaluating equitable tolling structures. The state transportation commissions would make determinations on the tolling program for the IBR Program, which will include toll rates, participation, and setting subsidies or exemptions.

Policy	Specific Goal	Alignment with IBR Program Goals
	The City must engage community partners, especially those representing Black, Indigenous, and People of Color (BIPOC) communities, Portlanders living on low incomes, people with disabilities, multilingual and displaced communities in the next stage of pricing policy development, as well as ongoing evaluation.	**Yes – Aligned.** The IBR Program would continue to uphold its commitment to meaningfully engage the public and priority equity communities in decision-making. Equity and equitable access to travel is a shared priority, and the IBR Program is committed to evaluating equitable tolling structures. The state transportation commissions would make determinations on the tolling program.
	The City must advance complementary strategies alongside pricing to improve equitable mobility outcomes. Pricing is just one policy tool and not a stand-alone solution. Additional transportation demand management programs; multimodal infrastructure, operations and service investments; land use policies; affordable housing; and more must also be prioritized to create a more equitable and sustainable mobility system.	**Yes – Aligned.** Variable pricing would be used and is a key component to manage demand. The IBR Program is committed to evaluating equitable tolling structures. The state transportation commissions would make determinations on the tolling program.
	Prioritize the goal of reducing traffic demand and using the existing transportation system as efficiently as possible to move people and goods in a more climate-friendly and equitable way. While pricing generates revenue and the reinvestment of revenue is a critical way to make pricing strategies equitable, revenue generation should never be the top priority.	**Yes – Aligned.** Variable pricing would be used and is a key component to manage demand. The IBR Program is committed to evaluating equitable tolling structures. The state transportation commissions would make determinations on the tolling program.

Policy	Specific Goal	Alignment with IBR Program Goals
	Recognize that a pricing policy is only effective if it reduces traffic demand and/or raises enough revenue to fund effective demand management or multimodal improvements. • Setting rates or surcharges too low to affect demand or fund improvements is inequitable. • Programs should be designed to be data driven and regularly reviewed for impact. Rates and surcharges should be set to meet policy goals.	**TBD**. Variable pricing would be used and is a key component to manage demand. The IBR Program is committed to evaluating equitable tolling structures. The state transportation commissions would make determinations on the tolling program.
	Provide exemptions for households living on low incomes. • The City should develop one set of income-based policy standards that can be applied to current and future pricing programs to limit administrative costs and complexity. • Until a universal basic income can be guaranteed, exempting households living on low- incomes should be the highest priority to avoid exacerbating current inequities. • When exemptions are not possible, cash rebates or payments to households living on low incomes is preferred as it allows individuals to make the best transportation decisions for their personal situation.	**TBD**. Variable pricing would be used and is a key component to manage demand. The IBR Program is committed to evaluating equitable tolling structures. The state transportation commissions would make determinations on the tolling program. The IBR Program would continue to uphold its commitment to meaningfully engage priority equity communities in decision-making. Equity and equitable access to travel is a shared priority, and the Program is committed to evaluating equitable tolling structures.

Policy	Specific Goal	Alignment with IBR Program Goals
	• More evaluation and community engagement are needed to determine what specific design would be most equitable and would minimize overall burdens, while still achieving demand management outcomes. • Pricing programs should build off existing means-testing systems wherever possible to not add additional Program access burdens.	
	Center climate and equity outcomes (e.g., reducing GHG emissions, reducing transportation cost burdens, expanding job access) throughout pricing program design. • This includes evaluating how different variable-rate designs, where prices change based on factors like income, time of day, congestion levels, occupancy, geography, and fuel efficiency may further advance climate and equity goals, with a bias toward equitable outcomes. • Evaluation should not unnecessarily delay implementation but should be thorough and focused on understanding impacts to BIPOC community members, Portlanders with low incomes, and people with disabilities. The City should also commit to ongoing evaluation of equity implications of policies once implemented. • To move with the urgency required by the climate crisis, pricing policies that focus	**Yes – Aligned.** Variable pricing would be used and is a key component to manage demand. The IBR Program is committed to evaluating equitable tolling structures. The state transportation commissions would make determinations on the tolling program. The IBR Program centers climate and equity outcomes. Equity and equitable access to travel is a shared priority, and the IBR Program is committed to evaluating equitable tolling structures.

Policy	Specific Goal	Alignment with IBR Program Goals
	on managing demand for people with the most options should be prioritized. As stated above, exemptions for drivers with low incomes are critical.	
	Reinvest revenue generated from pricing in strategies that further expand equitable mobility. • Pricing revenue should be reinvested to support frequent, competitive and high-quality multimodal access to areas where pricing is implemented and to mitigate potential negative impacts of traffic diversion. • High-priority complementary investment areas include transit service, operations and infrastructure; biking and walking infrastructure; affordable housing near transportation options; and multimodal discounts and financial incentives, including driving options for those without access who need it. Additional investment areas include electrification infrastructure and rebates as well as maintaining the existing infrastructure necessary for multimodal mobility. • Community partners should always be involved in revenue allocation decisions.	**TBD.** Variable pricing would be used and is a key component to manage demand. The IBR Program is committed to evaluating equitable tolling structures. The state transportation commissions would make determinations on the tolling program.

Policy	Specific Goal	Alignment with IBR Program Goals
	Reduce unequal burdens of technology and enforcement. • Technology and payment systems must be designed to reduce barriers for individuals with limited access to bank accounts (e.g., by allowing use of prepaid debit cards). • Technology and payment systems should include strong privacy protections. • The location of pricing infrastructure should be considered so it doesn't overtly impact BIPOC or communities living on low incomes. • Automated enforcement mechanisms should be used to reduce the potential for enforcement bias. • Tickets and fines for non-compliance should be means-based (i.e., structured by income level) to mitigate disproportionate impacts.	**TBD.** Variable pricing would be used and is a key component to manage demand. The IBR Program is committed to evaluating equitable tolling structures. The state transportation commissions would make determinations on the tolling program.

BIPOC = Black, Indigenous, and People of Color; GHG = greenhouse gas; I-5 = Interstate 5; IBR = Interstate Bridge Replacement

Table B-7. Alignment of IBR Program and City of Vancouver Climate Goals and Policies

Policy	Specific Goal	Alignment with IBR Program Goals
2024–2044 Transportation System Plan (City of Vancouver 2024)	The Transportation System Plan policies significantly contribute to the City's goals for carbon neutrality by 2040. Climate policies include: • Target overall reduction in driving. • Create climate-friendly streets through design and materials selection. • Welcome transportation vendors who can add low and no-emissions forms of transportation to the city.	**Yes – Aligned.** The IBR Program has a goal to contribute to reducing GHG emissions. The goals associated with transportation options aim to shift travel demand to low GHG modes; construction goals center on reducing construction-based emissions; and goals for maintenance and operations all aim to reduce GHGs.
2023–2029 Strategic Plan (City of Vancouver 2023)	Climate and Natural Systems is one of eight focus areas of the Vancouver Strategic Plan. The strategic outcome for Climate and Natural Systems is: • Environmental stewardship and efforts to address climate change ensure that everyone has a sustainable future. We recognize the intrinsic value of the land beyond the economic benefits it provides. Vancouver protects, restores, and cares for the natural environment upon which all living things depend. The health of our natural systems supports the health of all who live, work, and play in our community.	**Yes – Aligned.** The IBR Program has a goal to contribute to reducing GHG emissions. The goals associated with transportation options aim to shift travel demand to low GHG modes; construction goals center on reducing construction-based emissions; and goals for maintenance and operations are all aiming to reduce GHGs.

Climate Action Framework (City of Vancouver 2022a); building on City Council Resolution on GHG Reduction (June 2022)	• Establishes strategies and actions to achieve citywide carbon neutrality by 2040, and an 80% reduction in community-wide emissions by 2030.
	• Supports a just and equitable transition to community-wide carbon neutrality by 2040, with particular support for low-income residents and communities of color.
	• Establishes near-term next steps to achieving carbon neutrality:
	  ○ Ongoing engagement with community and interested parties.
	  ○ Community climate risk assessment.
	  ○ Continued focus on high-priority areas.
		Yes – Aligned. The IBR Program has a goal to contribute to reducing GHG emissions. The goals associated with transportation options aim to shift travel demand to low GHG modes; construction goals center around reducing construction-based emissions; and goals for maintenance and operations are all aiming to reduce GHGs.

Policy	Specific Goal	Alignment with IBR Program Goals
	○ Increasing capacity for implementation, monitoring, and evaluation. • Establishes strategies and actions for six focus areas: ○ Equity and Green Economy ○ Buildings and Energy ○ Transportation and Land Use ○ Natural Systems and Water Resources ○ Solid Waste and Wastewater ○ City Governance	
City Council Resolution on GHG Reduction	**GHG Reduction Target.** The City of Vancouver is advancing its positive direction to achieve the leading-edge climate action goals it endorsed in 2021. On Monday, June 6, following in-depth analysis and discussion, Vancouver City Council unanimously approved an amended version of the City's Climate Priority Resolution that calls for adopting some of the most ambitious goals in the nation, including: • An 80% reduction in municipal operations GHG emissions by 2025 • An 80% reduction in GHG emissions by the Vancouver community by 2030 • Carbon neutrality by both municipal operations and the Vancouver community by 2040.	**Yes – Aligned.** The IBR Program has a goal to contribute to reducing GHG emissions. The goals associated with transportation options aim to shift travel demand to low GHG modes; construction goals center around reducing construction-based emissions; and goals for maintenance and operations are all aiming to reduce GHGs.

GHG = greenhouse gas; IBR = Interstate Bridge Replacement

Table B-8. Alignment of IBR Program and Port of Portland Climate Goals and Policies

Policy	Specific Goal	Alignment with IBR Program Goals
Climate Change Strategy (Port of Portland n.d.[b])	**GHG Reduction Target:** Our goal by 2020 is to lower all our carbon emissions by 15% below 1990 levels.	**Yes – Aligned.** The IBR Program has a goal to contribute to reducing GHG emissions. The goals associated with transportation options aim to shift travel demand to low GHG modes; construction goals center around reducing construction-based emissions; and goals for maintenance and operations all aim to reduce GHGs.
	Reduce diesel particulate matter by 75% from Port-controlled operations from 2000 baseline levels by 2020.	**N/A;** no conflict.
Environmental Objectives and Targets 2016–2017 (Port of Portland n.d.[a])	**Minimize impacts to air quality:** The Air Quality Program facilitates implementation of the Port's Air Quality Policy, which has a primary goal of promoting clean air for all who live in airsheds affected by Port activities. To do this, the Port utilizes emissions inventories and aspect/impact analyses of its planned and actual activities that have, or can have, a significant impact on the airshed. Recognizing that not all emission sources are under the Port's direct control, the Port seeks opportunities to improve air quality by facilitating and encouraging partnerships, education, and outreach to assist customers, tenants, and other interested parties in reducing marine and aviation-related emissions. The Port supports efforts of the International Maritime Organization and International Civil Aviation Organization to set global standards to reduce emissions from marine vessels and aircraft.	**Yes – Aligned.** The IBR Program has a goal to contribute to reducing GHG emissions. The goals associated with transportation options aim to shift travel demand to low GHG modes; construction goals center around reducing construction-based emissions; and goals for maintenance and operations are all aiming to reduce GHGs.
	Reduce energy consumption and carbon emissions: The Port developed the Energy and Carbon Management Master Plan to reduce energy consumption and carbon emissions. The plan aligns closely with the Air Quality Program and presents a six-point strategy for reaching the Port's GHG reduction goal. The master plan sets the foundation for establishing targets and a portfolio of projects identified and scheduled for implementation.	**Yes – Aligned.** The IBR Program has a goal to contribute to reducing GHG emissions. The goals associated with transportation options aim to shift travel demand to low GHG modes; construction goals center around reducing construction-based emissions; and goals for maintenance and operations are all aiming to reduce GHGs.

Policy	Specific Goal	Alignment with IBR Program Goals
	Minimize impacts and seek opportunities to enhance natural resources: The Natural Resources Program seeks to ensure the development and maintenance of a consistent, ecosystem-based framework for all decisions involving natural resources at the Port. The Port takes a proactive approach to managing natural resources and is responsible for the long-term management of its mitigation commitments. Engaging with the community to identify opportunities has been an important aspect in target selection to support regional conservation goals and initiatives.	**N/A;** no conflict.
	Minimize impacts to water resources: The Port of Portland's Stormwater Management Program is designed to prevent, reduce, and eliminate the discharge of polluted stormwater to the Columbia Slough and Willamette and Columbia rivers. In addition, the Port continues to set targets in support of the Water Conservation Strategy developed in 2014 that defines strategies to eliminate waste, improve efficiency and use alternative water sources across the Port. It strives to further integrate water conservation into the Port's daily operations, business planning, maintenance, and capital projects.	**Yes – Aligned.** IBR Program design would include stormwater management designed to accommodate increased storm intensities.
	Reduce waste generation and hazardous materials use: Five Years to Zero Waste is the Port of Portland's ambitious plan developed in 2014 to create a guidance framework for the actions necessary to reach "Zero-Waste" status, which the EPA defines as landfill waste diversion of 90% or greater. This plan has been developed through an ongoing partnership with Portland State University's Community Environmental Services, as part of the Port's commitment to innovative, industry-leading waste minimization efforts within the broader framework of the Port's Environmental Management System. This plan sets out a framework to achieve zero-waste status by implementing broad strategies in key areas, with specific actions, priorities, and targets. The Port has made great strides toward zero waste at Port-owned properties.	**Yes – Aligned.** IBR Program climate goals include zero-waste goals for demolition, helping to directly support this goal.

EPA = U.S. Environmental Protection Agency; GHG = greenhouse gas; IBR = Interstate Bridge Replacement

Table B-9. Alignment of IBR Program and Port of Vancouver Climate Goals and Policies

Policy	Specific Goal	Alignment with IBR Program Goals
Port of Vancouver Climate Action Plan (Port of Vancouver 2021)	Apply sustainability standards to new construction projects.	**Yes – Aligned.** The IBR Program is evaluating adherence to several sustainability rating systems for substantial project elements.
	Develop sustainable construction standards such as low-carbon concrete and asphalt, low-emission construction vehicles, construction waste reduction, and materials reuse.	**Yes – Aligned.** IBR Program climate goals include sustainable materials selection.
	Continue lighting retrofits.	**N/A;** no conflict. Does not apply to the IBR Program but has no conflict. Similarly, the IBR Program would be designed for energy-efficient lighting.
	Install occupancy sensors, building controls, programmable thermostats and smart meters.	**N/A;** no conflict. IBR Program assets would be designed to include sensors for smart operations
	Replace aging HVAC units with energy-efficient technology.	**N/A;** no conflict. IBR Program assets would be designed to include energy-efficient technology
	Explore renewable energy opportunities including on-site solar power generation, small-scale wind generation, geothermal energy, and replacement of natural gas.	**N/A;** no conflict. IBR Program assets would be designed to optimize access to renewable energy sources.
	Electrify or hybridize diesel and gasoline powered vehicles and equipment.	**Yes – Aligned.** Reducing emissions associated with maintenance and operations includes a goal to use an electric vehicle maintenance fleet. The use of an electric vehicle maintenance fleet by a public agency often increases the support/accessibility for other agencies to switch as well.
	Install EV charging infrastructure.	**Yes – Aligned.** The IBR Program is evaluating the integration of charging needs into the transportation system.
	Replace use of diesel with low-carbon fuels such as renewable diesel.	**Yes – Aligned.** The IBR Program aims to reduce emissions associated with maintenance and operations, including using a renewable power supply and electric vehicles for the maintenance fleet.

Policy	Specific Goal	Alignment with IBR Program Goals
	Work with C-TRAN to provide transit service to the Port and provide transit subsidies to employees.	**N/A;** no conflict.
	Install bicycle infrastructure such as secure parking and showers to promote bicycle commuting.	**Yes – Aligned.** The IBR Program includes goals to reduce vehicle-based emissions and shift to transit and active transportation, including bicycles. If routes that commuters use are accessible to bicycles, it would support this goal.
	Support effective carpool options.	**Yes – Aligned.** The IBR Program includes goals to reduce vehicle-based emissions and shifting to transit and active transportation, including a carpool/HOV lane.
	Promote telecommuting through enhanced virtual work infrastructure and policies.	**N/A;** no conflict.
	Offset emissions from business travel.	**N/A;** no conflict.
	Promote use of low-carbon ground transport options for business travel.	**Yes – Aligned.** The IBR Program would include high-capacity transit that can serve business travelers across the region.
	Provide recycling services and infrastructure.	**N/A;** no conflict.
	Develop a waste reduction plan.	**Yes – Aligned.** The IBR Program has zero-waste goals for demolition.
	Promote the use of green infrastructure to manage stormwater.	**Yes – Aligned.** IBR Program design would incorporate sustainable stormwater management strategies.
	Explore water system efficiencies.	**Yes – Aligned.** IBR Program design would incorporate sustainable design practices, such as water efficiency.
	Develop sustainability standards for new construction projects on port property.	**N/A;** no conflict.
	Develop sustainable construction standards such as low-carbon concrete and asphalt, low-emission construction vehicles, construction waste reduction, and materials reuse for projects occurring on port property.	**Yes – Aligned.** The IBR Program aims to reduce construction-related emissions.

Policy	Specific Goal	Alignment with IBR Program Goals
	Explore carbon-reduction during collaborations on agreements with tenants/customers.	**N/A;** no conflict.
	Pursue partnerships, incentives, and grant opportunities to support tenant/customer energy efficiency, equipment electrification and other carbon-reduction initiatives.	**N/A;** no conflict.
	Emphasize and increase marketing efforts to pursue innovative business opportunities and renewable, clean energy projects.	**N/A;** no conflict.
	Promote lighting retrofits by tenants.	**N/A;** no conflict.
	Promote installation of occupancy sensors, building controls, programmable thermostats and smart meters by tenants.	**N/A;** no conflict.
	Promote replacement of aging HVAC units with energy-efficient technology in tenant facilities.	**N/A;** no conflict.
	Support on-site renewable energy generation by tenants.	**N/A;** no conflict.
	Encourage tenants to replace natural gas use with low-carbon/renewable alternatives.	**N/A;** no conflict.
	Promote the electrification and hybridization of diesel and gasoline powered vehicles and equipment.	**Yes – Aligned.** The IBR Program aims to reduce emissions associated with maintenance and operations; The program aims to use an electric vehicle maintenance fleet.
	Install common use EV charging infrastructure.	**Yes – Aligned.** The IBR Program is looking at integrating charging facilities into the design.
	Promote the replacement of diesel with low-carbon fuels such as biodiesel, renewable diesel, and hydrogen.	**Yes – Aligned.** The IBR Program aims to reduce emissions associated with maintenance and operations; the Programs aims to use an electric vehicle maintenance fleet.
	Evaluate the use of fuel cells for heat and power, mobile equipment, and locomotives.	**N/A;** no conflict.

Policy	Specific Goal	Alignment with IBR Program Goals
	Promote the use of clean trucks and low-carbon drayage vehicles.	**Yes – Aligned.** The IBR Program aims to reduce emissions associated with maintenance and operations; the Program aims to use an electric vehicle maintenance fleet.
	Evaluate the use of shore power options for vessels visiting the Port.	**N/A;** no conflict.
	Facilitate the development of a terminal equipment inventory to help target new investments and grant opportunities.	**N/A;** no conflict.
	Encourage visits by cleaner or more fuel-efficient vessels.	**N/A;** no conflict.
	Explore partnerships to promote shipping via the river system for eastbound cargo.	**N/A;** no conflict.
	Promote idle reduction by rail vehicles/equipment (including locomotives).	**N/A;** no conflict.
	Evaluate the development of infrastructure to support electric locomotives for on-port switching operation.	**N/A;** no conflict.

EV = electric vehicle; IBR = Interstate Bridge Replacement; HOV = high occupancy vehicle; HVAC = heating, ventilation, and air conditioning; N/A = not applicable

Appendix C: Social Cost of Carbon Model Outputs

EPA Social Cost of Greenhouse Gases Application Workbook
Technical Background

Overview of Social Cost of Greenhous Gases (SC-GHG)

In December 2023, in the regulatory impact analysis of EPA's Final Rulemaking*, Standards of Performace for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review*, EPA estimated the climate benefits of the rule using a new set of Social Cost of Greenhouse Gas (SC-GHG) estimates. These estimates incorporate recent research addressing recommendations of the National Academies of Science, Engineering, and Medicine (2017), responses to public comments on an earlier sensitivity analysis using draft SC-GHG estimates included in the December 2022 supplemental proposed rulemaking, and comments from a 2023 external peer review of the accompanying technical report. The technical report, [Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances,] describing the methodology underlying the SC-GHG estimates, and all other files related to their development are available on EPA's webpage: https://www.epa.gov/environmental-economics/scghg.

The table below summarizes the averaged certainty-equivalent estimates of the social cost of carbon (SC-CO_2), the social cost of methane (SC-CH_4), and the social cost of nitrous oxide (SC-N_2O), (collectively referred to as the "social cost of greenhouse gases" (SC-GHG)), rounded to two significant figures, under three near-term Ramsey discount rates for emissions years 2020 through 2080. This table illustrates the magnitude of these estimates.

Estimates of the Social Cost of Greenhouse Gases (SC-GHG), 2020-2080 (2020 dollars)

	SC-GHG and Near-term Ramsey Discount Rate								
	SC-CO_2 *(2020 dollars per metric ton of CO_2)*			SC-CH_4 *(2020 dollars per metric ton of CH_4)*			SC-N_2O *(2020 dollars per metric ton of N_2O)*		
Emission	Near-term rate			Near-term rate			Near-term rate		
Year	2.5%	2.0%	1.5%	2.5%	2.0%	1.5%	2.5%	2.0%	1.5%
2020	120	190	340	1,300	1,600	2,300	35,000	54,000	87,000
2030	140	230	380	1,900	2,400	3,200	45,000	66,000	100,000
2040	170	270	430	2,700	3,300	4,200	55,000	79,000	120,000
2050	200	310	480	3,500	4,200	5,300	66,000	93,000	140,000
2060	230	350	530	4,300	5,100	6,300	76,000	110,000	150,000
2070	260	380	570	5,000	5,900	7,200	85,000	120,000	170,000
2080	280	410	600	5,800	6,800	8,200	95,000	130,000	180,000

Values of SC-CO_2, SC-CH_4, and SC-N_2O are rounded to two significant figures. The annual unrounded estimates are available in Appendix A.5 and at: https://www.epa.gov/environmental-economics/scghg.

The SC-GHG is the monetary value of the net harm to society from emitting a metric ton of that GHG into the atmosphere in a given year. The SC-GHG is also the societal net benefit of reducing emissions of the GHG by a metric ton. In principle, the SC-GHG is a comprehensive metric that includes the value of all future climate change impacts (both negative and positive), including changes in net agricultural productivity, human health effects, property damage from increased flood risk, changes in the frequency and severity of natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services. In practice, data and modeling limitations restrain the ability of SC-GHG estimates to include all physical, ecological, and economic impacts of climate change, implicitly assigning a value of zero to the omitted climate damages. The estimates are, therefore, a partial accounting of climate change impacts and likely underestimate the marginal benefits of abatement.

SC-GHG estimates are gas specific because one metric ton of CO_2, CH_4, N_2O, or other GHG differ in the temporal pathway of their impact on society, through both climate mediated effects of emissions (temperature, sea level rise, etc.) and non-climate mediated effects of emissions (e.g., carbon fertilization effects and ocean acidification due to CO_2 emissions, tropospheric ozone formation due to CH_4 emissions).

Calculating the Present Value and Annualized Values using the SC-GHG

The gas-specific SC-GHG estimate, $scghg_\tau$, represents the future damages associated with *one additional metric ton* of emissions of the gas, released in some year, τ, and discounted back to that emission year. For example, the SC-CH_4 of $2,400 for 2030 in the table above (using a near-term discount rate of 2%) reflects the future damages of one additional ton of methane emitted in 2030 and *discounted back to 2030*.

Multiplying the change in emissions for a future year by the SC-GHG for that year yields the monetized value of future emission changes from the perspective of that year. We refer to this as an "undiscounted, monetized value of emissions changes for that future year". The undiscounted, monetized value must then be discounted back to the present value year to obtain the present value of the damages. This produces the "discounted, monetized value of emissions changes for present year."

To calculate the monetized value of damages from some specific amount of emissions changes, x_τ, in year τ discounted back to the present value year, denoted as year 0, additional steps are required. For example, the 2023 Final Oil and Gas Rule is expected to reduce about 4.5 million metric tons of methane in 2030, and the RIA discounted values back to 2021. The additional steps necessary to calculate the present value, pv_0, of emissions changes, x_τ, in year τ discounted back to the present value year 0 are as follows.

- First, the annual, unrounded SC-CO_2, SC-CH_4, and SC-N_2O estimates provided in Appendix A.5 of EPA's Report on the Social Cost of Greenhouse Gases are reported in 2020 dollars. This means that the SC-GHG values reflect the purchasing power of a dollar in 2020. If an analysis reports its cost and benefits in a different dollar year, γ, then the SC-GHG must be adjusted to reflect the purchasing power for that dollar year. By convention, this adjustment is done using the Gross Domestic Product (GDP) implicit price deflator, d_γ. The SC-GHG, adjusted to reflect a different dollar year, γ, is given by: $(d_\gamma \cdot scghg_\tau)$. For example, the Oil and Gas Rule reported costs and benefits in 2019 dollars, so the annual, unrounded SC-CH_4 values were multiplied by 0.987 to reflect the values in 2019 dollars.

- Second, the emissions changes in a future year, x_τ, from a policy action are multiplied by the SC-GHG in that future year, $scghg_\tau$, to the obtain the future monetized net damages associated with those emissions. $(x_\tau \cdot d_\gamma \cdot scghg_\tau)$ is the undiscounted, monetized value of emissions changes for that future year. In monetized net damages associated with those emissions. ($x_\tau \cdot d_\gamma \cdot scghg_\tau$) is the undiscounted, monetized value of emissions changes for that future year. In our example, 4.5 million metric tons of methane reduced in 2030 is multiplied times the GDP deflator of 0.987 times the SC-CH_4 of $2,400 for 2030, to obtain an undiscounted, monetized benefit of about $10.7 billion in 2030 (in 2019 dollars).

• Third, the undiscounted, monetized values need to be discounted back to the present value year to obtain the present value of the damages, pv_0, using the discount factor $\widetilde{\delta_\tau}$. The discounted, monetized value of emissions changes in present value terms for the emissions in year τ if given by: pv_0 = ($x_\tau \cdot d_\gamma \cdot scghg_\tau \cdot \widetilde{\delta_\tau}$). Continuing with our example, if we use a constant discount rate of 2%, the discount factor from 2030 to 2021 is $\bar{\delta} = \left(\frac{1}{1+2\%}\right)^{(2030-2021)}$ = 0.837. Therefore, $10.7 billion times 0.837 produces a present value (in 2021) of about $9 billion (in 2019 dollars) in benefits from the emissions reducutions in 2030.

The total present value of benefits from a policy action is the sum of the discounted, monetized values for each year the policy produces emission changes. For example, the Oil and Gas Rule predicts methane emission reductions from 2024 to 2038. The total present value of benefits for the Oil and Gas rule using a constant 2% discount rate was about $110 billion, calculated as $pv_0 = \sum_{\tau=2024}^{2038}(pv_{0,\tau}) = \sum_{\tau=2024}^{2038}(x_\tau \cdot d_\gamma \cdot scghg_\tau \cdot \bar{\delta}_\tau)$.

Sometimes it is useful to report the cost or benefits as annualized values. An annualized value is an illustrative cost or benefit which, if incurred over the same number of years as the length of the analysis, would produce the same net present value (NPV) as the original time-varying stream of undiscounted, monetized costs or benefits. If a constant discount rate is used, the annualized value can be obtained using Excel's PMT function or the annualized cost formula when there is initial cost at t=0 in EPA's Guidelines for Preparing Economic Analyses (Chapter 6, page 6-3, equation (4)). The annualized value for 15 years (the same number of years as Oil and Gas Rule, 2024-2038) and a 2% discount rate reported in the Oil and Gas rule was $8.5 billion.[1]

Selecting the Appropriate Discount Rate

The discounting approach underlying the EPA's SC-GHG estimates rely on the Ramsey (1928) discounting formula, $r_t = \rho + \eta g_t$, to account for the relationship between economic growth and discounting. The socioeconomic assumptions used to develop the SC-GHG included probabilistic projections for population, income, and GHG emissions, which included probabilistic projections of future consumption growth rates. If there is uncertainty in future consumption growth, g_t, then there is uncertainty over the discount rate over time. EPA incorporated this uncertainty using the Monte Carlo technique of taking draws from probability distributions of g_t, making the Ramsey discount rate a dynamic parameter within the modeling framework. In developing the SC-GHG, each Monte Carlo scenario was discounted using calibrated ρ and η values and the specific consumption growth rate for that scenario. This uncertainty is summarized by the certainty-equivalent rate, $\widetilde{\delta_\tau}$, which is the constant discount rate (specific to the particular damage year, τ) that yields the same result as the average of all of the uncertain outcomes across Monte Carlo trials.

The ρ and η parameters for the Ramsey equation were calibrated so that

(1) the decline in the certainty-equivalent discount rate matches the latest empirical evidence on interest rate uncertainty estimated by Bauer and Rudebusch (2020, 2023), and

(2) the average of the certainty-equivalent discount rate over the first decade matches a near-term consumption rate of interest. Uncertainty in this starting rate is addressed by using three near-term target rates (1.5%, 2.0%, and 2.5%) based on multiple lines of evidence on observed real market interest rates.

The correct discount factor to use when discounting the SC-GHG estimates is the certainty-equivalent discount factor, $\widetilde{\delta_\tau}$. This is because the SC-GHG estimates are certainty-equivalent values that account for the uncertainty in future consumption per capita, and the certainty-equivalent discount factor incorporates this uncertainty. Discounting the SC-GHG estimates using a constant discount rate equal to the near-term target rate would not capture the uncertainty in consumption per capita for that year.

While applying the certainty-equivalent discount factor would ensure a full accounting of scenario uncertainty, this process introduces substantial complexity in the calculations, which may not be warranted in all situations. For analyses with moderate time frames (e.g., 30 years or less), the difference between discounting from the year of emissions to the year of analysis using a constant discount rate equal to the near-term target rate, and discounting using the certainty-equivalent discount factor, $\widetilde{\delta_\tau}$ will be small (EPA 2023, page 150, Figure A.3.1.). For example, if the present value year is 2024, using the near-term target rate to discount back from the year of emissions instead of the certainty-equivalent discount factor will underestimate the present value of emission reductions by less than 1% for the first ten years of future emissions.

Therefore, for most analyses, constant discounting using the near-term target rate provides a close approximation of the present value from a policy action. This is what is provided in the constant rate tab in this workbook. For policies with estimated emissions changes occuring over a longer time frame, analysts may consider using the certainty-equivalent discount rates developed using the Ramsey discount rate schedule. We recommend analysts contact NCEE for assistance in these situations.

[1] The annualized value for a constant discount rate can be obtained using Excel's PMT function or the annualized cost formula when there is initial cost at t=0 in EPA's *Guidelines for Preparing Economic Analyses*. By convention, annualization is done for the same number of periods as the length of the analysis, but the default approach of Excel's PMT function assumes that ***the annualized value begins in the first year after the present value year***. In the illustrative example for the Oil and Gas Rule, the analysis period is 2024-2038 (15 years), but the annualized value implicitly assumes a period of 2022-2036 (also 15 years). So, the annualized value for the rule, calculated by the PMT function and reported in the RIA, is $8.5 billion. (To see, enter "=PMT(2%,15,110)"in Excel. It will produce a value of about $8.5 billion.) This means that $8.5 billion per year from 2022-2036, discounted at 2, produces the same present value of $110 billion as the actual stream of monetized benefits for the period 2024-2038, discounted at 2%.

Cumulative Emissions Estimates

	Annual Difference Between Build and No-Build	Annual	Years	Total for # years
Construction Emissions CO2 and CO2e	+ (estimate / 10 year construction period)	46,875.57	2025-2034	468,756
Construction Emissions CH4	+ (estimate / 10 year construction period)	0.19	2025-2034	1.9
Construction Emissions N2O	+ (estimate / 10 year construction period)	0.04	2025-2034	0.4
Operations and Maintenance Emissions CO2e	0 (annual emissions of 1,088 lower or similar to No Build)	1,088.00	2040-2045	-
Transit Operational Emissions CO2e	2,524	2,524.00	2035-2045	27,764
Roadway User Emissions CO2	-15,802 MT/year (based on daily reduction of 45 MT/day)	(15,801.74)	2035-2045	(173,819)
Roadway User Emissions CH4		(3.49)	2035-2045	(38.4)
Roadway User Emissions N2O		(0.12)	2035-2045	(1.3)

MT = metric tons

Operations

Roadway Emissions	MT	# days	Total
Daily Savings-CO2e (Fuel Cycle)	(14.5992)	260	(3,796)
Daily Savings-CO2 (Exhaust)	(29.9756)	260	(7,794)
Daily Savings-CH4 (Exhaust)	(0.0098)	260	(2.56)
Daily Savings-N2O (Exhaust)	(0.0003)	260	(0.09)
Weekend Day Savings--CO2e (Fuel Cycle)	(13.1392)	105	(1,380)
Weekend Day Savings--CO2 (Exhaust)	(26.9780)	105	(2,833)
Weekend Day Savings--CH4 (Exhaust)	(0.0089)	105	(0.93)
Weekend Day Savings--N2O (Exhaust)	(0.0003)	105	(0.03)
Total CO2e and CO2			(15,802)
Total CH4			(3.5)
Total N2O			(0.1)

Construction-Speciated

Project Element	Total Emissions (MT)
Materials CO2e	420,471
Transportation and Construction CO2	48,284
Transportation and Construction CH4	1.9
Transportation and Construction N2O	0.4

Users should complete boxes colored in lavender, orange, and green.

Present Value Year	2024
Dollar Year	2020

	Emission Changes (metric tons)			Years used in Annualization
				21 years
	CO2	CH4	N2O	Please confirm this is correct
Year				
2020				
2021				
2022				
2023				
2024				
2025	46,876	0	0	✓
2026	46,876	0	0	✓
2027	46,876	0	0	✓
2028	46,876	0	0	✓
2029	46,876	0	0	✓
2030	46,876	0	0	✓
2031	46,876	0	0	✓
2032	46,876	0	0	✓
2033	46,876	0	0	✓
2034	46,876	0	0	✓
2035	(13,278)	(3)	(0)	✓
2036	(13,278)	(3)	(0)	✓
2037	(13,278)	(3)	(0)	✓
2038	(13,278)	(3)	(0)	✓
2039	(13,278)	(3)	(0)	✓
2040	(13,278)	(3)	(0)	✓
2041	(13,278)	(3)	(0)	✓
2042	(13,278)	(3)	(0)	✓
2043	(13,278)	(3)	(0)	✓
2044	(13,278)	(3)	(0)	✓
2045	(13,278)	(3)	(0)	✓
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2075				
2076				
2077				
2078				
2079				
2080				
Totals	322,701	(36)	(1)	

	Undiscounted, Monetized Value of Emission Changes, deflated to 2020 dollars								
	Undiscounted, Monetized Value of CO2 Emissions Changes (millions, 2020$)			Undiscounted, Monetized Value of CH4 Emissions Changes (millions, 2020$)			Undiscounted, Monetized Value of N2O Emissions Changes (millions, 2020$)		
	CO2	CO2	CO2	CH4	CH4	CH4	N2O	N2O	N2O
	Near-Term Ramsey Discount Rate			Near-Term Ramsey Discount Rate			Near-Term Ramsey Discount Rate		
Year	2.5%	2.0%	1.5%	2.5%	2.0%	1.5%	2.5%	2.0%	1.5%
2020									
2021									
2022									
2023									
2024									
2025	$6.09	$9.94	$16.88	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2026	$6.23	$10.08	$17.11	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2027	$6.38	$10.27	$17.34	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2028	$6.52	$10.45	$17.58	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2029	$6.61	$10.59	$17.81	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2030	$6.75	$10.78	$18.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2031	$6.89	$10.97	$18.23	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2032	$7.03	$11.11	$18.47	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2033	$7.17	$11.30	$18.66	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2034	$7.27	$11.48	$18.89	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2035	-$2.10	-$3.29	-$5.42	-$0.01	-$0.01	-$0.01	-$0.01	-$0.01	-$0.01
2036	-$2.14	-$3.35	-$5.47	-$0.01	-$0.01	-$0.01	-$0.01	-$0.01	-$0.01
2037	-$2.18	-$3.40	-$5.54	-$0.01	-$0.01	-$0.01	-$0.01	-$0.01	-$0.01
2038	-$2.22	-$3.44	-$5.60	-$0.01	-$0.01	-$0.01	-$0.01	-$0.01	-$0.01
2039	-$2.26	-$3.49	-$5.66	-$0.01	-$0.01	-$0.01	-$0.01	-$0.01	-$0.01
2040	-$2.30	-$3.55	-$5.72	-$0.01	-$0.01	-$0.01	-$0.01	-$0.01	-$0.01
2041	-$2.34	-$3.60	-$5.79	-$0.01	-$0.01	-$0.01	-$0.01	-$0.01	-$0.01
2042	-$2.38	-$3.65	-$5.86	-$0.01	-$0.01	-$0.02	-$0.01	-$0.01	-$0.01
2043	-$2.42	-$3.70	-$5.92	-$0.01	-$0.01	-$0.02	-$0.01	-$0.01	-$0.01
2044	-$2.47	-$3.76	-$5.99	-$0.01	-$0.01	-$0.02	-$0.01	-$0.01	-$0.01
2045	-$2.51	-$3.81	-$6.05	-$0.01	-$0.01	-$0.02	-$0.01	-$0.01	-$0.01
2046									
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Annual Unrounded SC-CO2, SC-CH4, and SC-N2O Values, 2020-2080 (in 2020$)									
Gas	CO2	CO2	CO2	CH4	CH4	CH4	N2O	N2O	N2O

Near-term Ramsey Discount Rate	2.50%	2.00%	1.50%	2.50%	2.00%	1.50%	2.50%	2.00%	1.50%
2020	117	193	337	1,257	1,648	2,305	35,232	54,139	87,284
2021	119	197	341	1,324	1,723	2,391	36,180	55,364	88,869
2022	122	200	346	1,390	1,799	2,478	37,128	56,590	90,454
2023	125	204	351	1,457	1,874	2,564	38,076	57,816	92,040
2024	128	208	356	1,524	1,950	2,650	39,024	59,041	93,625
2025	130	212	360	1,590	2,025	2,737	39,972	60,267	95,210
2026	133	215	365	1,657	2,101	2,823	40,920	61,492	96,796
2027	136	219	370	1,724	2,176	2,910	41,868	62,718	98,381
2028	139	223	375	1,791	2,252	2,996	42,816	63,944	99,966
2029	141	226	380	1,857	2,327	3,083	43,764	65,169	101,552
2030	144	230	384	1,924	2,403	3,169	44,712	66,395	103,137
2031	147	234	389	2,002	2,490	3,270	45,693	67,645	104,727
2032	150	237	394	2,080	2,578	3,371	46,674	68,895	106,316
2033	153	241	398	2,157	2,666	3,471	47,655	70,145	107,906
2034	155	245	403	2,235	2,754	3,572	48,636	71,394	109,495
2035	158	248	408	2,313	2,842	3,673	49,617	72,644	111,085
2036	161	252	412	2,391	2,929	3,774	50,598	73,894	112,674
2037	164	256	417	2,468	3,017	3,875	51,578	75,144	114,264
2038	167	259	422	2,546	3,105	3,975	52,559	76,394	115,853
2039	170	263	426	2,624	3,193	4,076	53,540	77,644	117,443
2040	173	267	431	2,702	3,280	4,177	54,521	78,894	119,032
2041	176	271	436	2,786	3,375	4,285	55,632	80,304	120,809
2042	179	275	441	2,871	3,471	4,394	56,744	81,714	122,586
2043	182	279	446	2,955	3,566	4,502	57,855	83,124	124,362
2044	186	283	451	3,040	3,661	4,610	58,966	84,535	126,139
2045	189	287	456	3,124	3,756	4,718	60,078	85,945	127,916
2046	192	291	462	3,209	3,851	4,827	61,189	87,355	129,693
2047	195	296	467	3,293	3,946	4,935	62,301	88,765	131,469
2048	199	300	472	3,378	4,041	5,043	63,412	90,176	133,246
2049	202	304	477	3,462	4,136	5,151	64,523	91,586	135,023
2050	205	308	482	3,547	4,231	5,260	65,635	92,996	136,799
2051	208	312	487	3,624	4,320	5,363	66,673	94,319	138,479
2052	211	315	491	3,701	4,409	5,466	67,712	95,642	140,158
2053	214	319	496	3,779	4,497	5,569	68,750	96,965	141,838
2054	217	323	500	3,856	4,586	5,672	69,789	98,288	143,517
2055	220	326	505	3,933	4,675	5,774	70,827	99,612	145,196
2056	222	330	510	4,011	4,763	5,877	71,866	100,935	146,876
2057	225	334	514	4,088	4,852	5,980	72,904	102,258	148,555
2058	228	338	519	4,165	4,941	6,083	73,943	103,581	150,235
2059	231	341	523	4,243	5,029	6,186	74,981	104,904	151,914
2060	234	345	528	4,320	5,118	6,289	76,020	106,227	153,594
2061	236	348	532	4,389	5,199	6,385	76,920	107,385	155,085
2062	239	351	535	4,458	5,280	6,480	77,820	108,542	156,576
2063	241	354	539	4,527	5,361	6,576	78,720	109,700	158,066
2064	244	357	543	4,596	5,442	6,671	79,620	110,857	159,557
2065	246	360	547	4,666	5,523	6,767	80,520	112,015	161,048
2066	248	363	550	4,735	5,604	6,862	81,419	113,172	162,539
2067	251	366	554	4,804	5,685	6,958	82,319	114,330	164,030
2068	253	369	558	4,873	5,765	7,053	83,219	115,487	165,521
2069	256	372	562	4,942	5,846	7,149	84,119	116,645	167,012
2070	258	375	565	5,011	5,927	7,244	85,019	117,802	168,503
2071	261	378	569	5,085	6,013	7,344	86,012	119,027	170,013
2072	263	382	573	5,160	6,099	7,444	87,006	120,252	171,523
2073	266	385	576	5,234	6,184	7,545	87,999	121,477	173,033
2074	269	388	580	5,309	6,270	7,645	88,992	122,702	174,543
2075	271	391	583	5,383	6,355	7,745	89,985	123,926	176,053
2076	274	394	587	5,458	6,441	7,845	90,978	125,151	177,563
2077	276	398	591	5,532	6,527	7,946	91,971	126,376	179,073
2078	279	401	594	5,607	6,612	8,046	92,964	127,601	180,582
2079	282	404	598	5,681	6,698	8,146	93,958	128,826	182,092
2080	284	407	601	5,756	6,783	8,246	94,951	130,050	183,602

Source: *EPA Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances (https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf)*

GDP Deflator (used to convert from 2020$ to currency dollar year)													
Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
GDP index	91.481	93.185	94.771	96.421	97.316	98.241	100.000	102.291	104.008	105.381	110.213	117.973	122.273
2020 Deflator	0.868097665	0.884267562	0.899317714	0.914975185	0.923468177	0.932245851	0.948937664	0.970677826	0.986971086	1	1.045852668	1.119490231	1.16029455

Source: *Gross domestic product (implicit price deflator), Index 2017=100, Annual, Not Seasonally Adjusted; Federal Reserve Economic Data. Downloaded 03-13-24 (https://fred.stlouisfed.org/series/A191RD3A086NBEA)*

Emission Changes			
	Emissions Changes (metric tons)		
Year	CO2	CH4	N2O
2020			
2021			
2022			
2023			
2024			
2025	46,876	0	0
2026	46,876	0	0
2027	46,876	0	0
2028	46,876	0	0
2029	46,876	0	0
2030	46,876	0	0
2031	46,876	0	0
2032	46,876	0	0
2033	46,876	0	0
2034	46,876	0	0
2035	(13,278)	(3)	(0)
2036	(13,278)	(3)	(0)
2037	(13,278)	(3)	(0)
2038	(13,278)	(3)	(0)
2039	(13,278)	(3)	(0)
2040	(13,278)	(3)	(0)
2041	(13,278)	(3)	(0)
2042	(13,278)	(3)	(0)
2043	(13,278)	(3)	(0)
2044	(13,278)	(3)	(0)
2045	(13,278)	(3)	(0)
2046			
2047			

Constant discounting			
Number of years (N)	21		
Discount Rate	2.5%	2.0%	1.5%

Present and Annualized Values of CO2 Emission Changes (millions, 2020$)			
GHG	**CO2**	**CO2**	**CO2**
Discount Rate	**2.5%**	**2.0%**	**1.5%**
Present Value in 2024 (2020$)	$41.34	$67.42	$115.17
Annualized Value (21 Years, 2020$)	$2.55	$3.96	$6.43

Present and Annualized Values of CH4 Emission Changes (millions, 2020$)			
GHG	**CH4**	**CH4**	**CH4**
Discount Rate	**2.5%**	**2.0%**	**1.5%**
Present Value in 2024 (2020$)	-$0.07	-$0.09	-$0.12
Annualized Value (21 Years, 2020$)	$0.00	-$0.01	-$0.01

Present and Annualized Values of N2O Emission Changes (millions, 2020$)			
GHG	**N2O**	**N2O**	**N2O**
Discount Rate	**2.5%**	**2.0%**	**1.5%**
Present Value in 2024 (2020$)	-$0.03	-$0.05	-$0.08
Annualized Value (21 Years, 2020$)	$0.00	$0.00	$0.00

Total Present and Annualized Values of all GHG Emission Changes (CO2, CH4, and N2O) (millions, 2020$)			
GHG	**Total**	**Total**	**Total**
Discount Rate	**2.5%**	**2.0%**	**1.5%**
Present Value in 2024 (2020$)	**$41.24**	**$67.29**	**$114.96**
Annualized Value (21 Years, 2020$)	**$2.55**	**$3.96**	**$6.42**

	Discounted, Monetized Value of Emission Changes, discounted to 2024 (millions, 2020$) - Constant Discounting								
	Discounted, Monetized Value of CO2 Emissions Changes (millions, 2020$)			Discounted, Monetized Value of CH4 Emissions Changes (millions, 2020$)			Discounted, Monetized Value of N2O Emissions Changes (millions, 2020$)		
	Discounted Back to 2024			Discounted Back to 2024			Discounted Back to 2024		
	CO2	CO2	CO2	CH4	CH4	CH4	N2O	N2O	N2O
Year	2.5%	2.0%	1.5%	2.5%	2.0%	1.5%	2.5%	2.0%	1.5%
2020									
2021									
2022									
2023									
2024									
2025	$5.95	$9.74	$16.63	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2026	$5.93	$9.69	$16.61	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2027	$5.92	$9.67	$16.59	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2028	$5.90	$9.66	$16.56	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2029	$5.84	$9.60	$16.53	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2030	$5.82	$9.57	$16.46	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2031	$5.80	$9.55	$16.43	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2032	$5.77	$9.48	$16.40	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2033	$5.74	$9.45	$16.32	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2034	$5.68	$9.42	$16.28	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2035	-$1.60	-$2.65	-$4.60	-$0.01	-$0.01	-$0.01	$0.00	-$0.01	-$0.01
2036	-$1.59	-$2.64	-$4.58	-$0.01	-$0.01	-$0.01	$0.00	-$0.01	-$0.01
2037	-$1.58	-$2.63	-$4.56	-$0.01	-$0.01	-$0.01	$0.00	-$0.01	-$0.01
2038	-$1.57	-$2.61	-$4.55	-$0.01	-$0.01	-$0.01	$0.00	-$0.01	-$0.01
2039	-$1.56	-$2.59	-$4.52	-$0.01	-$0.01	-$0.01	$0.00	-$0.01	-$0.01
2040	-$1.55	-$2.58	-$4.51	-$0.01	-$0.01	-$0.01	$0.00	-$0.01	-$0.01
2041	-$1.54	-$2.57	-$4.49	-$0.01	-$0.01	-$0.01	$0.00	-$0.01	-$0.01
2042	-$1.52	-$2.56	-$4.48	-$0.01	-$0.01	-$0.01	$0.00	-$0.01	-$0.01
2043	-$1.51	-$2.54	-$4.46	-$0.01	-$0.01	-$0.01	$0.00	-$0.01	-$0.01
2044	-$1.51	-$2.53	-$4.45	-$0.01	-$0.01	-$0.01	$0.00	-$0.01	-$0.01
2045	-$1.49	-$2.51	-$4.43	-$0.01	-$0.01	-$0.01	$0.00	-$0.01	-$0.01