INTERSTATE 5 COLUMBIA RIVER CROSSING

Cumulative Effects Technical Report for the Final Environmental Impact Statement

May 2011

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Cover Sheet

Interstate 5 Columbia River Crossing

Cumulative Effects Technical Report for the Final Environmental Impact Statement:

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ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
APE	area of potential effect
BNSF	Burlington Northern Santa Fe Railroad
CAFE	Corporate Average Fuel Economy
CD	collector-distributor
CEQ	Council on Environmental Quality
CH_4	methane
CIG	The University of Washington’s Climate Impacts Group
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CPU	Clark Public Utilities
CRC	Columbia River Crossing
CTR	Commute Trip Reduction (Washington)
C-TRAN	Clark County Public Transit Benefit Area Authority
DAHP	Washington Department of Archaeology and Historic Preservation
DEIS	Draft Environmental Impact Statement
DOT	U.S. Department of Transportation
Ecology	Washington State Department of Ecology
ECO	Employee Commute Options (Oregon)
eGRID	Emission and Generation Resource Integrated Database
EJ	environmental justice
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
F	Fahrenheit
FERC	Federal Energy Regulatory Commission
FEIS	Final Environmental Impact Statement
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
FVNT	Fort Vancouver National Trust
GCM	global circulation models
GHG	greenhouse gas
HBC	Hudson’s Bay Company

HFC	hydrofluorocarbons
ICNIRP	International Commission on Non-Ionizing Radiation Protection
IPCC	Intergovernmental Panel on Climate Change
IRT	Incident Response Team
L_{max}	maximum noise levels
LNG	liquid natural gas
LPA	Locally Preferred Alternative
LRV	light rail vehicle
LWCF	Land and Water Conservation Fund
MAX	Metropolitan Area Express
mG	milligauss
MOVES	Mobile Vehicle Emission Simulator
mpg	miles per gallon
MT	metric ton
MT/yr	metric tons per year
$MtCO_2e/yr$	metric tons of carbon dioxide equivalent per year
MTP	Metropolitan Transportation Plan
N_20	nitrous oxide
NEPA	National Environmental Policy Act
NGVD 29	National Geodetic Vertical Datum of 1929
NHTSA	National Highway Traffic Safety Administration
NIOSH	National Institute for Occupational Safety and Health
NO_x	nitrogen oxide
NPS	National Park Service
NRHP	National Register of Historic Places
NWPP	Northwest Power Pool
ODOT	Oregon Department of Transportation
OTC	Oregon Transportation Commission
OHP	Oregon Highway Plan
PFC	perfluorocarbon
PGE	Portland General Electric
PJWA	potentially jurisdictional water area
PNW	Pacific Northwest

ROD	Record of Decision
RTC	Regional Transportation Commission
RTP	Regional Transportation Plan
SF_6	sulphur hexafluoride
SHPO	Oregon State Historic Preservation Office
SPUI	single-point urban interchange
SR	State Route
TDM	transportation demand management
TRB	Transportation Research Board
TriMet	Tri-County Metropolitan Transportation
TSM	transportation system management
U.S.	United States
USDOE	United States Department of Energy
USGRCP	United States Global Change Research Program
VCCV	Vancouver City Center Vision
VMT	vehicle miles traveled
VNHR	Vancouver National Historic Reserve
WHI	West Hayden Island
WSDOT	Washington State Department of Transportation
WTC	Washington Transportation Commission
WTP	Washington Transportation Plan

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1. Introduction

This report describes the potential cumulative effects of the I-5 Columbia River Crossing (CRC) project when combined with other past, present, and future actions.

1.1 Organization of this Report

This report first defines cumulative effects and outlines the approach, timeline and geographic scope for analyzing those effects. It then summarizes the other past, present and reasonably foreseeable actions that are part of the cumulative effects analysis. The results of the cumulative impacts analysis are in Section 2 (built environment), Section 3 (natural environment), Section 4 (cultural environment), and Section 5 (climate change).

1.2 Description of Alternatives

This technical report evaluates the CRC project’s locally preferred alternative (LPA) and the No-Build Alternative. The LPA includes two design options: The preferred option, LPA Option A, which includes local vehicular access between Marine Drive and Hayden Island on an arterial bridge; and LPA Option B, which does not have arterial lanes on the light rail/multi-use path bridge, but instead provides direct access between Marine Drive and the island with collector-distributor (CD) lanes on the two new bridges that would be built adjacent to I-5. In addition to the design options, if funding availability does not allow the entire LPA to be constructed in one phase, some roadway elements of the project would be deferred to a future date. This technical report identifies several elements that could be deferred, and refers to that possible initial investment as LPA with highway phasing. The LPA with highway phasing option would build most of the LPA in the first phase, but would defer construction of specific elements of the project. The LPA and the No-Build Alternative are described in this section.

1.2.1 Adoption of a Locally Preferred Alternative

Following the publication of the Draft Environmental Impact Statement (DEIS) on May 2, 2008, the project actively solicited public and stakeholder feedback on the DEIS during a 60-day comment period. During this time, the project received over 1,600 public comments.

During and following the public comment period, the elected and appointed boards and councils of the local agencies sponsoring the CRC project held hearings and workshops to gather further public input on and discuss the DEIS alternatives as part of their efforts to determine and adopt a locally preferred alternative. The LPA represents the alternative preferred by the local and regional agencies sponsoring the CRC project. Local agency-elected boards and councils determined their preference based on the results of the evaluation in the DEIS and on the public and agency comments received both before and following its publication.

In the summer of 2008, the local agencies sponsoring the CRC project adopted the following key elements of CRC as the LPA:

- A replacement bridge as the preferred river crossing,
- Light rail as the preferred high-capacity transit mode, and

- Clark College as the preferred northern terminus for the light rail extension.

The preferences for a replacement crossing and for light rail transit were identified by all six local agencies. Only the agencies in Vancouver – the Clark County Public Transit Benefit Area Authority (C-TRAN), the City of Vancouver, and the Regional Transportation Council (RTC) – preferred the Vancouver light rail terminus. The adoption of the LPA by these local agencies does not represent a formal decision by the federal agencies leading this project – the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) – or any federal funding commitment. A formal decision by FHWA and FTA about whether and how this project should be constructed will follow the FEIS in a Record of Decision (ROD).

1.2.2 Description of the LPA

The LPA includes an array of transportation improvements, which are described below. When the LPA differs between Option A and Option B, it is described in the associated section. For a more detailed description of the LPA, including graphics, please see Chapter 2 of the FEIS.

1.2.2.1 Multimodal River Crossing

Columbia River Bridges

The parallel bridges that form the existing I-5 crossing over the Columbia River would be replaced by two new parallel bridges. The eastern structure would accommodate northbound highway traffic on the bridge deck, with a bicycle and pedestrian path underneath; the western structure would carry southbound traffic, with a two-way light rail guideway below. Whereas the existing bridges have only three lanes each with virtually no shoulders, each of the new bridges would be wide enough to accommodate three through-lanes and two add/drop lanes. Lanes and shoulders would be built to full design standards.

The new bridges would be high enough to provide approximately 95 feet of vertical clearance for river traffic beneath, but not so high as to impede the take-offs and landings by aircraft using Pearson Field or Portland International Airport to the east. The new bridge structures over the Columbia River would not include lift spans, and both of the new bridges would each be supported by six piers in the water and two piers on land.

North Portland Harbor Bridges

The existing highway structures over North Portland Harbor would not be replaced; instead, they would be retained to accommodate all mainline I-5 traffic. As discussed at the beginning of this chapter, two design options have emerged for the Hayden Island and Marine Drive interchanges. The preferred option, LPA Option A, includes local vehicular access between Marine Drive and Hayden Island on an arterial bridge. LPA Option B does not have arterial lanes on the light rail/multi-use path bridge, but instead provides direct access between Marine Drive and the island with collector-distributor lanes on the two new bridges that would be built adjacent to I-5.

LPA Option A: Four new, narrower parallel structures would be built across the waterway, three on the west side and one on the east side of the existing North Portland Harbor bridges. Three of the new structures would carry on- and off-ramps to mainline I-5. Two structures west of the existing bridges would carry traffic merging onto or exiting off of I-5 southbound. The new structure on the east side of I-5 would serve as an on-ramp for traffic merging onto I-5 northbound.

The fourth new structure would be built slightly farther west and would include a two-lane arterial bridge for local traffic to and from Hayden Island, light rail transit, and a multi-use path for pedestrians and bicyclists. All of the new structures would have at least as much vertical clearance over the river as the existing North Portland Harbor bridges.

LPA Option B: This option would build the same number of structures over North Portland Harbor as Option A, although the locations and functions on those bridges would differ, as described below. The existing bridge over North Portland Harbor would be widened and would receive seismic upgrades.

LPA Option B does not have arterial lanes on the light rail/multi-use path bridge. Direct access between Marine Drive and the island would be provided with collector-distributor lanes. The structures adjacent to the highway bridge would carry traffic merging onto or exiting off of mainline I-5 between the Marine Drive and Hayden Island interchanges.

1.2.2.2 Interchange Improvements

The LPA includes improvements to seven interchanges along a 5-mile segment of I-5 between Victory Boulevard in Portland and SR 500 in Vancouver. These improvements include some reconfiguration of adjacent local streets to complement the new interchange designs, as well as new facilities for bicyclists and pedestrians along this corridor.

Victory Boulevard Interchange

The southern extent of the I-5 project improvements would be two ramps associated with the Victory Boulevard interchange in Portland. The Marine Drive to I-5 southbound on-ramp would be braided over the I-5 southbound to the Victory Boulevard/Denver Avenue off-ramp. The other ramp improvement would lengthen the merge distance for northbound traffic entering I-5 from Denver Avenue. The current merging ramp would be extended to become an add/drop (auxiliary) lane which would continue across the river crossing.

***Potential phased construction option*:** The aforementioned southbound ramp improvements to the Victory Boulevard interchange may not be included with the CRC project. Instead, the existing connections between I-5 southbound and Victory Boulevard could be retained. The braided ramp connection could be constructed separately in the future as funding becomes available.

Marine Drive Interchange

All movements within this interchange would be reconfigured to reduce congestion for motorists entering and exiting I-5 at this location. The interchange configuration would be a single-point urban interchange (SPUI) with a flyover ramp serving the east to north movement. With this configuration, three legs of the interchange would converge at a point on Marine Drive, over the I-5 mainline. This configuration would allow the highest volume movements to move freely without being impeded by stop signs or traffic lights.

The Marine Drive eastbound to I-5 northbound flyover ramp would provide motorists with access to I-5 northbound without stopping. Motorists from Marine Drive eastbound would access I-5 southbound without stopping. Motorists traveling on Martin Luther King Jr. Boulevard westbound to I-5 northbound would access I-5 without stopping at the intersection.

The new interchange configuration changes the westbound Marine Drive and westbound Vancouver Way connections to Martin Luther King Jr. Boulevard and to northbound I-5. These two streets would access westbound Martin Luther King Jr. Boulevard farther east. Martin Luther King Jr. Boulevard would have a new direct connection to I-5 northbound.

In the new configuration, the connections from Vancouver Way and Marine Drive would be served, improving the existing connection to Martin Luther King Jr. Boulevard east of the interchange. The improvements to this connection would allow traffic to turn right from Vancouver Way and accelerate onto Martin Luther King Jr. Boulevard. On the south side of Martin Luther King Jr. Boulevard, the existing loop connection would be replaced with a new connection farther east.

A new multi-use path would extend from the Bridgeton neighborhood to the existing Expo Center light rail station and from the station to Hayden Island along the new light rail line over North Portland Harbor.

LPA Option A: Local traffic between Martin Luther King Jr. Boulevard/Marine Drive and Hayden Island would travel via an arterial bridge over North Portland Harbor. There would be some variation in the alignment of local streets in the area of the interchange between Option A and Option B. The most prominent differences are the alignments of Vancouver Way and Union Court.

LPA Option B: With this design option, there would be no arterial traffic lanes on the light rail/multi-use path bridge over North Portland Harbor. Instead, vehicles traveling between Martin Luther King Jr. Boulevard/ Marine Drive and Hayden Island would travel on the collector-distributor bridges that would parallel each side of I-5 over North Portland Harbor. Traffic would not need to merge onto mainline I-5 to travel between the island and Martin Luther King Jr. Boulevard/Marine Drive.

Potential phased construction option**:** The aforementioned flyover ramp could be deferred and not constructed as part of the CRC project. In this case, rather than providing a direct eastbound Marine Drive to I-5 northbound connection by a flyover ramp, the project improvements to the interchange would instead provide this connection through the signal-controlled SPUI. The flyover ramp could be constructed separately in the future as funding becomes available.

Hayden Island Interchange

All movements for this interchange would be reconfigured. The new configuration would be a split tight diamond interchange. Ramps parallel to the highway would be built, lengthening the ramps and improving merging speeds. Improvements to Jantzen Drive and Hayden Island Drive would include additional through, left-turn, and right-turn lanes. A new local road, Tomahawk Island Drive, would travel east-west through the middle of Hayden Island and under the I-5 interchange, improving connectivity across I-5 on the island. Additionally, a new multi-use path would be provided along the elevated light rail line on the west side of the Hayden Island interchange.

LPA Option A: A proposed arterial bridge with two lanes of traffic, one in each direction, would allow vehicles to travel between Martin Luther King Jr. Boulevard/ Marine Drive and Hayden Island without accessing I-5.

LPA Option B: With this design option there would be no arterial traffic lanes on the light rail/multi-use path bridge over North Portland Harbor. Instead, vehicles traveling between Martin Luther King Jr. Boulevard/Marine Drive and Hayden Island would travel on the collector-distributor bridges that parallel each side of I-5 over North Portland Harbor.

SR 14 Interchange

The function of this interchange would remain largely the same. 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. Downtown Vancouver I-5 access to and from the south would be at C Street rather than Washington Street, while downtown connections to and from SR 14 would be made by way of Columbia Street at 4th Street.

The multi-use bicycle and pedestrian path in the northbound (eastern) I-5 bridge would exit the structure at the SR 14 interchange, and then loop down to connect into Columbia Way.

Mill Plain Interchange

This interchange would be reconfigured into a SPUI. The existing "diamond" configuration requires two traffic signals to move vehicles through the interchange. The SPUI would use one efficient intersection and allow opposing left turns simultaneously. This would improve the capacity of the interchange by reducing delay for traffic entering or exiting the highway.

This interchange would also receive several improvements for bicyclists and pedestrians. These include bike lanes and sidewalks, clear delineation and signing, short perpendicular crossings at the ramp terminals, and ramp orientations that would make pedestrians highly visible.

Fourth Plain Interchange

The improvements to this interchange would be made to better accommodate freight mobility and access to the new park and ride at Clark College. Northbound I-5 traffic exiting to Fourth Plain would continue to use the off-ramp just north of the SR 14 interchange. The southbound I-5 exit to Fourth Plain would be braided with the SR 500 connection to I-5, which would eliminate the non-standard weave between the SR 500 connection and the off-ramp to Fourth Plain as well as the westbound SR 500 to Fourth Plain Boulevard connection.

Additionally, several improvements would be made to provide better bicycle and pedestrian mobility and accessibility, including bike lanes, neighborhood connections, and access to the park and ride.

SR 500 Interchange

Improvements would be made to the SR 500 interchange to add direct connections to and from I-5. On- and off-ramps would be built to directly connect SR 500 and I-5 to and from the north, connections that are currently made by way of 39th Street. I-5 southbound traffic would connect to SR 500 via a new tunnel underneath I-5. SR 500 eastbound traffic would connect to I-5 northbound on a new on-ramp. The 39th Street connections with I-5 to and from the north would be eliminated. Travelers would instead use the connections at Main Street to connect to and from 39th Street.

Additionally, several improvements would be made to provide better bicycle and pedestrian mobility and accessibility, including sidewalks on both sides of 39th Street, bike lanes, and neighborhood connections.

***Potential phased construction option*:** The northern half of the existing SR 500 interchange would be retained, rather than building new connections between I-5 southbound to SR 500 eastbound and from SR 500 westbound to I-5 northbound. The ramps connecting SR 500 and I-5 to and from the north could be constructed separately in the future as funding becomes available.

1.2.2.3 Transit

The primary transit element of the LPA is a 2.9-mile extension of the current Metropolitan Area Express (MAX) Yellow Line light rail from the Expo Center in North Portland, where it currently ends, to Clark College in Vancouver. The transit element would not differ between LPA and LPA with highway phasing. To accommodate and complement this major addition to the region's transit system, a variety of additional improvements are also included in the LPA:

- Three park and ride facilities in Vancouver near the new light rail stations.
- Expansion of Tri-County Metropolitan Transportation District's (TriMet's) Ruby Junction light rail maintenance base in Gresham, Oregon.
- Changes to C-TRAN local bus routes.
- Upgrades to the existing light rail crossing over the Willamette River via the Steel Bridge.

Operating Characteristics

Nineteen new light rail vehicles (LRV) would be purchased as part of the CRC project to operate this extension of the MAX Yellow Line. These vehicles would be similar to those currently used by TriMet's MAX system. With the LPA, LRVs in the new guideway and in the existing Yellow Line alignment are planned to operate with 7.5-minute headways during the "peak of the peak" (the two-hour period within the 4-hour morning and afternoon/evening peak periods where demand for transit is the highest) and 15-minute headways during off-peak periods.

Light Rail Alignment and Stations

Oregon Light Rail Alignment and Station

A two-way light rail alignment for northbound and southbound trains would be constructed to extend from the existing Expo Center MAX station over North Portland Harbor to Hayden Island. Immediately north of the Expo Center, the alignment would curve eastward toward I-5, pass beneath Marine Drive, then rise over a flood wall onto a light rail/multi-use path bridge to cross North Portland Harbor. The two-way guideway over Hayden Island would be elevated at approximately the height of the rebuilt mainline of I-5, as would a new station immediately west of I-5. The alignment would extend northward on Hayden Island along the western edge of I-5, until it transitions into the hollow support structure of the new western bridge over the Columbia River.

Downtown Vancouver Light Rail Alignment and Stations

After crossing the Columbia River, the light rail alignment would curve slightly west off of the highway bridge and onto its own smaller structure over the Burlington Northern Santa Fe (BNSF) rail line. The double-track guideway would descend on structure and touch down on Washington Street south of 5th Street, continuing north on Washington Street to 7th Street. The elevation of 5th Street would be raised to allow for an at-grade crossing of the tracks on Washington Street. Between 5th and 7th Streets, the two-way guideway would run down the center of the street. Traffic would not be allowed on Washington between 5th and 6th Streets and would be two-way between 6th and 7th Streets. There would be a station on each side of the street on Washington between 5th and 6th Streets.

At 7th Street, the light rail alignment would form a couplet. The single-track northbound guideway would turn east for two blocks, then turn north onto Broadway Street, while the single-track southbound guideway would continue on Washington Street. Seventh Street will be converted to one-way traffic eastbound between Washington and Broadway with light rail operating on the north side of 7th Street. This couplet would extend north to 17th Street, where the two guideways would join and turn east.

The light rail guideway would run on the east side of Washington Street and the west side of Broadway Street, with one-way traffic southbound on Washington Street and one-way traffic northbound on Broadway Street. On station blocks, the station platform would be on the side of the street at the sidewalk. There would be two stations on the Washington-Broadway couplet, one pair of platforms near Evergreen Boulevard, and one pair near 15th Street.

East-west Light Rail Alignment and Terminus Station

The single-track southbound guideway would run in the center of 17th Street between Washington and Broadway Streets. At Broadway Street, the northbound and southbound alignments of the couplet would become a two-way center-running guideway traveling east-west on 17th Street. The guideway on 17th Street would run until G Street, then connect with McLoughlin Boulevard and cross under I-5. Both alignments would end at a station east of I-5 on the western boundary of Clark College.

Park and Ride Stations

Three park and ride stations would be built in Vancouver along the light rail alignment:

- Within the block surrounded by Columbia, Washington 4th and 5th Streets, with five floors above ground that include space for retail on the first floor and 570 parking stalls.
- Between Broadway and Main Streets next to the stations between 15th and 16th Streets, with space for retail on the first floor, and four floors above ground that include 420 parking stalls.
- At Clark College, just north of the terminus station, with space for retail or C-TRAN services on the first floor, and five floors that include approximately 1,910 parking stalls.

Ruby Junction Maintenance Facility Expansion

The Ruby Junction Maintenance Facility in Gresham, Oregon, would need to be expanded to accommodate the additional LRVs associated with the CRC project. Improvements include additional storage for LRVs and other maintenance material, expansion of LRV maintenance bays, and expanded parking for additional personnel. A new operations command center would also be required, and would be located at the TriMet Center Street location in Southeast Portland.

Local Bus Route Changes

As part of the CRC project, several C-TRAN bus routes would be changed in order to better complement the new light rail system. Most of these changes would re-route bus lines to downtown Vancouver where riders could transfer to light rail. Express routes, other than those listed below, are expected to continue service between Clark County and downtown Portland. The following table (Exhibit 1-1) shows anticipated future changes to C-TRAN bus routes.

Exhibit 1-1. Proposed C-TRAN Bus Routes Comparison

C-TRAN Bus Route	Route Changes
#4 - Fourth Plain	Route truncated in downtown Vancouver
#41 - Camas / Washougal Limited	Route truncated in downtown Vancouver
#44 - Fourth Plain Limited	Route truncated in downtown Vancouver
#47 - Battle Ground Limited	Route truncated in downtown Vancouver
#105 - I-5 Express	Route truncated in downtown Vancouver
#105S - I-5 Express Shortline	Route eliminated in LPA (The No-Build runs articulated buses between downtown Portland and downtown Vancouver on this route)

Steel Bridge Improvements

Currently, all light rail lines within the regional TriMet MAX system cross over the Willamette River via the Steel Bridge. By 2030, the number of LRVs that cross the Steel Bridge during the 4-hour PM peak period would increase from 152 to 176. To accommodate these additional trains, the project would retrofit the existing rails on the Steel Bridge to increase the allowed light rail speed over the bridge from 10 to 15 mph. To accomplish this, additional work along the Steel Bridge lift spans would be needed.

1.2.2.4 Tolling

Tolling cars and trucks that use the I-5 river crossing is proposed as a method to help fund the CRC project and to encourage the use of alternative modes of transportation. The authority to toll the I-5 crossing is set by federal and state laws. Federal statutes permit a toll-free bridge on an interstate highway to be converted to a tolled facility following the reconstruction or replacement of the bridge. Prior to imposing tolls on I-5, Washington and Oregon Departments of Transportation (WSDOT and ODOT) would have to enter into a toll agreement with U.S. Department of Transportation (DOT). Recently passed state legislation in Washington permits WSDOT to toll I-5 provided that the tolling of the facility is first authorized by the Washington Legislature. Once authorized by the Legislature, the Washington Transportation Commission (WTC) has the authority to set the toll rates. In Oregon, the Oregon Transportation Commission (OTC) has the authority to toll a facility and to set the toll rate. It is anticipated that prior to tolling I-5, ODOT and WSDOT would enter into a bi-state tolling agreement to establish a cooperative process for setting toll rates and guiding the use of toll revenues.

Tolls would be collected using an electronic toll collection system: toll collection booths would not be required. Instead, motorists could obtain a transponder that would automatically bill the vehicle owner each time the vehicle crossed the bridge, while cars without transponders would be tolled by a license-plate recognition system that would bill the address of the owner registered to that license plate.

The LPA proposes to apply a variable toll on vehicles using the I-5 crossing. Tolls would vary by time of day, with higher rates during peak travel periods and lower rates during off-peak periods. Medium and heavy trucks would be charged a higher toll than passenger vehicles. The traffic-related impact analysis in this FEIS is based on toll rates that, for passenger cars with transponders, would range from $1.00 during the off-peak to $2.00 during the peak travel times (in 2006 dollars).

1.2.2.5 Transportation System and Demand Management Measures

Many well-coordinated transportation demand management (TDM) and transportation system management (TSM) programs are already in place in the Portland-Vancouver Metropolitan region and supported by agencies and adopted plans. In most cases, the impetus for the programs is from state-mandated programs: Oregon's Employee Commute Options (ECO) rule and Washington's Commute Trip Reduction (CTR) law.

The physical and operational elements of the CRC project provide the greatest TDM opportunities by promoting other modes to fulfill more of the travel needs in the project corridor. These include:

- Major new light rail line in exclusive right-of-way, as well as express bus and feeder routes;
- Modern bicycle and pedestrian facilities that accommodate more bicyclists and pedestrians, and improve connectivity, safety, and travel time;
- Park and ride lots and garages; and
- A variable toll on the highway crossing.

In addition to these fundamental elements of the project, facilities and equipment would be implemented that could help existing or expanded TSM programs maximize capacity and efficiency of the system. These include:

- Replacement or expanded variable message signs or other traveler information systems in the CRC project area;
- Expanded incident response capabilities;
- Queue jumps or bypass lanes for transit vehicles where multi-lane approaches are provided at ramp signals for entrance ramps;
- Expanded traveler information systems with additional traffic monitoring equipment and cameras, and
- Active traffic management.

1.2.3 LPA Construction

Construction of bridges over the Columbia River is the most substantial element of the project, and this element sets the sequencing for other project components. The main river crossing and immediately adjacent highway improvement elements would account for the majority of the construction activity necessary to complete this project.

1.2.3.1 Construction Activities Sequence and Duration

The following table (Exhibit 1-2) displays the expected duration and major details of each element of the project. Due to construction sequencing requirements, the timeline to complete the initial phase of the LPA with highway phasing is the same as the full LPA.

Exhibit 1-2. Construction Activities and Estimated Duration

Element	Estimated Duration	Details
Columbia River bridges	4 years	• Construction is likely to begin with the bridges. • General sequence includes initial preparation, installation of foundation piles, shaft caps, pier columns, superstructure, and deck.
Hayden Island and SR 14 interchanges	1.5 - 4 years for each interchange	• Each interchange must be partially constructed before any traffic can be transferred to the new structure. • Each interchange needs to be completed at the same time.
Marine Drive interchange	3 years	• Construction would need to be coordinated with construction of the southbound lanes coming from Vancouver.
Demolition of the existing bridges	1.5 years	• Demolition of the existing bridges can begin only after traffic is rerouted to the new bridges.
Three interchanges north of SR 14	4 years for all three	• Construction of these interchanges could be independent from each other or from the southern half of the project. • More aggressive and costly staging could shorten this timeframe.
Light rail	4 years	• The river crossing for the light rail would be built with the bridges. • Any bridge structure work would be separate from the actual light rail construction activities and must be completed first.
Total Construction Timeline	6.3 years	• Funding, as well as contractor schedules, regulatory restrictions on in-water work, weather, materials, and equipment, could all influence construction duration. • This is also the same time required to complete the smallest usable segment of roadway – Hayden Island through SR 14 interchanges.

1.2.3.2 Major Staging Sites and Casting Yards

Staging of equipment and materials would occur in many areas along the project corridor throughout construction, generally within existing or newly purchased right-of-way or on nearby vacant parcels. However, at least one large site would be required for construction offices, to stage the larger equipment such as cranes, and to store materials such as rebar and aggregate. Suitable sites must be large and open to provide for heavy machinery and material storage, must have 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 must have roadway or rail access for landside transportation of materials by truck or train.

Three sites have been identified as possible major staging areas:

1. Port of Vancouver (Parcel 1A) site in Vancouver: This 52-acre site is located along SR 501 and near the Port of Vancouver’s Terminal 3 North facility.

2. Red Lion at the Quay hotel site in Vancouver: This site would be partially acquired for construction of the Columbia River crossing, which would require the demolition of the building on this site, leaving approximately 2.6 acres for possible staging.

3. Vacant Thunderbird hotel site on Hayden Island: This 5.6-acre site is much like the Red Lion hotel site in that a large portion of the parcel is already required for new right-of-way necessary for the LPA.

A casting/staging yard could be required for construction of the over-water bridges if a precast concrete segmental bridge design is used. A casting yard would require access to the river for barges, including either 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 and/or railway for delivery of materials.

Two sites have been identified as possible casting/staging yards:

1. Port of Vancouver Alcoa/Evergreen West site: This 95-acre site was previously home to an aluminum factory and is currently undergoing environmental remediation, which should be completed before construction of the CRC project begins (2012). The western portion of this site is best suited for a casting yard.

2. Sundial site: This 50-acre site is located between Fairview and Troutdale, just north of the Troutdale Airport, and has direct access to the Columbia River. There is an existing barge slip at this location that would not have to undergo substantial improvements.

1.2.4 The No-Build Alternative

The No-Build Alternative illustrates how transportation and environmental conditions would likely change by the year 2030 if the CRC project is not built. This alternative makes the same assumptions as the build alternatives regarding population and employment growth through 2030, and also assumes that the same transportation and land use projects in the region would occur as planned. The No-Build Alternative also includes several major land use changes that are planned within the project area, such as the Riverwest development just south of Evergreen Boulevard and west of I-5, the Columbia West Renaissance project along the western waterfront in downtown Vancouver, and redevelopment of the Jantzen Beach shopping center on Hayden Island. All traffic and transit projects within or near the CRC project area that are anticipated to be built by 2030 separately from this project are included in the No-Build and build alternatives. Additionally, the No-Build Alternative assumes bridge repair and continuing maintenance costs to the existing bridge that are not anticipated with the replacement bridge option.

1.3 Defining Cumulative Effects

Cumulative effects result from the incremental effect of the proposed action when added to those of other past, present, and reasonably foreseeable future actions, regardless of the agency (federal or non-federal) or person that undertakes other such actions. Cumulative effects can result from individually minor but collectively significant actions that take place over a period of time (definitions paraphrased from 40 CFR, 1508.7). The combination of effects, and resulting environmental conditions, are the focus of the cumulative effects analysis.

The National Environmental Policy Act (NEPA) scoping process helped to inform the extent and level of analysis that were required for each environmental resource. Consultations with cooperating agencies, participating agencies, and the public contributed to defining the scope and scale of the cumulative effects analysis.

For all technical disciplines, current and planned projects included those assumed in the regional modeling of 2030 transportation conditions. On a discipline-by-discipline basis, additional projects and trends were considered if relevant to the analysis of cumulative effects. For example, the natural environment disciplines consider the effects of increased urbanization and land use changes on the amount of natural area near the project, and the built environment disciplines consider the plans and policies adopted for the area.

1.4 General Analytical Approach

The project team assessed which environmental and community resources would be affected by the CRC project, and how other past, present, or reasonably foreseeable future actions may affect the same resources. These actions and their cumulative effects were compared to the potential effects resulting from the LPA. This analysis considered: past major actions; planned transportation projects; population, employment and land use forecasts; comprehensive land use plans; and other major public and private projects that are under development or reasonably expected to occur. The temporal and geographic scales of analysis for the assessment of actions and forecasts can vary for each discipline. For some cumulative effects, namely climate change and energy, the analysis also assesses how global trends could affect the LPA.

The analysis of cumulative effects for the CRC project first employed quantitative methods where applicable. The analysis is also qualitative, with emphasis on comparing the relative cumulative effects of the LPA compared to the cumulative effects of the No-Build Alternative. This allows the appropriate context to be used in considering and comparing the two alternatives, based on available data.

The general analytical approach for each environmental resource (built, natural, and cultural) includes three major steps:

1. Identify appropriate timeframe and outline general past and future actions, as data allow. Assess the general impacts of these past actions on relevant built, natural, or cultural environment resources. Solicit input from the agencies or other stakeholders to assess the nature and extent of past, present, and reasonably foreseeable future effects on those resources.

2. Summarize the effects to environmental resources from the CRC No-Build and LPA. Assess changes in transportation systems (impervious surface, traffic volumes, patterns, and noise) and land use. These summaries draw from the technical reports prepared for the project.

3. Compare the aggregate effects of the LPA combined with other past, present, and reasonably foreseeable future actions.

Unless stated otherwise in this report, the LPA with highway phasing options would have the same cumulative impacts as the corresponding LPA full build options. Similarly, whether Option A or Option B is built, the cumulative impacts are expected to be the same, except where noted.

1.5 Study Area

The project study area runs along a 5-mile segment of I-5, between approximately State Route (SR) 500 in Washington and Columbia Boulevard in Oregon, as well as in downtown Vancouver west and east of I-5. Temporary construction easements would occur directly adjacent to the improvements, while larger staging areas and casting yards could be located upstream or downstream of the I-5 bridges. The Ruby Junction maintenance facility is located in Gresham, Oregon, and is also included in this analysis. Please see Exhibit 1-3 for a map of the study area.

1.6 Timeframe for the Analysis: Past, Present, and Reasonably Foreseeable Future Projects

To address cumulative effects, the project team established a temporal frame of reference for the analysis. The time frame of reference for cumulative impacts considered in this report is:

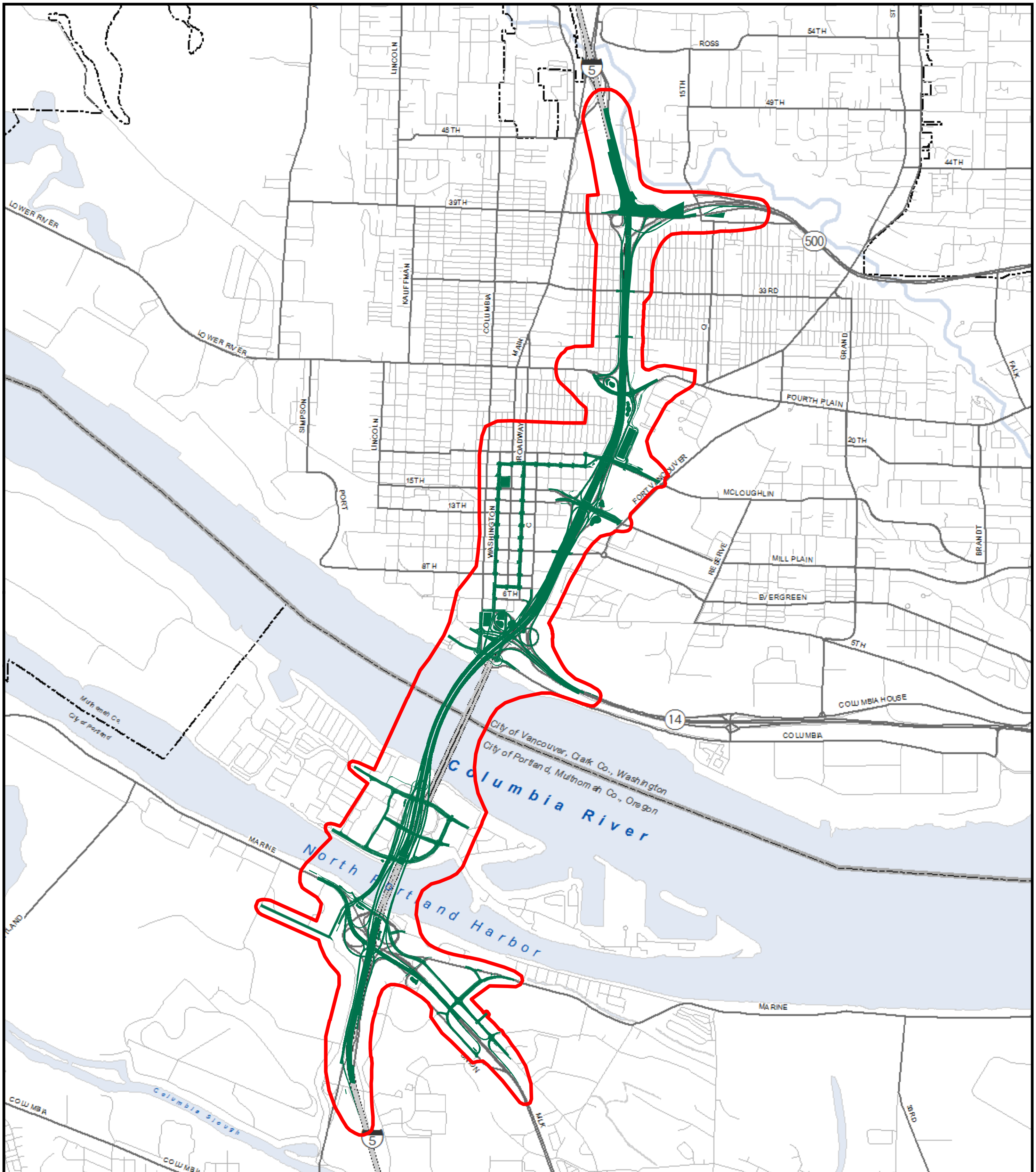
- The relevant timeframe for considering past actions varies by general discipline. The natural environment analysis looks at broad changes beginning in the 1800s. The cultural environment starts with prehistory, and the relevant past actions for evaluating built environment cumulative impacts started in the early 1960s with the construction and opening of I-5.
- Present is 2010.
- Future is 2030, the design year of this project.

The time periods and types of projects included in the analysis are described in greater detail below.

1.6.1 Past Projects and Actions

Past built environment projects include transportation, urbanization, housing, and other developments that have influenced the social, economic, and natural environment in the project area. Prior to the 1917 construction of a bridge across the Columbia River in this location, ferries and other boats were used to transport people and goods between Oregon and Washington. A second bridge, currently carrying southbound I-5 traffic, was added in 1958 to provide increased capacity and to separate southbound and northbound traffic. At that time, the bridges were linked to Oregon 99, the main north/south highway. The bridges later became part of the interstate system when I-5 was opened in the project area in the early 1960s.

For the built environment, the “past” will run from 1960 (prior to the opening of I-5) to the present day. For the natural environment, an earlier base year is evaluated to capture a longer history of the effects of development on natural resources in the area. To determine base thresholds the cultural environment team solicited input from the Cultural Resources/Section 4(f) Workgroup, which was composed of local and state agency representatives, the Washington Department of Archaeology and Historic Preservation (DAHP), and the Oregon State Historic Preservation Office (SHPO).



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Main Project Area

Project Footprint

Exhibit 1-3. Main Project Area

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: Dec. 7, 2010; File Name: Ex_1_3_TL231.mxd

Generally, it is not necessary to evaluate the impacts of individual past actions in order to describe cumulative impacts; existing conditions reflect the collective impacts of past actions. Nevertheless, there is value in understanding how current conditions were shaped by historic actions. The following outlines the general past trends and major actions that have shaped the current built, natural, and cultural environment in the study area.

Native Americans have occupied or traveled through the CRC project area for thousands of years. Those activities had little effect on current environmental conditions in the CRC project area. In the 1800s European-American settlement began and expanded and the Portland and Vancouver area population began to dramatically increase. The following key historic events provide a basis for analysis of past actions that have helped shape current environmental conditions:

Past Actions

Pre-1800s	Native American paths along Siskiyou Trail on what is now the I-5 Corridor connected tribes from the Pacific Northwest to California's Central Valley.
1810 to 1850	Settlement of Fort Vancouver and the Hudson Bay Company. Commercial fur trapping on the Columbia and associated waterways developed between 1810 to the 1850s. Fur trappers from the Hudson Bay Company operating out of Fort Vancouver adopted the Siskiyou Trail as a major transport corridor between the Northern Oregon Territory and California.
1846	Ferry service across the Columbia between Vancouver and Portland was established by Carl Switzler. Private ferry service between Vancouver and Portland was offered intermittently after that time by various operators. The State of Washington begins offering ferry service at other points along the Columbia in the 1930s.
1890s to present	The advent of the trolley line system in Portland and Vancouver encouraged greater urbanization and development of neighborhoods east of the Willamette in Oregon, and north to Fourth Plain Boulevard in Vancouver. The automobile was introduced in the early 1900s and by the 1930s many middle class families could afford cars and travel greater distances for work, shopping, or leisure. This greatly influenced the urbanization of Portland and Vancouver.
1905	Pearson Field became a dirigible landing area. It was officially dedicated as Pearson Field in 1925.
1910 to present	Railroad construction, including a rail bridge over the Columbia River in 1910 allowed increased freight transport and increased the viability of the Port of Vancouver and Port of Portland in interstate trade. Industrialized farming, irrigation and water impoundment, and grain shipment increased.
1917	The Columbia River Interstate Bridge opened in 1917 and allowed easier transport of cargo and people between Vancouver and Portland, as well as the broader Pacific Northwest. This supported the expansion of industry and commerce in the region. In 1958, a second parallel bridge was constructed and the original 1917 bridge was converted to northbound only I-5 traffic (NPCC 2010).
1930s to 1970s	Construction of hydroelectric dams on the Columbia (Bonneville, The Dalles, John Day) – Several dams were built on the Columbia River between the 1930s and 1970s to provide electricity and irrigation water for the Pacific Northwest. Over-fishing, construction of these dams and other actions dramatically decreased salmon runs. This had a negative impact on the economic well-being of Native American tribes, for whom the salmon were a significant material and cultural resource.
1940s	Mobilization of shipyard manufacturing in support of World War II brought wartime employment in the Portland and Vancouver area to 75,000. This massive influx of workers from all over the U.S. created a housing shortage and many nearby areas were impacted by this temporary increase in housing demand and resulting building boom.
1948	The 1948 Vanport City Flood – In 1948 the Columbia River flooded and displaced approximately 20,000 public housing residents, including many minorities. Relocation occurred throughout the area and the Vanport community's residential base never recovered to those levels supported in 1948.
1950s	Post World War II housing construction was financed through federal grants and GI loans and created a greater supply and demand of outer urban and suburban housing both in Oregon and Washington.
1958	The Vancouver-Portland Interstate Toll Bridge was constructed in 1958. This development doubled automobile capacity across the Columbia, reduced congestion and allowed further commuting across the Columbia. This bridge carries southbound traffic.

Past Actions

1960s	Portland International Raceway and Delta Park were established on former roads and land from the Vanport Community that was destroyed by floods in 1948.
1952-60s	Construction of the interstate highway system in the 1950s and early 1960s was followed by increased freight and automobile traffic. The new highway separated neighborhoods in Portland and Vancouver. Construction of the interstate highway system also increased access to downtown Vancouver.
1973 to present	Growth management and implementation of Oregon planning laws in the 1970s have limited urban sprawl in the Portland metropolitan area.
1970s to present	Development of the Silicon Forest in the late 1970s and continuing through the 1990s – Firms settling in Beaverton, Hillsboro and other nearby suburbs were major players in the national high tech boom of the latter 20th Century. As the area's economy shifted from timber processing and sales to high tech and services, there was a high demand for professional workers. This encouraged commuting from throughout the Portland Metropolitan Area, including Vancouver, which increased commuting across the Columbia.
1990	The Washington Growth Management Act passes in 1990 and like the growth management and planning laws adopted by Oregon in the 1970s, this act seeks to restrict unplanned urban sprawl and concentrate growth in existing urban areas.

1.6.2 Recently Constructed Projects

Some of the more noteworthy recent transportation and development projects in or near the CRC project area are listed below. The development projects give a sense of the recent development trends in the area. The projects will create additional travel demand, and generally increase the density of housing, commercial, and retail enterprises in the CRC project area.

1.6.3 Recent Transportation Projects

- Failing Street Pedestrian Bridge rehabilitation
- Interstate Max (Max, Yellow line along Interstate Boulevard)
- Widening of I-5 north of the CRC project area

1.6.4 Recent Development

- Esther Short Park and Propstra Square (Vancouver)
- Heritage Place mixed use development (Vancouver)
- The Vancouver Center mixed use development (Vancouver)
- The Lewis and Clark Plaza housing and public space (Vancouver)
- The Esther Short Commons residential and retail development (Vancouver)
- The Vancouver Convention Center and Hilton Hotel (Vancouver)
- The Columbian Building office space (Vancouver)
- The West Coast Bank Building commercial and residential mixed use (Vancouver)
- The Northwynd at Columbia Shores commercial and residential mixed use (Vancouver)
- 400 Mill Plain Blvd Office Building (Al Angelo Company Building) (Vancouver)
- The Waterside Condominiums (Portland)
- Salpare Bay Condos (204 units) (Portland)

1.6.5 Reasonably Foreseeable Future Projects

One of the most challenging aspects of analyzing cumulative effects is identifying how conditions will change over time – what are the reasonably foreseeable actions, in addition to the proposed project, that will contribute to the cumulative effect on resources in the future? For many elements of the environment, this question is largely answered through the use of regional travel demand modeling. Many of the future impacts are linked to future changes in population, employment, transportation behavior and performance and land use patterns. Such changes will affect future air emissions, noise, induced growth, mobility, energy, greenhouse gas emissions, and other factors. The analysis of these impacts in the FEIS and technical reports are based on travel modeling that is built upon the best available projections of 2030 population, employment and land use changes. In addition, the regional modeling includes the transportation improvements that are reasonably expected to occur by 2030. As such, these analyses in the FEIS provide the best available projection of how reasonably foreseeable changes to population, employment, transportation infrastructure and travel behavior would be expected to affect air emissions, noise, induced growth, mobility, energy, greenhouse gas emissions, and other factors. This forms much of the basis for forecasting future conditions, but there are other factors to be considered as well.

Multiple plans contain lists of reasonably foreseeable future projects. These plans include Transportation System Plans, neighborhood plans, and comprehensive plans, among others.

The No-Build Alternative includes a list of projects through 2030, including present projects and planned improvements for which need, commitment, financing, and public and political support are identified and are reasonably expected to be implemented. These projects meet the criteria of being “reasonably foreseeable”. All transportation improvements included in the No-Build Alternative are included in either Metro’s 2025 Regional Transportation Plan (RTP) (including amendments) or the RTC 2030 Metropolitan Transportation Plan (MTP). Transportation infrastructure projects under way or planned through 2030 within the CRC project limits are listed in Appendix A, which includes highway and transit projects on both sides of the Columbia River.

With the exception of the I-5 widening to six lanes from Lombard Street to Victory Boulevard (the Delta Park Highway Widening Project), the No-Build Alternative does not assume any major capacity improvements on I-5 near the CRC project. Outside of the project area, there are minor I-5 capacity enhancements and several major maintenance projects, specifically identified in the financially constrained regional transportation plans of both Metro and RTC. Capacity improvements on Interstate 5 will provide additional vehicular and freight mobility and reduce travel times. The projects will also require materials, equipment, and energy to complete. The projects have temporary traffic impacts associated with construction.

Projects more specific to the immediate area include local transportation improvements, infrastructure associated with higher density residential communities along Marine Drive in Portland, the revitalization of downtown Vancouver, and general infrastructure improvements such as sewer and water facility expansions which further enable development.

Some of the other anticipated projects near the CRC projects include:

Riverwest: This site adjoins the I-5 right-of-way, just south of Evergreen Boulevard. The development will include a new main library for the Fort Vancouver Regional Library System. Riverwest is a$165 million public-private mixed-use development that includes four multi-story buildings. During project construction, there may be temporary traffic impacts, though these should conclude before the CRC project begins construction.

Vancouver Waterfront Mixed Use Development: The project is a large-scale mixed-use development. Significant amounts of new office space, public space, and residential uses are planned. Pedestrian amenities from the east side of the Vancouver shoreline would cross under the CRC improvements and extend through the development. The project will provide new parking, and substantial new traffic generation. It is related to new underpasses through the Burlington Northern Santa Fe Railroad (BNSF) berm, and the possible extension of Main Street to the Columbia River. During project construction, there may be temporary traffic impacts, although these should conclude before the CRC project begins construction.

West Barracks: The federally-established Vancouver National Historic Reserve (VNHR) includes many buildings previously used by the United States military. The VNHR partners—including the City of Vancouver, National Parks Service, State of Washington, U.S. Army and the Fort Vancouver National Trust (FVNT)—are working with private sector partners to renovate 16 historic buildings on the West Barracks for a variety of uses, from education and the arts to recreation and hospitality.

Planning is in its early stages for transferring the south and east barracks to the City. These areas will later be integrated with the master plans for the West Barracks. The rehabilitation of the Reserve is closely related to the east-west circulation issues between the east and west sides of I-5.

Bradwood Landing Liquid Natural Gas (LNG): This project is intended to import and store LNG to provide a new source of natural gas to the Pacific Northwest. LNG is natural gas cooled to about -260 degrees Fahrenheit (F) to reduce its volume so that it can be transported long distances across oceans in specially designed ships from its point of origin to foreign markets. NorthernStar, the project developer, proposes to provide up to 1.3 billion cubic feet per day of natural gas to the region through interconnects at two industrial facilities, an intrastate pipeline, and an interstate pipeline system.

The waterway for LNG marine traffic would extend from the boundary of the United States (U.S.) territorial sea, located 12 nautical miles off the Pacific Coast, up the Columbia River approximately 38 miles to the LNG terminal. The proposed LNG terminal is located at the former town site of Bradwood, in Clatsop County, Oregon, and would occupy about 40 acres of land within a 411-acre site controlled by NorthernStar. About 46 acres within a 58-acre area in the Columbia River would be dredged to create a ship maneuvering area for the terminal berth.

The Bradwood Landing project is no longer considered reasonably foreseeable because the proponent company, NorthernStar Energy, has declared bankruptcy and has put the project on hold indefinitely. If another investor chose to fund the project and restart the permitting process, the Federal Energy Regulatory Commission (FERC) license would still be applicable; however, it is not possible to predict whether or not any new investors will support the project.

Jantzen Beach Redevelopment: Redevelopment plans for the shopping center were in preliminary stages, but have been placed on hold. The redevelopment project intends to transform the area from a conventional suburban shopping center to a more urban retail center with mixed land uses. The City of Portland, the developers, and the CRC project team are sharing information, such as the preliminary transportation circulation plan for the Center. An important element of the plan is to construct a connecting facility that would allow traffic to move across the Interstate without interfering with traffic on the I-5 ramps.

West Hayden Island: The City of Portland is in the process of developing a concept plan for the Port of Portland-owned West Hayden Island (WHI). The Port requested this planning as part of their proposal for a combination of marine terminal facility development and open space uses on WHI. The Port's conceptual plans for the future development of WHI include an arterial road connection between WHI and Marine Drive as well as rail infrastructure improvements.

In this FEIS, the analysis of Hayden Island local roads and the Hayden Island interchange includes estimated auto and truck trips that would be generated by the Port of Portland's proposed WHI marine terminal development. Based on current assumptions regarding the Port's proposed facility, the additional traffic generated would not significantly impact the roadway facilities that would be constructed as part of the CRC LPA Option A or Option B. The primary difference between the two LPA options relative to the Port's proposed WHI development would be that LPA Option A would include an arterial bridge that could potentially address the proposed Port facility's need for an arterial connection between WHI and Marine Drive. LPA Option B would not include a separate arterial bridge. Therefore, if the Port's WHI proposal is constructed, the cumulative impacts associated with bridge construction across North Portland Harbor could be lower with CRC LPA Option A than with Option B.

1.6.6 State, Regional and Local Plans

Several adopted state, regional, and local plans include visions of growth or change in the study area over the next 20 years.

1.6.6.1 State Plans

The Washington Transportation Plan (WTP) includes goals to reduce person and freight delays on WTP corridors, increase travel options, and promote competitive freight movement.

The Oregon Statewide Planning Goals encourage urbanized growth within the Portland metropolitan area.

The Oregon Transportation Planning Rule requires local jurisdictions to consider changes to land use densities as a way to meet transportation needs and encourages transit and multimodal transportation systems.

The Oregon Highway Plan (OHP) requires coordination of land use and transportation decisions to protect highway mobility (ODOT 2006). It identifies I-5 as a major truck freight route. The OHP grants alternative standards to the Portland metropolitan area due to its established higher minimum densities, mixed-use development, and multimodal transportation options. The plan requires the adoption of Interchange Area Management Plans for all new or upgraded highway interchanges where the function of the interchange may be hindered due to changes in adjacent land uses.

1.6.6.2 Regional Plans

C-TRAN's Service Preservation Plan outlines performance standards for C-TRAN and fare increases to account for inflation. It requires equitable service hours for local urban service, paratransit services, commuter services to Portland, and service to smaller Clark County cities. There are several service changes in the project area; more information on these can be found in the transit technical report.

The MTP for Southwest Washington supports an efficient, balanced, multimodal regional transportation system. The MTP for Clark County (Dec. 2007, amended Jul. 2008) supports an efficient, balanced, multimodal regional transportation system providing mobility and accessibility for people and freight within and through the region. The MTP's strategic planning section describes the Clark County HCT System Study underway at time of MTP publication. The HCT Study, published December 2008, considers how a Clark County HCT system could connect to the CRC project's light rail transit extension into Clark County. The HCT Study's recommended system includes bus rapid transit improvements in the Highway 99, Fourth Plain, and Mill Plain corridors and significant bus improvements in the I-205 corridor.

The RTP includes an extension of the light rail system into downtown Vancouver.

The Metro 2040 Growth Concept encourages efficient use of land, a balanced transportation system, and other elements that will aid Portland Metropolitan cities to manage growth.

The Metro Regional Framework Plan includes policies to provide adequate transportation facilities to support adopted land use plans, and enhance jobs, housing, and community identity. It also provides for a system of arterials and collectors to connect the central city, regional centers, industrial areas, and intermodal facilities.

TriMet's Transit Investment Plan provides a framework for regional transportation partnerships and places a high priority on expanding high-capacity transit, including options such as commuter rail, streetcar, bus rapid transit and other modes.

1.6.6.3 Local Plans

Vancouver

The Vancouver City Center Vision (VCCV) for the Vancouver downtown area expands the City Center boundary to approximately 130 city blocks including the city center waterfront. It includes high-density residential uses, especially along the waterfront with public access to the river's shoreline area. Other planned uses include recreation, cultural, hospitality, entertainment and commercial uses. The plan identifies several new city blocks in the area of the existing I-5 downtown Vancouver interchange that may be available for development as a result of the CRC project.

The plan proposes easy access to Oregon from downtown Vancouver through high-capacity transit and a new southbound I-5 off-ramp to 6th Street. It proposes easy access to the VNHR and an integrated pedestrian, bicycle, transit and automobile transportation system. Downtown connectivity is improved in the plan through a new arterial route south of the railroad berm extending from east of I-5 to Jefferson, connecting with Columbia, Esther, and Jefferson Streets.

The City of Vancouver Comprehensive Plan includes policies that encourage achievement of average densities of eight units per acre within the urban area, and infill and redevelopment. It encourages full development of urban centers and corridors that provide a range of transportation options and the development of mixed uses. The Comprehensive Plan encourages integrative area planning and the development of compatible and complementary uses.

The Comprehensive Plan designates future growth within the primary impact area from the Columbia River to Mill Plain Boulevard as City Center, Public Facility, and Parks and Open Space. The City Center designation has been expanded and plans include future redevelopment of the area and a greater focus on the riverfront area. Designations north of Mill Plain Boulevard within the primary impact area include Light Industrial, Urban Medium and Low Density, and Community Commercial.

The Vancouver Shoreline Management Master Program includes design elements with goals for a "visually coherent" design that enhances the waterfront, an integrated trail system, good transportation networks, and strong bike and pedestrian circulation.

The City of Vancouver has several overlay districts within the study area. These include an Historic Preservation Overlay which preserves significant architectural character or areas within the city with cultural significance. There are areas within the overlay along the southern blocks of Main Street. There is a Noise Impact Overlay District along the Columbia River shoreline and extending west to the Esther Short Park neighborhood and along blocks that abut I-5 up to McLoughlin Boulevard. An Office Development Overlay District protects neighborhoods from noise, light and increased pedestrian and automotive traffic, or other community aesthetic changes. Transit Overlay Districts within the study area encourage high-density residential and commercial development along main traffic corridors.

Portland

The City of Portland Comprehensive Plan was updated in 2006 to include the Freight Master Plan and the Transportation System Plan. The Comprehensive Plan supports minimizing the effects of interregional traffic on Portland neighborhood and commercial areas. It supports public transportation such as light rail and bus service, intermodal freight facilities and congestion pricing. It promotes energy efficient transportation through the construction of a regional light rail system.

The Comprehensive Plan designates future growth within the study area north of Marine Drive as: General, Central, and Urban Commercial; and south of Marine Drive as: Industrial Sanctuary and Open Space. Most of the areas within the study area are developed; however, new residential development is occurring along Marine Drive and further redevelopment on Hayden Island is anticipated.

There are several overlay districts within the study area including: Alternative Design Density, which encourages infill development; Environmental and Conservation overlays, which protect natural resources; Design Overlay, which preserves areas of the City with special scenic, architectural or cultural value; and Aircraft Landing Overlay, which provides safer operating conditions for aircraft in the vicinity of Portland International Airport.

In early 2009 the City of Portland Bureau of Planning and Sustainability published the Hayden Island Plan. The plan includes goals, objectives, proposed comprehensive plan and zoning changes, an implementation strategy, a street plan, development standards, a conservation strategy, and an affordable housing preservation strategy.

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2. Built Environment Cumulative Effects

The built environment includes the following disciplines or resource areas:

- Air quality
- Acquisitions
- Economics
- Electric and magnetic fields
- Energy and Peak Oil
- Environmental justice
- Land use
- Neighborhoods
- Noise and vibration
- Public services and utilities
- Visual quality and aesthetics

Key elements of the built environment in the study area include the roadway and transit network, downtown Vancouver and surrounding neighborhoods, and the neighborhoods and commercial uses on Hayden Island and north Portland near the river. Development projects that are likely to be considered in the analysis include large commercial developments (especially near highway interchanges), highway-oriented developments, industrial developments or redevelopment (e.g., the area between Columbia Boulevard and Columbia Slough), and housing developments near the highway or urban edge.

The temporal frame of reference for the built environment "past" will generally be from 1960, prior to the opening of I-5 through Oregon and Washington, to the present. As data allow and are relevant, a general discussion of cumulative effects may stretch back to 1917, the time of construction and opening of the first bridge across the Columbia River.

2.1 Air Quality and Air Toxics

2.1.1 Project Effects

The air quality analysis indicates that future regional air pollutant emissions from I-5 traffic would be lower than the existing conditions with or without the project. On a regional scale, the project emissions would be lower than the No-Build Alternative. Emissions at the subarea level would also be lower, except for CO and NO_x in Subarea 2 (running along I-5 from SR 14 to SR 500), where emissions from I-5 would be slightly higher than No-Build conditions but still be substantially lower than existing conditions (Note: under the LPA, I-5 related emissions of volatile organic compounds, particulate matter, and mobile source air toxics would be lower in Subarea 2 relative to the No-Build condition). Construction for the LPA would be extensive and would involve demolition, a wide variety of heavy construction equipment and operations, on-road construction vehicle activity, and off-site activities such as a concrete plant or borrow operations. Traffic congestion would occur in the construction area and potentially along detour or construction haul routes. Construction impacts would vary in extent and location throughout the project area, and would also vary depending on precipitation, because rain suppresses dust. Since other transportation projects have not shown excessive levels of pollutants, the CRC project is unlikely to cause an exceedance of air quality standards.

2.1.2 Effects from Other Actions (Past, Present, Future)

During the 1970s, pollutant concentrations in the Portland-Vancouver area exceeded the standards for CO on one out of every three days, and ozone levels were often as high as 50 percent over the federal standard. Programs and regulations put into effect to control air pollutant emissions have been effective, and air quality in the area has improved. The area was redesignated from a nonattainment area to a maintenance area in 1997. In general, most pollutants have shown continuing patterns of reductions in recent years.

Starting in the early 1970s, the EPA has promulgated numerous regulations to control air pollutant emissions from motor vehicles. Recent regulations promulgated in the early 2000s, and most recently in February 2007, created controls on heavy-duty diesel on-road and off-road vehicles, sulfur in fuels, and air toxic emissions from mobile sources through control of fuel formulations. The gasoline reformulation rules are expected to substantially reduce benzene emissions. While these standards are not specific to the LPA, they apply to all vehicles on the highway system and are the regulatory controls responsible for substantial reductions in vehicle emissions since the 1970s and additional projected vehicle emissions reductions over the next 25 to 30 years.

Traffic data used in the air quality analysis are based on projected land use and employment information and include expected overall growth in the region and the project area. Background concentrations representing the cumulative emissions of other sources in the area are added into the predicted local concentrations for CO at intersections. Long-term monitoring has shown that air quality has improved over the years. Current and new regulations would continue to reduce emissions from mobile sources and other sources in the future, and air quality should continue to improve.

2.1.3 Conclusions

The air quality analysis incorporates reasonably foreseeable changes in the region’s future land use, population, employment and travel behavior, including the effects of the CRC project. For all pollutants analyzed, future 2030 emissions are projected to be lower than existing conditions with both the LPA and No-Build Alternatives. Regulations on other source types would also reduce additional future emissions. Therefore, the cumulative effects of air quality would improve with time despite the increase of traffic on I-5 and projected growth in the region. Compared to past, present and foreseeable future actions, the LPA will have a positive effect on air quality.

2.2 Acquisitions

2.2.1 Project Effects

Approximately 90 acres of property would have to be permanently acquired for the construction and long-term operations and maintenance of the LPA. A total of 216 parcels would be permanently impacted by LPA Option A, with 73 full acquisitions and 141 partial acquisitions. LPA Option B would permanently impact 202 parcels—73 full parcel acquisitions and 129 partial parcel acquisitions. Up to 57 residences, including 32 floating homes, would need to be relocated due to these effects, along with approximately 70 commercial uses and two public facilities.

2.2.2 Effects from Other Actions (Past, Present, Future)

Most of the area directly affected by the CRC project is already occupied by public right-of-way resulting from previous transportation or other capital construction projects.

The original construction of I-5 during the late 1950s and early 1960s had significant property acquisitions and displacements in Portland and Vancouver. For example, when the segment of I-5 known as the Minnesota Freeway was constructed from the Rose Garden area to the Columbia River Slough in northeast Portland, it removed over 180 dwellings and displaced more than 400 residents (Kramer 2004).

Future actions, such as the planned redevelopment associated with the Hayden Island Plan, would likely require the additional displacement of existing businesses on the island, while providing commercial space for the relocation of others. Proposed developments in Vancouver would displace additional businesses there as well.

2.2.3 Conclusions

The real estate acquisitions required for the LPA are high in the context of other recent actions in this vicinity, but they are relatively low for a project of this size located in an already urbanized area. At the corridor level, impacts would be substantially smaller when compared to the acquisitions associated with the original construction of I-5 in the corridor. There would be very few residential displacements in neighborhoods that were directly affected by the original construction of I-5. Most of the displacements would be commercial properties and floating homes on Hayden Island.

The LPA would require the displacement of up to 40 businesses on Hayden Island, which accounts for more than half of all commercial displacements. It is important to note, however, that commercial development on the island is relatively recent (1970s and 1980s) and was not affected by past highway construction or other actions. Future actions, such as the planned redevelopment associated with the Hayden Island Plan, would likely require the additional displacement of existing businesses on the island, while providing commercial space for the relocation of others. See the Land Use Technical Report for more discussion on this topic.

Cumulative effects on the floating home community would not be much greater than the effects of the project on the floating home community. According to historic aerial photos, it appears that the floating home moorages were developed following the original construction of I-5, so they would not have been affected by past I-5 construction. No known future projects would require additional floating home displacements. However, state and federal regulations that make it difficult to permit new moorage space would tend to reduce opportunities for relocating displaced floating homes. Compared to past, present and foreseeable future actions, the LPA will have a negligible effect on property.

2.3 Economics

2.3.1 Project Effects

The overall long-term economic effects to freight and vehicular traffic after project construction are expected to be positive. This is due to the LPA’s suite of highway and transit improvements which effectively and efficiently move people and commerce through this corridor, which serves a variety of interstate, regional, and local needs. The LPA also improves the movement of marine traffic along the Columbia River.

Extending light rail transit across the Columbia River is a great improvement to the regional network, and is expected to attract some riders from their vehicles, potentially lowering vehicle miles traveled and the overall forecasted volumes of single-occupancy vehicles. This is intended to result in an extended service life of the CRC highway improvements. Furthermore, transit improvements are often linked to economic development around station areas.

Enhanced vehicular and transit access to downtown Vancouver and across the Columbia River is expected to positively affect employers and businesses in the area. The LPA could increase the attractiveness of commercial and industrial properties located in the vicinity of the project interchanges by improving highway and transit access. This in turn may attract new businesses and make the location more attractive to employees. Tolls may temper these benefits, but potential benefits to businesses are expected to outweigh potential tolling costs.

2.3.2 Effects from Other Actions (Past, Present, Future)

The I-5 corridor serves as the backbone of the region’s transportation network. Many past projects have worked to solidify I-5 as the central component of the regional infrastructure, although development in recent decades has accompanied increased growth in other parts of the region. Demand on I-5 comes from freight, business, and personal vehicle use. Freight needs are an important driver for future improvements along the I-5 corridor.

The ports of Portland and Vancouver are critical to the economic growth and prosperity of the region. In order for the ports to remain competitive with other West Coast ports, efficient and cost-effective multimodal transportation systems must be available. The total annual tonnage moving through the two ports is expected to double from approximately 300 million tons in 2000 to almost 600 million tons in 2035 (Metro 2006). This growth has implications for the transportation network as products move to and from the region as well as within the region. Similarly, economic growth in the region would increase demands along the I-5 corridor, as Metro forecasts that the number of jobs in the Portland-Vancouver Metropolitan Statistical Area (MSA) would increase by approximately 60 percent from 2005 to 2030 (Metro 2009).

The Metro RTP includes several capacity and safety projects at Rivergate, and along Columbia Boulevard and Marine Drive west of I-5, that are designed to improve safety and flow for commercial trucks traveling between Rivergate and I-5.

Improvements along Lombard Street and Marine Drive would generally improve conditions for commercial trucks. These improvements would decrease travel times along the local arterial network (Platman 2007). Travel times for commercial trucks traveling along I-5 are expected to improve due to capacity projects north of Vancouver and south of Expo Center, but gains would be offset by projected growth in population and employment.

2.3.3 Conclusions

This project would positively contribute to other projects aimed at reducing congestion and enhancing freight mobility by further relieving congestion. Congestion relief in the main project area would benefit freight traffic generated by Swan Island, the Rivergate area, the Port of Portland, and the Port of Vancouver. Incremental benefits would decrease travel times, increase mobility, and increase travel time reliability for freight vehicles.

The LPA would improve access to Hayden Island, improving its ability to succeed as a shopping center and as an option for residential development. These benefits may be tempered by tolls, and is dependent on overall economic conditions outside of the CRC project.

This project would enhance vehicular and transit access to and from downtown Vancouver, SR 14, Evergreen, and Mill Plain, which would benefit employers, businesses, and economic activity. The LPA supports the VCCV and the Hayden Island Plan by providing greater access and transit service.

Without the LPA, economic development planned for the area may occur, albeit more slowly, as business owners may be more reluctant to locate in an area with restricted access caused by mobility constraints. Customers may elect to shop in other areas with lower levels of congestion and easier access. Compared to past, present and foreseeable future actions, the LPA will have a positive effect on economics.

2.4 Electric and Magnetic Fields

2.4.1 Project Effects

The extension of the light rail line with the LPA would result in the generation of additional electric and magnetic fields (EMF) within the main project area. Based on EMF measurements and available data, operation of proposed segments of the MAX light rail are unlikely to generate sufficiently intense levels of EMF to cause significant exposure risks to human health. The anticipated intensities of electromagnetic fields at locations where humans would be exposed (within and adjacent to the light rail right-of-way, near power substations, or in the light rail vehicles) are considerably below exposure guidelines set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the American Conference of Governmental Industrial Hygienists (ACGIH).

Light rail-generated EMF would be just one of many sources of EMF that comprise the cumulative personal magnetic field exposure. A survey conducted for the EMF Rapid Program (a program conducted under the National Institutes of Health) provides some perspective to the cumulative exposures to EMF. The purpose of the 1997 survey was to characterize personal magnetic field exposure in the general population (Enertech Consultants 1998). Slightly over 1,000 people participated in the survey of exposure over one-hour and 24-hour periods. In the one-hour survey period, approximately 25 percent of people were exposed to magnetic fields greater than 4 milligauss (mG) and about 9 percent were exposed to magnetic fields greater than 8 mG.

For the average 24-hour exposure period, approximately 14 percent, 6 percent, and 2.5 percent of the general population were exposed to magnetic field strengths exceeding 2 mG, 3 mG, and 5 mG, respectively. Only 0.46 percent of the general population was exposed to a 24-hour average exceeding 10 mG. The highest average magnetic field exposure occurred at work and the lowest at home in bed. The average magnetic field in homes is 1.7 mG.

The survey was useful in assessing the general population that would be at risk of exposure. While there are no regulatory guidelines for exposure limits, there are voluntary guidelines. The ACGIH has established a voluntary guideline for magnetic fields of 10 G (10,000 mG), which is quite high, but these levels are intended for electrical workers and other persons who routinely are exposed to very high EMF in their jobs. For non-electrical workers, it is good practice to reduce exposure to EMF to the extent possible.

2.4.2 Effects from Other Actions (Past, Present, Future)

Other future actions and trends likely to affect cumulative EMF exposure include increasing use of hybrid and electric vehicles, increasing use of electronic equipment in general and the increasing prevalence of wireless devices. The frequencies and field strengths of different types of equipment vary widely. The National Institute for Occupational Safety and Health (NIOSH) does not consider EMFs a proven health hazard, but because some studies have associated high magnetic field exposures with increased cancer risks, government agencies continue to study EMFs. NIOSH suggests that concerned workers and employers might consider simple measures to reduce EMF exposures. These are aimed at workers in industries where personal EMF exposure levels are considerably higher than that experienced by the general population (NIOSH 1996).

2.4.3 Conclusions

EMF is widespread throughout the general environment and EMF levels from the light rail system are well below the ICNIRP and ACGIH exposure standards. There would be slightly increased cumulative exposure for those persons riding or working on the light rail system. While there is concern about the potential health effects of EMF exposure, there is no evidence to indicate that light-rail generated EMF would change the human health risk associated with cumulative EMF exposure. Compared to past, present and foreseeable future actions, the LPA will have a negligible effect on electric and magnetic field exposure.

2.5 Energy and Peak Oil

The amount of energy demand to construct the LPA is large at the local level, but minor compared to the total demand for petroleum-derived energy in Washington and Oregon. The LPA full build would account for approximately 0.97 percent of Washington's and Oregon's annual (2008) demand.

The cumulative impact of primary concern for energy use is "peak oil." Peak oil refers to the point in time at which the maximum global petroleum production rate is reached, after which the rate of production enters a terminal decline. Potentially substantial impacts could occur if peak oil production does not coincide with a terminal decline in petroleum demand. Peak oil results from many incremental actions, few of which are individually substantial, including the CRC project. However, the potential impacts of reaching peak global petroleum production is an important consideration for projects intended to address transportation needs for decades to come. A number of stakeholders expressed a variety of concerns about the impacts of the project on peak oil, and the impacts of peak oil on the project. This section addresses the following questions:

- How will the LPA affect peak oil?
- When will peak oil occur and how will it affect petroleum prices and availability for CRC project users?
- How will the rising cost of petroleum affect travel demand projections developed for the CRC project?
- Will the transportation infrastructure proposed for the LPA accommodate the transition from petroleum-based transportation energy to other energy sources?
- How can the CRC project ease the potential adverse impacts of peak oil on the project, and the adverse impacts of the project on peak oil?

2.5.1 How will the LPA affect peak oil?

Under the CRC No-Build Alternative, future (2030) transportation demand for petroleum in the CRC energy impact area is projected to increase by about 43 percent compared to today. At the global scale this will be a very small but incrementally adverse contribution to increasing oil demand. In this same time frame (2030), the global demand for liquid fuels is projected to grow by 21 percent, driven in large part by transportation needs (EIA 2010). Petroleum accounts for the largest percentage of liquid fuels globally.

Compared to the No-Build Alternative, operation of the LPA is projected to reduce future (2030) transportation petroleum demand in the CRC energy impact area by approximately 5.4 percent. At the macro scale, these fuel savings will be very small, roughly 0.6 percent, but incrementally beneficial over the No-Build Alternative.

The CRC LPA includes a number of elements that would reduce adverse impacts on peak oil, relative to the No-Build Alternative. These include:

- The bridge and highway improvements are focused on replacing or updating aging infrastructure, not on building new highway corridors;
- They include substantial improvements to public transportation, with projected increases in transit mode share in the afternoon peak direction from 8 percent with the No-Build Alternative to as much as 15 percent with light rail transit;
- They provide substantially improved facilities for non-motorized transportation (such as walking and bicycling);
- They support land use planning that seeks to control sprawl, concentrate development, and decrease auto dependency;
- They include road use pricing options (highway tolling);
- Because of the addition of high-capacity transit and the bridge toll, the LPA is projected to have lower daily I-5 river crossings than under the No-Build Alternative;
- It improves highway operations at a key pinch point, which improves fuel efficiency and lowers emissions; and
- It increases highway safety, which decreases collisions and congestion, further improving fuel efficiency.

These elements are consistent with national,[1] state (ODOE 2009; ODOT 2006; WSDOT 2007), and local (CPBPS 2006; BOCC 2009) recommendations that support energy efficiency and conservation through environmentally conscious transportation planning.

[1] ISTEA (Intermodal Surface Transportation Efficiency Act of 1991), Energy Policy Act of 2005, and 42 USC § 6201, 13401, and 13431.

2.5.2 When will peak oil occur and how will it affect petroleum prices and availability for CRC users?

That peak oil will occur is foreseeable, but the timeframe is uncertain. Oil production in the U.S. —the world's third largest oil producing nation—reached its peak around 1970 and has been in a declining trend since then. Most estimates place peak global production occurring sometime between 1990 and 2040, although a few suggest that it will not occur until the next century.

The U.S. Department of Energy (USDOE) published a report titled Peaking of World Oil Production: Impacts, Mitigation, & Risk Management (USDOE 2005). It stated, "The peaking of world oil production presents the U.S. and the world with an unprecedented risk management problem. As peaking is approached, liquid fuel prices and price volatility will increase dramatically, and, without timely mitigation, the economic, social, and political costs will be unprecedented. Viable mitigation options exist on both the supply and demand sides..." Some of the conclusions from the USDOE report include:

- World oil peaking is going to happen, and will likely be abrupt.
- Mitigation efforts will require substantial time.
- Both supply and demand will require attention.
- More information is needed to more precisely determine the peak time frame.

Although peak oil is likely to cause petroleum prices to increase, there are uncertainties regarding peak oil's timing and the availability of substitute fuels – both variables that will determine the effect of peak oil on fuel prices (petroleum and substitutes), and on travel behavior. The effect that peak oil has on transportation fuel prices will depend largely on when peak oil occurs and the availability of substitute fuels.

2.5.3 How will the rising cost of petroleum affect travel demand projections developed for the CRC project?

A concern relevant to planning the CRC project is the potential impact of peak oil on economic activity and travel behavior. Significant increases in oil prices can have both short term and long term effects on travel behavior. In the short term, the options for responding to rising gas prices are more limited, and include driving less and/or changing from driving to walking, biking or transit for at least some trips. During recent increases in gasoline prices, transit use increased and off-peak highway travel decreased. Peak period highway travel changed little.

Over the long term, there are more options for adjusting to changes in gasoline prices, besides changing driving behavior. Technological advances and legislative mandates can increase fuel efficiency standards in the long term. In turn, as older vehicles wear out, more consumers can replace them with more fuel efficient vehicles. Automobile manufacturers are developing and will continue to develop new vehicle and engine technologies that require much less, or even no, petroleum-based fuels. This trend is already happening as evidenced by the growing popularity of gasoline-electric hybrid and small electric vehicles.

If substitute fuels are not readily available as petroleum supplies decrease, the rising cost and reduced supply of petroleum could directly reduce auto and truck travel, and could result in dramatic reductions in economic activity, which, among other effects, could further reduce vehicle trips below those forecasted. These vehicle trip forecasts influence the proposed size of the transportation facilities. A travel demand model estimates that vehicle miles traveled (VMT) in the corridor would increase, even with a doubling of fuel prices (VMT would increase 22 percent instead of 32 percent if fuel prices doubled).

2.5.4 Will the transportation infrastructure proposed for the LPA accommodate the transition from petroleum-based transportation energy to other energy sources?

The future transition from existing transportation vehicles that use petroleum, to vehicles that use substantially less or no petroleum, poses a potential risk to the CRC project. The risk is that the new vehicles would not properly operate on the CRC infrastructure (bridges, highway, and bike and pedestrian paths) that are being designed for existing vehicles. However, based on the alternative fuel vehicles that are currently being researched and developed, it is highly likely that they will be fully compatible with the transportation infrastructure that is proposed in the CRC project. The electric hybrids, electric plug-ins, and vehicles powered by biodiesel, ethanol, and hydrogen fuel cells, are being designed to operate on modern highway and roadway infrastructure. The light rail guideway can be used by vehicles powered by a variety of fuel types. Additionally, the capacity of the proposed bicycle and pedestrian facilities can accommodate substantial growth in non-motorized transportation demand, although it is possible that some adaptation may be required.

History has shown that transportation infrastructure has been adaptable to changing technologies. For example, the northbound I-5 bridge over the Columbia River was built in 1917 and originally carried electric trolley cars and Model T autos (which ran on either gasoline or ethanol). As transportation technology, energy policy and prices, vehicle types, and travel behavior evolved over the past century, the original bridge was periodically adapted to accommodate those changes. It is highly likely that the proposed CRC infrastructure could readily accommodate and/or adapt to accommodate changes in substitute fuel vehicles, higher than projected growth in non-motorized modes and higher than projected growth in transit demand.

2.5.5 How can the CRC project ease the potential impacts of peak oil on the project, and the impacts of the project on peak oil?

A number of factors are likely to ease the impact of peak oil on the LPA, and the impacts of the LPA on peak oil. Many aspects of the LPA are consistent with international and national recommendations for preparing transportation to address peak oil’s impacts (as well as climate change impacts). Some of these recommendations include:

- Focus on maintaining or replacing aging infrastructure rather than building new highway corridors;
- Invest in public transportation;
- Improve facilities for non-motorized transport (such as bicycling and walking);
- Use land use planning and infrastructure planning to influence mobility needs; and
- Implement road pricing (such as tolling).

2.5.6 Conclusions

Cumulative effects related to energy use are partially incorporated into the long-term energy demand estimates prepared for the CRC project. Those estimates are based on travel demand forecasts that factor in projected local changes in land use patterns, employment, population growth, and other programmed transportation improvements. Two factors related to CRC, 1) the energy demand to construct the CRC project and 2) background traffic growth in the corridor, are projected to increase petroleum demand which will add to global oil demand. At the same time, operation of the LPA is projected to lower the transportation demand for petroleum relative to the No-Build Alternative. Peak oil could reasonably occur within the life of the CRC project, and could potentially affect the way travelers use the facilities. Those changes can likely be supported and/or accommodated by the LPA. Compared to past, present and foreseeable future actions, the LPA will have a negligible effect on energy and peak oil.

2.6 Environmental Justice

2.6.1 Project Effects

The project would acquire right-of-way from residences and businesses along I-5 and the light rail transit alignment. Acquisitions would displace 57 homes including 32 homes in the Hayden Island floating home community, four homes in the Shumway neighborhood adjacent to I-5, and nine homes in the Rockwood neighborhood of Gresham for the Ruby Junction transit maintenance base expansion.

When assessed in isolation, the displacements in the Rockwood neighborhood could be viewed as disproportionately impacting environmental justice (EJ) populations because the displacements have proportionately higher rates of EJ households than are found in the main project area and Multnomah County as a whole. However, the LPA would displace households throughout the project area and most of the displacements would occur in neighborhoods that have low rates of minority and low-income populations. When assessed at the project level, the displacements are not disproportionate, as low-income or minority households are not being impacted more than other households. The Ruby Junction displacements, and all other displacements, would be mitigated with a dedicated Relocation Plan.

Noise impacts would be reduced for most homes that are currently impacted by I-5 traffic noise in the main project area, including noise impacts to residents of the Normandy apartments, a building believed to include lower income tenants. However, noise impacts cannot be reasonably mitigated for the upper story units in The Fort Apartments, another apartment building believed to include lower income tenants.

Approximately 40 businesses would be displaced on Hayden Island, with hundreds of employees affected, including many restaurant and bar establishments currently near the existing freeway. These service and sales sector jobs are major sources of employment for Hayden Island residents as well as residents of Vancouver and North Portland. As a whole, these jobs are more likely to offer low-income positions; for example, dishwashers, cooks, host, and counter attendants. Some of these displaced businesses may choose not to relocate locally. Even with relocation assistance, some of the employees may be unable to retain their jobs; for example, an employee may have to accept a new job during the transition period of relocation.

For most low-income populations, the impact of tolling would not be highly adverse due to the project benefits and the options to avoid the toll by walking, biking, or using transit, or minimize the toll's impact by carpooling. The analyses of the equity of tolling (found in the Environmental

Justice Technical Report) have concluded that the effect would not constitute a disproportionately high, adverse effect. Low-income populations would benefit from the construction of light rail transit; improved travel times on the Interstate; significantly improved bike and pedestrian facilities; safer vehicle, bicycle and pedestrian travel; and a decrease in noise levels in locations where no sound walls currently exist. The decrease in transit travel time and increase in transit reliability would be a key benefit for all the traveling public, but particularly for low-income people who ride transit proportionally more than people with higher incomes.

2.6.2 Effects from Other Actions (Past, Present, Future)

The environmental justice populations in the project area have been impacted by past actions that generate noise and air pollution, and that have displaced residents and businesses (see discussion in 2.1, Air Quality; 2.2, Acquisitions; and 2.9 Noise). Some past actions have also provided benefits to one or more of these populations, including improved access and mobility associated with roadway and transit improvements, public housing development, and employment and training opportunities associated with commercial and educational development.

The original construction of I-5 through Portland had significant effects on the populations in and adjacent to the highway's path. Entire blocks were cleared for the development of the roadway, dividing neighborhoods, displacing residences, and affecting businesses. Historically, these neighborhoods were composed of more minority and low-income persons than in Portland as a whole. The construction of I-5 through Vancouver changed the City by closing 5th Street (the route heading east) and encouraging development of housing to the north of downtown. Fewer displacements occurred in Vancouver because the area was less densely developed than Portland at that time.

Generally, the development of transit by C-TRAN and TriMet, including the Yellow Line MAX through north Portland, benefits low-income populations, who ride transit in higher proportions than higher-income populations.

2.6.3 Conclusions

Construction of the LPA would not generate high or adverse effects on a minority or low-income population that would be appreciably more severe or greater in magnitude than the effect that would be borne by non-minority and/or higher income populations. In addition, the benefits of the project are expected to accrue to EJ as well as non-EJ populations. Some people, including minority and low-income individuals, would be adversely affected by the project (including displaced businesses and residents, and noise and traffic during construction). But in general, the CRC project would be likely to improve conditions (such as noise, air pollution, poor access, and poor transit service) for populations and neighborhoods that have historically been adversely affected by other past actions.

Finally, potential mitigation discussed in the Environmental Justice Technical Report (e.g., transportation assistance for tolling impacts and enhanced communications) could minimize impacts and increase benefits to EJ populations. Compared to past, present and foreseeable future actions, the LPA will have a negligible effect on EJ populations.

2.7 Land Use

2.7.1 Project Effects

The No-Build Alternative would fail to support the principle elements of adopted growth management and community plans for the area, including goals pertaining to accepted levels of service; improved freight mobility; multimodal transportation; focused, compact development; and safety.

The LPA is consistent with local plans and policies, which encourage investment in inner urban infrastructure, multimodal transportation, freight mobility, economic development, and compact urban development. The greatest direct impacts on land use are the result of the numerous displaced businesses on Hayden Island and the construction of a large park and ride facility in downtown Vancouver.

Adding light rail stations in Hayden Island and downtown Vancouver is expected to contribute to economic development with vibrant mixed use urban nodes. There is a moderate to high potential for transit-oriented development on Hayden Island and in the City of Vancouver (particularly the Mill Plain district). Plans adopted by the City of Portland and Metro call for the extension of light rail to Hayden Island.

2.7.2 Effects from Other Actions (Past, Present, Future)

Historic development in the area transformed land use from frontier wilderness, to agriculture and settlement, to ever-increasing urbanization. Since the 1960s, actions affecting land use have included the construction of I-5 and other transportation projects, increasing urbanization, and new growth management regulations. Modeling also suggests that regional land use plans that focused growth and transportation development to other parts of the region may have reduced employment growth and housing demand in the North Portland and Vancouver portion of the I-5 corridor. The lack of any major improvements to I-5 highway operations in this location since the 1960s has also allowed gradual deterioration of highway operations and safety and reliability, which in turn could further contribute to distributing some portion of population and employment growth to other parts of the region.

Land use on Hayden Island has been defined by residential development and commercial development, including the Jantzen Beach SuperCenter (a large shopping mall) and surrounding retailers. Residential uses in the area include manufactured homes and floating homes associated with small marinas, as well as other low to medium density developments. The City of Portland has recently completed a planning project for Hayden Island which calls for redevelopment of the commercial core – transitioning from the current large scale retail land use pattern to a more urban form with more mixed uses, pedestrian scale, and transit orientation.

Vancouver's downtown has changed greatly during the past decade. The focus of the downtown and waterfront areas has broadened from predominantly office (and some industrial) uses to tourism and recreation development, retail shopping, meeting and convention activities, housing, and entertainment. Along with revitalizing overall downtown activity, new residential opportunities and revitalization of the retail core and central waterfront have been emphasized. New office and mixed use development has increased in the last decade, with projects such as the Vancouver Center, West Coast Bank Building, Public Service Center, Convention Center, and numerous smaller projects. New and growing uses in the downtown include eateries, bars/ taverns, a new playhouse, and personal services.

In addition to private and private-public partnered projects, Vancouver has adopted the VCCV as well as plans for both the lower Grand Avenue area and Central Park. The FVNT has completed and adopted a reuse and management plan for the West Barracks in Fort Vancouver. These projects have value commercially, in terms of tax revenue, and in terms of providing inner-urban opportunities for family-wage jobs. The VCCV plan includes projections of employment capacities and housing units. These projections were used to model and assess potential impacts of planned development. The plan's build-out projections are used in this report to assess the impacts to different developments and areas.

2.7.3 Conclusions

The LPA would generally support the land use policies listed above and be generally consistent with expected development trends. With the LPA, subsequent development would potentially be more urban in nature and focused near light rail facilities. The project would contribute to the intensification and mixing of land uses both on Hayden Island and Vancouver. These changes in land uses have been planned for and are consistent with adopted policies. However, to a lesser degree, the project's decreased highway travel times may also have the potential to contribute to lower-density development nearer the urban edge. This issue is explored in detail in the Indirect Effects Technical Report.

The LPA would continue the trend of roadway development, and more recent trend of transit development, and would balance that development with the improvement of bicycle and pedestrian infrastructure. Compared to past, present and foreseeable future actions, the LPA will have a slightly positive effect on land uses in the area.

2.8 Neighborhoods

2.8.1 Project Effects

The largest adverse neighborhood impact from the LPA would occur on Hayden Island, where the project would require the displacement of 32 floating homes in North Portland Harbor. In addition to the floating homes displaced from North Portland Harbor, eight shelters for boat storage would be displaced, some of which contain seasonal apartments. Two businesses located on the on-land parcel associated with the Jantzen Beach Moorage would be displaced, and access at the east end of the property would be eliminated with the remaining access being at the far west end of the property.

The LPA would displace approximately 40 businesses, including many restaurants and one of two banks that currently operate on the island. Although restaurants and banks are not typically considered community resources, the loss of these businesses, if not relocated on the island or replaced by other businesses, would result in fewer dining and banking choices on Hayden Island. Construction of the LPA would also displace the Safeway grocery store and pharmacy on Hayden Island; this is the only grocery store and pharmacy and an important community resource on the island. If another grocery store or pharmacy does not open on the island, displacing the Safeway would be a significant impact, as Hayden Island residents would have to leave the island to purchase groceries and/or pharmaceuticals.

Fifteen parcels would be impacted by the expansion of the maintenance center in the Rockwood neighborhood in Gresham, Oregon. Within these fifteen parcels, nine residences and eight businesses would be displaced because some parcels contain two buildings, one serving as a residence, and one serving as a business. Because of previous impacts, little neighborhood cohesion remains in this immediate area. With the LPA, only one non-industrial parcel would remain in this community, eliminating any remaining neighborhood cohesion.

The project would improve on-island circulation, and reduce the hours of congestion in this area along I-5. Additionally, the current sub-standard and difficult to navigate bike and pedestrian connection to the existing I-5 bridge would be improved, and a light rail transit station would serve the island. Other neighborhoods would also be affected by the LPA. In the Kenton neighborhood, the LPA would displace several structures around the Marine Drive Interchange, including three floating homes and one duplex on land. Four marine businesses would also be displaced in this area.

2.8.2 Effects from Other Actions (Past, Present, Future)

As described in Section 2.6 (Environmental Justice), past highway development had significant effects on neighborhoods along the I-5 corridor. The development of I-5 required the acquisition of right-of-way and the relocation of many businesses and homes. Local planning efforts serve to strategically place and design current and future transportation so as to maximize benefits and minimize negative impacts.

In the Rockwood neighborhood in Gresham, the original development of the Ruby Junction maintenance facility (opened in 1984) and subsequent expansions and improvements since then displaced existing uses from that site including single-family residences.

There are currently development proposals to locate a new pharmacy and one or two grocery stores on Hayden Island. If these developments occur, it would eliminate or mitigate the adverse impacts related to the loss of the Safeway.

2.8.3 Conclusions

Past projects (such as the displacements associated with the construction of I-5 through North Portland) directly impacted neighborhoods in the I-5 corridor. These neighborhoods have experienced both incremental adverse effects as well as improvements since then. More recent transportation projects have generally provided net benefits through improved access, pedestrian oriented development, mitigation and other amenities. The CRC project is expected to continue this more recent positive trend in the corridor. The exception would be on Hayden Island where, until displaced businesses relocate or are replaced on the island, the impacts would be more adverse than beneficial.

One major difference, however, between these impacts and the impacts of past actions, is that past projects were often not necessarily planned and implemented with meaningful input and communication with the public. Involving communities and understanding impacts has become an essential part of project planning. This allows projects to more successfully reduce impacts where possible, or mitigate impacts where they cannot be reduced. Providing overall benefits to Hayden Island neighborhoods would require successfully relocating displaced floating home residents, and successfully relocating or re-establishing the neighborhood-serving businesses (especially a grocery store, pharmacy, bank and restaurants) that would be displaced during construction. Compared to past, present and foreseeable future actions, the LPA will have a slightly positive effect on neighborhoods.

2.9 Noise and Vibration

2.9.1 Project Effects

During project construction noise levels throughout the corridor could, at times, substantially exceed the existing and future traffic noise levels. Major construction activities, such as demolition of existing structures, hauling, concrete pumping, pile driving and paving would occur throughout the corridor. During these heavy construction periods, noise levels could reach 75 to 95 dBA maximum noise levels (L_{max}) at 50 to 100 feet from the activities, and in the case of pile driving, noise level could exceed 105 dBA L_{max} at 50 to 100 feet. Although there may be other unrelated construction activities that could be occurring at the same time as this project, within the study area of 500 feet from the proposed right-of-way, this project would likely be the dominate noise source.

In addition to the direct effects within the project study area, noise from hauling to and from the site along with noise from construction staging areas could also contribute to the cumulative noise in the greater Portland-Vancouver area. This would include noise from cement mixers, haul trucks and other large delivery trucks accessing the project corridor using established haul routes. All construction activities, including noise from staging, lay-down and storage areas, would be required to meet the local noise regulations or obtain a noise variance from the appropriate agency.

With the construction of new, taller noise walls, the long-term noise impacts from I-5 would decrease with the LPA compared to the existing condition and future No-Build.

2.9.2 Effects from Other Actions (Past, Present, Future)

The noise environment in the general project area has long been characterized by typical urban noise sources and noise levels. Sources include traffic on I-5, SR 14, SR 500, Martin Luther King Jr. Boulevard, Marine Drive, and various arterials and other roadways. Air traffic associated with the Portland International Airport as well as Pearson Field are also substantial sources of noise that have increased over time. Marine vessels on the river, trains on two rail lines, as well as industrial uses and the Portland International Raceway further add to the cumulative noise environment.

In the future, projected growth in air traffic as well as freight rail traffic could be expected to increase noise levels in the study area. If the land use plans for the City of Vancouver and Hayden Island are realized, then residential and commercial construction activities could be a substantial, intermittent source of noise over the next couple of decades. Highway noise would also be expected to increase over time as population and employment growth lead to increased auto trips. This projected highway noise increase is reflected in the CRC traffic noise analysis which is based on the region’s projected increase in population and employment through 2030. In the project area there are currently an estimated 233 traffic noise impacts to noise sensitive land uses along I-5 and that number would rise to 275 under the future No-Build Alternative. Under the No-Build Alternative, no new noise walls would be constructed. Background traffic growth would cause a general increase in traffic noise levels throughout the project area.

2.9.3 Conclusion

Many residences and other uses in the project area, including those adjacent to I-5 and the proposed light rail transit guideway, have experienced increasing noise levels over time due to steady growth in auto traffic, air traffic, and other urban noise sources. These same receivers are expected to experience continually increasing noise levels in the future as population, employment, highway traffic, air traffic, freight rail traffic and other sources grow. With the LPA, which includes new and higher sound walls adjacent to I-5, many residences along I-5 would have lower noise impacts than today. Compared to past, present and foreseeable future actions, the LPA will have a positive effect on noise and vibration in the area.

2.10 Public Services

2.10.1 Project Effects

Overall, the direct physical impacts to public services from the LPA are minor. Two public service buildings would be fully displaced; the ODOT Permitting Station on Hayden Island and the Clark Public Utilities information building immediately east of the northbound I-5 bridge in Vancouver. The project would require right-of-way acquisition and impact some parking at the FHWA Western Federal Lands office; would displace structures and parking at the Clark College Annex; and Discovery Middle School and Kiggins Bowl would have minor, temporary impacts.

Projected traffic congestion on local streets under the No-Build Alternative and the LPA would include some intersections performing at unacceptable levels of service. Intersections with unacceptable levels of service negatively impact the mobile services of public service providers and cause delays in response times for emergency vehicles. Mitigation is proposed under the LPA to reduce the number of failing intersections, which would lessen the impact to public services.

2.10.2 Effects from Other Actions (Past, Present, Future)

Past population growth has incrementally increased demand on public services. It is unknown what effects other future projects would have to local public services. Presumably, the primary effects from most development would be changes to traffic patterns and increased demand on services. These effects are mitigated via participation from affected service providers. These providers are generally included in planning processes and have adequate time to make needed adjustments prior to changes in development patterns and the street network.

2.10.3 Conclusion

Adopted land use plans and projected population growth is expected to create an increased demand for public services. However, since those increases are planned, it is reasonable to assume that the public service sector would have adequate time to plan and adjust for future conditions. The adverse effects of increased demand associated with population could be slightly exacerbated by the CRC light rail operations that would decrease auto capacity on some local streets and prohibit some turning movements. Beneficial impacts from CRC would include fewer accidents on I-5 due to safety improvements and improved emergency response times on I-5 and other roadways where congestion would be decreased. Compared to past, present and foreseeable future actions, the LPA will have a positive effect on public services.

2.11 Visual and Aesthetics

2.11.1 Project Effects

The primary elements of the LPA that affect visual quality and character are new highway bridge structures across North Portland Harbor and the Columbia River, interchanges, transit bridges, stations, park and ride facilities, and light rail transit guideways. The visual quality of the entire length of the corridor and all landscape units would be at least slightly affected. Visual impacts would occur from:

- The removal of the existing bridges and the greater heights and widths of the new structures across the Columbia River;
- The widened or higher ramps for reconfigured interchanges at Marine Drive, Hayden Island, SR 14, Mill Plain, and SR 500; and
- The effective widening of I-5 corridor due to the addition of auxiliary lanes along I-5.

Elimination of roadside vegetation without restoration of such would reduce natural elements within the corridor. These elements serve to soften the effect of the built environment within the transportation corridor.

Other impacts would result from new transit stations and accompanying park and ride structures.

2.11.2 Effects from Other Actions (Past, Present, Future)

In the Columbia River, Portland, and Vancouver areas, visual character has steadily evolved from frontier, through rural and agriculture, to suburban and urban. The I-5 corridor has steadily grown in development intensity and in use as a major transportation route.

The continued intensification of the corridor has led to a decline in the quality of many views due to obstruction of scenic or natural landscapes by buildings, walls, signage, berms and ramps, pilings, columns, bridges, the loss of vegetation, natural landforms, and smaller scale historic settlements. Continued decline is not inevitable if cities and the region implement well-designed, visually coherent urban design that protects scenic or important views.

Unrelated projects involving transportation, urban design, and development will be implemented and continue the transformation of the landscapes of the Columbia River, Portland, and Vancouver region. The trend has been and will likely continue to be one of increasing urbanization. Projects being considered by various jurisdictions and agencies include:

- Interchange improvements such as constructing or rebuilding highway ramps;
- Bridge upgrades, replacement or construction (such as the pedestrian Land Bridge recently constructed just east of the SR 14 interchange);
- Local street network and regional access route improvements;
- New traffic signals, wider sidewalks, curb extensions, bike lanes, on-street parking and street trees, pedestrian crossings and pavement reconstruction;
- Intersection realignment;
- The Vancouver Waterfront redevelopment;
- Various urban development projects throughout downtown Vancouver; and
- The redevelopment of the central Hayden Island commercial area.

Cumulative visual impacts would result from the collective individual actions.

2.11.3 Conclusions

Cumulative visual impacts are observable when the character of a place changes over time (for example from an agricultural landscape to residential development) or when the vividness, unity, or intactness of the visual environment changes. Within the project area, visual character has steadily progressed toward a compact mixed use urban form, progressing from a largely frontier character prior to the mid-1800s through rural, agricultural and early settlement periods. The I-5 corridor has steadily grown in footprint and intensity of use as a major transportation route. Overall, impacts from the project would continue and reinforce that urban transportation corridor character. In some cases, such as a light rail station, the intensification would implement adopted goals for urban vibrancy and activity centers. In other cases, such as the higher and more visually complex SR 14 interchange, visual impacts would represent a continuation of changes that are less supportive of downtown livability, human scale, and historic preservation. Compared to past, present and foreseeable future actions, the LPA will have a negligible effect on visual and aesthetic resources.

3. Natural Environment Cumulative Effects

This section discusses the cumulative effects on the natural environment. Local, state, and federal regulations require protection of natural areas, slowing the destruction of these habitats and mandating replacement of their functions. Where feasible, the approach for analyzing cumulative effects under the federal Endangered Species Act and other state or federal regulations, as applicable, was coordinated in order to develop a common area of analysis.

The natural environment includes the following resource areas:

- Ecosystems (terrestrial and aquatic habitats, and plant and animal species)
- Geology and soils
- Water quality and hydrology
- Wetlands
- Hazardous materials

Key resources in the natural environment include Burnt Bridge Creek, the Columbia River, and the backwaters and other tributaries of the Columbia River, including the Columbia Slough. Non-transportation-related projects that are considered in the analysis include the Vanport Wetlands project (restoration of wetlands by the Port of Portland) and active habitat improvement and restoration activities on the Columbia Slough.

Historical environmental conditions within the study area were greatly influenced by the seasonal flows of the Columbia River. Historically, river volumes were highest between April and September during basin-wide snowmelt, and lowest from December to February when much of the basin's moisture can be locked up in snow and ice.

Although annual flooding affected the Oregon side of the study area much more than the Washington side, flood control measures have been implemented that affect the entire lower Columbia River environment. Levees and river embankments were constructed in the early 1900s on both sides of the river, which isolated the majority of the floodplain from all but the highest flows. As the floodplain experienced increased development, elaborate pumping operations were implemented on the Oregon side to prevent overbank flow. Today, pumps run nine to 10 months a year, and continuously 24 hours every day during the winter rainy period, resulting in over a billion gallons pumped per day by the Multnomah County Drainage District #1. Construction of the mainstem Columbia River dams effectively regulated flows, starting with completion of the Bonneville Dam in 1938.

3.1 Ecosystems

3.1.1 Project Effects

Although the effects of the LPA would include disturbance to native vegetation and trees and wetland buffers, the most significant ecosystems effects of the LPA are beneficial changes to aquatic habitat. The LPA would significantly improve water quality in area waterways as a result of improved stormwater management, although its in-water bridge piers would have adverse effects on protected fish species in the Columbia River similar to the effects of the existing I-5 bridge piers.

The LPA would also remove the peregrine falcon habitat in the steel structure of the existing I-5 bridges. Whether these effects are temporary, with peregrine falcons reestablishing themselves on new bridge structures, or permanent, long-term adverse effects on the overall viability of the species are not anticipated.

3.1.2 Effects from Other Actions (Past, Present, Future)

Historically, many activities, including deforestation, urbanization, dams for hydroelectricity, irrigation and flood control, hatchery operations and over fishing have contributed to a loss of habitat and a reduction in fish and wildlife species. These past actions have made significant changes to the health and capacity of the natural environment in the region.

No specific projects have been identified in or adjacent to the main project area that would significantly impact habitat; however, growth and development will likely continue to impact species present in the project area, in particular protected fish species. Compliance with the relevant laws, regulations, policies, and codes in force at the time of such development would help to minimize or mitigate the effects of such actions on resources important to juvenile salmonids and other aquatic species. However, even if new development has a net positive impact on these fish species, many of them would still face the possibility of extinction.

For protected fish species, the impacts of LPA construction would contribute to, and be overshadowed by, conditions in the larger Columbia River Basin. Federal agencies have developed a Basinwide Salmon Recovery Strategy aimed at recovering the threatened and endangered salmon and steelhead species in the Columbia River Basin, most of which travel through the main project area. The Recovery Strategy includes changes in habitat, hydropower, hatcheries, and harvest, all factors that will have the greatest impact on species survival.

Recent research has also indicated that climate change could modify fish habitat in the Pacific Northwest in multiple ways. Changes may include less snowfall due to warmer temperatures that could in turn decrease snow pack and change the flow timing, including peak flow levels, of streams and rivers, as well as an overall increase in water temperatures (ISAB 2007). It is important to note that river dams on the Columbia and Snake Rivers would manage flows in the project area, such that the flow extremes in the Columbia River would be moderated where the river flows through the project area. See Section 5.3.2 of this technical memorandum for more discussion related to fish habitat impacts related to climate change.

3.1.3 Conclusions

The impacts resulting from the LPA are small, but historic development and expected growth throughout the region will likely continue to have impacts on ecosystems. The mitigation measures that are likely to occur under the LPA would serve to reduce harmful effects, and even improve parts of the local ecosystem relative to existing conditions. The long-term health of species most significantly affected by the project–protected fish species–are tied to the success of the Basinwide Salmon Recovery Strategy. Compared to past, present and foreseeable future actions, the LPA will have a slightly positive effect on ecosystems.

3.2 Geology and Groundwater

3.2.1 Project Effects

The main project area consists of soils with a high relative earthquake hazard rating, susceptible to severe ground shaking and liquefaction during a major seismic event. The primary difference between the No-Build Alternative and the LPA is that the No-Build would not include upgrades to or retrofitting of the existing bridge; where new infrastructure related to the LPA would be built to modern seismic safety standards. As such, the LPA would likely better withstand a major seismic event.

Sensitive groundwater resources have been identified in the project area that supply municipal, commercial, and irrigation water to surrounding communities. The distribution and occurrence of groundwater resources are not anticipated to be adversely impacted by project activities.

The steep slopes and soils susceptible to erosion present in the Burnt Bridge Creek area have been disturbed in the past from the construction of I-5 and SR 500. Compared to the No-Build Alternative, the LPA would disturb these soils again with project construction activities in this area.

The aggregate needed for concrete construction may be more than is available through local suppliers. The construction contractor may need to transport construction material to the project site from several suitable source areas throughout the region.

3.2.2 Effects from Other Actions (Past, Present, Future)

Past activities in the project area include settlement and development of the region, clearing of native vegetation, filling of lowland areas, grading of slopes, and construction in earthquake prone areas. Current development projects, including roads, bridges, and buildings, are being constructed under updated codes which require additional protection against earthquakes and measures to limit adverse effects in sensitive zones (such as landslide prone areas). However, in some cases, future actions may include development and regrading that could lead to soil erosion, even with erosion control practices in place. Past actions have also resulted in contamination of groundwater. Updated construction codes help protect ground water sources from present and future actions that could further contaminate groundwater. Several recent and present soil and groundwater remediation actions have helped and will continue to help reduce existing contaminants in groundwater.

3.2.3 Conclusions

Many of the geologic effects of the CRC project would be beneficial and would help offset adverse geologic impacts of other past actions. The new bridges and other CRC structures would substantially correct the seismic vulnerability of the existing bridges and other I-5 structures that were built before design standards addressed the impacts associated with subduction zone earthquakes, including severe liquefaction. The project could improve groundwater quality by remediating some existing contamination; it would not contribute to past actions that have introduced contaminants to the groundwater including the sole source aquifer.

The project would disturb some steep slopes and soils susceptible to erosion that have been impacted by past actions. It would also decrease the risk of landslide and erosion in some areas by building retaining walls, improving soil stability and improving drainage.

Construction of the LPA would require aggregate for concrete, adding to the cumulative demand of past, present, and other future construction projects. This would further decrease local supplies and lead to either this or other future projects seeking aggregate from sources outside the area. Compared to past, present and foreseeable future actions, the LPA will have a positive effect on geology and groundwater.

3.3 Water Quality and Hydrology

3.3.1 Project Effects

Long-term effects from the No-Build Alternative may include effects to water quality and stormwater. The No-Build Alternative would adversely affect the quality of receiving waters in the long-term. Pollutant-loading of project waterways is currently influenced by a high percentage of untreated stormwater across the project corridor. Under the No-Build Alternative, this stormwater would likely remain untreated.

Under the LPA, an overall increase in impervious surfaces within the project area is likely to result in increased stormwater runoff rates and volumes. Without mitigation, this would adversely affect the hydrology of project waterways. The Columbia River and Columbia Slough are large, tidally influenced waterbodies, and the project-related increase in stormwater quantity would not result in a measurable increase of flows in these surface waters. Burnt Bridge Creek and Fairview Creek are smaller waterbodies and more prone to be affected by increased stormwater quantity resulting from increased impervious surfaces. However, engineered water quality facilities would also be designed to reduce the rate of runoff from the project to these two waterbodies to pre-development conditions.

Improvements to stormwater treatment on new and resurfaced impervious surfaces, including the I-5 and North Portland Harbor bridges, would result in a net improvement for water quality in the Columbia Slough, Columbia River, North Portland Harbor, Burnt Bridge Creek, and Fairview Creek, with the exception of an increase in dissolved copper levels at the Columbia Slough. Most of the runoff generated by the existing highway corridor is not treated before being discharged. All new and rebuilt impervious surfaces, as well as some resurfaced and existing pavement, would be treated in accordance with current stormwater treatment standards before being discharged to project area receiving streams.

3.3.2 Effects from Other Actions (Past, Present, Future)

Historic land use changes and increasing urbanization have decreased the amount of natural areas and natural flow regimes in the main project area. Flood control measures have been implemented that affect the entire lower Columbia River environment. Levees and river embankments were constructed in the early 1900s on both sides of the river, which isolated the majority of the floodplain from all but the highest flows. Projected population and employment growth will continue to increase urbanization as well as increase the geographic extent of development. Located just south of the main CRC project area, the I-5 Lombard to Delta Park project will affect water quality within the Columbia Slough watershed. Most of the immediate project area is already developed, so future projects would mostly consist of redevelopment and would be subject to current regulations which generally result in a reduction in stormwater runoff and associated pollutants.

A recent decrease in upstream heavy industrial activities and the enactment of environmental laws beginning in the 1960s have resulted in addressing many known contamination sources and improving water quality in the Columbia Slough, although the water quality remains substantially impaired.

Increased scrutiny by regulatory agencies on chemicals at much lower levels than current standards is occurring and may result in new standards. Current treatment systems and regulations do not fully address these likely new standards. However, even with new treatment systems, increased development may still lead to impaired water quality in some locations.

3.3.3 Conclusions

The CRC project is likely to reverse some of the adverse water quality and hydrology impacts associated with past actions. With new stormwater treatment and infiltration, the CRC project is expected to improve surface water quality, increase groundwater recharge, and help restore natural flow regimes. This will also be true of other future actions that 1) are constructed on already developed property, 2) decrease the area of untreated, pollutant generating surfaces, and 3) infiltrate treated runoff. On the other hand, future actions that convert undeveloped areas into impervious surfaces are likely to add to the adverse effects of past actions, although regulatory requirements will reduce those effects compared to historic actions. Compared to past, present and foreseeable future actions, the LPA will have a slightly positive effect on water quality and hydrology.

3.4 Wetlands

3.4.1 Project Effects

The long-term effects to wetlands and waters resulting from the LPA include decreased vegetated wetland buffer areas, increased impervious surface areas, and placement of fill and other alterations of waters of the states and the United States.

The LPA results in impacts to the buffers of three wetlands. One wetland is in the Burnt Bridge Creek Watershed, west of the intersection of NE 45th St and NE Leverich Park Way, on the east side of I-5 in the City of Vancouver. The LPA impacts less than 0.1 acre of this wetland buffer. A second wetland is located in the Burnt Bridge Creek watershed, west of I-5 in the Kiggins Bowl area in the City of Vancouver. The LPA has an impact on approximately 0.3 acre of this wetland buffer. The third wetland is in the Columbia Slough watershed, on the west side of I-5, south of Victory Boulevard in the City of Portland. The LPA impacts approximately 0.01 acre (0.05 acre under LPA Option B) of this wetland’s buffer.

The Columbia River flows from east to west through the project area, between the Cities of Portland and Vancouver. The LPA impacts approximately 1.4 acres of the Columbia River (including the North Portland Harbor). Permanent bridge piers in the Columbia River for the new bridges would displace a volume of 47,400 cubic yards. The No-Build Alternative would result in no additional effects to wetlands and other waters of the states and U.S.

3.4.2 Effects from Other Actions (Past, Present, Future)

Since 1958 (the base year of I-5 construction) improvements have occurred to some wetlands near the southern portion of the project. The Port of Portland has an ongoing wetland restoration project at the 90-acre Vanport wetlands parcel, located immediately to the west of the existing highway and light rail line. Other historic wetlands east of the highway, in the Delta Park area and on Hayden Island, have undergone increased development, draining, or filling since 1964.

Continued growth throughout the region will affect portions of the main project area. Located just south of the main project area, the Lombard to Delta Park project will impact a relatively small area of wetland habitat and natural areas. Although no additional projects have been specifically identified that would impact wetlands in or near the main project area, it is reasonable to assume that temporary and permanent impacts from future projects are likely to occur.

Increased urbanization and land use changes have decreased the amount of wetlands in the project area. Local, state, and federal regulations require protection of wetlands and jurisdictional waters, slowing the destruction of these habitats and mandating replacement of their functions.

3.4.3 Conclusions

Compared to historical conditions, there are very few wetlands remaining in the main project area. Mechanical methods introduced to control water flow (dikes in the project vicinity and dams on the Columbia River), have reduced the presence of wetlands in the project area. The habitat losses due to these activities are irrecoverable. The LPA would neither help to recover or exacerbate the loss of such habitats.

In the context of widespread urban development in the main project area, the potential impacts to wetlands buffers resulting from the LPA are minor. Although the affected wetlands perform important functions and are valuable due to their relative rarity, they are not of high quality. Mitigation for these impacts would replace or improve the functions to the extent possible, as close to the project as is feasible.

Based on the volume of flow and the existing conditions in the Columbia River, the removal and fill associated with the LPA is not likely to have measurable effects on the function of the river. Compared to past, present and foreseeable future actions, the LPA will have a negligible effect on wetlands.

3.5 Hazardous Materials

3.5.1 Project Effects

The CRC main project area is heavily urbanized, and many of the past and present land uses have generated, used, and/or stored hazardous materials. Hazardous material sites that are most likely to impact the project are those being acquired for right-of-way or near the roadway or guideway alignments.

For the LPA, disturbances to existing hazardous materials sites would result in site cleanup and could increase demand for contaminated soil disposal facilities. Cumulative exposure from hazardous materials to construction and excavation workers or ecologic receptors could occur. It is not anticipated that the operation or maintenance of the LPA would increase the occurrence or transport of hazardous materials within the study corridor.

Compared to the No-Build Alternative, long-term adverse effects to human health and the environment from hazardous materials would likely be reduced because the LPA would entail:

- Upgrades or enhancements to the current stormwater conveyance and treatment system. This would reduce the spread of existing residual contaminants to soil, surface water and groundwater from stormwater runoff and infiltration.
- Likely placement of surficial caps or barriers at any sites identified with existing contamination, which decreases likelihood of direct exposure to potential receptors.

- Increases and enhancements to roadway and transit system capacities. This could lower the frequency of incidental spills or releases of hazardous substances associated with trucking and automotive transit.

3.5.2 Effects from Other Actions (Past, Present, Future)

The evaluation of risks to the CRC project from existing hazardous materials is based on a review of past actions and their effects on existing and potential soil and groundwater contamination. There may also be unknown contamination caused by past land uses and actions in the corridor, that pose additional risks.

Future, unrelated development in the project area could add exposure risks, as well as add clean up and remediation benefits. Population and employment growth could cause increased traffic that may result in slightly higher incidents of hazardous materials spills. Since 1964, several laws have been implemented that have led to improved handling of hazardous materials, reducing the amount of new hazardous materials released into the soil and groundwater. Environmental liability laws generally require identification and cleanup of hazardous materials during property transfers, which have resulted in the overall reduction of hazardous material contamination near the main project area.

3.5.3 Conclusions

CRC construction would reverse some contamination associated with past releases of hazardous materials (by cleaning up existing contaminated sites that would be acquired for the project) and would reduce the risk of future contamination from highway crashes (by improving highway safety and by capturing, conveying and treating stormwater runoff). Because any hazardous material discovered during construction would be remediated, development of the LPA could result in reduced hazardous material exposure to the general public. Because the project is unlikely to introduce new hazardous material sites, and may identify or remediate existing hazardous material sites, it may contribute to a cumulative beneficial impact to groundwater, human, and ecological receptors in the project area. Compared to past, present and foreseeable future actions, the LPA will have a positive effect on hazardous materials in the area.

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4. Cultural and Recreational Environment Cumulative Effects

Resources included in this category are parks, historic, and prehistoric resources. They include issues associated with Section 4(f) and Section 106 resources. Tribal consultations contributed to the Cultural Resources technical analysis. Key cultural resources include Fort Vancouver, potential archaeological (historic and prehistoric) sites along the Columbia River, and a variety of historic buildings and properties in the project area.

Projects considered in addition to those listed in Appendix A include the Land Bridge pedestrian overpass and Interpretive Trail over SR 14, and the Vancouver Barracks, West Reserve Area, and other improvements planned for the Fort Vancouver Historic Reserve.

The analysis examined the general adverse and beneficial effects of past development, and the cumulative effects resulting from the CRC project in conjunction with other past, present, and reasonably foreseeable future actions. Issues considered include past effects on cultural resources in the project area, including loss of historic resources due to development and past effects on areas used for burial sites. The project team conducted the analysis with the appropriate consultation with DAHP, SHPO, tribal governments, local planners, and others.

4.1 Archaeology and Cultural Resources

4.1.1 Potential Effects

Within the area of potential effect (APE), 32 significant archaeological sites were identified during the initial discovery work for the CRC project. All recorded sites are in Washington. All 32 of these sites are preliminarily considered eligible, or potentially-eligible, for the National Register of Historic Places.

In view of the great amount of development and ground disturbance in the I-5 corridor and adjacent areas, the identification of archaeological sites requires extensive subsurface investigations using a variety of excavation methods during several phases of project construction. Based on extensive background research, the initial archaeological discovery work, and predictive models, the construction of the LPA is highly likely to adversely affect known archaeological resources, and discover additional historic and prehistoric archaeological resources.

4.1.2 Effects from Other Actions (Past, Present, Future)

Both shores of the Columbia River have been the location of extensive development in the past 200 years. Several types of historic era development occurred within or immediately adjacent to the present I-5 transportation corridor, and there are indications of Native American settlements associated with those developments, as well as prehistoric use of the area.

Since the late 19^{th}-century, diking, draining, dredging and filling along the shores have altered the banks of the Columbia River, possibly damaging archaeological sites, or encapsulating them under fill. The Interstate Bridge transformed both Hayden Island and Vancouver. Its first bridge was completed in 1917 as part of the major west coast highway corridor (Pacific Highway 99) running from Canada to Mexico. A second bridge structure was built in 1958, and it began service as I-5 in 1964. Traffic on the route has mounted with the steady growth and development of Clark and Multnomah counties and surrounding areas. Intensive residential, commercial and transportation development over the past 160 years have had major impacts on the cultural and historic landscape in the I-5 corridor and vicinity. In particular, the construction of I-5 and SR 14 affected the historic archaeology of the HBC/Kanaka Village/U.S. Army presence in Vancouver. Evidence also exists that I-5 construction uncovered human remains.

The earliest settlement and development in the City of Vancouver occurred in the 1850’s in the area immediately west of modern-day I-5. Historic Sanborn insurance maps indicate that the City of Vancouver had begun to spread north of 20th Street by 1907 and had reached 41st Street by 1949, indicating a moderate to high likelihood of encountering buried historical archaeological deposits associated with residences and businesses dating to the early 20th-Century settlement of Clark County. While the development of Vancouver formed the historic part of the archaeological record, the construction of each road, house, and trash pit potentially destroyed or disturbed evidence of prehistoric sites in the area.

While not every parcel is likely to contain significant archaeological resources, recent historical archaeological investigations demonstrate the potential for encountering archaeological remains associated with early residences, businesses, and industries in this portion of Vancouver. Based on the results of these projects, there is reason to believe that abundant and well-preserved archaeological remains are present beneath the older portions of Vancouver.

20th-century development along the I-5 corridor likely altered near-surface evidence of prehistoric or historic period Native American occupancy and use of the area. However, geoarchaeological and geomorphological investigations in Oregon indicate that deep alluvial soils have the potential to contain evidence of the prehistoric archaeological record as well as important paleoenvironmental data. The proposed depth of project impacts would have an incrementally greater potential to affect deeply buried resources than other past and reasonably foreseeable actions.

4.1.3 Conclusion

Past activities have had a dramatic impact on the preservation of archaeological resources in the project area. Many have been lost or altered, although some have been preserved under fill during previous construction projects, and some have been recovered, studied, and archived as part of more recent construction projects. Unrelated future actions are likely to disturb or destroy additional archaeological resources, although some will continue to be preserved or to be recovered. The likelihood of inadvertent destruction is reduced by current local, state, and federal cultural resources laws and regulations that help to protect archaeological resources.

Based on the archaeological testing completed to-date, the project’s incremental impact to the loss of the area’s archaeological resources is not expected to be significant although that is still uncertain. Identified archaeological resources within the LPA have a high likelihood of being adversely impacted. There is also a high likelihood that additional archaeological resources will be discovered during construction of the LPA. Appropriate measures would be taken to protect, preserve, or mitigate the presence of these resources. Further refinements in the design may aid in the avoidance of some resources, and appropriate mitigations would be implemented where adverse effects cannot be avoided. Compared to past, present and foreseeable future actions, the LPA will have a negligible effect on archaeological and cultural resources.

4.2 Historic Resources

4.2.1 Potential Effects

Within the primary APE, 877 resources were inventoried. For each resource a determination of eligibility was submitted to SHPO and DAHP. Following their reviews and discussions with project staff, 201 resources were considered National Register of Historic Places (NRHP) listed historic properties or NRHP-eligible historic resources.

The LPA could potentially affect 18 historic properties. Of these, three have been preliminarily determined to be adverse effects. The LPA would require dismantling of the NRHP-listed 1917 I-5 Bridge, which would be an adverse effect to the structure. Numerous impacts to the VNHR (and associated Historic District) also constitute an adverse effect. The remaining adverse impact is to the Pier 99 building. Section 106 evaluations of effect on historic resources are discussed in more detail in the Historic Built Environment Technical Report.

Removing the existing 1917 bridge could potentially be an adverse effect to the region's historic fabric. This bridge structure has been part of the landscape for both Oregon and Washington since 1917 (northbound), as has the southbound bridge built in 1958. An adverse effect to the VNHR could be considered regional because that area was one of the first Euroamerican settlements in the Pacific Northwest and its multi-layered historic context represents a continuous record of the area's development.

4.2.2 Effects from Other Actions (Past, Present, Future)

For the purposes of historic resources, the base year in analyzing cumulative impacts is 1960, prior to I-5 construction, which created a substantial change in land use and historic context in the project area. The highway removed several buildings that had been constructed during the early history of Vancouver, and created a substantial barrier between eastern and western portions of the historic community.

Several other substantial projects and developments have had an impact on the historic built environment in the project study area, including:

- Significant population growth from 1950 to the present in Portland, Vancouver, and surrounding areas which has put a high demand on housing in historic neighborhoods, causing new development adjoining the historic sections of town, and ultimately diminishing the integrity of historic neighborhoods.
- Significant population growth from 1950 to present in Portland, Vancouver, and the surrounding areas which has attracted urban and industrial development in the project area, changing the use and nature of the open space along the river, and causing the displacement of some historic buildings.
- The completion of Interstate 5 through Vancouver in 1954, which used access onto the 1917 bridge to Portland. Construction of the parallel bridge in 1958 (southbound) accommodated increased traffic flow on the new highway resulting in increased interstate traffic and commerce.
- In 1961, an urban renewal project covered 28 blocks in downtown Vancouver removed or altered many nineteenth and early twentieth century buildings.
- The loss of businesses in Downtown Vancouver from competition with shopping malls built at Jantzen Beach in Portland and the Vancouver Mall in the 1970s.

Unrelated present and future development would likely affect historic properties in the APE. For example, the new Vancouver Main Library is under construction at Evergreen Boulevard and C Street, requiring the removal of historic houses and representing the introduction of contemporary architecture directly adjacent to the NRHP-listed Academy (House of Providence). In addition, historic resources that are currently vacant or underutilized may be lost through deterioration because of their current state of disrepair and the high cost of adapting them for reuse.

4.2.3 Conclusion

Past activities have had a dramatic impact on the preservation of historic resources in the project area. Many resources were demolished, and the historic contexts largely altered to the extent that, except for a few places such as the VNHR, the area would not be easily recognized by people from the historic periods prior to the 1950s. Unrelated future actions would likely demolish additional historic resources, although some resources would likely be preserved or restored.

The CRC project's removal of the historic 1917 bridge, as well as the other adverse impacts to historic structures identified in the Historic Built Environment Technical Report represents an incremental impact to the loss of the area's historic fabric. The LPA has been designed to avoid areas with significant concentrations of historic resources but some losses are unavoidable. Further refinements in the design and appropriate mitigations would aid in the maintenance of the region's historic character. Compared to past, present and foreseeable future actions, the LPA will have a negligible effect on historic resources.

4.3 Parks and Recreation Areas

4.3.1 Project Effects

The CRC project would improve access to regional recreational resources in Portland and Vancouver, including the Portland Exposition Center, Portland International Raceway, East Delta Park, and Vancouver National Historic Reserve. Additionally, the LPA would result in improved pedestrian and bicycle access in the area, particularly between Oregon and Washington. Trail linkages, including those in and through the Marine Drive Interchange in Portland and along the Columbia River in Vancouver, would be greatly improved.

The nearly half-acre Waterfront Park plaza would be acquired for construction of the new I-5 bridges, while the Waterfront Renaissance and Historic Discovery Loop Trails would be realigned beneath the existing and new I-5 bridges. The Boat of Discovery Monument located within the impacted portion of Waterfront Park would need to be relocated. Additional waterfront property beneath the existing I-5 bridges could be vacated following construction; this could provide an opportunity to mitigate impacts to the Waterfront Park by opening up new space along the waterfront for park use by the City. This space could potentially provide a new location for the plaza and displaced artwork.

The largest parkland acquisition required for the LPA would be 8 acres from the VNHR. The LPA would require land near the planned reconstruction of the Fort Vancouver (Hudson's Bay Company-HBC) Village, although it is not expected to substantially interfere with National Park Service (NPS) plans. Impacts would be limited to strips of existing and planned landscaping along SR 14, the I-5/SR 14 interchange, and I-5, as well as substantial changes in views from the Village area. The Confluence Land Bridge would not be physically impacted by the reconstruction of the I-5/SR 14 interchange, although views from the Land Bridge to the west would change due to the increased heights of the interchange ramps and the river crossing.

The LPA would require the acquisition of parkland from Marshall Community Center and Park and Clark College Recreational Fields. Additionally, Marshall Community Center and Park and the Clark College Recreational Fields would lose access to on-street parking on McLoughlin Boulevard, as well as some parking stalls on the park property, but would gain direct transit access.

Additional minor property acquisitions would be required at Leverich Community Park and Kiggins Sports Fields/Stadium, though it is not expected that the recreational use of either facilities would be affected.

Lastly, the LPA would not preclude the planned Bridgeton Trail connection near the Marine Drive interchange, or the Waterfront Trail extension or 7th Street Pedestrian Connection in Vancouver.

4.3.2 Effects from Other Actions (Past, Present, Future)

Park and trail development have been ongoing efforts in the region. These efforts will be continued and are supported by current plans and programs. The impacts listed above are small in the context of local park resources and are balanced by investments in parks and trails elsewhere in the area (e.g., Esther Short Park in downtown Vancouver, the development of the Land Bridge over SR 14 in Vancouver, the potential opening of the Vanport wetland mitigation site to the public).

Planned park and trail development along the Vancouver Waterfront, at the VNHR, at Marshall Community Center, and at Mill Plain/Memory Park would expand the provision of park and recreation facilities to the public. Other development could result in loss of parkland, but the extent of such loss is currently not known. Parks in the project area that received Land and Water Conservation Fund (LWCF) grant dollars are encumbered and thus somewhat difficult to convert from parkland to transportation use without substantial replacement mitigation. This funding will prevent the loss of parkland from these resources.

4.3.3 Conclusion

Park impacts that would result from the LPA, considered in context of the past and planned projects (including park expansions), are relatively minor and do not constitute a negative cumulative effect for the region. Additionally, the LPA would improve access to the Vancouver waterfront, and connect parks on both the east and west sides of the bridges. This would essentially restore the once connected waterfront that was bifurcated by the existing bridges. Compared to past, present and foreseeable future actions, the LPA will have a slightly positive effect on park and recreation areas.

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5. Climate Change

In the Council on Environmental Quality's (CEQ) Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions issued on Feb. 18, 2010, the agency states that in the NEPA context, climate change issues arise in relation to the consideration of 1) the GHG emissions caused by a proposed action and alternative actions, and 2) climate change effects to a proposed action or alternatives. On June 3, 2011, the State of Washington's Department of Ecology (Ecology) issued a "Guidance for Ecology: Including Greenhouse Gas Emissions in SEPA Reviews" to assist Ecology staff in determining which projects should be evaluated for GHG emissions and how to evaluate those emissions under SEPA when Ecology is the lead agency or the agency with jurisdiction. Recognizing the increased interest from the public and other agencies to determine and disclose information about GHG emissions for transportation projects, WSDOT also developed guidance for analyzing project-level GHG emissions from all WSDOT projects subject to NEPA and SEPA. The WSDOT guidance is consistent with the guidance documents on considering the effects of climate change and GHG emissions developed by CEQ and Ecology. The CRC project team followed WSDOT's guidance to evaluate project-level GHG emissions and assess the project's resiliency to the effects of climate change.

Based on best available science and best practice GHG emissions measurement and modeling, the LPA will result in a net reduction of GHG emissions compared to the "no build" alternative. Nonetheless, and consistent with agency guidance documents, the CRC project team recognizes that climate change can increase the vulnerability of a resource, ecosystem or human community, causing a proposed action to result in consequences that are more damaging than prior assessment of environmental impacts may indicate. In this chapter the CRC project team presents background information on climate change, identifies climate change policies relevant to the transportation sector, and summarizes project-level GHG emissions. The focus of this chapter, however, is the analysis of the potential effects climate change may have on the CRC project, with special consideration given to the anticipated effects of climate change on the Columbia River, as a step toward assessing the LPA's vulnerability to the effects of climate change.

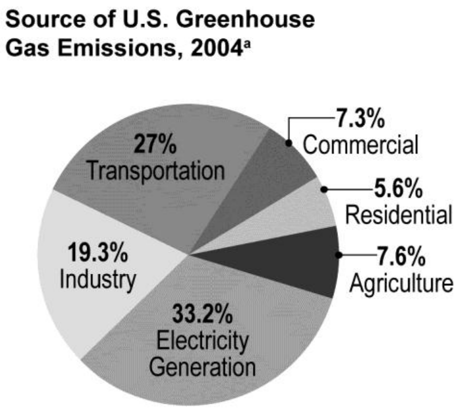
5.1 Background

Estimates of future atmospheric concentrations of carbon dioxide equivalent (CO_2e) range from 549 to 970 parts per million (ppm), or 2 to 3.5 times the pre-industrial value of 280 ppm. Unlike the pollutant emissions discussed in Section 2.1, Air Quality and Air Toxics, GHG emissions have not until very recently been classified as pollutants. As a result, GHG emissions have consistently grown, and absent regulations to reduce emissions, are projected to continue growing as the population increases. Scientists anticipate that as atmospheric concentrations of GHG emissions continue to rise in the coming decades, average global temperatures and sea levels will continue to rise as a result and precipitation patterns will change, with potentially wide-ranging impacts on agriculture, water supply, public health, and infrastructure. Current policies designed to reduce GHG emissions in the transportation sector are highlighted below.

5.1.1 GHG Emissions from the Transportation Sector

Virtually all human activities have an impact on our environment, and transportation is no exception (Exhibit 5-1). Transportation is a substantial source of GHG emissions, and contributes to global warming through the burning of petroleum-based fuel. Any process that burns fossil fuel releases CO_2into the air. CO_2 is the primary GHG emitted by vehicles, and therefore it is the focus of this analysis. The level of CO_2 emissions from vehicles is driven by the distance vehicles are traveled; the speeds at which they are travelling; the fuel efficiency of the vehicles; and the carbon content of the fuels that power the vehicles.

Exhibit 5-1. Source of U.S. Greenhouse Gas Emissions, 2004[a]



Source: EPA 2006.

[a] Excluding emissions in U.S., territories, which accounted for 0.88% of total emissions.

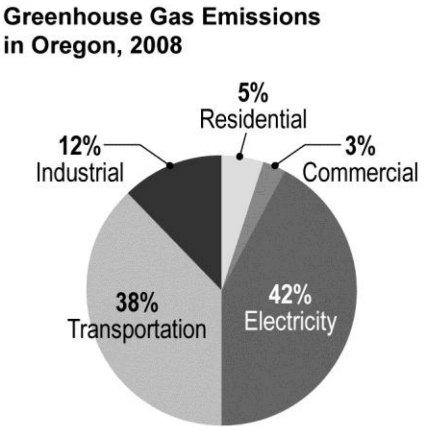
Changes in CO_2 emissions from fossil fuel combustion are influenced by many long-term and short-term factors, including population and economic growth, energy price fluctuations, technological changes, and seasonal temperatures. On an annual basis, the overall consumption of fossil fuels in the United States generally fluctuates in response to changes in general economic conditions, energy prices, weather, and the availability of non-fossil alternatives (EPA 2008). Over time, carbon emissions have increased with population growth and while the rate of growth should slow, total emissions are expected to continue to increase for the foreseeable future. The population, as well as the number of miles being driven, has grown and is expected to continue growing.

5.1.1.1 Regional Trends

Transportation accounts for an estimated 38 percent of Oregon's CO_2 emissions, with vehicle CO_2 emissions predicted to increase by 33 percent by 2025 because of increased driving (Exhibit 5-2).

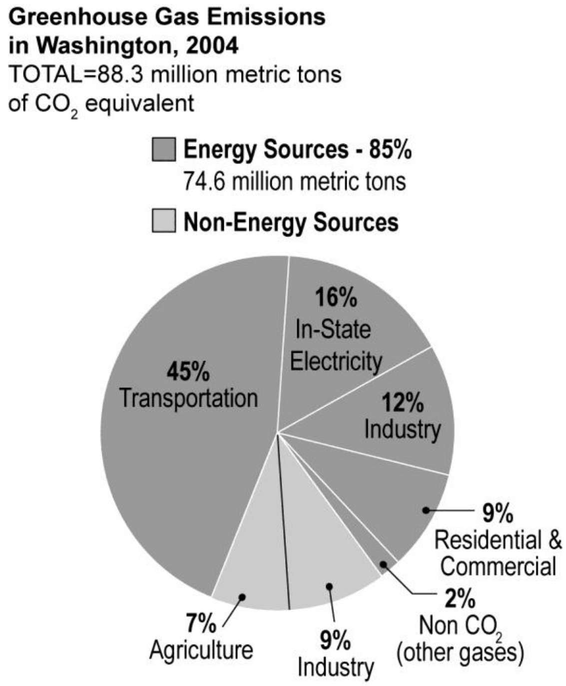
Washington State predicts that, with the state's abundance of in-state hydropower for electricity generation, the transportation sector accounts for almost 50 percent of GHG emissions in Washington (Exhibit 5-3).

Exhibit 5-2. Greenhouse Gas Emissions in Oregon, 2008



Source: Oregon Department of Energy, January 2008.

Exhibit 5-3. Greenhouse Gas Emissions in Washington, 2008



Source: Washington Department of Community, Trade and Economic Development (Preliminary Estimate)

Total future carbon emissions for the CRC project are difficult to estimate precisely because such a wide variety of factors could influence carbon emissions by 2030. Some of the factors that could change between now and 2030 include government regulations, price and availability of fuel and alternative energy sources, and vehicle technology (such as electric hybrid or fuel cell vehicles). That said, if historic and recent transportation trends continue, CO_2 emissions will continue to increase. By 2030, CO_2 emitted from vehicles on all regional roadways, including I-5 and I-205, are expected to increase over existing conditions. For example, the population is expected to increase in Clark County by 66 percent between 2005 and 2030, which could have a dramatic effect on vehicle miles traveled in the region. Without the CRC improvements, the four-county region (Washington, Clackamas, Multnomah, and Clark) is expected to produce 41 percent more GHG emissions by 2030 compared to existing conditions.

5.1.1.2 Policies Regulating GHG Emissions

There are numerous federal, state and local policies designed to regulate and mitigate GHG emissions. This section summarizes climate and energy policies and regulations that are anticipated to result in regulation and reduction of GHG emissions from the transportation sector. A comprehensive evaluation of climate policies is presented in the Energy Technical Report for the FEIS.

Federal Policies

The National Highway Traffic Safety Administration (NHTSA), which is part of the U.S. Department of Transportation (DOT), establishes and amends the Corporate Average Fuel

Economy (CAFE) standards for vehicles. The CAFE program gives manufacturers an incentive to sell more fuel-efficient light trucks and automobiles. Congress sets CAFE standards for cars. EPA reports the CAFE results for each manufacturer to NHTSA annually, and NHTSA determines if they comply with CAFE standards and assesses penalties as required. A tax is imposed on makers of new model year cars that fail to meet the minimum fuel economy standard. In 2011, the standard will change to include many larger vehicles.

On December 19, 2007, President Bush signed into law the Clean Energy Act of 2007, which requires in part that automakers boost fleet-wide gas mileage to 35 miles per gallon (mpg) by the year 2020. The previous CAFE standard for cars set in 1984 required manufacturers to achieve an average of 27.5 mpg, while a second CAFE standard required an average of 22.2 mpg for light trucks such as minivans, sport utility vehicles, and pickups. The 2007 CAFE standards under the Bush Administration required that these standards be increased such that, by 2020, the new cars and light trucks sold each year deliver a combined fleet average of 35 mpg. In 2009, President Obama revised the CAFE standards to hit an earlier target: a combined fleet average of 35 mpg by 2016. It is uncertain how the phase-in of these new cars will impact the overall fuel efficiency of the fleet mix between now and 2030, partially because the impact of the efficiency improvement depends on how many people buy new vehicles over this time frame.

In December 2009, EPA issued an "endangerment finding" that classified CO_2 and five other GHG emissions as threats to public health, establishing a legal basis for regulating GHGs as pollutants. This action is a prerequisite to finalizing the EPA's proposed GHG emission standards for light-duty vehicles.

State Policies

Several jurisdictions in the project area have goals to reduce GHG emissions. In 2007 Governor Gregoire and the Washington Legislature passed a statute that aims to achieve 1990 GHG levels by 2020 and a 50 percent reduction below 1990 levels by 2050. The goals of the Oregon Climate Change Integration Act seek to reduce emissions 10 percent below 1990 levels by 2020, with a 75 percent reduction below 1990 levels by 2050. Both Oregon and Washington are members of the Western Climate Initiative, which has established a regional, economy-wide GHG emissions target of 15 percent below 2005 levels by 2020, or approximately 33 percent below business-as-usual levels (WCI 2010). Both states have also developed or are pursuing a variety of programs to further reduce GHG emissions, including low-carbon fuel standards, GHG reporting rules, efficient vehicle standards, GHG reduction targets for transportation and land use planning, renewable portfolio standards, and various tax incentives.

In March 2008, the governor signed Washington's Climate Change Framework/Green-Collar Jobs Act (HB 2815), which was developed with the help of a broad coalition of business, environment, education, labor, and energy leaders. This law includes, among other elements, statewide per capita VMT reduction goals as part of the state's GHG emission reduction strategy.

In 2009, the governor of Washington issued Executive Order 09-05. Under the order, WSDOT is currently leading an effort to evaluate the changes needed in transportation, including reductions in VMT, to meet the state's GHG reduction goals. The agency is collaborating with businesses, environmental groups, transportation advocates, and local and regional jurisdictions to complete this work. In addition, WSDOT is among the six agencies leading the development of the initial climate change response strategy—due December 2011.

On March 18 and 19, 2010, the governors of Oregon and Washington signed bills to further investigate opportunities to reduce GHG emissions from transportation in their states. Oregon

Senate Bill 1059a directs the Oregon Transportation Commission to "adopt a statewide transportation strategy on GHG emissions…," including the establishment of guidelines for developing land use and transportation alternatives that would decrease GHG emissions and the creation of a program to assist local governments in reducing GHG emissions from vehicles. The bill also calls for ODOT and the Department of Land Conservation and Development to educate the public about the need to reduce GHG emissions from vehicles and other sources. Those two agencies are to report back to the Legislature on the financing needed to implement the bill's directives, as well as the progress made in achieving them.

Washington Senate Bill 6373 modifies the state's GHG reporting requirements so that they align more closely with the requirements established by the EPA in September 2009. In contrast to the EPA's regulations requiring entities to report if their emissions equal or exceed 25,000 metric tons of carbon dioxide equivalent per year ($MtCO_2e/yr$), Washington will require reporting from any source that emits greater than 10,000 $MtCO_2e/yr$. Further, in 2008 the Washington State Legislature approved the Climate Change Framework that established GHG reduction limits in the Revised Code of Washington 70.235.020, and directed Ecology to develop a comprehensive plan to reduce the state's emissions, including strategies to reduce emissions from transportation.

Consistent with federal and state policies, current WSDOT activities that reduce GHG emissions include:

- Transportation options – For 30 years, WSDOT has supported carpooling, vanpooling, and public transportation through the funding, building, and maintenance of the freeway HOV system, ferries, rail, and other programs. WSDOT's Commute Trip Reduction program has been partnering with employers to offer alternatives to drive alone commuting for 17 years and WSDOT has the nation's largest public vanpool program. All of these programs continue to expand. These investments help to reduce the number of vehicles on the roadway during peak congestion and help reduce total vehicle miles traveled.
- Incident response team (IRT) – WSDOT has 55 vehicles that patrol 500 miles of highway to clear blocking incidents quickly and safely. IRT clears 98.6 percent of all incidents in less than 90 minutes, reducing the amount of time motorists spend sitting and idling in traffic.
- Using biodiesel in ferries – Each year, the state ferry system burns approximately 17 million gallons of diesel fuel in its ferries, making the agency a significant fuel consumer in Puget Sound. In March 2008, The WDOT Ferries Division began testing the use of biodiesel in the marine environment. Using biodiesel instead of traditional petroleum-based fuels reduces emissions of particulate matter and GHGs, improving both local air quality and the Earth's climate.

Local Policies

In 1993, Portland was one of the first U.S. cities to adopt a plan to address climate change. In 2001, Multnomah County joined Portland in adopting a revised plan, the Local Action Plan on Global Warming, outlining more than 100 short- and long-term actions to reduce emissions 10 percent below 1990 levels by 2010 (CPMC 2005). In October 2009, the City of Portland and Multnomah County adopted a major revision to their Climate Action Plan, establishing a goal of reducing GHG emissions 80 percent below 1990 levels by 2050, and identifying actions to be taken by 2012 to begin to reduce emissions. In addition, the mayors of Portland and Vancouver signed the U.S. Mayors' Climate Protection Agreement, committing to reduce carbon emissions in their cities below 1990 levels.

5.2 Project Effects

The CRC project constitutes a short section of I-5; nevertheless, the consumption of fuel for the movement of people and goods on I-5 across the Columbia River contributes to the cumulative effects of GHG emissions. The project team estimated GHG emissions for the locally preferred alternative (LPA). The methodology for estimating long-term energy use in the DEIS was based on methodologies outlined in the Oregon Energy Manual, and CO_2 emissions were estimated using data provided by EPA. The methodology used in the FEIS was changed to utilize EPA's recently released Mobile Vehicle Emission Simulator (MOVES) model.

As described in detail in Chapter 3 (Section 3.01, Transportation) of the FEIS and in the Energy Technical Report for the FEIS, the LPA is projected to reduce personal vehicle travel demand and improve the operations of the I-5 crossing, resulting in a net reduction of GHG emissions compared to No-Build conditions.

The results of the GHG analysis are summarized in Exhibit 5-4.

Exhibit 5-4. 2030 No-Build and Locally Preferred Alternative (LPA) Greenhouse Gas Emissions

Scale	2030 No-Build CO2 Emissions (Mt)	2030 LPA CO2 Emissions (Mt)c
Macroscale (regional emissions)[a]	24,876	24,746
Microscale (local emissions)[b]	389	368

Source: Energy Technical Report.

Notes: CO_2e: carbon dioxide equivalents; standard unit representing global warming potential; MT: metric ton.

a Includes interstates, highways, and principal arterials within Washington, Clackamas, Multnomah, and Clark Counties as well as light rail related emissions. Emissions are reported as daily estimates.

b Includes a 12.2-mile segment of I-5 between Portland and Vancouver. Emissions are reported for a 4-hour AM peak period and 4-hour PM peak period.

c Estimates for LPA Option A and B with or without highway phasing are the same.

The LPA is expected to reduce regional emissions by approximately 130 $MtCO_2$/day, which equates to a reduction of approximately 0.5 percent. For the 12.2-mile length of I-5 surrounding the CRC project area, the LPA is expected to reduce emissions by roughly 21 $MtCO_2$ during the AM and PM peak periods, or 5.5 percent.

The reductions in GHG emissions associated with the LPA result from three primary factors. First, the LPA would toll the I-5 crossing, which is expected to decrease the number of cars crossing the River compared to the No-Build Alternative. Second, the LPA provides light rail transit that is expected to divert a portion of personal vehicular travel demand to transit. Third, the LPA decreases congestion on I-5, which increases average speeds and improves fuel efficiency. Since the fuel efficiency of passenger vehicles typically improves as speeds increase (up to approximately free flow conditions), less fuel would be consumed and a reduced amount of GHGs would be emitted.

It is important to note that these CO_2 emission estimates do not capture all of the potential reductions in CO_2 emissions associated with the highway improvements. The estimates do not capture a reduction in congestion associated with frequent highway collisions or the elimination of congestion associated with bridge lifts. The Energy Technical Report provides additional information on these additional considerations.

5.2.1 Light Rail Sensitivity Analysis

Light rail is operated by electricity. Although light rail vehicles do not emit CO_2 during travel, the process of converting primary energy sources (e.g., coal, natural gas, etc.) to electricity does. In the DEIS, the electricity demand was assumed to be provided by Portland General Electric (PGE) and Clark Public Utilities (CPU). Data specific to PGE and CPU operations regarding the distribution of primary energy sources and emission factors for each primary energy source were used to calculate the CO_2 emissions. In this FEIS, the PGE and CPU specific data were substituted with data from EPA's Emission and Generation Resource Integrated Database (eGRID). eGRID is a comprehensive source of data on the environmental characteristics of almost all electric power generated in the U.S. eGRID is unique in that it links air emissions data, including CO_2, CH_4, and N_2O emissions, with electric generation data for United States power plants. The decision to use eGRID data from the Northwest Power Pool (NWPP) were based on the following reasons:

- The distribution of primary energy sources from PGE and CPU change over time and the resulting CO2 emission estimates could vary substantially, compared to eGRID NWPP data that is less volatile;
- Local electricity use may not have been generated locally since electricity is frequently distributed across the NWPP region;
- The State of Washington uses eGRID NWPP data for the climate registry, and eGRID NWPP data is also used by the Department of Ecology for emissions inventory;
- Use of the eGRID NWPP data maintains uniformity between project level analyses and State of Washington procedures related to air quality conformity requirements; and
- Metro, the Vancouver and Portland area Metropolitan Planning Organization, is in the process of releasing a GHG Inventory, which will utilize eGRID NWPP data.

A sensitivity analysis was completed to compare the light rail CO_2 emission estimates based on the PGE and CPU localized data versus the eGRID NWPP data. While the light rail CO_2 emission estimates based on eGRID NWPP data were 5 to 7 percent higher compared to the estimates based on PGE and CPU data, the conclusions of both analyses were consistent; i.e., the LPA would result in higher CO_2 light rail emissions relative to No Build as a result of increased light rail transit service. Since the CO_2e emission estimates were higher using the eGRID NWPP data, the disclosure of operational impacts is, if anything, conservatively high.

5.2.2 Potential Climate Change Mitigation Measures

Currently no federal, state, or local regulations specify a threshold for CO_2 emissions from transportation projects that trigger mitigation requirements, and the LPA would reduce emissions compared to No-Build Alternative. Nonetheless, aspects of the LPA reflect guidelines established by international, national, and state organizations to encourage infrastructure design that reduces GHG emissions (IPCC 2007; CCIG 2008). Several of these recommendations and relevant LPA design features are described below.

- Provide bicycle and pedestrian infrastructure. The LPA includes a bicycle and pedestrian multi-use path across the river, separated from vehicle traffic.
- Provide transit options. Currently, the only transit option between Portland and Vancouver is buses that flow and stop with traffic. The LPA will provide light rail transit that will operate on a separate guideway, unaffected by vehicle congestion.

- Implement tolls. The CRC project is proposing including highway toll structure that would include higher tolls during peak periods. Traffic modeling shows that variable tolls would cause a mode shift to transit and non-motorized transit (bicycle and pedestrian) or encourage people to not make certain trips.
- Increase efficiency of transportation systems. The elimination of bridge lifts, variable toll pricing, the addition of auxiliary lanes between closely spaced interchanges in the project area, and the intersection improvements proposed for the CRC project will reduce congestion and stop-and-go conditions and thereby improve energy efficiency.
- Support transit-oriented development. The LPA provides an opportunity for transit-oriented development that is consistent with existing land use plans for the Cities of Portland and Vancouver.
- Replace aging infrastructure in existing corridors. The LPA will upgrade an existing facility in an urban area instead of creating a new transportation corridor.

Additional measures for further reducing GHG emissions include:

- Encouraging the use of public transit (as described in the TDM technical report).
- Promoting compact development in addition to transit-oriented development, as is done by the Cities of Vancouver and Portland, C-TRAN and TriMet.
- Providing safe and well-lighted sidewalks to encourage walking.
- Providing safe and more accessible connections to paths for bicyclists and pedestrians.
- Partnering with the ride-share and commute choice programs of Metro and the CTR program in Vancouver.
- Constructing with materials and build systems that meet efficiency standards for equipment and lighting design.
- Recycling building materials, such as concrete, from the project.
- Planting vegetation to absorb and reduce or offset carbon emissions.

5.3 Effects from Other Actions (Past, Present, Future)

The CRC project team followed the WSDOT Guidance for Project-Level Greenhouse Gas and Climate Change Evaluations and received technical support from the WSDOT Air/Noise/Energy Program to evaluate existing climate change projections, identify the variable conditions expected as a result of climate change, and assess the project's resiliency to climate change impacts. Recognizing that the effects of climate change may alter the function, sizing, and operation of the LPA, the CRC project team evaluated research conducted by the University of Washington's Climate Impacts Group (CIG) to ensure that the LPA is designed to perform under the variable conditions expected as a result of climate change.

Based on the CIG's climate projections available at http://cses.washington.edu/cig/fpt/ccscenarios.shtml, over the next 50 years both Oregon and Washington states are likely to experience:

- Increased temperature (extreme heat events, changes in air quality, glacial melting).
- Changes in volume and timing of precipitation (reduced snow pack, increased erosion, flooding).

- Sea-level rise, coastal erosion, salt water intrusion.
- Ecological effects of a changing climate (spread of disease, altered plant and animal habitats, negative impacts on human health and well-being).

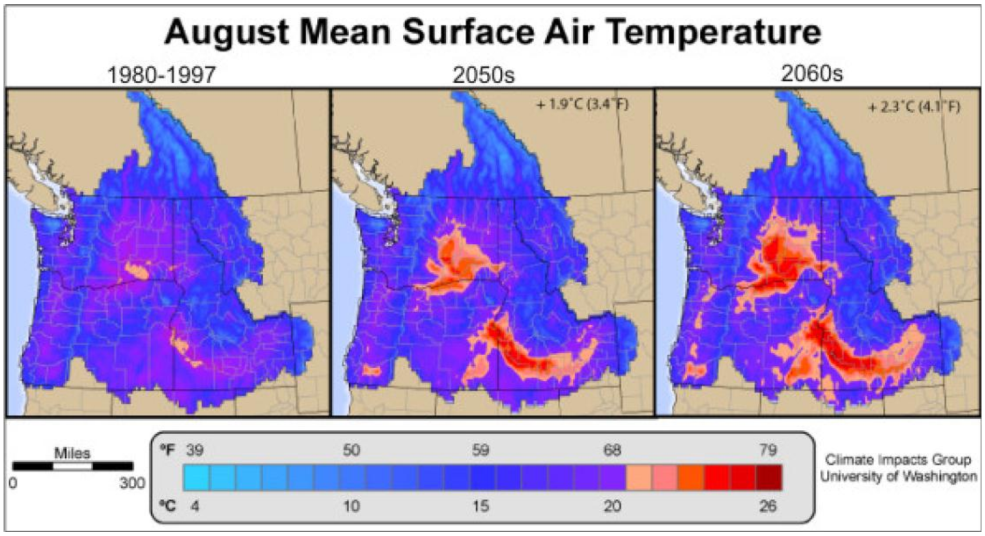
The following sections elaborate on the findings of the CIG and focus on the likelihood and magnitude of anticipated climate change impacts most relevant to the LPA, namely changes in temperature, precipitation, the frequency and severity of extreme events, and impacts to sensitive species in the Columbia River Basin.

5.3.1 Temperature

As with previous assessments of Pacific Northwest (PNW) climate change, all scenarios evaluated by the CIG project a warmer PNW climate in the 21st century. In comparison with the 20th century, PNW climate change may exhibit the following:

- Climate models project an average rate of warming of approximately 0.5ºF (0.3ºC) per decade through the 2050s (range: 0.2-1.0ºF, or 0.1-0.6ºC, per decade). The rate of change after the 2050s depends increasingly on the choice of GHG emissions scenarios. For comparison, the observed rate of 20th century PNW warming was approximately 0.2ºF (0.1ºC) per decade. The observed rate of warming for the second half of the 20th century was approximately 0.4ºF (0.2ºC) per decade.
- Average annual temperature is projected to increase 2.0ºF (1.1ºC) by the decade of the 2020s, 3.2ºF (1.8ºC) by the decade of the 2040s, and 5.3ºF (3.0ºC) by the decade of the 2080s, relative to 1970-1999 average temperature. The projected change in average annual temperature is substantially greater than the 1.5ºF (0.8ºC) increase in average annual temperature observed in the PNW during the 20th century (Mote et al. 2003).
- Temperatures are projected to increase across all seasons with most models projecting the largest temperature increases in summer (June-August).
- Annual temperature in the 21st century could increase beyond the range of year-to-year variability observed in the PNW during the 20th century as early as the 2020s. This means that species or systems that respond primarily to changes in temperature are likely to continually face new conditions as a result of climate change.

Exhibit 5-5. August Mean Surface Air Temperature



Source: Climate Impacts Group, University of Washington.

5.3.2 Precipitation and Extreme Events

The CIG predicts modest changes in regional precipitation through mid-century, although changes in precipitation are less certain than changes in temperature due to challenges associated with modeling precipitation at the global and regional scale.

- **The projected change in average annual precipitation for all models combined is near zero.** Little change in 21st century average annual precipitation is expected**.** While individual models produce changes as much as -10 percent or +20 percent by the 2080s, the **CIG's** best estimate of change is that average annual precipitation will increase 1 to 2 percent.
- **Existing seasonal patterns of precipitation could be emphasized. Just over half (59 percent) of the models and scenarios analyzed by the CIG show an increase in winter (Dec.–Feb.) precipitation in the 2020s and 2040s.** By the 2080s, increases in winter precipitation are more likely. More than 70 percent of models and scenarios analyzed agree that summer precipitation will decrease. Regardless of how much winter precipitation changes, a larger percentage of overall winter precipitation is expected to fall as rain rather than snow due to warmer winter temperatures.
- **Average annual precipitation will likely stay within the range of 20th century variability.** Average annual precipitation is likely to stay within the range of 20th century variability**.** This does not, however, **predict** how the intensity of precipitation may change.

The divergence in the CIG's model projections results from the fact that precipitation is affected by complex yet sometimes subtle changes in large-scale atmospheric circulation patterns which, in turn, are influenced by many imperfectly understood processes (e.g., ocean currents, tropical circulation, interactions between vegetation and the atmosphere).

It is also important to note that natural year-to-year and decade-to-decade fluctuations in precipitation are likely to be more noticeable than longer term trends associated with climate change. Thus, species or systems that respond primarily to changes in precipitation are likely to have already experienced the range of variability expected in the 21st century. Systems that are tuned to precipitation and temperature, however, are likely to find the conditions of the 21st century different from what they have previously experienced.

Because many key aspects of climate (e.g., windstorms, heat waves) either are not well simulated by models or cannot be studied using monthly mean values which are the standard model output, the CIG cannot speculate how they may change in the future. However, droughts may become more common due to the effects of warmer temperatures and reduced winter snowpack on late summer streamflows. Changes in the intensity of precipitation are uncertain, although a preliminary analysis suggests that average monthly (November–January) winter precipitation could become more intense by the end of the 21st century. Additionally, ongoing work by the CIG suggests that extreme daily precipitation could increase by the end of the century.

5.3.3 Sea Level

The Transportation Research Board (TRB) published a predicted sea level rise of 0.6 to1.9 feet by 2100, and predicted change in the PNW to be slightly less than the average global increase of 1.3 feet (TRB 2008). Mote et al. (2008) predicted that sea level rise in the PNW will vary with regional rates of uplift, but would be similar to the global average increase.

Under current conditions, tide levels affect river stage at the project site in Portland, Oregon. Data from the USGS gage in Portland show that the effect of the tide is greater at lower river stages (generally in the summer) and less at higher river stages, which generally occur in the winter. When river stages are less than approximately 10 feet, the tide can alter river stages by up to 2 feet. At stages above 15 feet National Geodetic Vertical Datum of 1929 (NGVD29), the effect of the tide on river stage is less than 1 foot, with the highest stages being almost unaffected by tidal fluctuations (USGS 2009).

5.3.4 Ecological Effects of Climate Change in the Columbia River Basin

The CIG has investigated the projected impacts of climate change in the Columbia River Basin and found the following:

- The impacts of climate change on streamflow timing would result in a decreased ability of the reservoir system to meet minimum streamflow requirements for fish, a slight reduction in firm power production, and improved compliance with flood control targets (Hamlet and Lettenmaier 1999; Mote et al. 1999; Miles et al. 2000; Hamlet et al., in review).
- Related work funded by the Accelerated Climate Prediction Initiative showed that instream fish flow targets would suffer under the range of future climate conditions considered, even with changes in flood operation specifically designed to mitigate the effects of climate change (e.g., reduced flood storage, earlier refill) (Payne et al., in press).

The projected impacts of climate change and other reasonably foreseeable actions could change the relative severity of CRC's impact on salmon in the context of cumulative impacts. However, climate change impacts are expected to be significantly lower than other factors related to human activity. Lost or degraded freshwater habitat is identified as a primary contributor to the decline of salmon species in the PNW (Bisson 2008).

5.4 Conclusion

Based on the best available science, the effects of climate change in the project area are projected as follows:

- It is highly likely that as a result of natural- and human-caused climate change, average annual air temperatures will increase.
- Warmer winter temperatures in the Columbia River Basin will result in lowered 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.
- Sea level rise in the PNW will vary with regional rates of uplift, but would be similar to the global average increase of 1.3 feet by 2100.
- Climate change could negatively impact salmon and trout populations in the Columbia River Basin; however, climate change–induced impacts are anticipated to be less severe than impacts from human activities such as destruction or degradation freshwater habitat.

The project team considered the information on climate change with regard to preliminary design and potential for changes in the surrounding natural environment. As part of its standard design, the LPA has incorporated features that will provide greater resilience and function with the potential effects brought on by climate change. Specifically, the lead agencies and project partners developed the Columbia River Crossing Sustainability Strategy (Strategy) to explain how the project is connected to regional and state sustainability goals, and developed a "triple bottom line" approach to measuring and minimizing the project's impacts in order to promote a healthy and balanced environment, society, and economy. The Strategy was developed from a framework of aspirational principles, and includes both strategic goals and specific tactical activities to be implemented during project phases. The Strategy addresses a comprehensive array of resource impacts and project activities, including but not limited to climate change impacts and adaptation. The full Strategy is included as Appendix C to the FEIS.

In addition to mitigation activities designed to protect and enhance air quality and minimize emissions, the Strategy specifies LPA activities to "design, construct, maintain, and operate the project to resiliently adapt to climate change." As detailed in the Strategy, the following aspects of the LPA consider the anticipated effects of climate change, and/or incorporate elements to improve the project's resilience to anticipated climate-change induced impacts:

- The LPA will avoid fragmentation and degradation of significant floodplain hydrology by sensitively locating new and modified transportation and utility project components. Climate change is anticipated to bring more frequent flooding and reduced water quality, especially in unmanaged systems. The Columbia River is a highly managed system (Hamlet et al. 2003). Nonetheless, conserving floodplains is an urgent and necessary form of ecosystem-based climate change adaptation (Opperman 2009).
- The LPA will maximize management of stormwater by restoring existing unused impervious paved areas to natural, permeable, and vegetated conditions during the design phase to the maximum extent practical. The project team included treatment devices such as bioretention ponds, soil-amended biofiltration swales, bioslopes, and constructed treatment wetlands in the conceptual stormwater management design. In addition to improving water quality in the region, these devices will reduce adverse impacts to the hydrologic system and improve the project area's water provisioning services, which will in turn reduce the likelihood and magnitude of increased flood risk.
- The LPA bridge design will accommodate potential climate-change induced rise in the Columbia River's high water levels.

Finally, while the following activities are not CRC project commitments, the Strategy provides the following recommendations for improving the project's ability to withstand disruption caused by climate change–induced impacts in future project phases:

- Continue to reduce vulnerability and resilience (e.g., to water level rise and extreme storm events, respectively) through project operations and maintenance by integrating adaptive climate change features and performance mechanisms into the design.
- Evaluate the climate change analysis methodologies and related projections to assess probable outcomes for the CRC project area over the next 50 to 100 years, and consider opportunities for adaptive management and participation in the carbon market.Based on the available information, the CRC project team concludes that the proposed project has carefully considered and disclosed GHG emissions, and has used existing climate change projections to assess the project's resiliency to the effects of climate change.

6. Temporary Effects – Construction

Cumulative impacts during construction can result when simultaneous or sequential construction projects have an additive effect to the temporary effects resulting from CRC project construction. Simultaneous or sequential construction projects can increase congestion, create more employment opportunities, cause community and natural resource impacts, and require additional public and private spending. Construction projects that may contribute to these effects when combined with CRC include:

- I-5: Salmon Creek Interchange Project
- I-5: I-205 to 179th Street
- I-205: Mill Plain Exit
- Fourth Plain: I-5 to Railroad Bridge
- Highway 99: 63rd to Ross Street
- SR 500: St. John's Interchange
- Main Street: 6th Street to 15th Street
- Columbia Shores: South of SR 14
- Vancouver Waterfront – Mixed use development
- Jantzen Beach - Redevelopment

These projects have, or would have, their own traffic control plans developed, but some may influence the travel route of commuters and freight, and could place more traffic in the CRC project corridor. Likewise, some of the projects are on planned haul routes and could influence the delivery of supplies and materials to the job sites for the CRC project. As more detailed plans are developed, traffic control plans would need to be developed with consideration of these projects and their timelines.

Other likely or potential construction projects in the vicinity are described in the Land Use Technical Report.

Construction activities associated with the LPA have the potential to cause economic impacts by temporarily blocking visibility and access to businesses, causing traffic delays, and rerouting traffic on detours that increase travel times and make access to some locations difficult. Access restrictions or difficulties may divert customers and clients, hamper deliveries, and complicate the provision of emergency services. However, most traffic movements would remain open for the LPA throughout the construction stages.

Construction of the LPA could also result in increased employment and spending in the project area during construction. The extent of these effects depends on the source of project funding and the makeup of work crews used during construction. Funds from local or regional sources are transfers that could be spent by residents and businesses on other economic activities. Federal or state funds that are new to a region can have a measurable economic effect on employment and income gains resulting from project construction. The federal government and the states of Oregon and Washington would provide the funds for the CRC project resulting in some income and job benefits that would otherwise not occur.

Some likely effects to marine commerce are as follows:

- The duration of in-water construction is projected to be periodic over six years.
- The lift span channel would be closed for a two-month period for the LPA. This channel is one of three channels available to marine commerce; during construction, efforts would be made to keep at least one channel open at all times.
- The 300-foot channel is expected to be closed for a three-month period; after this there could be room for selected river traffic, but it would be on a case by case basis and require coordination to maintain safe and effective working conditions. This channel is one of three channels available to marine commerce and during construction efforts would be made to keep at least one channel open at all times.
- Marine commerce may need an extra tow to help maneuvering during construction, which would carry an extra cost.
- Temporary river travel restrictions are anticipated in the LPA as barges are used to ferry materials to and from work sites.

The temporary effects from the CRC project, in combination with other planned projects, would cause delays and disruptions to local residents and businesses. Mitigation plans, including traffic control plans and business assistance, would reduce the negative consequences of the construction project, while the employment demands would result in positive economic outcomes for the region.

Community impacts are due to local traffic congestion and rerouting, as well as noise and air quality impacts, where CRC construction overlaps with the construction of other projects in the area. The highest potential for such impacts is likely near the bridge landing in Vancouver and on Hayden Island where other large projects are anticipated and where CRC construction duration and intensity are likely to be high.

In terms of the natural environment and biological resources, most of the construction impacts would be localized to the extent that cumulative effects from other projects may not create significant impacts. Other projects in the area would not directly impact the same waters or wetlands, or regulated habitats that the CRC project would affect. Temporary effects of the LPA are those immediate impacts resulting from construction, demolition, and associated activities. Temporary water quality impacts include turbidity due to sediment disturbance associated with in-water work, toxic contamination due to disturbance of hazardous sediments during in-water work, and toxic contamination due to accidental equipment leaks or spills in the vicinity of project waterways. Additional short-term effects to aquatic resources include harassment and non-lethal disturbance from in-water work; potential sub-lethal injury due to hydroacoustic impacts associated with pile driving and fish handling; increased risk of predation due to in-water shading during construction; and potential mortality associated with hydroacoustic impacts and fish handling.

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