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November 24, 2004

Distribution to: RCC Members

Subject: Transmittal of Columbia River Crossing Project Review Draft Working Paper Working Paper B2.3/2.4

Attached for your review and comment is: Review Draft - Working Paper B2.3/2.4 - Concept Identification, Summary of Analysis Completed, & Risk/Gap Analysis.

This working paper has been prepared to provide a summary of the analyses conducted on the concepts previously developed as part of the I-5 Columbia River Crossing Project. The working paper documents the analyses conducted for each bridge and highway concept and provides an assessment of the work completed to date. Further this working paper answers a number of "milestone" questions that provide information as to the amount of additional work required prior to NEPA scoping.

This technical memorandum is part of our larger 2004-2005 efforts to clarify and update information about the potential project concepts in the project study area. If you have questions about how it fits with other technical analyses under way, please do not hesitate to contact us. We would appreciate receiving your comments on the draft document by November 29, 2004.

Regards,

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Attachment(s)

I-5 Columbia River Crossing Partnership:
Conceptual Engineering & Environmental Analysis

Concept Identification, Summary of Analysis Completed, & Risk/Gap Analysis

Working Papers #B.2.3 and #B.2.4

Prepared by

Kittelson & Associates, Inc.

November 24, 2004

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EXECUTIVE SUMMARY

This memo identifies the array of concepts that have been considered as part of this I-5 Columbia River Crossing Partnership work that has been ongoing since 1999, and presents the Project Team's responses to key milestone questions.

Since 1999 the concept development and consideration has evolved from a brainstorming of the wide array of potential solutions (the 20 full corridor concepts) to a more detailed analysis of the blended full corridor concepts (the 9 full corridor concepts), which included conceptual engineering work, travel demand forecasts, travel performance measures and cost estimates. Subsequently, the Partnership Task Force recommended that, in the future: Interstate 5 (I-5) remain a three lane facility; a light rail loop connecting Clark County and Portland be constructed; interchange improvements and merging lanes between SR500 in Vancouver and Columbia Boulevard in Portland be constructed; and a more detailed study of the corridor between Columbia Boulevard and SR 500 be conducted. This portion of the corridor came to be known as the Bridge Influence area (BIA). Within the BIA, additional concepts (the eight concepts) were developed to meet the high volume of trips between interchanges within the study area. As allowed by scope and schedule constraints, detailed analyses (e.g. cost estimating, engineering, travel demand forecasts and performance measures, link level operations analyses) were conducted on four of the eight concepts that were identified as representative of all eight BIA concepts.

Critical team findings from this work are summarized in the milestone questions at the end of this document.

INTRODUCTION

The I-5 Columbia River Crossing Partnership Conceptual Engineering and Environmental Analysis project has been conducted as a connection between past work on the corridor and the upcoming environmental analysis for the corridor. The purpose of this project is to enumerate the array of concepts that have been considered; identify the work completed for each concept; and identify any critical gaps in the analysis that should be closed prior to initiating or within the upcoming environmental process.

To accomplish this, the consultant team gathered documentation of past work, developed a web-integrated database as a warehouse for existing and future work, and conducted a peer review assessment of the data gathered. These activities included numerous meetings with the Oregon Department of Transportation (ODOT), the Washington Department of Transportation (WSDOT), David Evans & Associates, Inc. (DEA), and Parsons Brinkerhoff (PB).

This working paper presents the identified concepts, the work completed to date on these concepts and an engineering and environmental assessment of the critical gaps that may exist.

PROCESS SUMMARY

To understand the work completed to date, it is first necessary to understand the process that has occurred. Therefore, the consultant team conducted the research necessary to develop an

understanding of the chronology of activities and the decisions made. The following summarizes our assessment:

- The I-5 Columbia River Crossing Partnership has done a substantial amount of work since 1999 when the project began with a bi-state leadership committee. This committee considered potential solutions to congestion on the I-5 corridor between Portland and Vancouver. In 2001 a Governor's Task Force was established to guide the development of a strategic plan for the corridor and a public process was convened to provide input to the process[1]. At that time, 20 concepts were identified as possible ways to decrease congestion on the I-5 corridor between I-84 and I-205. For the purposes of this project, these are called the "20 full corridor concepts". Subsequently, the Partnership consolidated the 20 concepts into 9 concepts. These are also full corridor concepts and are essentially a blending of many of the 20 full corridor concepts. A great deal of analysis was conducted on the 9 full corridor concepts. In 2002 this culminated in a Task Force decision to pursue an I-5 corridor concept that included:

    - Three through lanes in each direction on I-5 including southbound through Delta Park;
    - A phased light rail loop in Clark County in the vicinity of the I-5, SR500/4th Plain and I-205 corridors;
    - An additional span or a replacement bridge for the I-5 crossing of the Columbia River, with up to 2 additional lanes in each direction for merging and 2 light rail tracks;
    - Interchange improvements and additional merging lanes where needed between SR500 in Vancouver and Columbia Boulevard in Portland. These include a full interchange at Columbia Boulevard; and
    - Additional analysis and concept development on I-5 between Columbia River Boulevard and SR 500. This came to be known as the Bridge Influence Area (BIA). Within the BIA, eight concepts were developed that could address forecast travel needs. These eight concepts were consolidated into four representative concepts, and the four concepts were analyzed in great detail.

- The past work ended with a series of public meetings to present findings and the development of the Final Strategic Plan, which was published in June 2002. That plan summarizes all of the project analyses, findings and recommendations.

[1] "Transportation Presentations for the Portland/Vancouver I-5 Transportation and Trade Partnership", David Evans & Associates, April 2004.

LISTING OF THE 20 FULL CORRIDOR CONCEPTS

The 20 full corridor concepts are summarized in Table 1. These concepts were developed to a schematic planning level for the purposes of conveying an image of the concept, a description of how the concept might work, and the broadest level of understanding of impacts.

Table 1: Summary of the 20 Full Corridor Concepts

	20 Full Corridor Concepts
20-1	Baseline 2020
20-2	Express Bus Without Corridor Wide Capacity Increase
20-3	Commuter Rail
20-4	Other Transit Modes
20-5	Enhanced Town Centers with Transit and Arterial Improvements
20-6	Freight Arterials
20-7	Extended Westside Freight Corridor Including North Extension
20-8	Third Freeway Corridor
20-9	Three Through Lanes
20-10	Three Through Lanes with Light Rail Transit
20-11	Three Through Lanes with Express Bus
20-12	Columbia River Crossing with Supplemental Bridge (no new HCT)
20-13	Columbia River Crossing with Supplemental Bridge (with LRT)
20-14	Columbia River Crossing with New Freeway Bridge
20-15	Freight Freeway
20-16	Widen Freeway for Reversible Express Lanes, Including Light Rail
20-17	LRT Plus Widen Freeway for HOV lanes (Supplemental Columbia River Bridge)
20-18	LRT Plus Widen Freeway for HOV lanes (New Columbia River Bridge)
20-19	Express Bus Plus Widen Freeway for HOV Lanes (New Columbia River Bridge)
20-20	New Freeway Parallel to Existing Freeway

Table 2 identifies the 9 full corridor concepts that evolved from the evaluation and consideration of the 20 full corridor concepts. In many cases elements of the 20 corridor concepts were blended together and became portions of the nine full corridor concepts.

Table 2: Summary of the 9 Full Corridor Concepts

	9 Full Corridor Concepts
9-1	Baseline
9-2	Express bus without corridor-wide freeway capacity increase
9-3	Light rail transit without corridor-wide freeway capacity increase
9-4	Commuter rail without corridor-wide freeway capacity increase
9-5	Planned regional bus system with corridor-wide freeway capacity increase
9-6	Express bus with corridor-wide freeway capacity increase
9-7	Light rail transit with corridor-wide freeway capacity increase
9-8	New arterial corridor/Columbia River crossing
9-9	New freeway corridor

LISTING OF THE 8 BIA CONCEPTS

To initiate the BIA analysis, the 2002 Project Team developed three categories of potential solution concepts. These are shown below in Table 3.

Table 3: Summary of the BIA Concept Categories

River Crossing Concepts		
Category 1	**Category 2**	**Category 3**
River crossings that provide five freeway lanes in each direction. (Concepts 1,2,3,4)	A freeway and river crossing system that provides three mainline freeway lanes in each direction, plus a four-lane collector-distributor bridge/roadway west of the freeway. (Concepts 5,6)	Four through freeway lanes in each direction plus a two-lane arterial system connecting Hayden Island to Marine Drive and downtown Vancouver. (Concepts 7,8)

Within each of these categories two to four concepts were developed, evaluated by the 2002 Project Team and discussed at public meetings. Table 4 summarizes the concepts that were developed. Four of these concepts were selected for detailed analysis by the project team. The four selected are marked with an asterisk in Table 4. These were selected because they represented at least one of the above categories, and because each represented a different range of impacts or operating conditions. This selection was not intended to indicate that the four further refined concepts were superior to the other remaining four concepts.

Table 4: Summary of BIA Concepts

	BIA Concepts
8-1*	• Five Northbound Lanes on Existing Bridge; • 5 southbound lanes on new double-deck bridge; LRT on lower deck; west of existing bridges
8-2	• Five northbound lanes on new bridge east of existing bridges, • 5 southbound lanes on existing bridges, • New LRT bridge west of existing bridges
8-3	• New 5 lane double deck bridge, northbound upper deck, southbound lower deck, • LRT on existing west bridge
8-4*	• New five lane double-deck bridge; northbound upper deck, southbound lower deck, • LRT on new bridge west of existing bridges; • Only option to shift navigational channel
8-5	• New 6 lane bridge east of existing bridges; • 2 lanes northbound/southbound collector-distributor on existing bridges; • LRT on new bridge west of existing bridges
8-6*	• 3 lanes northbound/southbound on existing bridges; • New 4-lane collector-distributor double deck bridge with LRT on lower deck
8-7*	• 3 southbound lanes on existing west bridge; • HOV only, southbound and northbound on existing east bridge; • 3 northbound lanes on new bridge east of existing bridges; • 2 arterial lanes and LRT on new bridge west of existing bridges
8-8	• New 8-lane Bridge east of existing bridges • Local Arterials on existing northbound ridge • LRT on southbound Bridge

CONCEPTS NOT MEETING VISION OF CONGESTION RELIEF

The 2002 Final Strategic Plan also identified concepts that, if constructed as the only improvements in the corridor, would not meet the vision for congestion relief along the corridor. These are summarized in Table 5.

Table 5: Concepts Not Meeting Vision of Congestion Relief

	Concepts Not Meeting Vision of Congestion
1	Collector-Distributor Bridge Concepts
2	Arterial only bridge concepts
3	Tunnel concepts
4	6-Lane Freeway plus two 2-lane arterials, one in the vicinity of the I-5 corridor and one in the vicinity of the railroad bridge
5	Commuter Rail

ANALYSIS CONDUCTED ON THE 20 FULL CORRIDOR CONCEPTS

The 20 full corridor concepts were developed at a planning level as part of a brainstorming process. The purpose of the process was to identify the broadest range of concepts that might meet the future vision for transportation on the I-5 corridor. Forecast 2020 traffic volumes were developed for the Baseline alternative. The Baseline alternative included projects programmed at the time of the analysis or very likely to be programmed and built prior to 2020.

All of the concepts were developed to a planning level providing a description of the concept (e.g. personal rapid transit), a schematic alignment (e.g. horizontal or vertical), and/or a typical cross section. Table 6 summarizes in detail the work that was completed for each alternative.

Table 6: Analysis Conducted on the 20 Full Corridor Concepts

	Concept	Analysis Conducted
20-1	Baseline	2020 Forecast, Travel Performance
20-2	Major Transit Improvements	Description only
20-3	Commuter Rail	Schematic of alignment
20-4	Other Transit Modes	Description only
20-5	Enhanced Town Centers	Description, conceptual mapping
20-6	Freight Arterials	Schematic of alignment
20-7	Extended Westside Freight Corridor	Schematic of alignment
20-8	Third Freeway Corridor	Schematic of alignment
20-9	Three Through Lanes	Schematic of alignment and cross-section
20-10	Three Through Lanes with LRT	Schematic of alignment
20-11	Three Through Lanes with Express Bus	Schematic of alignment
20-12	Columbia River Crossing with Supplemental Bridge (No New HCT)	Schematic of cross-section and alignment
20-13	Columbia River Crossing with Supplemental Bridge (With LRT)	Schematic of cross-section and alignment
20-14	Columbia River Crossing with New Freeway Bridge or Tunnel	Schematic of cross-section alignment, and profile
20-15	Freight Freeway	Schematic of alignment and profile
20-16	Widen Freeway for Reversible Express Lanes including LRT	Schematic of cross-section and alignment
20-17	Widen Freeway for HOV Lanes including LRT (Supplemental Columbia River Bridge)	Schematic of cross-section and alignment
20-18	Widen Freeway for HOV Lanes including LRT (New Columbia River Bridge)	Schematic of cross-section and alignment
20-19	Widen Freeway for HOV Lanes plus Express Bus (New Columbia River Bridge)	Schematic of cross-section and alignment
20-20	New Freeway Parallel to Existing Freeway	Schematic of cross-section and alignment

Following a planning level review and discussions with the Governors' Task Force these twenty concepts were consolidated and narrowed to the 9 full corridor concepts.

ANALYSIS CONDUCTED ON THE 9 FULL CORRIDOR CONCEPTS

Once consolidated to the 9 full corridor concepts, a significant amount of modeling, engineering, and cost estimating was conducted. Year 2020 emme/2 travel demand forecasts and performance measures were developed for each concept. These performance measures included:

- Vehicle miles traveled,
- Vehicle hours of delay,
- Truck delay,
- Congested lane miles,
- Link capacity analysis, and
- Vehicle user cost savings.

In addition to the schematic alignments developed as part of the first stage of the project, detailed conceptual plans were developed for most of these concepts. At the time of the preparation of this working paper, the consultant team has not received any functional layout related information and therefore was unable to complete any assessment of these.

Table 7 summarizes the analyses conducted for the 9 full corridor concepts.

Table 7: Analysis Conducted on the 9 Full Corridor Concepts

	Concept	Analysis Conducted
9-1	Baseline	2020 Forecast, Travel Performance
9-2	Express Bus/3 Lanes	2020 Forecast, Travel Performance, Schematic horizontal alignment
9-3	Express Bus/3 Lanes	2020 Forecast, Travel Performance, Schematic horizontal alignment and cross-section
9-4	Commuter Rail/3 Lanes	2020 Ridership Estimate, Schematic horizontal alignment, $1.5 to $1.7 Billion capital plus 8.7 million annual operating
9-5	Planned Regional Bus System/4 Lanes – Analyzed with Express Bus/ 4 Lanes	Integrated into Express Bus/4 Lanes

	Concept	Analysis Conducted
9-6	Express Bus/4 Lanes	2020 Forecast, Travel Performance, Schematic horizontal alignment and cross-section
9-7	Light Rail/4 Lanes	2020 Forecast, Travel Performance, Schematic horizontal alignment
9-8	West Arterial Road	2020 Forecast, Travel Performance, Schematic horizontal alignment
9-9	New Freeway Corridor	Schematic of alignment

ANALYSIS CONDUCTED ON THE 8 BIA CONCEPTS

As the project continued, the Task Force agreed that I-5 would be a three-lane facility, there would be a light-rail loop connecting Portland and eastern and western Clark County, and that more detailed analyses were required in the Bridge Influence Area: I-5 between Columbia Boulevard in Portland, and SR 500 in Vancouver.

Initially the eight BIA concepts were developed to represent the array of possible concepts for relieving transportation congestion in the smaller corridor. Subsequently, four of these concepts were developed and analyzed in more detail to respond to questions about detailed traffic operations, environmental impacts, and design considerations. The BIA concepts that were analyzed in more detail were selected based on the fact that they represented a cross-section of the impacts and traffic operating conditions, they were not selected or intended to represent preferred concepts.

The analyses conducted on the 8 BIA concepts were limited to the four representative concepts (Concepts 1, 4, 6 and 7). No analyses were conducted for the other concepts due to time and budget constraints.

The analyses conducted on the four detailed representative BIA concepts included Metro's 2020 travel demand forecast modeling, VISSIM modeling, detailed CAD functional layouts, and cost estimating based on 2002 dollars for each concept. This information is summarized in Table 8.

Table 8: Analysis Conducted on the 8 Bridge Influence Area Concepts

	Concept	Analysis Conducted
8-1*	Concept 1: 5-lane SB Supplemental Bridge for Freeway Traffic w/ LRT	2020 Forecast, VISSIM Model, CAD and MicroStation layouts, $1.2 billion (2002)
8-2	Concept 2: Five northbound lanes on new bridge east of existing bridges	None
8-3	Concept 3: New 5 lane double deck bridge, northbound upper deck,	None

	Concept	Analysis Conducted
	southbound lower deck	
8-4*	Concept 4: 10-lane Double Deck, Replacement Bridge, plus LRT on Separate New Bridge	2020 Forecast, VISSIM Model, CAD and MicroStation layouts, $1.175 billion (2002)
8-5	Concept 5: New 6 lane bridge east of existing bridges	None
8-6*	Concept 6: 4-lane Supplemental C-D Bridge w/ LRT, plus 6-lane Freeway	2020 Forecast, VISSIM Model, CAD and MicroStation layouts
8-7*	Concept 7: 8-lane Freeway Concept plus new LRT Bridge w/ 2-lane Arterial	2020 Forecast, VISSIM Model, CAD and MicroStation layouts, $1.161 billion (2002)
8-8	Concept 8: New 8-lane Bridge east of existing bridges	None

ANALYSIS CONDUCTED ON THE CONCEPTS NOT MEETING THE VISION FOR CONGESTION RELIEF

The analyses conducted on the concepts that do not meet the vision for congestion relief showed that, while there is merit to each of these concepts, implemented individually, the concepts would not meet the desires for congestion relief on the corridor. Details are summarized in Table 9 below.

Table 9: Analysis Conducted on the Concepts Not Meeting the Vision for Congestion Relief

	Concept	Analysis Conducted
1	Collector-Distributor Bridge Concepts	Origin-destination analyses, 2020 forecasts, travel performance measures including vehicle miles traveled, congested lane miles and delay.
2	Arterial only bridge concepts	Origin-destination analyses, 2020 forecasts, travel performance measures including vehicle miles traveled, congested lane miles and delay.
3	Tunnel concepts	Origin-destination analyses, 2020 forecasts, travel performance measures including vehicle miles traveled, congested lane miles and delay. A Technical Memorandum documenting this specific work will be prepared by David Evans & Associates, Inc.
4	6-Lane Freeway plus two 2-lane arterials, one in the vicinity of the I-5 corridor and one in the vicinity of	Origin-destination analyses, 2020 forecasts, travel performance measures including vehicle miles traveled, congested lane miles and delay. A Technical

	Concept	Analysis Conducted
	the railroad bridge	Memorandum documenting this specific work will be prepared by David Evans & Associates, Inc.
5	Commuter Rail	Ridership forecasts, capital and on-going operating cost estimates, anticipated service frequencies, and anticipated alignments. A Technical Memorandum documenting this specific work will be prepared by David Evans & Associates, Inc.

ASSESSMENT OF ANALYSES CONDUCTED TO DATE

BIA Conceptual Engineering

To conduct a detailed peer review of the concepts our approach was to highlight potential design concerns quickly, without the benefit of all background information. Appendix A provides a summary of the peer review results and includes graphics that highlight the areas where we had questions or comments

There is a clear distinction between WSDOT and ODOT concepts related to the range of concepts considered and the level of engineering performed at this design level. The ODOT concepts reflect a range of concepts between the south bridgehead and the Columbia Boulevard interchange. The WSDOT concepts generally reflect a single collector-distributor concept north of the bridgehead with minor variations to the configuration. The ODOT concepts have been developed to varying levels of detail but it appears ODOT generally considered three-dimensional design relationships. The WSDOT concepts appear to have been developed primarily addressing the horizontal plan and may not have considered three dimensional design relationships.

The ODOT concepts appear to have been generated to avoid impacts in the Delta Park area. In some cases, some local movements are not provided and in one concept weaving is introduced on the mainline. As the concepts are developed, it would be reasonable to consider configurations that meet a comprehensive transportation objective at the expense of environmental impacts. With an understanding of total footprint needs, appropriate modifications could be made to balance design, avoidance, and mitigations.

Because the WSDOT concepts may not have been considered in three dimensions, the plans do not presently address contemporary design, operations, safety, and FHWA policy requirements. When the WSDOT concepts are developed to address these specific points, the impact areas in and around the corridor will likely exceed the footprint currently conveyed on the plans.

Environmental Analysis

As part of the Task Force work, reconnaissance-level of environmental analyses were documented in two planning documents – an Environmental Impact Assessment (EIA) completed in October 2001 and a BIA Summary Report completed in April 2002. These two analyses covered different study

areas. The EIA addressed six corridor-length options, while the BIA addressed the eight concepts that looked specifically at the Columbia River crossing. And of the eight concepts, environmental information was only provided for four. The environmental information presented in these documents was intended to be at a reconnaissance level and, as such, provides a general sense of the environmental issues associated with each of the alternatives reviewed. Although some general conclusions could be gleaned, neither document contains the detailed environmental analysis required to evaluate and compare alternatives in a National Environmental Policy Act (NEPA) Environmental Impact Statement (EIS).

The information in Appendix B extrapolates the environmental information in these two documents to the 8 BIA concepts, using approximations of the relationships between the different geographical areas reviewed in the two source documents. It is organized by environmental subject area in the same way that an NEPA document would be organized. In addition to the summary of findings from this task, Appendix B flags potential environmental issues compiled from the environmental team that could deserve special attention during the NEPA EIS process.

Cost Estimating

When the original twenty options were developed, there were no cost estimates developed for these. However, because some of the elements that make up these options are common with the more refined nine options or the eight BIA concepts, there is partial cost information available for these options. The cost information would not be sufficient to carry these options through the environmental phase.

For the nine more refined options, cost information was developed for Options 2 (express bus), 3 (LRT), 6 (express bus with freeway capacity increase), 7 (LRT with freeway capacity increase) and 8 (new arterial corridor). Cost information was also developed for Option 1 (baseline) except that improvements in the Rose Quarter area were not estimated. This information is found in a set of memos from Parsons Brinkerhoff, dated September 2001. The cost information in these memos is lumped into several consistent categories, but it is not known what method was used to develop these numbers. Because some of these options have common elements, there is some information available for Options 4 (commuter rail without freeway capacity increase), 5 (regional bus system with freeway capacity increase) and 9 (new freeway corridor), but this information does not account for the total cost of these options. It is not clear for any of these options if major cost elements such as construction staging, temporary signing and bridge foundations conditions were adequately addressed.

As stated above, eight concepts were developed for the Bridge Influence Area, but it became apparent that the impact and relative merits of these concepts could be tested by just developing information about four of them (1, 4, 6 and 7). These were to serve as surrogates for the others. Then about midway through the analysis of these concepts, the decision was made to continue to display Concept 6, but because of it limited benefits to reducing congestion, no further detail such as cost estimating was done. The team was supplied with cost estimating spreadsheets for Concepts 1, 4 and 7. These spreadsheets include about 50 line items, grouped in about ten categories. These spreadsheets are dated March 28, 2002. They show that Concept 1 costs about $1.05 billion, Concept 4 about $1.18 billion and Concept 7 about $875 million.

Detail about how these cost estimates were developed was not available, but further interviews determined that ODOT developed the costs for the portion of the project south of the Columbia River and the bridges over the Columbia River. PBQD provided cost estimates for the project elements north of the Columbia River and added those costs to those prepared by ODOT.

Having cost estimates developed by two different entities could raise a flag of caution. The line items for overlay surfacing and signage appear to be low. It is not clear how construction staging and temporary signing, striping, flagging, etc. were addressed in these estimates. That might be a major risk in using these numbers. Other risk areas are where unseen or unknown conditions will apply. These include physical things, such as foundations in the river bottom, but also construction elements that may have to be added to satisfy stakeholders, regulatory agencies and political realities.

Price movement for materials could also have a major impact on a project of this magnitude. The recent spikes in steel prices and fuel costs would have increased the costs drastically if the cost estimates were being prepared now.

Another huge risk might be the viability of the existing Columbia River structures. Most of the concepts and options developed to date assume that these bridges will continue to be used in some way. David Cox, FHWA Regional Administrator, recently addressed a transportation seminar at Portland State University. When asked if these old bridges would be used as part of the new system, he stated, "I'm sure not. They are very old and would probably be among the first to come down during a seismic event." It is not known how thoroughly this issue was researched during the previous work.

These estimates were intended to be "order of magnitude" only for comparison purposes and were not intended for management decisions.

Appendix C provides detailed review of the cost estimating conducted to date

Boat Survey

The boat survey provided new information to the I-5 Columbia River Crossing study and verified the clearance requirements of the existing vessels navigating the subject portion of the Columbia River. Based on this survey, it was determined that river has been at a Stage 15' or lower 98 percent of the time over the past 25 years. This information combined with the vessel inventory between the I-5 and I-205 bridges indicates that a future bridge with a vertical clearance of 125 feet above the Columbia River Datum could effectively accommodate all existing vessels. It was further determined that a lift span bridge with a closed vertical clearance of 80 feet above the Columbia River Datum could accommodate all river traffic with the exception of 4 construction related barges and two recreational sailboats.

Appendix D provides a detailed summary of the boat survey that was conducted as part for this project.

Toll Facilities

A separate analysis is being conducted related to the potential financial, policy, engineering, and other impacts of implementing tolling facilities within the BIA. To date, information related to this has not been received.

MILESTONE QUESTIONS

As this project moves into the environmental analysis phase, by addressing a number of outstanding milestone questions, ODOT and WSDOT will be better able to complete the NEPA scoping process. The questions and the consultant team's responses are presented below.

Environmental Issues

What is the extent to which previous information and design concepts can be relied upon for complete evaluation in the environmental process?

From an environmental prospective, the information gathered to date is helpful in the screening of concepts. Much of it, however will quickly become out of date, and will not be specific to the refined alternatives carried into the NEPA document.

Are there key environmental issues regarding adequacy or consistency that need to be addressed to complete future NEPA scoping activities?

There are no key environmental issues that need to be resolved prior to the initiation of NEPA scoping. Critical environmental areas include:

- Threatened and Endangered species in the river: Impacts will be a function of bridge design including pier and ramp locations

- Fort Vancouver National Historic Monument: The buildings and likely the surrounding properties have special protections under Section 4f. Alternatives will need to be examined that do not impact Fort Vancouver in any way. It appears that all eight of the BIA concepts encroach upon the Fort Vancouver property in some way.

- Wetland mitigation site at the radio tower: As with Fort Vancouver, this wetland mitigation site has special protections by USCOE and State DSL. Alternatives need to be examined that avoids this mitigation site entirely. It appears that BIA Option 4 is the only BIA concept that successfully avoids this mitigation site.

- Residential impacts north of the river: Impacts to residences along I-5 north of the Columbia River have special political sensitivities. It appears that none of the BIA concepts under consideration avoid these residences completely (displacements were avoided in Concepts 1, 4, 6 and 7; however these do include residential encroachments). Concepts 1 and 7 had no displacements (residential or non-residential) If possible, an alternative(s) will need to be developed that does avoid those impacts.

Conceptual Engineering

Are there critical freeway and/or interchange improvements within each of the bridge concepts that need further refinement?

Overall, the four representative concepts of the eight original BIA concepts have been developed at a sketch level from an engineering perspective. As highlighted in Appendix A there are a number of basic lane balance, constructability/maintenance of traffic, vertical/horizontal alignment, and signing issues that appear to have not been fully addressed. As these and other concepts are carried forward in future project development efforts, the questions and issues identified can form the basis for developing specific alternatives within the range of concepts.

Are there concepts identified in the Strategic Plan that require more study, but whose study was deferred to the next phase?

The Strategic Plan recommended additional study on the 6-lane freeway plus two 2-lane arterials concept. Previous traffic modeling analyses conducted by David Evans & Associates, Inc. indicates that this concept does not effectively address the congestion issues or provide the necessary connectivity between I-5 and SR 14. As a result, David Evans & Associates, Inc. will prepare a technical memorandum documenting these deficiencies with the 6-lane freeway plus two 2-Lane arterials concept.

The ODOT concepts appear to represent a range of alternative configurations. Discussions with ODOT design staff indicate this range of concepts was meant to represent a broad spectrum of configurations. In time, elements of these concepts could potentially be mixed and matched to generate new concepts or specific alternatives.

The WSDOT concepts essentially focus on a single north and southbound Collector-Distributor system to match to the various bridge concepts. There could be variations in the Collector-Distributor system concepts including partial Collector-Distributor roads or other variations in the access provided to and from existing service and system interchanges.

Are there other concepts that should be addressed in the Phase II portion of this study based on meetings with ODOT, WSDOT and other affected agency staff?

Based on the work that has been conducted to date under the Phase 1 portion of this study and the meetings with ODOT and WSDOT, two additional concepts have been identified for further analysis. These concepts include the *Tunnel Concept* and the *Northshore Elevated Lift Bridge Concept.*

The *Tunnel Concept* as indicated by its name would cross the Columbia River via a tunnel versus the bridge scenarios discussed in the other BIA concepts. Preliminary traffic modeling analyses conducted by David Evans & Associates, Inc. indicate that this concept may not effectively address the congestion issues or the origin-destination needs within the BIA. To fully understand the traffic

demand capabilities of this concept, David Evans & Associates, Inc. will be preparing a technical memorandum that evaluates the merits of the *Tunnel Concept* in addressing the transportation issues.

The *Northshore Elevated Lift Bridge Concept* was conceived as a scenario whereby the existing northerly navigation channel could be retained through the development of an elevated lift-structure that would clear the Burlington Northern Santa-Fe railroad tracks on the Washington side of the river and only require occasional bridge lifts for the small number of vessels requiring clearances greater that approximately 90 to 100 feet. The feasibility of the *Northshore Elevated Lift Bridge Concept* will be analyzed using the information gained through the Boat Survey (WP #B.3.4) and the anticipated Vertical Bridge Construction Window Analysis. This analysis will focus on navigational needs, the glide path requirements for Pearson Airpark and PDX, the vertical clearance needs at the Burlington Northern-Santa Fe rail line, the structural needs of a lift span, and the structural depth requirements of a single and double deck bridge structure.

Should existing concept drawings be changed based on interchange issues, incorporating toll collection footprint concepts and other results from other traffic work currently underway and/or vertical clearance and channel issues associated with the marine and air constraints?

Based on the BIA Conceptual Engineering Assessment summarized above and the information provided in Appendix "A", there are a number of issues that have been identified regarding the current concept drawings that should be addressed more thoroughly in the EIS process. While these issues may result in substantive changes to the existing conceptual drawings, it is not recommended that the conceptual drawings be changed at this time. Rather, the information presented in this working paper and the accompanying appendices should be used as information and guidelines in the overall development of the alternatives within the EIS process. In summary, the work completed to date yields a wealth of knowledge about engineering issues, impact areas, and general information that will be useful in future scoping activities and to develop engineering alternatives of various concepts.

Are there critical engineering considerations related to construction of the design concepts (e.g. ability to maintain traffic flow, need for a temporary bridge, or time impacts of in-water construction)?

Based on the review of the existing eight BIA concepts, there are a number of critical engineering considerations related to construction that need to be thoroughly addressed through the EIS process, including:

- The ability to maintain traffic flow on the I-5 mainline as well as from SR-14, downtown Vancouver, and Jantzen Beach. Many of the concepts, while functional in their final state, do not appear to have construction staging opportunities that would allow for traffic to be maintained effectively to/from the four identified origins/destinations.

- It is conceivable that elaborate traffic maintenance plans may be required to provide access and circulation during major construction activity. In some cases, temporary roadways may need to be constructed or existing interchanges and ramp movements may need to be closed

or provided via temporary construction. Given the extent of construction, the construction duration could be lengthy and, therefore, the impacts during construction will need to be considered in addition to the impacts of the completed project.

Are the three categories developed in the BIA process comprehensive?

The BIA included three categories for concepts:

- River crossings that provide five freeway lanes in each direction;
- A freeway and river crossing system that provides three mainline freeway lanes in each direction, plus a four-lane collector-distributor bridge/roadway west of the freeway; and
- Four through freeway lanes in each direction plus a two-lane arterial system connecting Hayden Island to Marine Drive and downtown Vancouver.

The categories developed in the BIA process have been helpful to frame the range of alternative concepts. As the categories have yielded specific alternative concepts, the usefulness of the previous categories has diminished. As the concepts move forward for further evaluation, it is likely that specific design alternatives may include combinations of each concept. Further, potential toll facility needs may further reduce the value of the categories as toll operations may dictate modifications to the current design concepts.

Cost Estimating

Are there any fatal flaws in the cost estimating work that would significantly change the anticipated magnitude of costs?

As stated above, there are at least four major potential issues that could have very significant impacts to the anticipated costs. These are:

1. The issue of how this complex project could be built while still accommodating a heavy traffic load (staging, traffic control, etc.)
2. The unseen and unknown conditions (physical, as well as stakeholder, environmental and political impacts)
3. The volatility of material costs over time.
4. The viability of using the existing Columbia River bridges as part of a new system.

Will the cost estimating work need to be updated as part of the environmental analysis?

Cost estimating will have to be done as part of the environmental analysis. Even for the previously determined options, let alone any that may still develop, the estimates were not sufficient to make value judgments about the balance between function, impacts and cost. The estimates were intended only to aid in making rough comparisons between brainstormed concepts and options.

Additional Analyses

Can dropping the Collector-Distributor option, Tunnel option, and Commuter Rail option from further consideration be justified, and has sufficient justification been provided for each?

None of these concepts appear to provide sufficient capacity, in and of themselves, to meet the vision for congestion relief on the I-5 corridor. Travel forecasts, origin-destination analyses, operations analyses, alignment concepts, and operating and initial investment costs have been estimated. David Evans & Associates, Inc. is preparing documentation explaining the operations and potential impacts associated with these concepts. This should be sufficient to include these concepts in the "alternatives considered, but not carried forward" category of the future environmental impacts statement.

To assist with developing screening criteria, what are some of the key distinctions between options?

Construction

- All concepts will require extensive efforts to maintain traffic during construction. The duration to construct some concepts could far exceed others. The difference in construction duration could be a distinguishing factor.

- Some concepts will require extensive temporary roadways or road closures. Temporary roadways could add to the project capital cost and road closures could impact industrial, commercial, and retail land uses.

- The concepts will require many traffic sequencing phases as various roadways are constructed. The quality, in terms of safety and operations, may vary between plans. Safety and operations during construction could vary between concepts.

Design consistency and driver expectations

- Some concepts include creative configurations to use the existing bridges. Others require extensive ramps and connecting roadways. These configurations may not meet driver expectations. Concepts that provide a design that is consistent with driver expectations should be ranked higher than those that do not.

Additional Notes

There are a few additional noteworthy items:

- ❖ All of the previous analyses were conducted on 2020 traffic volumes. As the project moves into the next stages of the operational and environmental analysis it will be necessary to update the traffic volume forecasts to opening year and opening year plus twenty years.

- ❖ Some of the concepts provide complex roadway and ramp configurations that may not be accurately modeled using traditional traffic analysis tools. Microsimuliation may be a valuable tool in analyzing the complex roadway networks.

NEXT STEPS

Following this memo, the consultant team will develop a scope of work designed to further assist ODOT and WSDOT with beginning the environmental process. The scope of work will be developed in collaboration with ODOT and WSDOT and as an outcome of discussions related to the findings from this memo.

APPENDIX "A"

I-5 Columbia River Crossing
Bridge Influence Area (BIA) Conceptual Engineering
Qualitative Concept Assessment

This document summarizes the Conceptual Engineering Qualitative Assessment for the four BIA representative concepts on both the Washington and Oregon sides of the Columbia River.

OVERVIEW AND SUMMARY

There is a clear distinction between WSDOT and ODOT concepts related to the range of concepts considered and the level of engineering performed at this design level. The ODOT concepts reflect a range of concepts between the south bridgehead and the Columbia Boulevard interchange. The WSDOT concepts generally reflect a single collector-distributor (C-D) concept north of the bridgehead with minor variations to the configuration. The ODOT concepts have been developed to varying levels of detail but it appears ODOT generally considered three-dimensional design relationships. The WSDOT concepts appear to have been developed primarily addressing the horizontal plan and may not have considered three dimensional design relationships.

The ODOT concepts appear to have been generated to avoid impacts in the Delta Park area. In some cases, provisions for all local movements have not provided. Additionally, one concept introduces a weaving section on the mainline. As the concepts are developed, it would be reasonable to consider configurations that meet a comprehensive transportation objective at the expense of environmental impacts. With an understanding of total footprint needs, appropriate modifications could be made to balance design, avoidance, and mitigations.

Because the WSDOT concepts may not have been considered in three dimensions, the plans do not presently address contemporary design, operations, safety, and FHWA policy requirements. When the WSDOT concepts are developed to address these specific points, the impact areas in and around the corridor will likely exceed the footprint currently conveyed on the various concept plans.

QUALITATIVE CONCEPT ASSESSMENT

Our approach was to highlight potential design concerns quickly without the potential benefit of all the available background information. A narrative on design questions is challenging to comprehend. As a result, figures have been provided to accompany the narrative and to illustrate the various points and design related questions. The following general comments apply to ODOT and WSDOT developed concepts on the south and north sides of the Columbia River, respectively.

Horizontal Alignment

There are several key elements to consider when establishing a horizontal alignment. Current concepts have locations that would need to be addressed during the alternatives design development. The design features listed below are a few of the critical elements:

Broken-Back Curves

AASHTO recommends that "broken-back" arrangement of curves (with a short tangent between two curves in the same direction) be avoided. Successive curves in opposite directions meet driver expectation. Broken back curves can violate driver expectations and may degrade traffic operations and safety.

Compound Curves

Where topography or right-of-way restrictions may make compound curves necessary, AASHTO recommends exercising caution when using the design approach. The curve radii of the larger radius should not exceed the smaller radius by more than 50 percent. Compound curves with large differences in radius introduce potential speed reductions that can degrade traffic operations and safety.

Reverse Curves

Reverse curves require sufficient tangent lengths to provide appropriate super-elevation transitions. Back-to-back reverse curves do not allow sufficient transition and create potential operational issues.

Off-Ramp, On-Ramp and Loop Ramp Design

The following factors are critical in the determination of the length of an off-ramp:

- Deceleration length necessary from freeway design speed to ramp speed (especially in the presence of a sharp curve),
- Stopping sight distance to the back of queue, and
- The anticipated 95^{th} percentile queue at the controlled terminal intersection.

For on-ramps, it is critical to know the speed differential between the ramp and the freeway to determine the required acceleration length, as well as the location of the on-ramp to meet the necessary sight distances. In addition, unconventional left-hand ramps should be avoided to maintain design consistency and driver expectation. Further, the number of successive off- and/or on-ramps and the spacing between these ramps are critical in order to provide adequate signing to assist the driver decision process. Combining two or more ramps and reducing access points to the freeway can minimize "friction" along the mainline. However, combining exits can create driver comprehension issues as signs require excessive message units for multiple destinations.

Lane Balance

Lane balance is a critical component of a successful highway design. A lack of lane balance can be the single-most contributor to poor traffic operations, excessive lane changing, and high crash experience. The questions listed below need to be revisited with the traffic volumes anticipated for the specific road sections to determine the required number and arrangement of lanes.

- Is it possible to serve multiple interchanges by one off-ramp from the freeway to the C-D road system and/or on-ramp from the C-D road system to the freeway? What are implications associated with developing the appropriate numbers and arrangement of lanes to accommodate the forecasted demand volumes? Can the facility be appropriately signed?
- Are adequate lane numbers (basic lanes plus auxiliary lanes) at all mainline ramp locations? Have traffic operations been adequately considered in locations of multiple off ramps and especially at two lane exits?
- Are there lane drops on the mainline? If so, what are the appropriate ways to reduce lane numbers while maintaining lane balance?

Profile

Vertical curves must meet the appropriate design speed and have grades that are consistent with the roadway functional classification. The freeway grades are relatively flat and require relatively longer distances between exit gores and subsequent grade separations. Complex ramp systems require extensive evaluations to attain appropriate grades and vertical alignments. These evaluations are critical to ensuring an attainable profile and providing reasonable grades, alignments, and adequate decision and stopping sight distances.

Lane Changing

A C-D road system reduces weaving along the mainline freeway by shifting it to a lower order ramp system. However C-D systems require carefully considering the number (how many roadways are being served) and arrangement (left and right hand ramps) of accesses. Concepts requiring numerous lane changes over short distances can create poor operations caused by excessive signing (affecting driver decision making), weaving, and forced lane changes.

Gore Overlap

Ramps between the freeway and C-D road require a physical overlap of the gore areas. "Gore overlap" is needed to prohibit motorists from making unauthorized movements (across gore point) between the freeway and C-D system.

ASSESSMENT COMMENTS

The attached figures summarize design questions for Concepts 1, 4, 6 and 7. In addition, we thought it would be helpful to provide more specific feedback regarding the WSDOT concepts especially just north of the Columbia River, because the concepts do not conform to contemporary design, operations, safety, and FHWA policy requirements.

OREGON STATE (ODOT) CONCEPTS

We have generalized the topics into two primary categories: Bridgehead and Delta Park related issues. We understand configurations presented in Concepts 1, 4, 6, and 7 have superceded recent design alternatives developed for the I-5/Columbia Boulevard interchange. We will not address the prior interchange concepts at this location.

Bridgehead

Extensive development on Hayden Island creates constraints to physically locate the concept mainline and ramp system while tmodifying the existing local street network. Ramp lengths to and from I-5 should be investigated to ensure that there is sufficient storage and adequate deceleration distance for off ramps and sufficient acceleration distance for on ramps. Local connections on Hayden Island are critical for access and circulation for the various land uses. Ramp terminal intersection signals will need to be coordinated with local signals to provide an integrated system. LRT in this area can affect signal timing and alignment needs.

Delta Park

The Delta Park section is bound to the west by wetlands and to the east by park land. These constraints have clearly dictated the configuration of the various concepts. Depending on the concept, connections between Marine Drive and Interstate Avenue and the mainline have been accommodated in various ways; or not at all. Local street connections provide route choices and connectivity that can take local trips off the interstate system. We recommend investigating the impacts of providing those alternative connections in each concept while being sensitive to environmental impact needs. Given the size of the project, there may be alternatives to mitigate wetland or park impacts within the project corridor. While avoiding impacts is always a priority, at this concept stage, the concept alternatives should not be unduly compromised.

Summary

The ODOT concepts reflect a range of potential configurations with a spectrum of impacts. As the concepts are advanced, there are potential combinations or components between the schemes that may be intermixed. These variations could help optimize transportation system objectives in balance with known corridor constraints. Similarly, the concepts appear to have been developed to avoid corridor impacts. This is admirable and is consistent with objectives to eliminate or minimize impacts. However, it appears that in absolute avoidance of potential impacts, the transportation benefits of a comprehensive roadway network may have been compromised. Future alternatives within the EIS process should investigate the importance of local access and circulation connections to determine the long-term value of creating a well-connected network that meets system planning needs.

The following discussion highlights specific issues at various locations within each concept.

Concept 1

This concept uses the existing bridges for the northbound movements. The current southbound bridge will carry three mainline lanes and the current northbound bridge will be for the

northbound 3-lane C-D roadway. The future southbound traffic will have a new 5-lane bridge over light rail transit (LRT).

Design issues/ locations requiring review

- There appear to be profile issues between the LRT and the southbound ramp from Marine Drive.
- There may be constructability issues or profile conflicts between the I-5 southbound connection to eastbound Marine Drive and the LRT connection.
- At the northbound I-5 onramp from Marine Drive, the ramp gore and divider on the mainline should overlap.
- The southbound exit ramp from I-5 to Hayden Island should be analyzed to verify adequate ramp length can be provided and to be sure there are no profile conflicts with the LRT.

Concept 4

This concept has a new double deck structure over the existing northbound structure. The new mainline bridge will be 6 lanes northbound and 5 lanes southbound. A new bridge would be constructed west of the existing bridges to serve LRT.

Design issues/ locations requiring review

- There could be lane changing and weaving on the ramp connection northbound between the Columbia Boulevard connection and the Victory Boulelvard ramp terminal intersection. Current configurations for the Columbia Boulevard interchange may address this potential issue.
- The "local" movement between Marine Drive and Interstate Avenue occurs via the I-5 mainline. Serving this local movement violates system hierarchy and could degrade mainline operations within this short weaving section.
- The southbound exit ramp from I-5 to Marine Drive should be analyzed to verify that there are no profile conflicts with the LRT alignment.
- It will be challenging to construct the new double deck bridge and maintain mainline and interchanging traffic. The ability to maintain traffic during construction for the freeway, ramps, and local streets should be verified.

Concept 6

This concept maintains the I-5 mainline on the existing lift bridges over the Columbia River. A new 4-lane bridge would be built west of the existing bridges as part of the northbound and southbound C-D system for distribution of local traffic and LRT.

Design issues/ locations requiring review

- Similar to Concept 4, the southbound exit ramp from I-5 to Marine Drive should be analyzed to verify that there are no profile conflicts with the LRT alignment.

- The ramp lengths to the split diamond interchange on Hayden Island appear to be minimal. These ramps should be evaluated to ensure that southbound traffic does not back on to the freeway and that adequate acceleration distance is provided to northbound I-5. The entrance appears to be a parallel type but the speed differential between the ramp and freeway traffic could be significant.

Concept 7

This concept splits the I-5 mainline over three bridges by using the two existing lift spans and adding a new three lane bridge on the east side. A combination LRT and local street bridge would be constructed west of the existing bridges. I-5 northbound would have three lanes on the new bridge. Southbound I-5 will have three lanes on the existing southbound bridge. Two bi-directional lanes (HOV, express, or reversible lanes) would use the existing northbound bridge.

Design issues/ locations requiring review

- The concept of splitting the mainline is unconventional and may not meet driver expectations. At a minimum, this concept creates extensive signing and striping challenges. The traffic operational adequacy of this plan should be verified including investigating if the system can be adequately signed.
- There should be a physical overlap of the gore between the northbound on-ramp from Interstate Avenue and the rightmost northbound freeway travel lane. As proposed, traffic from Interstate Avenue could cross the painted gore area to the left northbound freeway travel lane.
- The profiles between the northbound I-5 on-ramp from Marine Drive and the northbound I-5 off-ramp to Hayden Island should investigated to be sure that the desired grades are attainable.
- The Hayden Island circulation system contains relatively close signal spacing. These signals would need to be coordinated to ensure acceptable operations.

WASHINGTON STATE (WSDOT) CONCEPTS

We have organized the topics into three general categories related to the concepts: Bridgehead, Northbound C-D system, and Southbound C-D system. The following discussion summarizes issues in each category. This section is followed by more detailed observations for each concept in the bridgehead area.

Bridgehead

This area is complex given the close proximity of SR 14, service access to and from downtown Vancouver, and the beginning of the northbound and southbound C-D system. Each of the concepts requires modifications (some rather extensive) to conform to contemporary geometric design practice. These modifications would be needed to ensure that the roadway could physically be constructed and signed to meet operational and safety needs. We believe the required changes will expand the impact area into the Columbia River. Specific changes are likely needed for:

- Providing appropriate I-5 mainline alignments and ensuring adequate numbers and arrangements of lanes;
- Improving the vertical and horizontal geometric design of ramps for the SR 14 interchange;
- Increasing ramp spacing between successive ramps serving SR 14 and the Northbound C-D road system;
- Achieving attainable ramp profiles within the Bridgehead area; and
- Validating the constructability and identifying the potential impacts of temporary roadways.

Northbound C-D System

The proposed C-D system concept is a valid potential solution. Changes appear to be required to provide appropriate horizontal and vertical alignments between the Bridgehead and Mill Plain Boulevard. Minor improvements are needed along its length to assure adequate and safe traffic operations. These changes could result in increased right of way and impacts not currently anticipated based on the current plans.

Southbound C-D System

In concept, the proposed southbound C-D system is also valid; however, the current concept requires extensive revisions to conform to contemporary design practice and achieve desired operational objectives. As presently configured, the schemes are over ambitious in their plan of serving all local access via a C-D system. The conceptual layout requires extensive redesign to meet driver expectations, to provide adequate signing, and to achieve desired traffic operations. The required changes for the Southbound C-D, which are more extensive than the Northbound C-D, would likely result in more extensive impacts than are anticipated based on the current plans.

Summary

The complexity of these concepts can be attributed to the effort to maintain access to both State Routes (14 and 500) and both City arterials (4th Plain and Mill Plain) immediately north of the Columbia River. Retaining all access is a reasonable consideration, however, the appropriate design required to provide this access would be more impacting than the current concepts depict. While the FHWA supports "flexibility in design," there are minimum design requirements that must be met to provide a safe and effective plan.

The close proximity of SR 14 to the Columbia River as well as the constraints of the downtown, Pearson Airpark, and Fort Vancouver create a challenging design task. The current concepts attempt to reduce these impacts, while keeping the interchange influence area off the Columbia River. Unfortunately, the concepts developed within these constraints deviate significantly from contemporary design practice. In some cases the plans may not be constructible nor will they achieve acceptable operational and safety performance.

We appreciate the efforts and challenges undertaken by previous designers. It is understood that the completed design concepts will likely require deviations from "full standard" designs; however, we believe the concepts may dramatically underestimate the likely impacts when applying contemporary design principles. The northbound and southbound C-D concepts will require modifications; particularly southbound, which has more locations needing attention than the northbound system. The "fixes" for the C-D system are relatively straight forward compared to the bridgehead concepts. Adjustments to the C-D system will likely increase the footprint of the schemes. The following discussion focuses on the bridgehead area since changes to the current concepts to attain minimum AASHTO policy objectives could significantly affect the bridge concepts.

BRIDGEHEAD CONCEPTS

Concept 1

This concept uses the existing bridges for the northbound movements. The current southbound bridge will carry three mainline lanes and the current northbound bridge will be for the northbound 3-lane C-D roadway. The future southbound traffic will have a new 5-lane bridge over LRT.

Design issues/ locations requiring review

- The southbound I-5 mainline has horizontal alignment deficiencies including compound curves leading to back-to-back (little to no tangent between) reverse curves.
- The northbound C-D road and I-5 mainline should be physically separated.
- The SR 14 ramp to northbound I-5 profile and connection to the northbound C-D road appears unattainable. SR 14 loop ramp to southbound I-5 horizontal alignment and lane drop in combination with profile that appears unattainable given the shortened ramp and I-5 profile that must be climbing to clear LRT.

Concept 4

This concept has a new double deck structure over the existing northbound structure. The new mainline bridge will be 6 lanes northbound and 5 lanes southbound. A new bridge would be constructed west of the existing bridges to serve LRT.

Design issues/ locations requiring review

- The concept appears nearly impossible to construct (building in the location of the existing northbound bridge) while maintaining current I-5 crossing volumes. Potential use of the future LRT for temporary southbound I-5 traffic would require an extensive temporary roadway that would impact City land and close much of the SR 14 interchange.
- The southbound I-5 mainline has horizontal alignment deficiencies including a "broken back curve," short curve lengths, and insufficient radii to meet design speeds.
- The northbound I-5 mainline has short curve lengths and a broken back alignment.

- The northbound exit to SR 14 does not comply with contemporary design practice for a two-lane exit. The distance to the split to downtown is half of the 800 feet described by AASHTO. In addition, this connection has back-to-back reverse curves that will not allow for the appropriate amount of super-elevation.
- The northbound I-5 exit to the northbound C-D does not comply with contemporary two-lane exit design. In addition to violating AASHTO policy by dropping two mainline lanes, the plan depicts a ramp with a profile that appears unattainable.

Concept 6

This concept maintains the I-5 mainline on the existing lift bridges over the Columbia River. A new 4-lane bridge would be built west of the existing bridges as part of the north and southbound C-D system for distribution of local traffic and LRT.

Design issues/ locations requiring review

- Northbound I-5 has three successive off ramps with spacing of about 750 feet and 300 feet between the Vancouver ramp and the C-D road. AASHTO states 1,000 feet is the minimum spacing to meet operational and signing needs.
- The SR 14 ramp to the southbound C-D road has a horizontal alignment inconsistent with a State Route ramp and a profile that appears unattainable.
- The profiles for ramps connecting to the northbound C-D road appear to be unattainable.

Concept 7

This concept splits the I-5 mainline over three bridges by using the two existing lift spans and adding a new three lane bridge on the east side. A combination LRT and local street bridge would be constructed west of the existing bridges. I-5 northbound would have three lanes on the new bridge. Southbound I-5 will have three lanes on the existing southbound bridge. Two bi-directional lanes (HOV, express, or reversible lanes) would use the existing northbound bridge.

Design issues/ locations requiring review

- Northbound and southbound I-5 mainline is reduced to <u>two basic lanes</u>. Northbound this occurs just beyond the SR 14 exit: the right lane drops as an auxiliary lane to the northbound C-D as the express lane is added. Southbound this occurs as the left lane is trapped as an express lane and the right lane is added as an auxiliary lane from the southbound C-D road.
- Northbound I-5 has an 800-foot, two-sided weave between the express lane and the exit to the northbound C-D road.
- The northbound exit to SR 14 does not comply with contemporary design practice and would need to be lengthened to provide adequate deceleration
- The northbound exit to the C-D road does not comply with contemporary design practices for length and reverse curves.
- The northbound I-5 entrance ramp from SR 14 has a profile that appears unattainable.

- The SR 14 ramp from the express lane has a profile under the railroad and over the northbound mainline that appears unattainable.

CLOSING

We appreciate the extensive amount of analysis completed over the years; and recognize our review was performed quickly without the benefit of all the potential available background information. However, we trust that our technically objective comments are viewed as opportunities to reduce project risks as the project development process proceeds. We look forward to working with all the previous design staff members to clarify how our observations may not be valid. Similarly, we offer our assistance in working with design staff to mitigate the potential design issues.

APPENDIX "B"

I-5 Columbia River Crossing
Bridge Influence Area (BIA)
Environmental Qualitative Concept Assessment

Introduction

This section provides a summary of environmental analysis conducted to date on the Columbia River crossing segment of the Portland/Vancouver I-5 Transportation and Trade Partnership project. Specifically, this section describes the analysis conducted and findings identified by the previous studies, and flags potential environmental issues that could deserve special attention during the National Environmental Policy Act (NEPA) Environmental Impact Statement (EIS) process.

The following documents were reviewed:

- Portland/Vancouver I-5 Transportation and Trade Partnership Environmental Impact Assessment Draft Report (October 30, 2001)
- Portland/Vancouver I-5 Transportation and Trade Partnership Bridge Influence Area Summary Draft (April 19, 2002)
- Portland/Vancouver I-5 Transportation and Trade Partnership Final Strategic Plan, including Attachment C: Land Use Compatibility of Task Force Recommendations (June 2002)
- Natural Resource Technical Report, I-5 Trade Corridor Study (October 2001)
- Cultural/Historic Resources Technical Report, I-5 Trade Corridor Study (October 2001)
- Land Use Technical Report (including Appendix B Adopted City and Regional Plans) I-5 Trade Corridor Study (October 2001)
- Portland/Vancouver I-5 Transportation and Trade Partnership Air Quality Screening Analysis Summary (November 2001)

The scope of this analysis is the Bridge Influence Area (BIA) described in the BIA Summary Draft Report. The BIA is considered to be the I-5 freeway between SR 500 in Vancouver and Columbia Boulevard in Portland.

This section analyzes the eight concepts evaluated in the BIA Summary Report. The section organizes itself by environmental discipline and, where possible, it differentiates impacts among the various alternatives.

Review of Environmental Analysis Conducted to Date

A cursory level of environmental analysis was conducted for both the BIA Summary report and the Environmental Impact Assessment (EIA). The BIA addressed eight concepts that

looked specifically at the Columbia River crossing, and the EIA addressed six corridor-length options.

The two reports are related. The BIA Summary report, published in April 2002, elaborates on the findings from the October 2001 EIA, analyzing in greater detail the impacts associated with various river crossing concepts. However, specific land use analysis for the BIA was also included in the earlier-published EIA and its background technical reports. Although neither the methodology nor the findings between the EIA and the BIA Summary Reports are identical, the EIA and its background technical reports were reviewed as well.

Although both documents evaluated the river crossing, some translation needs to occur between the terminology used to explain the concepts in the two documents. Table 1 below provides a comparison.

TABLE 1
Comparison of BIA Concepts and EIA Options

BIA Concept No.	EIA Option No.	EIA Option Name
Concept 1	Option 6	Express Bus with Capacity Increase - 4 Lane Supplemental
Concept 2		
Concept 3		
Concept 4	Option 6	Express Bus with Capacity Increase - 10 Lane Replacement
Concept 5		
Concept 6	Option 3C Option 6 Option 8	LRT/Arterial HOV Express Bus with Capacity Increase - 4 Lane Supplemental West Arterial Road
Concept 7	Option 6	Express Bus with Capacity Increase - 6 Lane Supplemental
Concept 8		

Land Use

Environmental analysis was performed at a cursory level for both the EIA and the BIA Summary document. The methodology used for both analyses was to overlay project design details onto maps containing land use information from regional metropolitan Geographic Information Systems (GIS) databases. Two forms of impacts were identified:

- Displacements were defined as those parcels where the concept impacted the entire parcel and/or part of the structure.
- Encroachments were defined as those parcels where the concept affected a portion of a parcel but the remaining property was likely to remain useful to the property owner.

BIA Concept 1

BIA Concept 1 consists of five northbound lanes on the existing bridges, and the construction of a new double-decker bridge west of the existing structures, with five southbound lanes on the upper deck and light-rail transit (LRT) on the lower deck. The new

bridge would be a low- to mid-span level bridge, with a lift span over the existing navigation channel. The BIA Summary report identified the following potential land use impacts associated with BIA Concept 1.

TABLE 2
BIA Concept 1: Potential Property Displacements and Encroachments

	Residential	Non-Residential
Displacements		
Vancouver	0	0
Portland	8	16
Total	*8*	*16*
Encroachments		
Vancouver	21	15
Portland	0	17
Total	*21*	*32*

There are 77 potential property impacts identified with this concept.

EIA Option 6 (4-Lane Supplemental Bridge)

The EIA Option 6 "Express Bus with Capacity Increase" also looked at the option of adding a four-lane supplemental bridge over the Columbia River. This is similar though not identical to the BIA Concept 1. Impacts identified with the 4-lane supplemental bridge variation of EIA Option 6 are actually quite different from the BIA Summary report. These are highlighted in Table 3 below.

TABLE 3
EIA Option 6, 4-Lane Supplemental Bridge Variation: Potential Property Displacements and Encroachments

	Residential	Non-Residential
Displacements		
Vancouver	0	0
Portland	15	9
Total	*15*	*9*
Encroachments*		
Vancouver	6	
Portland	22	
Total	*28*	

* The EIA did not separate residential from non-residential encroachments

Both the BIA Summary report and the EIA identified 24 potential displacements associated with adding a 4-5 lane supplemental bridge to the existing river crossing, though the BIA report identified 8 residential and 16 non-residential impacts, though the EIA identified 15 residential and 9 non-residential impacts. The design differences that would result in these discrepancies are not clear.

A plan and policy review matrix was developed as an appendix to the land use technical report which analyzed each corridor-long EIA option against a series of local and regional plans and policies. BIA-specific analysis was not available. The options were found to be generally consistent with state, regional, and local plans and policies, however some potential conflicts were identified which could require further analysis for avoidance or mitigation opportunities. Specific conflicts related to EIA Option 6 include:

- Adopted Humboldt Neighborhood Plan, Policy 1, Objective 5, Neighborhood Livability
- City of Portland Comprehensive Plan, Transportation Element, Policy 6.18, Clean Air and Energy Efficiency
- City of Portland Central City Transportation Management Plan, Policy 9.1, Air Quality
- Albina Community Plan, Policy II, Objective 5, Transportation
- Visions for the Vancouver Urban Area, Policy P52, Land Use
- Visions for the Vancouver Urban Area, Policy P102, Mobility Management
- Regional Framework Plan, Policy 2.26.3, Clean Air

A revised plan and policy review would be needed to capture new or updated local or regional plans, in relation to the specific BIA Concepts.

BIA Concept 2

BIA Concept 2 includes a five-lane supplemental bridge east of the existing bridges and a separate LRT bridge to the west. Northbound traffic would flow on the new five-lane bridge, and southbound traffic would be split between the two existing bridges. BIA Concept 2 was not analyzed in the Summary report though the added footprint (five traffic lanes, two LRT lanes) is similar to BIA Concept 7. As discussed in a later section, BIA Concept 7 is anticipated to have 43 displacements and 59 encroachments.

BIA Concept 3

BIA Concept 3 consists of ten lanes on a new five-lane double-deck low- to mid-level bridge, with LRT retrofitted on the existing bridge crossings. The new bridge would have a lift span over the existing navigation channel. BIA Concept 3 was not analyzed for environmental impacts in the BIA Summary report, however it adds a five-lane bridge structure similar to BIA Concept 1. Concept 1 was discussed in a previous section.

BIA Concept 4

This concept includes the replacement of the existing bridges with two new bridge structures. One bridge would be a ten-lane double-decker bridge (five southbound lanes on the lower deck, five northbound lanes on the upper deck). The other new bridge, west of

the existing bridges, would contain LRT only. Both structures would be mid- to high-level bridges. The navigation channel would be relocated to the center of the river. This is the only option to shift the navigational channel. Both structures are potentially fixed or lift spans. Potential property impacts from this concept are summarized in Table 4 below.

TABLE 4
BIA Concept 4: Potential Property Displacements and Encroachments

	Residential	Non-Residential
Displacements		
Vancouver	0	1
Portland	6	8
Total	*6*	*9*
Encroachments		
Vancouver	9	8
Portland	0	27
Total	*9*	*35*

BIA Concept 4, which replaces the current bridge structure with a replacement bridge, has the least number of likely property impacts (15 potential displacements and 44 potential encroachments). This is because the structure would follow near the existing bridge and freeway alignment, and creates a five-lane footprint for vehicle travel, by decking the southbound movement on top of the northbound.

EIA Option 6 (10-Lane Replacement Bridge)

EIA Option 6 "Express Bus with Capacity Increase" also looked at possibly replacing the existing bridge structure with a new bridge. This option did not consider a double-decked bridge and therefore identified impacts associated with a new ten-lane structure. Even so, the identified impacts were anticipated to be less than those identified in the BIA Summary report. This may be due to more information available for the BIA Summary report, or a difference in design location. See Table 5 below.

TABLE 5
EIA Option 6, 10-Lane Bridge Replacement Variation: Potential Property Displacements and Encroachments

	Residential	Non-Residential
Displacements		
Vancouver	0	0
Portland	0	9
Total	*0*	*9*

TABLE 5
EIA Option 6, 10-Lane Bridge Replacement Variation: Potential Property Displacements and Encroachments

Encroachments*	
Vancouver	12
Portland	20
Total	*22*

* The EIA did not separate residential from non-residential encroachments

A plan and policy review matrix was developed as an appendix to the land use technical report. Specific conflicts related to EIA Option 6 were summarized earlier in this report, under BIA Concept 1.

BIA Concept 5

Concept 5 consists of a new six-lane supplemental bridge to the east of the existing structures, to accommodate through traffic. The existing bridge crossings would be used for collector-distributor movement. Another new structure would be built to the west of the existing structures to accommodate LRT. Concept 5 was not analyzed in the Summary report though the added footprint (six traffic lanes, two LRT lanes) is similar to BIA Concept 7. BIA Concept 7 is discussed in a later section.

BIA Concept 6

Concept 6 uses the existing bridge structure in the same manner used today. It constructs a new, low- to mid-level bridge structure to the west of the existing one with a 4-lane collector-distributor on the top level and LRT on the lower level. The bridge requires fly-over ramps to the north and south for ramp access.

TABLE 6
BIA Concept 6: Potential Property Displacements and Encroachments

	Residential	**Non-Residential**
Displacements		
Vancouver	0	2
Portland	20	21
Total	*20*	*23*
Encroachments		
Vancouver	15	26
Portland	1	17
Total	*16*	*43*

R = Residential
NR = Non-Residential

The BIA Summary report projected approximately 43 displacements and 59 encroachments associated with Concept 6.

Three Options considered in the EIA – Option 3C, Option 6 (with 4-lane supplemental bridge) and Option 8 have a similar footprint to the BIA Concept 6. Option 3C added a new joint-use arterial/LRT bridge across the Columbia River. Option 6 contained a variation of a 4-lane supplemental bridge. Option 8 added a new four-lane arterial road plus bike lanes and sidewalks crossing the Columbia river. Anticipated environmental impacts associated with Option 6 with the 4-lane supplemental bridge are described under BIA Concept 1. Information in the EIA related to these other two options are described below.

Option 3

A plan and policy review matrix was developed as an appendix to the land use technical report. The matrix analyzed each corridor-long EIA option against a series of local and regional plans and policies. BIA-specific analysis was not available. The options were found to be generally consistent with state, regional, and local plans and policies, however some potential conflicts were identified which could require further analysis for avoidance or mitigation opportunities. Specific conflicts related to EIA Option 3 include:

- City of Portland Comprehensive Plan, Transportation Element, Policy 6.24 Land Use
- 2000 Regional Transportation Plan, Policy 7.0 The Natural Environmental
- 2000 Regional Transportation Plan, Policy 8.0 Water Quality
- City of Portland Comprehensive Plan Goals and Policies, Goal 4.2 Land Use/Livability
- City of Portland Comprehensive Plan Goals and Policies, Goal 8.15 Wetlands/Riparian/Water Bodies Protection
- Clark County 20-Year Comprehensive Growth Management Plan, Goal 2.4, Environmental
- Clark County 20-Year Comprehensive Growth Management Plan, Goal 8.3, Regional Conservation and Greenway Systems
- Visions for the Vancouver Urban Area, P19, P20, P21, and P23 Sensitive Lands
- Visions for the Vancouver Urban Area, P52 and P53 Land Use
- Regional Framework Plan, Policy 2.4.4 Environmental System Objectives
- Regional Framework Plan, Policy 2.24.1, 2.24.2, and 2.24.3Natural Environment
- Regional Framework Plan, Policy 4.6 Water Quality

A plan and policy review would be needed to capture new or updated local or regional plans, in relation to the specific BIA Concepts.

Option 8

The Land Use technical report noted that Option 8 would require a new road that would affect wetlands and other habitat areas, which would conflict with adopted environmental

goals. Depending on the location of the arterial bridge, the lower noise, traffic, and air quality impacts on land uses adjacent to I-5 are offset by potentially increased traffic, noise, and air quality impacts in the vicinity of North Portland Road, also providing a potential conflict.

As an appendix to the technical report, a plan and policy review matrix was developed that analyzed each corridor-long EIA option against a series of local and regional plans and policies. The options were found to be generally consistent with state, regional, and local plans and policies, however some conflicts were identified. Specific conflicts listed in the appendix related to EIA Option 8 include:

- City of Portland Comprehensive Plan, Transportation Element, Policy 6.3
- City of Portland Comprehensive Plan, Land Use Element, Policy 6.8
- City of Portland Comprehensive Plan, Land Use Element, Policy 6.24
- 2000 Regional Transportation Plan, Policy 7.0 The Natural Environment
- 2000 Regional Transportation Plan, Policy 8.0 Water Quality
- 2000 Regional Transportation Plan, Policy 19.2 Transportation
- 2000 Regional Transportation Plan, Policy 20.2 Environmental
- Metro 2040 Growth Concept, Objective 14.2 Environmental Considerations
- Portland Comprehensive Plan Goals and Policies, Goal 8.14 Natural Resources
- Portland Comprehensive Plan Goals and Policies, Goal 8.15 Wetlands/Riparian/Waterbodies Protection
- Portland Comprehensive Plan Goals and Policies, Goal 8.16 Uplands Protection
- Portland Comprehensive Plan Goals and Policies, Goal 12.6 Land Use/Livability
- Salmon Creek/Fairgrounds Regional Road Plan, Objective T-2, Policy 2, Improve Existing Roadways
- Visions for the Vancouver Urban Area, Policy P52 Land Use
- Regional Framework Plan, Policy 2.4.4, Environmental System Objectives
- Regional Framework Plan, Policy 2.24.1 and 2.24.3, Natural Environment
- Regional Framework Plan, Policy 3.2.6, Protection of Regionally Significant Parks, Natural Areas, Open Spaces, Trails, and Greenways
- Regional Framework Plan, Policy 4.6, Water Quality
- Regional Framework Plan, Policy 4.16, Urban Planning and Natural Systems

A plan and policy review would be needed to capture new or updated local or regional plans, in relation to the specific BIA Concepts.

BIA Concept 7

Concept 7 uses existing structures to accommodate three southbound lanes (west bridge) and northbound and southbound HOV movement (east bridge). There is also potential for the east bridge structure to serve as express lanes or reversible lanes. Under Concept 7, two new low- to mid-level bridge structures with lift spans would be constructed. The first structure, to the east of the HOV bridge, would contain three northbound lanes. The second structure, to the west of the southbound movement, would contain two arterial lanes and LRT. See Table 7 below.

TABLE 7
BIA Concept 7: Potential Property Displacements and Encroachments

	Residential	Non-Residential
Displacements		
Vancouver	0	0
Portland	6	17
Total	*6*	*17*
Encroachments		
Vancouver	13	10
Portland	0	19
Total	*13*	*29*

The BIA Summary report anticipated 23 displacements and 42 encroachments associated with Concept 7.

The 6-lane supplemental bridge variation of EIA Option 6 is similar though not identical to BIA Concept 7. Impacts identified with the 4-lane supplemental bridge variation of EIA Option 6 are different from the BIA Concept 7. See Table 8.

TABLE 8
EIA Option 6, 6-Lane Supplemental Bridge Variation: Potential Property Displacements and Encroachments

	Residential	Non-Residential
Displacements		
Vancouver	0	3
Portland	0	4
Total	*0*	*7*
Encroachments*		
Vancouver	12	
Portland	12	

TABLE 8
EIA Option 6, 6-Lane Supplemental Bridge Variation: Potential Property Displacements and Encroachments

Total	*24*

* The EIA did not separate residential from non-residential encroachments

The EIA anticipated 7 displacements and 24 encroachments associated with a six-lane supplemental bridge crossing. It is not clear whether this is due to a change in methodology to assessing land use impacts, or a shift in design footprint.

BIA Concept 8

Concept 8 consists of an eight-lane low- to mid-level supplemental bridge east of the existing bridges, LRT retrofit on the existing southbound bridge, and a two-lane arterial on the existing northbound bridge.

Concept 8 was not analyzed in the BIA Summary report. It is most similar to BIA Concept 7, which is discussed in the previous section.

Potential Land Use Issues

A thorough land use analysis will be undertaken when this project moves into the NEPA process, which will include an inventory of current land uses and current zoning and comprehensive plan designations, a description of development projects planned and underway, and a detailed analysis of how each project concept would directly or indirectly affect land uses in the study area as well as its compatibility with adopted local, regional, and state plans. Some considerations for the EIS process as related to land use include:

- *Statewide Plan Compliance* – No exceptions to the statewide planning goals are expected, though a more thorough analysis will need to occur prior to or during the NEPA process. A goal exception would have necessary budget and schedule impacts. The options evaluated in the EIA are considered generally consistent with the Oregon Highway Plan. In Washington, the state's Growth Management Act is implemented through regional comprehensive and transportation plans, which are discussed below.
- *Regional Plan Compliance* – According to the Final Strategic Plan, all Concepts considered in the EIA support the Metro 2040 Growth Concept, Metro's Regional Transportation Plan, Clark County Comprehensive Plan, and the Clark County Metropolitan Transportation Plan by reducing delay and congestion in the I-5 Corridor and improving bi-state transit service.
- *Local Plan Compliance* – Overall, the concepts evaluated in the EIA are considered compatible with the City of Portland Comprehensive Plan. Expected impacts from this project to environmentally sensitive areas are likely to conflict with adopted environmental policies from the City of Portland Comprehensive Plan, the Columbia South Shore Natural Resource Protection Plan, and other similar plans, though impact avoidance, minimization, and mitigation is a likely objective during the design phase. In Washington, all Concepts are consistent overall with the Visions for the Vancouver Urban Area, though Option 3C conflicts with environmental policies related to sensitive

lands, and Options 3C, 6, and 8 conflict with the plan's land use policy related to protecting sensitive lands from incompatible land uses. Option 6 may conflict with mobility management policy to reduce the total number of average daily traffic trips throughout the Vancouver urban area. These conflicts would need to be addressed through the project's design phase and NEPA process.

- *Impacts to Industrial Land Uses* – The project is likely to result in several acres of direct impacts to existing and zoned industrial land uses. Identifying similarly sized, zoned, and available parcels within the study area may be difficult, and could result in an undue impact on this land use.
- *Impacts to Residential Land Uses* – densely populated neighborhoods are located along the BIA, especially at the southern and northern edges. Displacements of single-family and multi-family residential parcels will require an assessment of other similarly valued and available parcels within the study area. Increased land values around interchanges could create pressure to change zoning from residential to commercial or industrial.
- *Development Pressure*– There may be some development pressure around the interchanges in the BIA that could increase demands on the freeway system.
- *Tunneling* – if a tunneling option were pursued, substantial amounts of land would be required on both sides of the Columbia River for launching and landing the cars.

Socioeconomics

The BIA Summary Report did not describe any additional socioeconomic analysis over and above what was included in the EIA. However, some discussion of neighborhood impacts was included in the EIA. Those neighborhoods within the bridge study area include Hayden Island and Kenton/Bridgeton in Oregon, and Hudson's Bay/Central Park, Esther Short, Arnada, Rosemere, and Shumway in Washington. Neighborhood impacts were determined by overlaying project design details onto maps containing land use information from regional metropolitan Geographic Information Systems (GIS) databases. Two forms of impacts were identified:

- Displacements were defined as those parcels where the concept impacted the entire parcel and/or part of the structure.
- Encroachments were defined as those parcels where the concept affected a portion of a parcel but the remaining property was likely to remain useful to the property owner.

BIA Concept 1

BIA Concept 1 is the only concept of the four analyzed that does not encroach into the Delta Park greenspace area.

EIA Option 6 "Express Bus with Capacity Increase" (four-lane)

The Land Use technical report did not identify potential neighborhood impacts for the four-lane supplemental bridge variation of EIA Option 6. However, the EIA Environmental Justice section does call out that information, as shown in the table below.

TABLE 9
Land Use Technical Report, Option 6, 4-Lane Supplemental Bridge Variation: Potential Neighborhood Impacts

Neighborhood	Full and Partial Property Impacts
Kenton/Bridgeton	16
Hayden Island	30
Rosemere	27
Hudson's Bay/Central Park	0
Shumway	16
Arnada	9
Esther Short	6
TOTAL	*104*

BIA Concept 2

BIA Concept 2 was not analyzed in the Summary report though the added footprint (five traffic lanes, two LRT lanes) is similar to BIA Concept 7, as discussed in a later section.

BIA Concept 3

BIA Concept 3 was not analyzed for environmental impacts in the BIA Summary report, however it adds a five-lane bridge structure similar to BIA Concept 1. Concept 1 is discussed above.

BIA Concept 4

BIA Concept 4 encroaches into the Delta Park greenspace area (between 60 and 120 feet). If a park resource is impacted, federal regulations would require a Section 4(f) analysis to determine that there are no feasible or prudent concepts before mitigation could be determined.

EIA Option 6 "Express Bus with Capacity Increase" (ten-lane)

Neighborhood impacts within the project area for the 10-lane bridge replacement option are described in Table 10 below:

TABLE 10
Land Use Technical Report, Option 6, 10-Lane Bridge Replacement Variation: Potential Neighborhood Impacts

Neighborhood	Full and Partial Property Impacts
Kenton/Bridgeton	15
Hayden Island	18
Rosemere	24
Hudson's Bay/Central Park	12

TABLE 10
Land Use Technical Report, Option 6, 10-Lane Bridge Replacement Variation: Potential Neighborhood Impacts

Neighborhood	Full and Partial Property Impacts
Shumway	16
Arnada	0
Esther Short	2
TOTAL	*87*

The majority of impacts occur to commercial and industrial properties.

BIA Concept 5

Concept 5 was not analyzed in the Summary report though the added footprint (six traffic lanes, two LRT lanes) is similar to BIA Concept 7. BIA Concept 7 is discussed in a later section.

BIA Concept 6

BIA Concept 6 encroaches into the Delta Park greenspace area (between 60 and 120 feet). If a park resource is impacted, federal regulations (Section 4(f)) would require that there are no feasible or prudent concepts before mitigation could be determined.

EIA Option 3

Neighborhood impacts within the study area associated with Option 3 are as follows:

TABLE 11
Land Use Technical Report, Option 3: Potential Neighborhood Impacts

Neighborhood	Full and Partial Property Impacts
Kenton/Bridgeton	20
Hayden Island	20
Rosemere	0
Hudson's Bay/Central Park	8
Shumway	0
Arnada	6
Esther Short	15
TOTAL	*69*

Option 8

Neighborhood impacts within the study area associated with Option 8 include impacts to 12 parcels, mainly commercial and rural, on Hayden Island and impacts to 28 parcels, mainly

industrial, in Kenton/Bridgeton. In Washington, 4 properties, all industrial, are expected to be impacted in the study area. These all occur in the Esther Short neighborhood.

BIA Concept 7

BIA Concept 7 encroaches into the Delta Park greenspace area (between 60 and 120 feet). If a park resource is impacted, federal regulations (Section 4(f)) would require that there are no feasible or prudent concepts before mitigation could be determined.

Option 6 (6-Lane Supplemental Bridge)

Neighborhood impacts within the project area for EIA Option 6 with a six-lane supplemental bridge are described in Table 12 below:

TABLE 12
Land Use Technical Report, Option 6, 6-Lane Supplemental Bridge Variation: Potential Neighborhood Impacts

Neighborhood	Impacts
Kenton/Bridgeton	14
Hayden Island	10
Rosemere	24
Hudson's Bay/Central Park	12
Shumway	16
Arnada	9
Esther Short	3
TOTAL	*88*

The majority of impacts are anticipated to occur to commercial and industrial properties.

BIA Concept 8

Concept 8 was not analyzed in the BIA Summary report. It is most similar to BIA Concept 7, which is discussed in the previous section.

Potential Socioeconomics Issues

Additional analysis of neighborhood impacts associated with each concept under consideration would need to be undertaken as part of the NEPA process. Some issues that may arise in this subject area include:

- *Neighborhood Cohesion* – how does the displacement of residential properties affect the cohesiveness of the study neighborhoods? This is of special concern on the Vancouver side of the project area.
- *Travel Patterns* – a large number of commercial and industrial parcels were projected to be displaced by the various concepts. This may affect the travel patterns of

neighborhood residents, forcing them to travel farther for employment, or to run errands.

- *Traffic* – Further analysis will need to be done to determine the extent of potential traffic cut-through on neighborhood streets. This could cause a safety problem and/or a noise problem.
- *Pressure to Change Zoning* – There may be some pressure to change zoning from industrial to commercial in the study area.

Environmental Justice

The BIA Summary Report did not include any specific analysis related to Environmental Justice, though this analysis was conducted for the EIA. Earlier in this report, the EIA Options were translated into those BIA Concepts they best reflected. This format is followed through the discussion below.

The EIA stated a goal of avoiding, minimizing, or mitigating disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations and low-income populations, and of preventing the delay of receipt of benefits by these same groups.

The environmental justice section of the EIA identified those neighborhoods within the study area that were (1) low income and minority; (2) low income or minority; or (3) neither low income nor minority. Table 13 describes the seven neighborhoods within the BIA in terms of these three environmental justice categories:

TABLE 13
Neighborhoods within the BIA

Neighborhood	State	Low Income	Minority
Shumway	Washington	Yes	No
Rosemere	Washington	Yes	Yes
Arnada	Washington	Yes	Yes
Esther Short	Washington	Yes	Yes
Hudson's Bay/Central Park	Washington	Yes	Yes
Hayden Island	Oregon	No	No
Kenton/Bridgeton	Oregon	No	No

The Environmental Justice analysis analyzed project impacts by neighborhood to discern any disproportionate impacts to minority or low-income neighborhoods.

It should be noted that the Environmental Justice analysis conducted for the EIA is incomplete and now out-of-date. Though it serves a descriptive value, it should not be relied upon in future analyses.

BIA Concept 1

The BIA Summary Report did not outline displacements and encroachments by neighborhood. This Concept is most similar to EIA Option 6 (four-lane supplemental bridge), which is described below.

EIA Option 6 "Express Bus with Capacity Increase" (four-lane supplemental bridge)

The Shumway, Rosemere, and Arnada neighborhoods experienced a large decrease in auto travel times (greater than 10 percent) with Option 6. This is a positive benefit. No neighborhoods were observed as having significantly increased travel times under this option.

TABLE 14
Option 6 4-Lane Supplemental Bridge Displacements/Encroachments to Neighborhoods within BIA

Neighborhood	EJ Category	No. Displacements	No. Encroachments
Shumway	Low Income	2 residential	14
Rosemere	Low Income, Minority	27 residential	0
Arnada	Low Income, Minority	3 residential	6
Esther Short	Low Income, Minority	0	6
Hudson's Bay/Central Park	Low Income, Minority	0	0
Hayden Island	Neither Low Income nor Minority	15 residential 7 non-residential 2 public/open space	6
Kenton/Bridgeton	Neither Low Income nor Minority		16

The greatest number of displacements associated with this option are to Rosemere, which is a low income, minority neighborhood. Rosemere is expected to experience 27 residential displacements as a result of this option. The neighborhood with the second highest number of impacts is Hayden Island, which is neither low income nor minority. Hayden Island is expected to experience 15 residential and 7 non-residential displacements, plus 6 encroachments from this option.

BIA Concept 2

BIA Concept 2 was not analyzed in the Summary report though the added footprint (five traffic lanes, two LRT lanes) is similar to BIA Concept 7. As discussed in a later section.

BIA Concept 3

BIA Concept 3 was not analyzed for environmental impacts in the BIA Summary report, however it adds a five-lane bridge structure similar to BIA Concept 1. Concept 1 was discussed in a previous section.

BIA Concept 4

The BIA Summary Report did not outline displacements and encroachments by neighborhood. This Concept is most similar to EIA Option 6 (ten-lane replacement bridge), which is described below.

EIA Option 6 "Express Bus with Capacity Increase" (ten-lane replacement bridge)

The Shumway, Rosemere, and Arnada neighborhoods experienced a large decrease in auto travel times (greater than 10 percent) with Option 6. This is a positive benefit. No neighborhoods were observed as having significantly increased travel times under this option.

TABLE 15
Option 6 10-Lane Replacement Bridge Displacements/Encroachments to Neighborhoods within BIA

Neighborhood	Status	No. Displacements	No. Encroachments
Shumway	Low Income	2 residential	14
Rosemere	Low Income, Minority	27 residential	0
Arnada	Low Income, Minority	3 residential	6
Esther Short	Low Income, Minority	0	2
Hudson's Bay/Central Park	Low Income, Minority	2 public/open space	10
Hayden Island	No special status	0	12
Kenton/Bridgeton	No special status	0	8

Although Hayden Island avoids any displacements with this option (as opposed to the four-lane bridge variation), the impacts to the low income, minority Rosemere neighborhood remain the same, at 27 residential displacements.

BIA Concept 5

Concept 5 was not analyzed in the Summary report though the added footprint (six traffic lanes, two LRT lanes) is similar to BIA Concept 7. BIA Concept 7 is discussed in a later section.

BIA Concept 6

The BIA Summary Report did not outline displacements and encroachments by neighborhood. This Concept is most similar to EIA Option 3C Light Rail Loop and Option 8 West Arterial Road, which are described below.

EIA Option 3C Light Rail

The Rosemere, and Esther Short neighborhoods experienced a large decrease in auto travel times (greater than 10 percent) associated with Option 3 (positive benefit). No neighborhoods within the BIA were observed as having significantly increased travel times under this option.

TABLE 16
Option 3 Light Rail – Displacements/Encroachments to Neighborhoods within BIA

Neighborhood	Status	No. Displacements	No. Encroachments
Shumway	Low Income	0	0
Rosemere	Low Income, Minority	29 residential	10
Arnada	Low Income, Minority	2 non-residential	4
Esther Short	Low Income, Minority	2 non-residential	10
Hayden Island	No special status	7 residential 4 non-residential 1 public/open space	10
Kenton/Bridgeton	No special status	0	0

Option 8 West Arterial Road

The West Arterial Road option showed a decrease in travel time greater than 10 percent (greater benefit) for two neighborhoods in Vancouver within the BIA, Rosemere and Shumway. No neighborhoods experienced an increase in travel time greater than 10 percent for this option.

Several residential displacements and encroachments take place under this option, though due to the construction of a new arterial roadway to connect Vancouver with the Northwest Industrial District most of those displacements occur outside the BIA neighborhoods (e.g., St. John's, Northwest Industrial). These impacts to neighborhoods within the BIA are listed as follows:

TABLE 17
Option 8 West Arterial Road Displacements/Encroachments to Neighborhoods within BIA

Neighborhood	Status	No. Displacements	No. Encroachments
Shumway	Low Income	0	0

TABLE 17
Option 8 West Arterial Road Displacements/Encroachments to Neighborhoods within BIA

Neighborhood	Status	No. Displacements	No. Encroachments
Rosemere	Low Income, Minority	0	0
Arnada	Low Income, Minority	0	0
Esther Short	Low Income, Minority	0	0
Hudson's Bay/Central Park	Low Income, Minority	0	0
Hayden Island	No special status	1 non-residential	22
Kenton/Bridgeton	No special status	0	7

No displacements or encroachments to low income or minority neighborhoods within the BIA are expected to occur under Option 8.

BIA Concept 7

The BIA Summary Report did not outline displacements and encroachments by neighborhood. This Concept is most similar to EIA Option 6 (six-lane supplemental bridge), which is described below.

Option 6 (6-Lane Supplemental Bridge)

The Shumway, Rosemere, and Arnada neighborhoods experienced a greater than 10 percent decrease in auto travel times with Option 6 (positive benefit). No neighborhoods were observed as having significantly increased travel times under this option.

Table 18 below outlines impacts to environmental justice neighborhoods within the BIA associated with the six-lane bridge variation of Option 6.

TABLE 18
Option 6 6-Lane Supplemental Bridge Displacements/Encroachments to Neighborhoods within BIA

Neighborhood	Status	No. Displacements	No. Encroachments
Shumway	Low Income	2 residential	14
Rosemere	Low Income, Minority	27 residential	
Arnada	Low Income, Minority	3 residential	6
Esther Short	Low Income, Minority	0	3
Hudson's Bay/Central Park	Low Income, Minority	1 non-residential 2 public/open space	9
Hayden Island	No special status	3 non-residential	3

TABLE 18
Option 6 6-Lane Supplemental Bridge Displacements/Encroachments to Neighborhoods within BIA

Neighborhood	Status	No. Displacements	No. Encroachments
Kenton/Bridgeton	No special status	1 non-residential	9

As with the other variations of Option 6, the Rosemere neighborhood experiences far more residential displacements than the other neighborhoods. The Shumway and Hudson's Bay/Central Park neighborhoods see a number of encroachments (14 and 9 respectively).

BIA Concept 8

Concept 8 was not analyzed in the BIA Summary report. It is most similar to BIA Concept 7, which is discussed in the previous section.

Potential Environmental Justice Issues

It should be noted that the Environmental Justice analysis conducted for the EIA is incomplete and now out-of-date. Though it serves a descriptive value, it should not be relied upon in future analyses.

Additional analysis on environmental justice associated with each concept under consideration would be undertaken as part of the NEPA process. Some issues that may arise in this subject area include:

- *Residential Displacements* – all of the neighborhoods on the Washington side of the BIA are identified as low income or low income and minority. Special attention will need to be paid to residential impacts to these neighborhoods to ensure that disproportionate impacts do not occur.
- *Commercial, Industrial, and Open Space Displacements* – similar to the bullet point above, special attention will need to be paid to ensure that disproportionate impacts do not occur for low income or minority residents in terms of access to jobs, recreation, and services.

Cultural Resources

The BIA Summary report limited its screening of potential impacts to historic resources to the consideration of the Fort Vancouver National Historic site, the Columbia Cemetery located north of Columbia Boulevard and east of I-5, and the existing I-5 Columbia River Bridges.

The EIA and its Cultural Resources technical report analyzed all properties 500 feet from the widest point of each side of each proposed option disturbance area, as well as any properties with historic designations adjacent to this buffer area. No field surveys or historic research were completed. Databases were queried for information on historic and culturally significant properties within the study area. These included the National Register of Historic Places (NRHP), the Washington Office of Archaeology and Historic Preservation (Washington OAHP), and the Oregon State Historic Preservation Office (Oregon SHPO).

Locations of historic properties were mapped using GIS, and overlaid onto a map showing design details for all options being analyzed to determine direct, major, minor, or indirect impacts. Direct impacts were defined as full acquisition of the parcel; major impacts were defined as requiring acquisition of half or more of the parcel; and minor impacts were defined as requiring less than half of the parcel. Indirect impacts were defined as where nearby construction or project-related disturbance could have an affect on the quality of life.

BIA Concept 1

BIA Concept 1 has an encroachment onto the Ft. Vancouver Historical Site (between 60-120 feet). An encroachment over 60' would impact the FHWA building located near the SR 14 ramp to I-5 northbound. However, no historic buildings would be impacted. This concept includes a new bridge structure to the east of the existing bridges. This minimizes the impacts to the Fort Vancouver Historic Site, in comparison to concepts with a structure to the west of the existing bridges.

This concept would impact the Historic I-5 Columbia River Bridge, though not to the extent of Concept 4 which replaces the historic structure. The existing northbound bridge is registered on the National Register of Historic Places and the southbound bridge is eligible for registration.

This concept would require evaluation to determine if the new bridge structure substantially impairs the historic integrity of the historic bridges.

EIA Option 6 "Express Bus with Capacity Increase" (four-lane)

As noted in previous sections, EIA Option 6 (four-lane bridge variation) is closest in footprint to BIA Concept 1. The EIA was more specific than the BIA Summary report in listing potential historic impacts.

Although the BIA report indicated no impacts to historic structures, the EIA indicated that the House of Providence and the Fort Vancouver National Historic Site are two properties in Washington likely to experience minor impacts under Option 6 (4-Lane). The House of Providence was added to the NRHP in 1978 and its significance is largely due to its architecture. The EIA stated that it is unlikely that the small portion of property required for new right-of-way would adversely impact the architectural character of the property.

In Oregon, The Columbia River Interstate Bridge and the Columbia Cemetery are likely to experience indirect impacts associated with nearby construction activity or other work-related activities. The Columbia Cemetery is listed on the City of Portland's Historic Landmarks Register, is designated as historically significant by the City of Portland, and is notable because it is one of the few existing pioneer cemeteries. Indirect impacts would not affect the essential historic qualities that qualify this property for historic status.

BIA Concept 2

BIA Concept 2 was not analyzed in the Summary report though the added footprint (five traffic lanes, two LRT lanes) is similar to BIA Concept 7. BIA Concept 7 is discussed in a later section.

BIA Concept 3

BIA Concept 3 was not analyzed for environmental impacts in the BIA Summary report, however it adds a five-lane bridge structure similar to BIA Concept 1. Concept 1 was discussed in a previous section.

BIA Concept 4

BIA Concept 4 is likely to result in an encroachment onto the Ft. Vancouver Historical Site (60-120 feet). An encroachment over 60' would impact the FHWA building located near the SR 14 ramp to I-5 northbound. However, no historic buildings would be impacted. This Concept, by fully replacing the I-5 Columbia River Bridge with a replacement bridge, has the greatest impact of all the BIA concepts to this historic structure. The existing northbound bridge is registered on the National Register of Historic Places and the southbound bridge is eligible for registration.

EIA Option 6 "Express Bus with Capacity Increase" (ten-lane)

As discussed in a previous section, EIA Option 6 (10-Lane Variation) is most similar to BIA Concept 4. Impacts discussed in the EIA under this variation of Option 6 are as follows.

Although the BIA report indicates no likely impacts to historic structures, the EIA indicates this option may have indirect impacts to Kiggins House. The Kiggins House was added to the NRHP in 1995, for its association with significant historical figures. It is unlikely that the indirect impacts associated with this option would adversely impact the historical site.

The House of Providence (described under BIA Concept 1) may also experience indirect impacts. The Columbia River Interstate Bridge would be fully removed under this option, creating a direct impact to the structure. The Columbia Cemetery is likely to experience indirect impacts associated with this option.

This option directly conflicts with Oregon state and local historic preservation policies, as it would result in the removal of the historic bridges. Pursuit of this option would necessitate a Section 106 and Section 4(f) process. This process would also be followed for impacts to the Kiggins House.

BIA Concept 5

Concept 5 was not analyzed in the BIA Summary report though the added footprint (six traffic lanes, two LRT lanes) is similar to BIA Concept 7. BIA Concept 7 is discussed in a later section.

BIA Concept 6

BIA Concept 6 has an encroachment onto the Ft. Vancouver Historical Site (60-120 feet). An encroachment over 60' would impact the FHWA building located near the SR 14 ramp to I-5 northbound. However, the BIA Summary Report indicates that no historic buildings would be impacted. This concept includes a new bridge structure to the east of the existing bridges. This minimizes the impacts to the Fort Vancouver Historic Site in comparison to concepts with a structure to the west of the existing bridges.

This concept indirectly impacts the Historic I-5 Columbia River Bridge by building a new structure adjacent to it. Concept 6 has less impact to the bridges than Concept 4. The

existing northbound bridge is registered on the National Register of Historic Places and the southbound bridge is eligible for registration.

This concept would require evaluation to determine if the new bridge(s) substantially impair the historic integrity of the historic bridges.

EIA Option 3C

EIA Option 3C is most similar to BIA Concept 6, and therefore impacts to cultural resources associated with this option and discussed in the EIA are included here. This option is likely to have indirect impacts to the historic Columbia River Interstate Bridge associated with nearby construction activity or other work-related activities. It is also likely to have indirect impacts to five properties in Vancouver, including the First Christian Church, Hidden Houses, and three residences. It is also likely to have minor impacts to four properties in Washington, including the Fort Vancouver Historical Site, Koplan's Furnishings, the Spic 'n' Span, and Luepke Flowers.

Option 3 was evaluated in relation to state and local policies and ordinances, and found to be consistent with policies calling for the preservation of historic properties.

Option 6 "Express Bus with Capacity Increase" (six-lane)

EIA Option 6 (6-Lane Variation) is most similar to BIA Concept 6. Kiggins House (described under BIA Concept 4) and the House of Providence (described under BIA Concept 1) may experience minor impacts that are unlikely to aversely impact the properties.

The Columbia River Interstate Bridge may experience indirect impacts associated with nearby construction and other project-related activities. The Columbia Cemetery is likely to experience indirect impacts associated with this option.

Option 6 (6-Lane Variation) could conflict with Oregon state and local historic preservation policies, as the option has indirect impacts on the historic Columbia River Crossing Bridge. Pursuit of this option would necessitate a Section 106 and Section 4(f) process. This process would also need to be followed for impacts to the Kiggins House.

Option 8

No impacts to identified historic properties were identified in the EIA or the Cultural Resources Technical Report with this option.

BIA Concept 7

BIA Concept 7 has an encroachment onto the Ft. Vancouver Historical Site (60-120 feet). An encroachment over 60' would impact the FHWA building located near the SR 14 ramp to I-5 northbound. However, the BIA Summary Report indicates no historic buildings would be impacted. This concept includes two new bridge structures, one to the east of the existing bridges and one to the west. This has greater impacts to the Fort Vancouver Historic Site than those concepts with a structure to the east of the existing bridges.

This concept indirectly impacts the Historic I-5 Columbia River Bridge, though not to the extent of Concept 4. The existing northbound bridge is registered on the National Register of Historic Places and the southbound bridge is eligible for registration. Concept 7 would

undergo study to determine if the new bridges substantially impair the historic integrity of the historic bridges.

BIA Concept 8

Concept 8 was not analyzed in the BIA Summary report. It is most similar to BIA Concept 7, which is discussed in the previous section.

Potential Cultural Resource Issues

The following potential issues were identified in relation to Cultural Resources:

- If a listed historic or cultural resource is impacted, Section 106 of the National Historic Preservation Act (NHPA) would require that ODOT and WSDOT take in to account the effect of the project on the property, and the Advisory Council on Historic Preservation (ACHP) must be given the opportunity to independently comment on the impact.
- The Fort Vancouver Historic Site is listed as a National Historic Landmark. Section 110 of the NHPA specifies that impacts to National Historic Landmarks must be minimized.
- Section 4(f) of the Department of Transportation Act of 1966 requires that before impacting a historic property, the agency determine that there are no feasible or prudent concepts before mitigation could be determined.
- Local and regional plans also include goals and policies related to properties of historic or cultural significance, with the intent of preserving these properties. Impacts related to the various concepts may conflict with local and regional goals and policies.
- There is potential for archaeological findings in the study area, perhaps by Fort Vancouver.

Visual

No visual analysis has been conducted to date.

BIA Concept 1

BIA Concept 1 includes construction of a new low- to mid-level bridge west of the existing bridges, with a lift span. No visual analysis has been conducted to date though the new structure could have visual impacts related to its height, the fact that it is a decked structure, and its style of design in relation to the existing historic structures.

BIA Concept 2

BIA Concept 2 was not analyzed in the Summary report though the added footprint (five traffic lanes, two LRT lanes) is similar to BIA Concept 7. This is discussed in a later section.

BIA Concept 3

BIA Concept 3 was not analyzed for environmental impacts in the BIA Summary report, however it adds a five-lane bridge structure similar to BIA Concept 1. Concept 1 was discussed in a previous section.

BIA Concept 4

BIA Concept 4 replaces the existing structures with one double deck mid- to high-level bridge and a separate new bridge for light rail. No visual analysis has been conducted to date on this concept. Typically a taller structure could have the potential for greater visual impacts than a low structure. In addition, the construction of two separate bridges as part of this concept could increase visual impacts.

BIA Concept 5

Concept 5 was not analyzed in the Summary report though the added footprint (six traffic lanes, two LRT lanes) is similar to BIA Concept 7. BIA Concept 7 is discussed in a later section.

BIA Concept 6

BIA Concept 6 constructs one new low- to mid-level bridge with a lift span, to be used as a collector-distributor bridge with LRT. No visual analysis has been conducted. However, the new structure could have visual impacts related to its height, the fact that it is a decked structure, and its style of design in relation to the existing historic structures.

BIA Concept 7

BIA Concept 7 constructs two new structures, one east and one west of the existing bridges. The westernmost structure would be a low-to mid-level bridge with a lift span, to be used for LRT with northbound and southbound vehicle movement. The easternmost structure would be a low-to mid-level bridge with a lift span, to accommodate the northbound freeway traffic.

No visual analysis has been conducted for this Concept. However, the number of additional structures is greater than other concepts and could have a visual impact. In addition, the existing structures will be retained; if the new structures are of a different design than the existing historic bridges this could have a visual impact as well.

BIA Concept 8

Concept 8 was not analyzed in the BIA Summary report. It is most similar to BIA Concept 7, which is discussed in the previous section.

Potential Visual Resource Issues

A visual resource analysis would be required for the concepts under consideration as part of the NEPA process. Generally, projects that have the greatest potential for negative visual impacts have new alignments, additional lanes, changes in vertical or horizontal alignments, new structures, large cuts or fills, waterway changes, and any changes to existing parkways or scenic byways. The Columbia River Crossing includes scenic views of the river, mountain peaks, and downtown Portland and Vancouver. Some expected issues include:

- New bridge lift structures, trusses, or arches may partially obstruct scenic views by travelers and off-road viewers.
- Higher bridges may have greater visual impact

- Double-deck structures may partially obstruct scenic views by travelers on the lower deck.
- If a tunnel option were pursued, it would wholly eliminate scenic views by travelers and could impact the visual intactness of the landscape.
- Multi-lane roadways may partially restrict travelers' scenic views of the river from middle lanes.
- Changes to alignments may change existing scenic views by travelers and off-road viewers or provide entirely new views.
- Construction activities may include temporary visual impacts from cranes, scaffolding, forms, earthwork, and so on.
- Because the existing I-5 bridges are historic structures, if new supplemental structures were of a different design, the visual unity of the Columbia Crossing could be impacted.

Noise

No noise analysis has been conducted to date.

BIA Concept 1

BIA Concept 1 includes construction of a new low- to mid-level bridge west of the existing bridges, with a lift span. No noise analysis has been conducted to date. The new structure may have noise impacts on businesses and residential locations to the west of the existing structure.

BIA Concept 2

BIA Concept 2 was not analyzed in the Summary report though the added footprint (five traffic lanes, two LRT lanes) is similar to BIA Concept 7. This is discussed in a later section.

BIA Concept 3

BIA Concept 3 was not analyzed for environmental impacts in the BIA Summary report, however it adds a five-lane bridge structure similar to BIA Concept 1. Concept 1 was discussed in a previous section.

BIA Concept 4

BIA Concept 4 replaces the existing structures with one double deck mid- to high-level bridge and a separate new bridge for light rail. No noise analysis has been conducted to date. The new structures may have noise impacts on businesses and residential locations near the footprint of the bridges.

BIA Concept 5

Concept 5 was not analyzed in the Summary report though the added footprint (six traffic lanes, two LRT lanes) is similar to BIA Concept 7. BIA Concept 7 is discussed in a later section.

BIA Concept 6

BIA Concept 6 constructs one new low- to mid-level bridge with a lift span west of the existing structures, to be used as a collector-distributor bridge with LRT. No noise analysis has been conducted to date. The new structure may have noise impacts on businesses and residential locations to the west of the existing structure.

BIA Concept 7

BIA Concept 7 constructs two new structures, one east and one west of the existing bridges. The westernmost structure would be a low-to mid-level bridge with a lift span, to be used for LRT with northbound and southbound vehicle movement. The easternmost structure would be a low-to mid-level bridge with a lift span, to accommodate the northbound freeway traffic. No noise analysis has been conducted for this Concept. Noise impacts may be observed near the new structures.

BIA Concept 8

Concept 8 was not analyzed in the BIA Summary report. It is most similar to BIA Concept 7, which is discussed in the previous section.

Potential Noise Issues

A detailed noise analysis would be required for the concepts under consideration as part of the NEPA process. The following issues may be of interest for this project:

- The BIA is currently subject to high noise levels from the existing freeway
- Industrial uses in Columbia Boulevard vicinity and Hayden Island are not likely to be noise-sensitive
- More traffic, associated with greater road capacity, will lead to greater noise impacts
- Noise sensitive locations are more likely to be located in Washington than Oregon, where the freeway passes near historic structures, commercial businesses, and residences in Vancouver.
- Noise can be a "constructive use" of a public park if it interferes with the appropriate use of the park
- Noise walls would be primarily constructed to protect "outdoor use areas"

Air Quality

A first-level air quality impact screening was conducted in 2001 and included in the EIA. The impact screening provided a general analysis of air quality impacts associated with the various options under consideration. Impacts were described for the I-5 corridor as a whole (Rose Quarter to I-205). Although three corridor segments were explored for more spot-based analysis, none of these segments were within the BIA. Impacts were assessed for both freeway mainline emissions as well as arterial screenline emissions.

The following pollutant emissions were analyzed:

- CO = Carbon Monoxide, a colorless, odorless, poisonous gas that reduces the blood's oxygen-carrying capability.
- VOC = Volatile Organic Compounds, a compound that, with NO_x produces ozone. Ozone causes eye irritation and respiratory tract irritation, and contributes to smog.
- NO_x = Nitrogen Oxides, a compound that, with VOC, produces ozone.
- PM_{10} = Particulate Matter, less than 10 micrometers in size, small particles of dust, soot, and organic matter suspended in the atmosphere. Particulate Matter may carry absorbed toxic substances.

The assessment identified potential total daily pollutant emissions that could result from the various options under consideration. General findings from the corridor-wide analysis are included in this section, organized by EIA Option. The BIA contained no additional air quality analysis.

BIA Concept 1

The BIA Summary Report did not describe air quality impacts. This Concept is most similar to EIA Option 6 (four-lane supplemental bridge), which is described below.

EIA Option 6 "Express Bus with Capacity Increase" (four-lane)

The first-level screening air quality analysis was conducted for Option 6 with the six-lane supplemental bridge variation, but not for the four-lane supplemental bridge variation or the ten-lane replacement bridge variation. The results of this analysis are described under BIA Concept 7.

The four-lane supplemental bridge variation of Option 6 has less capacity than the six-lane variation. Overall, the air quality screening found that lower capacity led to fewer localized emissions. It is therefore assumed that the four-lane bridge variation would have fewer localized emissions than the six-lane variation, though the actual amount is unknown.

BIA Concept 2

BIA Concept 2 was not analyzed in the Summary report though the added footprint (five traffic lanes, two LRT lanes) is similar to BIA Concept 7. As discussed in a later section.

BIA Concept 3

BIA Concept 3 was not analyzed for environmental impacts in the BIA Summary report, however it adds a five-lane bridge structure similar to BIA Concept 1. Concept 1 was discussed in a previous section.

BIA Concept 4

EIA Option 6 "Express Bus with Capacity Increase" (ten-lane)

The first-level screening air quality analysis was conducted for Option 6 with the six-lane supplemental bridge variation, but not for the ten-lane replacement bridge variation or the four-lane supplemental bridge variation. The results of this analysis are described under BIA Concept 7.

The ten-lane replacement bridge variation of Option 6 has less capacity than the six-lane supplemental bridge variation. Overall, the air quality screening found that lower capacity led to fewer localized emissions. It is therefore assumed that the four-lane bridge variation would have fewer localized emissions than the six-lane variation, though the actual amount is unknown.

BIA Concept 5

Concept 5 was not analyzed in the Summary report though the added footprint (six traffic lanes, two LRT lanes) is similar to BIA Concept 7. BIA Concept 7 is discussed in a later section.

BIA Concept 6

The BIA Summary Report did not describe air quality impacts. This Concept is most similar to EIA Option 3C (light-rail loop), and EIS Option 8 (West Arterial Road) which are described below.

EIA Option 3C

The air quality analysis showed a high level of freeway emissions in comparison to the baseline for the light rail loop option. These freeway emissions were comprised of CO, VOC, NO_x, and PM_{10}. Option 3C showed a 15 percent increase in CO, a 66 percent increase in VOC, a 14 percent increase in NO_x, and a 6 percent increase in PM_{10}. These increases in freeway emissions were typical for options adding capacity on the bridge crossing.

Arterial screenline emissions displayed less of a difference, varying between 7 and 9 percent higher than the baseline. See Table 19 below.

TABLE 19
Option 3 Air Quality Impacts (Corridor-Wide)

ARTERIAL SCREENLINE EMISSIONS		
Pollutant	**Baseline - Daily Emissions (Kilograms/Day)**	**Option 3 Daily Emissions (Kilograms/Day)**
CO	3,534	3,815
VOC	140	151
NO_x	131	141
PM_{10}	34	37

TABLE 19
Option 3 Air Quality Impacts (Corridor-Wide)

FREEWAY EMISSIONS		
Pollutant	**Baseline - Daily Emissions (Kilograms/Day)**	**Option 3 Daily Emissions (Kilograms/Day)**
CO	11,888	13,655
VOC	393	651
NO_x	435	497
PM_{10}	106	112

Option 8

The West Arterial Option observed the highest arterial screenline pollutant emissions, with between 19 and 21 percent higher emissions than the baseline. However, the freeway emissions are much closer in line with the baseline condition than other options. See Table 20.

TABLE 20
Option 8 Air Quality Impacts (Corridor-Wide)

ARTERIAL SCREENLINE EMISSIONS		
Pollutant	**Baseline - Daily Emissions (Kilograms/Day)**	**Option 8 Daily Emissions (Kilograms/Day)**
CO	3,534	4,317
VOC	140	167
NO_x	131	159
PM_{10}	34	41
FREEWAY EMISSIONS		
Pollutant	**Baseline - Daily Emissions (Kilograms/Day)**	**Option 8 Daily Emissions (Kilograms/Day)**
CO	11,888	11,918
VOC	393	394
NO_x	435	436
PM_{10}	106	107

BIA Concept 7

The BIA Summary Report did not describe air quality impacts. This Concept is most similar to EIA Option 6 (six-lane supplemental bridge variation) which is described below.

6-lane supplemental bridge variation of EIA Option 6

The air quality analysis was conducted for Option 6 with the six-lane supplemental bridge variation. This option displayed the highest freeway pollutant emissions of all options studied, with emissions between 16 and 66 percent greater than the baseline. This option observed arterial screenline emissions that were between six and seven percent higher than the baseline. See Table 21 below.

TABLE 21
Option 6 Air Quality Impacts (Corridor-Wide)

ARTERIAL SCREENLINE EMISSIONS		
Pollutant	**Baseline - Daily Emissions (Kilograms/Day)**	**Option 6 Daily Emissions (Kilograms/Day)**
CO	3,534	3,793
VOC	140	148
NO_x	131	140
PM_{10}	34	36
FREEWAY EMISSIONS		
Pollutant	**Baseline - Daily Emissions (Kilograms/Day)**	**Option 6 Daily Emissions (Kilograms/Day)**
CO	11,888	14,818
VOC	393	651
NO_x	435	539
PM_{10}	106	123

BIA Concept 8

Concept 8 was not analyzed in the BIA Summary report. It is most similar to BIA Concept 7, which is discussed in the previous section.

Potential Air Quality Issues

Regardless of which concept is considered, the air quality report concluded that air quality in the future is expected to be cleaner than it is today for all emissions but Particulate Matter. This is due to an expectation that vehicles will have lower emissions and burn cleaner fuels, as well as the anticipation that air quality maintenance plans will continue to be implemented. Location-specific air quality modeling, based on engineering design of the

project concepts, would be required during the NEPA process to identify more precise air quality impacts.

- Options that minimize traffic are likely to have the least negative impacts on air quality. Because automobiles are the primary producer of the pollutant CO, when mobility decreases (associated with greater traffic volumes in relation to capacity) cars take longer to pass through a given area, thereby releasing more CO. Additionally, idling engines are known for releasing higher levels of CO. In addition, in the Air Quality analysis specific localized emissions increased with additional road capacity. For this reason, road capacity needs to be considered in conjunction with mobility when choosing among concepts.
- Air quality is likely to be a sensitive issue with neighborhood residents in North Portland and Vancouver. The air quality issues that will need to be addressed to respond to public concerns range from regulatory to policy.
- Air quality conformity, air toxics, environmental justice, human health risk, CO hot spots, and Ozone impacts are all areas to be analyzed in the NEPA process.

Natural Resources

The Natural Resource Technical Report I-5 Trade Corridor Study represents a good approach to screening of potential options for natural resources impacts, particularly wetlands, and provides useful baseline information on the corridor; however, the difference and variations in design options reviewed in the Natural Resource Technical Report versus those in the BIA Summary Draft limits the direct applicability of the impact analysis to future EIS analysis (as well as the work completed for this report). Likewise, some of the information collected for the Natural Resource Technical Report, which was published in 2001, will need to be updated because of to the availability of new or more accurate information.

The BIA analysis in this report focuses on the eight BIA Concepts between Columbia Boulevard and SR-500 included in the BIA Summary Report. This report use information about BIA Concepts 1, 4, 6, and 7 to posit impacts that might result from the other concepts. The following analysis was based on review of aerial photographs of the project area with an overlay of the alignments and supporting text from BIA Summary Draft (Maps 2, 3, 4, and 5). The project maps (photographs) of Washington provided a much greater level of detail than the Oregon maps (photographs) due to their larger scale, and therefore provided better visibility of natural resources that would be impacted.

The BIA analysis did not provide a detailed analysis regarding potential impacts to natural resources, but did provide a limited analysis focusing on potential impacts to aquatic, wetland, and terrestrial habitat in the vicinity of the Columbia River. The primary areas of concern include the Columbia River, North Portland Harbor, the Columbia Slough, and the wetland mitigation site known as the former radio towers site (south of Marine Drive and west of I-5 in Oregon). The BIA Concepts and the three additional options studied included additional crossings of the Columbia River, North Portland Harbor, and the Columbia Slough. An analysis of potential natural resource impacts by concept follows.

Aquatic Resources

Impacts to aquatic resources of specific concern are limited to impacts to fish and fish habitat. Anadromous and resident fish and macroinvertebrate species are potentially at risk from proposed improvements presented in the four concepts. Anadromous and resident fish would likely include salmon and trout that may be federally or state-listed as threatened or endangered, or are candidates for listing. Macroinvertebrates could also be impacted. Fish habitat includes riparian habitat around streams and rivers. Removal of vegetation within a watershed, especially within a riparian zone, has the potential to increase sedimentary runoff from land. In addition, noise and vibration from construction equipment could temporarily negatively impact the behavior of salmonids and other organisms inhabiting the area, and could impede migration, halt normal daily activities (feeding, spawning, resting), or induce territorial out-migration.

The areas of impacts to aquatic resources include bridge and arterial crossings over the Columbia River, North Portland Harbor, and the Columbia Slough. Final design of bridge type, including the number of bridges and the number and placement of piers and abutments, will determine the extent of the impacts. Also important to determining construction impacts is the number of bridges across the Columbia River to be removed.

BIA Concept 1

BIA Concept 1 involves constructing a new southbound bridge crossing the Columbia River directly west of the existing I-5 Bridge, a bridge and arterial crossing North Portland Harbor, and a bridge and arterial crossings over the Columbia Slough. Impacts to aquatic resources would depend on the number and placement of piers and abutments, but are expected to be moderate in extent.

BIA Concept 2

Although BIA Concept 2 was not presented in detail in the BIA Summary Draft, Concept 2 is likely to have impacts to Columbia River resources most similar to BIA Concept 7 because both concepts result in two new bridges (with similar footprints) and a total of four bridges across the river. Roadway design south of the bridge crossing was not presented in the BIA Summary Draft for Concept 2, but impacts to North Portland Harbor and Columbia Slough are presumed to be most similar to Concept 7. (BIA Concept 7 is discussed later.)

BIA Concept 3

BIA Concept 3 was not presented in detail in the BIA Summary Draft. In terms of post-construction impacts to Columbia River resources, BIA Concept 3 is likely to have impacts most similar to BIA Concept 4 because both result in two bridges across the river. (Concept 4 is discussed later.) In terms of potential construction impacts to Columbia River resources, BIA Concept 3 is most similar to Concept 1 because one new 5-lane bridge is to be constructed; however, Concept 3 differs slightly because one current bridge is to be removed under Concept 3. Roadway design south of the bridge crossing was not presented in the BIA Summary Draft for Concept 3, but impacts to North Portland Harbor and Columbia Slough are presumed to be most similar to Concept 1. (BIA Concept 1 was discussed previously.)

BIA Concept 4

BIA Concept 4 includes a 10-lane double-deck replacement for the I-5 Bridge, with LRT on a separate new bridge crossing the Columbia River; a bridge crossing North Portland Harbor; a possible connector at Hayden Island, and a bridge over the Columbia Slough. Moderate impacts to aquatic resources are expected on the Columbia River, Columbia Slough, and North Portland Harbor.

BIA Concept 5

Although BIA Concept 5 was not presented in detail in the BIA Summary Draft, this concept is likely to have impacts to the Columbia River resources similar to BIA Concept 7 because both result in two new bridges for a total of four bridges across the river. Roadway design south of the bridge crossing was not presented in the BIA Summary Draft for Concept 5, but impacts to North Portland Harbor and Columbia Slough are presumed to be most similar to Concept 7. (BIA Concept 7 is discussed later.)

BIA Concept 6

BIA Concept 6 includes a new 4-lane supplemental collector-distributor bridge with LRT crossing the Columbia River; a southbound I-5 bridge and arterial crossing North Portland Harbor; ramp construction near the radio tower wetland mitigation site; and multiple bridges over the Columbia Slough. Moderate impacts to aquatic resources are expected on the Columbia River, Columbia Slough, North Portland Harbor, and Hayden Island.

BIA Concept 7

BIA Concept 7 includes a new northbound bridge and LRT crossing the Columbia River; an concept LRT crossing to Hayden Island, then to Marine Drive; an concept connector from Hayden Island to Marine Drive; and multiple bridges over the Columbia Slough. Aquatic resources that are associated with the Columbia River, Hayden Island, North Portland Harbor, and the Columbia Slough would be moderately impacted.

BIA Concept 8

BIA Concept 8 was not presented in detail in the BIA Summary Draft. It is likely to have impacts to Columbia River resources similar to BIA Concept 1 because both result in one new bridge (except the Concept 8 bridge has several more travel lanes) for a total of three bridges across the river. Concept 1 was discussed previously. Roadway design south of the bridge crossing was not presented in the BIA Summary Draft for Concept 8, but impacts to North Portland Harbor and Columbia Slough are presumed to be most similar to Concept 7. (BIA Concept 7 was discussed previously.)

Wetland Resources

Impacts to wetland resources would include direct impacts due to fill, clearing and grubbing of vegetation, and potential soil compaction that could alter hydrology. In addition, construction staging areas could lead to erosion and increased sedimentation resulting from vegetation removal and fill that could enter wetlands and impair water quality. Accidental leaks from fuel and oil tanks and improperly disposed stormwater could enter wetlands and impair water quality and damage wetland plants and wildlife.

Construction noise and increased human activity would temporarily disrupt wildlife associated with wetlands.

The areas of wetland resources that could be impacted are limited to the radio tower wetland mitigation site, potential wetland along the Columbia Slough, potential wetland adjacent to North Portland Harbor, and potential wetland on Hayden Island. However, at this level of analysis, it is not clear if wetland exists in areas other than the radio tower wetland mitigation site.

BIA Concept 1

BIA Concept 1 involves constructing a new southbound bridge crossing the Columbia River directly west of the existing I-5 Bridge; a bridge and arterial crossing North Portland Harbor; and multiple bridges over the Columbia Slough. Impacts to wetland resources would depend on the number and placement of abutments relative to wetland location. It is unlikely that there is wetland along the Columbia River, Hayden Island, or North Portland Harbor; if wetland does exist in these areas, the impacts are expected to be minor. Wetland may exist along the Columbia Slough, but impacts are expected to be minor depending on design and placement and number of abutments.

BIA Concept 1 also involves construction of a southbound on-ramp that would impact the radio tower wetland mitigation site. Wetland impacts would be limited to direct fill on the eastern part of the mitigation site.

BIA Concept 2

BIA Concept 2 was not presented in detail in the BIA Summary Draft. Roadway design was not presented in the BIA Summary Draft for Concept 2, but based on the bridge crossing design, impacts to wetland resources are presumed to be most similar to Concept 7. (BIA Concept 7 is discussed later.)

BIA Concept 3

BIA Concept 3 was not presented in detail in the BIA Summary Draft. Roadway design was not presented in the BIA Summary Draft for Concept 3, but based on the bridge crossing design, impacts to wetland resources are presumed to be most similar to Concept 1. (BIA Concept 1 was discussed previously.)

BIA Concept 4

BIA Concept 4 includes a 10-lane double-deck replacement for the I-5 Bridge, with LRT on a separate new bridge crossing the Columbia River; a bridge crossing North Portland Harbor; a possible connector at Hayden Island; and a bridge over the Columbia Slough. Minor impacts to wetland are possible on the Columbia River, Columbia Slough, and Hayden Island, although the extent of wetland habitat is not known. There appear to be no impacts to the radio tower wetland mitigation site with this concept.

BIA Concept 5

BIA Concept 5 was not presented in detail in the BIA Summary Draft. Roadway design was not presented in the BIA Summary Draft for Concept 5, but based on the bridge crossing

design, impacts to wetland resources are presumed to be most similar to Concept 7. (BIA Concept 7 is discussed later.)

BIA Concept 6

BIA Concept 6 includes a 4-lane supplemental collector-distributor bridge with LRT crossing the Columbia River; a new southbound I-5 bridge and arterial crossing North Portland Harbor; ramp construction near the radio tower wetland mitigation site; and multiple bridges over the Columbia Slough. Minor impacts to wetland are possible on the Columbia River, Columbia Slough, and Hayden Island, although the extent of wetland habitat is not known. The radio tower wetland mitigation site would be impacted due to fill, but construction of a retaining wall would reduce impacts.

BIA Concept 7

BIA Concept 7 includes a new northbound bridge and a LRT crossing the Columbia River; an alternative LRT crossing to Hayden Island, then to Marine Drive; an alternative connector from Hayden Island to Marine Drive; multiple bridges over the Columbia Slough; and a bridge over the radio tower wetland mitigation site. Wetlands could be impacted along the Columbia River, Hayden Island, the radio tower wetland mitigation site, and along the Columbia Slough, but would be expected to be minor in extent.

BIA Concept 8

BIA Concept 8 was not presented in detail in the BIA Summary Draft. Roadway design was not presented in the BIA Summary Draft for Concept 8, but based on the bridge crossing design, impacts to wetland resources are presumed to be most similar to Concept 7. (BIA Concept 7 was discussed previously.)

Terrestrial Resources

Impacts to terrestrial resources of specific concern are primarily limited to fills and direct loss of plants and wildlife. Construction equipment and vehicles could also impact vegetation depending on staging area location, size, and action. The location and construction of stormwater facilities will likely impact terrestrial resources. Trees that would be retained near the project corridor and new alignments could have roots partially severed or excavated during construction. With the addition of asphalt, soil temperatures may be expected to increase, thereby affecting nearby plant survival by reducing the area in which water enters the soil and becomes available to plant roots. If water availability is insufficient in the smaller growing space, plant survival could be compromised. Impacts to plant communities are limited to developed/ornamental landscaping and limited forest habitat. Developed/ornamental landscape can include both native and non-native trees and shrubs planted for aesthetics near developed areas.

Wildlife could be impacted by direct loss of habitat. Smaller, less mobile species and those seeking refuge in burrows (e.g. voles, gophers, and snakes) could be killed inadvertently during construction activities along the I-5 corridor. Mobile species, such as songbirds and crows, could be temporarily displaced from suitable habitat in the immediate vicinity of the study corridor. Building new roadway and widening existing roadway would result in an increase in wildlife barriers and increase habitat fragmentation. Impacts to wildlife may include the bald eagle, heron species, and osprey, which use the Columbia River for feeding

and the shoreline for nesting and perching. There are documented bald eagle nests in the vicinity of the study area, and bald eagles overwinter in this area. The bald eagle is a federal and state threatened species. Bat species may use forested habitats. In addition, birds and small mammals that inhabit landscaped and forested habitats could be negatively affected.

Improvements to the SR-500 interchange near Leverich Park, widening of I-5 and arterial overpasses, and the redesign of SR-14 and I-5 interchange could impact terrestrial habitats in those areas.

BIA Concept 1

There are multiple elements to this design that have potential for impacts to terrestrial resources throughout the study area:

- BIA Concept 1 would involve construction of a northbound on-ramp to I-5 at SR-500 and Leverich Park in the northeast corner of SR-500 and I-5 interchange, and a new flyover ramp from SR-500 westbound to I-5 southbound. This concept could impact developed/ornamental and forest habitats in the vicinity of Leverich Park. Minor loss of habitat could displace the small mammals and birds that use this area. Removal of the current southbound I-5 on-ramp from 39th Street would result in a revegetated area with shrubs and groundcover.
- BIA Concept 1 involves widening two overpasses (East 33rd and East 29th Streets) between SR-500 and Fourth Plain Boulevard, and widening the Fourth Plain Boulevard overpass. Impacts would be limited to developed/ornamental landscaping, including shrubs and grass, and could kill or displace small mammals and birds, but would be minor in extent. The Mill Plain and Evergreen Boulevard overpasses would also be widened. Fill likely already exists here. Impacts would be limited to shrubs and grass, and could kill or displace rodents and birds.
- BIA Concept 1 involves widening I-5. However, constructing walls in some areas would reduce vegetation and wildlife impacts. Minor impacts to plants and wildlife would be limited to the removal of shrubs and grass and could kill or displace small mammals and birds.
- BIA Concept 1 involves a redesign of the SR-14 and I-5 interchange. Widening SR-14, constructing an overpass, and constructing a bridge ramp to northbound I-5 could impact grassland and shrubs and could kill or displace small mammals and birds.
- BIA Concept 1 includes a new 5-lane southbound supplemental bridge with LRT that would cross the Columbia River directly west of the existing I-5 Bridge. This concept could impact developed ornamental landscaping on Hayden Island, and may include both native and non-native trees and shrubs.

BIA Concept 2

BIA Concept 2 was not presented in detail in the BIA Summary Draft. Roadway design was not presented in the BIA Summary Draft for Concept 2, but based on the bridge crossing design, impacts to terrestrial resources are presumed to be most similar to Concept 7. (BIA Concept 7 is discussed later.)

BIA Concept 3

BIA Concept 3 was not presented in detail in the BIA Summary Draft. Roadway design was not presented in the BIA Summary Draft for Concept 3, but based on the bridge crossing design, impacts to wetland resources are presumed to be most similar to Concept 1. (BIA Concept 1 was discussed previously.)

BIA Concept 4

There are multiple elements to this design that have potential for impacts to terrestrial resources throughout the study area:

- BIA Concept 4 would involve construction of a northbound on-ramp to I-5 at SR-500 and Leverich Park in the northeast corner of the SR-500 and I-5 interchange, and a new flyover ramp from SR-500 eastbound to I-5 southbound. This concept could impact developed/ornamental and forest habitats in the vicinity of Leverich Park. Minor loss of habitat could displace the small mammals and birds that use this area. Removing the current southbound I-5 on-ramp from 39th Street would result in a revegetated area with shrubs and groundcover.
- BIA Concept 4 involves widening two overpasses (East 33rd and East 29th Streets) between SR-500 and Fourth Plain Boulevard, widening the Fourth Plain Boulevard overpass, and constructing a new southbound I-5 access to Mill Plain Boulevard. Impacts would be limited to developed/ornamental landscaping, including shrubs and grass, and could kill or displace the small mammals and birds that may use the shrubs and grass that would be removed, but these impacts would be minor in extent. The Mill Plain and Evergreen Boulevard overpasses would also be widened. Fill likely already exists here. Impacts would be limited to shrubs and grass and could kill or displace small mammals and birds.
- BIA Concept 4 involves widening I-5. However, constructing walls in some areas would reduce vegetation and wildlife impacts. Construction of new southbound I-5 lanes near Mill Plain would remove developed/ornamental landscape, including trees and shrubs. Minor impacts to plants and wildlife would be limited to the removal of trees, shrubs, and grass and loss of associated small mammals and displaced birds.
- BIA Concept 4 involves a redesign of the SR-14 and I-5 interchange. Widening SR-14, constructing an overpass, and constructing a bridge ramp to northbound I-5 could impact grassland and shrubs and could kill or displace small mammals and birds.
- BIA Concept 4 includes a 10-lane double-deck replacement for the existing I-5 Bridge with LRT, and a separate new bridge crossing the Columbia River; a possible connector at Hayden Island; and a bridge over the Columbia Slough that could impact developed ornamental landscaping on the Washington side near Columbia Street and on Hayden Island, and may include both native and non-native trees, shrubs, and grass.

BIA Concept 5

BIA Concept 5 was not presented in detail in the BIA Summary Draft. Roadway design was not presented in the BIA Summary Draft for Concept 5, but based on the bridge crossing

design, impacts to wetland resources are presumed to be most similar to Concept 7. (BIA Concept 7 is discussed later.)

BIA Concept 6

There are multiple elements to this design that have potential for impacts to terrestrial resources throughout the study area:

- BIA Concept 6 would involve constructing a northbound on-ramp to I-5 at SR-500 and Leverich Park; a new flyover ramp from I-5 southbound to SR-500 eastbound; widening East 39th Street; and constructing a bridge to connect westbound SR-500 to southbound I-5. This concept could impact developed/ornamental and forest habitats in the vicinity of Leverich Park. Minor loss of habitat could displace the small mammals and birds that use this area. Removal of the current southbound I-5 on-ramp from 39th Street would result in a revegetated area with shrubs and groundcover.
- BIA Concept 6 involves widening two overpasses (East 33rd and East 29th Streets) between SR-500 and Fourth Plain Boulevard, widening the Fourth Plain Boulevard overpass, and constructing new southbound I-5 lanes. Impacts would be limited to developed/ornamental landscaping, including shrubs and grass, and could kill or displace small mammals and birds, but these impacts would be minor in extent. The overpass at Mill Plain would also be widened. Fill likely already exists here. Impacts would be limited to shrubs and grass, and could kill or displace rodents and birds.
- BIA Concept 6 involves widening I-5. However, constructing walls in some areas would reduce vegetation and wildlife impacts. Construction of new southbound I-5 lanes near Mill Plain would remove developed/ornamental landscape that includes trees and shrubs. Minor impacts to plants and wildlife would be limited to the removal of trees, shrubs, and grass, and the loss of associated small mammals and displaced birds.
- BIA Concept 6 involves a redesign of the SR-14 and I-5 interchange. Widening SR-14 and constructing a bridge ramp to southbound I-5 could impact grassland and shrubs and could kill or displace small mammals and birds. Impacts to developed/ornamental landscape and associated small animals and birds are expected to be minor.
- BIA Concept 6 includes a 4-lane supplemental collector-distributor bridge with LRT crossing the Columbia River; a possible connector at Hayden Island; and a bridge over the Columbia Slough. This concept could impact developed ornamental landscaping on the Washington side near Columbia Street and on Hayden Island; this may include both native and non-native trees and shrubs. The new southbound I-5 lanes would cause minor impacts to Delta Park greenspace and result in minor loss of shrubs and grass and the associated displacement of small mammals and birds that use this area.

BIA Concept 7

There are multiple elements to this design that have potential for impacts to terrestrial resources throughout the study area:

- BIA Concept 7 would involve constructing a northbound on-ramp to I-5 at SR-500 and Leverich Park; a new flyover ramp from I-5 southbound to SR-500 eastbound; widening East 39th Street; and constructing a bridge to connect westbound SR-500 to southbound

I-5. This concept could impact developed, ornamental and forest habitats in the vicinity of Leverich Park. Minor loss of habitat could displace the small mammals and birds that use this area. Removing the current southbound I-5 on-ramp from 39th Street would result in a revegetated area with shrubs and groundcover.

- BIA Concept 7 involves widening two overpasses (East 33rd and East 29th Streets) between SR-500 and Fourth Plain Boulevard; widening the Fourth Plain Boulevard overpass; constructing a new southbound I-5 lane(s); and constructing a southbound I-5 bridge at Mill Plain. Impacts would be limited to developed and ornamental landscaping, including shrubs and grass, and could kill or displace small mammals and birds that may use the shrubs and grass that would be removed, but these impacts would be minor in extent. The overpass at Mill Plain would also be widened. Fill likely already exists here. Impacts would be limited to shrubs and grass and could kill or displace rodents and birds.
- BIA Concept 7 involves widening I-5. However, constructing walls in some areas would reduce vegetation and wildlife impacts. Constructing new southbound I-5 lanes near Mill Plain would remove developed and ornamental landscape that includes trees and shrubs. Minor impacts to plants and wildlife would be limited to the removal of trees, shrubs, and grass and the loss of associated small mammals and displaced birds.
- BIA Concept 7 involves a redesign of the SR-14 and I-5 interchange. Widening SR-14 and constructing a bridge ramp to southbound I-5 could impact grassland and shrubs, and could kill or displace small mammals and birds. Impacts to developed and ornamental landscape and associated small animals and birds are expected to be minor.
- BIA Concept 7 includes a new northbound bridge and LRT crossing the Columbia River; an alternative LRT crossing to Hayden Island, then to Marine Drive; an alternative connector from Hayden Island to Marine Drive; and multiple bridges over the Columbia Slough. Developed and ornamental landscape impacts would include both native and non-native trees and shrubs. The new southbound I-5 lanes would cause minor impacts to Delta Park greenspace and result in minor loss of shrubs and grass and the associated displacement of the small mammals and birds that use this area.

BIA Concept 8

BIA Concept 8 was not presented in detail in the BIA Summary Draft. Roadway design was not presented in the BIA Summary Draft for Concept 8, but based on the bridge crossing design, impacts to wetland resources are presumed to be most similar to Concept 7. (BIA Concept 7 was discussed previously.)

Potential Natural Resource Issues

As designed, the following impacts to key natural resources in the I-5 corridor study area as defined above were noted:

- *Aquatic Resources:* All BIA concepts have the potential for moderate impacts to fish habitat. Some concepts have more impacts than others, but all designs need to consider the impact to anadromous fish. Additionally, all BIA concepts would require permitting

under the federal Endangered Species Act (ESA) and Section 10 of the Rivers and Harbors Act.

- *Terrestrial Impacts:* Few significant terrestrial impacts were recognized as a result of this analysis and impacts were limited primarily to streetscape or small areas of native vegetation. However, detailed analysis in an EIS may result in identification of impacts to species or habitats not recognized in this or previous reviews due to the scale of the analysis.
- *Wetland Impact:* All concepts, except BIA Concept 4, would encroach onto the radio tower wetland site (100 to 240 feet depending on the concept). Impacts to mitigation sites can result in significant mitigation requirements although the impact proper may be small. Permitting for such impacts involves Sections 404 and 401 of the Clean Water Act, as well as state permitting through the Oregon Department of State Lands.

Hydrology, Hydraulics, Water Quality

No analysis has been conducted to date regarding hydrology, hydraulics, or water quality.

BIA Concept 1

BIA Concept 1 includes construction of a new low- to mid-level bridge west of the existing bridges, with a lift span. No hydrology, hydraulics, or water quality analysis has been conducted to date. General issues related to these areas that may arise during the NEPA process are discussed at the end of this section.

BIA Concept 2

BIA Concept 2 was not analyzed in the Summary report though the added footprint (five traffic lanes, two LRT lanes) is similar to BIA Concept 7. This is discussed in a later section.

BIA Concept 3

BIA Concept 3 was not analyzed for environmental impacts in the BIA Summary report, however it adds a five-lane bridge structure similar to BIA Concept 1. Concept 1 was discussed in a previous section.

BIA Concept 4

BIA Concept 4 replaces the existing structures with one double deck mid- to high-level bridge and a separate new bridge for light rail. No hydrology, hydraulics, or water quality analysis has been conducted to date. General issues related to these areas that may arise during the NEPA process are discussed at the end of this section.

BIA Concept 5

Concept 5 was not analyzed in the Summary report though the added footprint (six traffic lanes, two LRT lanes) is similar to BIA Concept 7. BIA Concept 7 is discussed in a later section.

BIA Concept 6

BIA Concept 6 constructs one new low- to mid-level bridge with a lift span west of the existing structures, to be used as a collector-distributor bridge with LRT. No hydrology, hydraulics, or water quality analysis has been conducted to date. General issues related to these areas that may arise during the NEPA process are discussed at the end of this section.

BIA Concept 7

BIA Concept 7 constructs two new structures, one east and one west of the existing bridges. The westernmost structure would be a low-to mid-level bridge with a lift span, to be used for LRT with northbound and southbound vehicle movement. The easternmost structure would be a low-to mid-level bridge with a lift span, to accommodate the northbound freeway traffic. No hydrology, hydraulics, or water quality analysis has been conducted to date. General issues related to these areas that may arise during the NEPA process are discussed at the end of this section.

BIA Concept 8

Concept 8 was not analyzed in the BIA Summary report. It is most similar to BIA Concept 7, which is discussed in the previous section.

Potential Hydrology, Hydraulics, and Water Quality Issues

A detailed analysis would be required for the alternatives under consideration as part of the NEPA process. The areas of impacts include bridge and arterial crossings over the Columbia River, North Portland Harbor, and the Columbia Slough. The following issues may be of interest for this project:

- Stormwater runoff from any new bridge structures would need to be collected and treated before discharging to the Columbia
- Placement of embankment material and revetment (scour protection) for the bridge abutments may impact riparian areas and wildlife habitat
- Increased runoff from the proposed development will not be a concern because this increase will be small in comparison to the flow in the Columbia
- The roadways leading up to the bridge may impact the existing drainage system and flow paths to wetlands, creeks, natural depressions in undeveloped areas or stormwater systems in urban areas.
- The Columbia River is designated as a 303(d) limited waterbody for several constituents, including temperature (summer only), PCB, DDT Metabolite, Arsenic, and Polynuclear Aromati. Stormwater runoff from the project will need to be sufficiently treated so as to not adversely affect the river. Several TMDLs have been developed to address these constituents. All construction/permitting will be impacted by TMDL requirements.
- A number of permits would be required, including a 401 Water Quality Certification from DEQ. ESA issues and permitting will be pertinent to the project.
- The project is likely to require a Section 9 U.S. Coast Guard bridge permit.

Hazardous Materials

No analysis of hazardous materials has been conducted to date.

BIA Concept 1

BIA Concept 1 includes construction of a new low- to mid-level bridge west of the existing bridges, with a lift span. No analysis of hazardous materials has been conducted to date. General issues related to these areas that may arise during the NEPA process are discussed at the end of this section.

BIA Concept 2

BIA Concept 2 was not analyzed in the Summary report though the added footprint (five traffic lanes, two LRT lanes) is similar to BIA Concept 7. This is discussed in a later section.

BIA Concept 3

BIA Concept 3 was not analyzed for environmental impacts in the BIA Summary report, however it adds a five-lane bridge structure similar to BIA Concept 1. Concept 1 was discussed in a previous section.

BIA Concept 4

BIA Concept 4 replaces the existing structures with one double deck mid- to high-level bridge and a separate new bridge for light rail. No analysis of hazardous materials has been conducted to date. General issues related to these areas that may arise during the NEPA process are discussed at the end of this section.

BIA Concept 5

Concept 5 was not analyzed in the Summary report though the added footprint (six traffic lanes, two LRT lanes) is similar to BIA Concept 7. BIA Concept 7 is discussed in a later section.

BIA Concept 6

BIA Concept 6 constructs one new low- to mid-level bridge with a lift span west of the existing structures, to be used as a collector-distributor bridge with LRT. No analysis of hazardous materials has been conducted to date. General issues related to these areas that may arise during the NEPA process are discussed at the end of this section.

BIA Concept 7

BIA Concept 7 constructs two new structures, one east and one west of the existing bridges. The westernmost structure would be a low-to mid-level bridge with a lift span, to be used for LRT with northbound and southbound vehicle movement. The easternmost structure would be a low-to mid-level bridge with a lift span, to accommodate the northbound freeway traffic. No analysis of hazardous materials has been conducted to date. General issues related to these areas that may arise during the NEPA process are discussed at the end of this section.

BIA Concept 8

Concept 8 was not analyzed in the BIA Summary report. It is most similar to BIA Concept 7, which is discussed in the previous section.

Potential Hazardous Materials Issues

A detailed analysis would be required for the alternatives under consideration as part of the NEPA process. The following issues may be of interest for this project:

- The levels and types of hazardous materials likely to be encountered within or adjacent to waterways increases as one moves toward the confluence of the Willamette and Columbia Rivers.
- North Portland is heavily industrialized through many of the likely corridor locations. Industrial uses in the project area are likely to have issues related to hazardous materials.
- Hazardous materials testing at multiple locations will be a given for any of the corridor locations under consideration. The levels of hazardous materials testing and analysis will be increasingly rigorous as the project moves further through planning and development processes.

Soils and Geology

No analysis of soils and geology has been conducted to date.

BIA Concept 1

BIA Concept 1 includes construction of a new low- to mid-level bridge west of the existing bridges, with a lift span. No analysis of soils and geology has been conducted to date. General issues related to these areas that may arise during the NEPA process are discussed at the end of this section.

BIA Concept 2

BIA Concept 2 was not analyzed in the Summary report though the added footprint (five traffic lanes, two LRT lanes) is similar to BIA Concept 7. This is discussed in a later section.

BIA Concept 3

BIA Concept 3 was not analyzed for environmental impacts in the BIA Summary report, however it adds a five-lane bridge structure similar to BIA Concept 1. Concept 1 was discussed in a previous section.

BIA Concept 4

BIA Concept 4 replaces the existing structures with one double deck mid- to high-level bridge and a separate new bridge for light rail. No analysis of soils and geology has been conducted to date. General issues related to these areas that may arise during the NEPA process are discussed at the end of this section.

BIA Concept 5

Concept 5 was not analyzed in the Summary report though the added footprint (six traffic lanes, two LRT lanes) is similar to BIA Concept 7. BIA Concept 7 is discussed in a later section.

BIA Concept 6

BIA Concept 6 constructs one new low- to mid-level bridge with a lift span west of the existing structures, to be used as a collector-distributor bridge with LRT. No analysis of soils and geology has been conducted to date. General issues related to these areas that may arise during the NEPA process are discussed at the end of this section.

BIA Concept 7

BIA Concept 7 constructs two new structures, one east and one west of the existing bridges. The westernmost structure would be a low-to mid-level bridge with a lift span, to be used for LRT with northbound and southbound vehicle movement. The easternmost structure would be a low-to mid-level bridge with a lift span, to accommodate the northbound freeway traffic. No analysis of soils and geology has been conducted to date. General issues related to these areas that may arise during the NEPA process are discussed at the end of this section.

BIA Concept 8

Concept 8 was not analyzed in the BIA Summary report. It is most similar to BIA Concept 7, which is discussed in the previous section.

Potential Soils and Geology Issues

A detailed analysis would be required for the alternatives under consideration as part of the NEPA process. The following issues may be of interest for this project:

- The existing bridges do not meet current seismic standards and in the event of a major earthquake, they could fail. New bridges built to current standards would have a higher probability of withstanding a major earthquake.
- River sediments consist of sand, silt and gravel in varying proportions. Sediment depth varies but can be greater than 100 feet. Sediments are late Pleistocene to Holocene age remnants of the Missoula floods. The sediments in the river channel are young, unconsolidated materials. Upper portions of the sediments may be susceptible to liquefaction or slope failure during strong ground motion seismic events.
- If a tunnel option is pursued, it would need to be deep enough below the dredge prism so that there is enough overburden to hold themselves in place.

APPENDIX "C"

I-5 Columbia River Crossing
Bridge Influence Area (BIA) Cost Estimating Qualitative Concept Assessment

This documents summarizes the Cost Estimating Qualitative Concept Assessment of the 8 BIA Concepts. The assessment includes major risk factors associated with the I-5 Columbia crossing cost estimates, concept-specific comments related to cost estimating and functional design, and review comments on Bridge Concepts 1, 4, 6 and 7.

Major risk factors associated with I-5 Columbia Crossing Cost Estimates

River Crossings

- Environmental mitigation
- Bridge foundations
- Movable spans and vertical clearance
- Seismic retrofit
- Material costs
  Example: recent spikes on steel prices
- Utility crossings
- Pier protection
  Not just fenders, but perhaps reshaping the river bottom so that large vessels are physically unable to float into any of the piers

Highway Elements

- Project phasing and temporary protection and direction of traffic
  Some of these concepts are extremely complex, requiring multiple shifts of traffic. It will not be known how this staging will be done until more complete design is done.
- Material costs
  Steel for rebar and fuel for equipment are just two of the more visible examples.
- Drainage and water quality
  There will be a major increase in impervious surfaces and major systems will be required to handle runoff volumes and to treat this runoff for water quality.

- Utility relocation
  There is no evidence that the utility network that must exist for this densely developed area has been adequately researched.

- Visual aspects and aesthetics
  This could be a real wild card as the project is developed with the neighboring residents, businesses and numerous other interested stakeholders.

- Toll plaza design and operation
  This is not common in Oregon so more is unknown than known.

Neighborhood Impacts

- Negative impacts for alignments, ramps, structures
  This includes mitigation measures for relocations, environmental impacts, disruption of residential neighborhoods and business clusters. This has a high potential for becoming highly political. On the Lombard-Delta Park project, the neighborhood is pushing to be made whole for all of the impacts of I-5 dating clear back to when it was constructed in the early 60's.

- Noise impact
  Traffic volumes are high, the area is highly developed, and space is very limited. These factors indicate complex and expensive noise mitigation.

- Access requirements
  Multiple roadways in the concepts make it very difficult to provide access "right at the front door." There will be a real challenge to balance the need for access against providing through traffic capacity. In some cases communities may want more ramps, while in others they may not.

- Security
  Significant security safeguards will have to be addressed, such as bridges on an Interstate Highway, crossing a major body of water, worldwide trade, and the glidepath to an International Airport.

Project Development

- Political requirements
  This project is already highly political. Political negotiations pose a high risk of extending the project schedule and increasing project cost. In the Bay Area, voters changed the bridge type, causing redesign.

- Regulatory requirements
  Probably near the top of this list is avoiding or mitigating impacts to the Fort Vancouver property. It will be very difficult, if not impossible, to avoid this impact all together.

- Appropriate contingency percentages
  How realistic a cost estimate is at any given point is heavily dependent upon the

percentage that is added in the form of contingencies to address the unknowns at that time. For a project of this magnitude, being off only a few percentage points will produce a huge swing in the projected cost.

- Design cost
  For many of the reasons stated above, the effort required to ultimately design this project can only be estimated right now and not very accurately because of all of the unknowns, not the least of which is project phasing. There seems to be a different philosophy regarding building highway capacity between ODOT and WSDOT. This could be very problematic, unless resolved. Will there be two sets of design standards?

Concept-Specific Comments Related to Cost Estimating and Functional Design

Concept 1

LRT is shown as the bottom level of a four-level stack at Marine Drive Interchange. Then it quickly has to gain elevation to go over the Portland Harbor Bridge. We don't know how feasible this elevation gradient is, but it looks to be a big cost item with extensive walls and a system to handle drainage from the light rail to the Columbia River.

The vertical grades for southbound I-5 look they may be difficult to achieve in the vicinity of Marine Drive.

A lot of curvature in the ramps and roadways will make this concept hard for the unfamiliar drivers to negotiate.

With all concepts, the southbound I-5-to-eastbound SR 500 ramp requires a very long (expensive) structure.

The ramps connect into Mill Plain Blvd. west of I-5 in such a manner as to encourage wrong-way movements onto the off-ramp.

This concept, along with most of the others looks to encroach on the Fort Vancouver property.

For any case where HOV lanes are to be placed in the center of the through lanes, a flyover structure is probably required. These structures are a big ticket cost item.

Construction staging is probably one of the highest risks associated with cost estimates at this level of planning. One really can't quantify how much this phasing will cost until more detailed design is done. However, the staging for this concept appears to be more straightforward than the other concepts.

Design build may be the most efficient way to get the staging to work.

Concept 4

It's not known how the new double-deck bridge could be built without first removing the existing northbound structure. This does not seem feasible from a traffic maintenance perspective.

On Hayden Island, a single point diamond interchange with Hayden Island Drive pulled to the south may be a better concept, causing less disruption to the adjacent businesses. It would also eliminate the two ramp structures over Hayden Island Drive.

It is not clear what happens to the CD road at Mill Plain Blvd.

In order for northbound traffic to exit to SR 500, they would have to enter the CD road at the SR 14 interchange. Because this is so far in advance of SR 500, it would cause a signing challenge and be something out of the ordinary for drivers.

Because the northbound CD road serves multiple interchanges, very quick decisions would be required at the north shore of the Columbia River.

The SR 500 Interchange is a mix of system interchange and service interchange. This mixture is not good and should be avoided if possible.

To really evaluate any of these concepts, a signing plan should be developed. If the signing cannot be made to work, the design is not good.

Concept 6

The arterial requires very expensive flyover structures south of Marine Drive and at the SR 14 Interchange.

The SR 14 Interchange is very complex and very expensive.

Concept 6 appears to have the biggest footprint.

Concept 7

This concept requires extensive walls.

It looks to be a little more friendly to the westside Hayden Island businesses, but eliminates a number of the eastside businesses.

Will the Hayden Island LRT station be elevated and therefore, more expensive?

Since the new northbound bridge must go under the railroad, its elevation must be fairly low, requiring more frequent openings.

All of these concepts include a downtown Vancouver LRT station. If a park-and-ride lot must also be provided, that will be expensive because of the land cost.

Once traffic has entered the northbound CD road, there is no way to reenter I-5. The CD road ends in a "must exit" situation at SR 500.

Northbound HOV traffic cannot get to the CD road to be able to exit at Mill Plain Blvd. or SR 500.

Other concepts

It appears that an concept that should be studied is one where the existing Columbia River bridges are used for arterial traffic and perhaps LRT with two new I-5 structures on either side of the existing structures. These new bridges would each carry one direction of I-5 traffic and would be high enough that they would not open at all or only infrequently.

Review Comments on Bridge Concepts 1, 4, 6 and 7

The information provided for the review is incomplete. The descriptions for Concepts 1, 2, 3, 6, 7 and 8 described in the memorandums do not match the color line drawings of Bridge Concepts 1, 4, 6 and 7. Table C-1 provides a status of the various cost elements for all the concepts considered to date. The table identifies what data was available and what gaps appear to exist in the existing cost evaluations.

With out concept drawings of the bridge alternates, it is very difficult to evaluate the unit costs of the bridges. The unit cost items will be evaluated when the concept drawings are provided.

Final estimates are in 2001 dollars. An inflation factor should be applied to each unit cost item to update estimates to 2004 dollars.

Final estimates should include major maintenance (upgrades) and seismic retrofit for all bridges impacted by the proposed improvements. If the existing river bridges are included in the alternates, the cost of seismic retrofit and upgrades for both structures, and the movable spans, should be included the final estimates.

The final estimates should include transition structures from the double-deck river crossing to the at-grade roadway section at the south and north approaches. It is unclear if these structures are included. Extensive ramps configuration to facilitate free flow of traffic in both directions would be required from the double-deck crossing to SR 14 and SR 14 to the main crossing.

Bicycle and pedestrian lanes should be included to the new bridge width. They are not included in the bridge estimates.

Major maintenance cost for movable span alternates and existing movable spans should be included in the final estimates. These costs should be considered when comparing movable span alternate to fixed span alternate.

Due to vertical constraints imposed by Pearson Airpark, and required vertical clearance for maritime activities on the Columbia River, a single level bridge would tend to fair better than a two-level structure when overhead constraints and under clearance are both required.

Comments on each Bridge Concept:

Bridge Concept 1:

Combine existing bridges for NB traffic and construct new double-deck bridge for SB traffic (top level) and LRT (bottom level)

A single level combined use (traffic and LRT) structure for the main crossing should be considered with this concept.

A fixed span alternate should be considered in addition to the lift span for the double-deck structure. The lift span alternate should include major maintenance cost of the lift span and the cost of operating the lift span.

Bridge Concept 4:

Replace existing bridges with new double-deck bridge, NB (top level) and SB (bottom level) and construct new LRT structure

Removal of existing bridge crossings and construction of the new double-deck bridge at the same location of the two existing bridges may not be feasible. If feasible, the cost associated with stage construction of the new double-deck bridge should be included in the final estimate. The current estimate does not include this cost.

604,000 SF of deck area for the new LRT structure seems high based on the approximate width of the structure carrying two tracks.

460,00 SF of deck area for the double-deck structure seems low if the deck area is based on two levels. Deck area for the new double-deck structure should be higher than the deck area of the two existing bridges. The existing bridges have the approximate deck area of 500,175 SF.

A single level structure should be considered for the freeway crossing, and for comparison with the double-deck alternative.

Bridge Concept 6:

Maintain existing bridges for NB and SB, and construct new double-deck bridge for NB and SB traffic ramp (top level) and LRT (bottom level)

Final estimate for this alternate was not available for review.

A single level bridge for traffic and LRT should be considered as an alternate, and for comparison with the double-deck concept. With the double-deck alternate, LRT will not occupy the entire lower level, leaving an area on each side of the two LRT tracks unused. Combining LRT and traffic lanes to single level will reduce the combined widths required for traffic and LRT.

Bridge Concept 7:

Maintain existing bridges for SB and NB (HOV and reversible lanes only) and construct new two-lane arterial and LRT bridge, and new NB bridge for freeway traffic

A fixed span alternate should be considered and for comparison with the movable span alternate.

Costs to upgrade existing NB river crossing to accommodate HOV and reversible lanes should be included in the final estimate.