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

TABLE OF CONTENTS

List of Tables

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.