INTERSTATE 5 COLUMBIA RIVER CROSSING

Stacked Transit/Highway Bridge Memorandum

May 2008

Columbia River CROSSING

TO: Readers of the CRC Technical Reports

FROM: CRC Project Team

SUBJECT: Differences between CRC DEIS and Technical Reports

The I-5 Columbia River Crossing (CRC) Draft Environmental Impact Statement (DEIS) presents information summarized from numerous technical documents. Most of these documents are discipline-specific technical reports (e.g., archeology, noise and vibration, navigation, etc.). These reports include a detailed explanation of the data gathering and analytical methods used by each discipline team. The methodologies were reviewed by federal, state and local agencies before analysis began. The technical reports are longer and more detailed than the DEIS and should be referred to for information beyond that which is presented in the DEIS. For example, findings summarized in the DEIS are supported by analysis in the technical reports and their appendices.

The DEIS organizes the range of alternatives differently than the technical reports. Although the information contained in the DEIS was derived from the analyses documented in the technical reports, this information is organized differently in the DEIS than in the reports. The following explains these differences. The following details the significant differences between how alternatives are described, terminology, and how impacts are organized in the DEIS and in most technical reports so that readers of the DEIS can understand where to look for information in the technical reports. Some technical reports do not exhibit all these differences from the DEIS.

Difference #1: Description of Alternatives

The first difference readers of the technical reports are likely to discover is that the full alternatives are packaged differently than in the DEIS. The primary difference is that the DEIS includes all four transit terminus options (Kiggins Bowl, Lincoln, Clark College Minimum Operable Segment (MOS), and Mill Plain MOS) with each build alternative. In contrast, the alternatives in the technical reports assume a single transit terminus:

- Alternatives 2 and 3 both include the Kiggins Bowl terminus
- Alternatives 4 and 5 both include the Lincoln terminus

In the technical reports, the Clark College MOS and Mill Plain MOS are evaluated and discussed from the standpoint of how they would differ from the full-length Kiggins Bowl and Lincoln terminus options.

Difference #2: Terminology

Several elements of the project alternatives are described using different terms in the DEIS than in the technical reports. The following table shows the major differences in terminology.

DEIS terms	Technical report terms
Kiggins Bowl terminus	I-5 alignment
Lincoln terminus	Vancouver alignment
Efficient transit operations	Standard transit operations
Increased transit operations	Enhanced transit operations

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Difference #3: Analysis of Alternatives

The most significant difference between most of the technical reports and the DEIS is how each structures its discussion of impacts of the alternatives. Both the reports and the DEIS introduce long-term effects of the full alternatives first. However, the technical reports then discuss “segment-level options,” “other project elements,” and “system-level choices.” The technical reports used segment-level analyses to focus on specific and consistent geographic regions. This enabled a robust analysis of the choices on Hayden Island, in downtown Vancouver, etc. The system-level analysis allowed for a comparative evaluation of major project components (replacement versus supplemental bridge, light rail versus bus rapid transit, etc). The key findings of these analyses are summarized in the DEIS; they are simply organized in only two general areas: impacts by each full alternative, and impacts of the individual “components” that comprise the alternatives (e.g. transit mode).

Difference #4: Updates

The draft technical reports were largely completed in late 2007. Some data in these reports have been updated since then and are reflected in the DEIS. However, not all changes have been incorporated into the technical reports. The DEIS reflects more recent public and agency input than is included in the technical reports. Some of the options and potential mitigation measures developed after the technical reports were drafted are included in the DEIS, but not in the technical reports. For example, Chapter 5 of the DEIS (Section 4(f) evaluation) includes a range of potential “minimization measures” that are being considered to reduce impacts to historic and public park and recreation resources. These are generally not included in the technical reports. Also, impacts related to the stacked transit/highway bridge (STHB) design for the replacement river crossing are not discussed in the individual technical reports, but are consolidated into a single technical memorandum.

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1. Stacked Transit/Highway Bridge

This memorandum serves as an addendum to the technical reports prepared for the I-5 Columbia River Crossing (CRC) Draft Environmental Impact Statement (DEIS). These technical reports assessed the range of alternatives being evaluated in the DEIS, but were completed prior to the introduction the stacked transit/highway bridge design option (STHB). This memorandum documents how the effects of the STHB would compare to the effects discussed in each of the technical reports. This documentation is comparative, and does not discuss results common between the STHB option and other alternatives and design options evaluated in the technical reports.

The stacked transit/highway bridge is a design option for the two alternatives (Alternatives 2 and 3) that include a replacement river crossing. A replacement river crossing with STHB would replace the existing I-5 bridges with two parallel bridges. The two bridges would carry northbound and southbound Interstate traffic, separately. Transit would travel within the hollow girders supporting the deck of the southbound bridge. Bicyclists and pedestrians would use an open air mutli-use path suspended underneath the eastern edge of the northbound bridge. The multi-use path could be suspended from the overhang of the top deck or supported by a beams cantilevered off of the outside of the foundation. In contrast, a standard replacement river crossing design would replace the existing I-5 bridges with three new structures; two would carry northbound and southbound I-5 traffic, and the third would have high-capacity transit and a multi-use path for bicycles and pedestrians.

The conceptual and baseline design for STHB for purposes of this NEPA analysis was developed with a concrete box girder type of bridge; however the STHB concept could be implemented with a variety of bridge types, including a composite structure.

In addition, the project team considered, but has not thoroughly studied, the concept of placing the southbound transit guideway and the northbound transit guideway in separate bridges. Preliminary assessment of this concept design showed that connectivity with local streets and geometry of the transit line would be difficult.

The southbound bridge needs to be designed to handle the larger loads of both highway and transit, and would have a larger foundation and piers. The overall increase in cross-sectional area of the southbound STHB relative to the standard concrete girder box bridge (northbound) is approximately 33 percent. For the southbound bridge, individual pier structures per foundation are approximately 30 percent larger for the STHB design option than the standard replacement design.

From the south, the transit guideway would join the highway bridge near the northern shore of Hayden Island. Once inside the girder, transit vehicles would effectively operate in a tunnel environment for approximately 2,600 feet, requiring lighting, ventilation systems and other safety features. The guideway would split from the highway after reaching the Vancouver shore. After reaching Vancouver, the transit guideway would diverge to the northwest, leaving the I-5 bridge on a separate structure and touching down near Fifth Street. When transit leaves the box girder and separates from the highway at the transition piers, the minimum distance from the top of roadway to top of rail is approximately 20 feet. At this point, the transit guideway will require its own conventional bridge structure, and therefore more piers and pilings might be built in the river to support it. As such, the southbound bridge with STHB will be more complicated to build than a standard concrete box girder bridge.

Either light rail transit (LRT) or bus rapid transit (BRT) could travel on the guideway in the hollow girder of the southbound bridge. The depth of the segmental box structure meets the clearance requirements for LRT according to TriMet standards. The segmental box structure must accommodate an LRT vertical clearance envelope of 16 feet from top of rail. This will also provide enough clearance for BRT. The bottom of the bridge would be designed to support LRT or BRT.

Some structural elements will be different between the southbound and northbound bridge, since the southbound bridge will be carrying transit and the northbound bridge will be supporting a multi-use path. A few major modifications must be made to the southbound and northbound bridges, compared to the standard replacement crossing:

- The profile of the southbound highway alignment must be raised five feet to offset some of the increased foundation depth and provide adequate clearance over the BNSF Railroad in Washington.
- The southbound structure will need additional pilings to support the additional loading from transit, and additional piers must be added in the water on the south shore due to the transition where transit enters the superstructure.
- The vertical depth of the southbound bridge will change at the piers, by approximately five feet, and at the transition piers by approximately 15 feet.

Therefore the two bridges—spaced with 50 feet of separation—will not be aesthetically similar.

Lastly, in comparison to the standard replacement option, STHB could reduce construction duration and construction costs because there is less structure to build.

1.1 Navigation

Navigation would not be significantly impacted by a STHB replacement crossing. The STHB structure would be approximately ten feet deeper than the downstream replacement crossing at the midspan and two feet deeper at the piers. In addition, the vertical profile of the bridge would be raised five feet when compared to the downstream replacement crossing. This results in navigation clearances that are three feet higher at the piers and five feet shorter at the midspan. However, these slight changes in clearances would not conflict with the design envelop of 95 feet above river level from Columbia River and a 300-foot navigational opening.

Long-term effects to navigation would be similar to those described for the downstream replacement crossing. Tugs and tows requiring a 60-foot clearance over a 300-foot horizontal clearance would be able to pass at all times of year. High mast sailboats requiring an 88-foot vertical clearance over a 50-foot horizontal clearance would be able to pass at all times of year. Marine contractors requiring a 110-foot vertical clearance over a 100-foot horizontal clearance will not be able to pass under the bridge without partial disassembly of their loads.

Navigation would benefit from STHB compared to the standard replacement crossing. Since the STHB design options requires only two bridges and two sets of piers, instead of the three bridges and three sets of piers in the downstream replacement crossing, there will be fewer obstacles to navigation in the water.

1.2 Aviation

Aviation would be slightly impacted by a STHB replacement crossing. The southbound bridge is raised five feet in the STHB design option as compared to the standard replacement crossing. The raised bridge will obstruct Pearson Field’s Obstacle Clearance Surface (OCS) for westbound departure to a slightly greater degree than the downstream replacement crossing.

STHB may provide a net benefit to aviation if LRT were selected as the transit mode. With LRT, STHB eliminates the overhead catenary system from the deck. As with the replacement crossing, the greatest obstruction to the OCS for westbound departure will not be a consequence of the bridge type or alignment, but instead result from ramps that comprise the SR 14 interchange.

Temporary effects due to the STHB design option will be similar to that described in the Aviation Technical Report for the replacement crossing. The additional five-foot increase in height may slightly increase the height of construction equipment obstructing Pearson Field’s obstacle clearance surface for westbound departure. As with the replacement crossing, the greatest obstruction would likely be activities associated with the demolition or deconstruction of the existing Interstate Bridge’s lift span towers.

STHB has short-term benefits compared to the standard replacement option. Due to the shorter construction time, the duration of temporary obstructions to aviation will also be shorter than the replacement or supplemental crossing.

1.3 Ecology and Water Quality

The long-term effects of the STHB design option on aquatic resources and water quality in the immediate bridge area—Columbia River and North Portland Harbor—would be similar but slightly different than the standard replacement crossing.

1.3.1 Aquatic Resources and Aquatic Species

Endangered and threatened aquatic species, including Chinook, steelhead, sockeye, coho, chum, coastal cutthroat and bull trout, as well as species of concern, lamprey and sturgeon, would be affected by the presence of piers in the Columbia River and in North Portland Harbor. Piers disrupt stream flow of the water as well as migrating patterns of anadromous fish. For all build alternatives, piers may impact shallow waters which serve as essential habitat (i.e., spawning) for fish. The addition of piers is also a negative impact because non-native predaceous fish are known to use piers and other in-water structure for refugia from the current, a vantage point to feed on passing fish – especially juvenile endangered fish.

Under current conditions, stream flow in the Columbia River and North Portland Harbor is disturbed by the presence of eleven pier sets in the main channel and six pier sets in the harbor channel. The standard replacement crossing would place fewer pier sets in the Columbia River – six pier sets in the main channel and four in the slough. With STHB fewer piers would go in the water because STHB eliminates the need for a third bridge. STHB would put approximately 18 percent less structure in the water than the standard replacement bridge, assuming 96 inch vertical piles are used to support the piers.

Even though one fewer bridge would be built for STHB compared to standard replacement crossing, spans on the southbound bridge would require an additional set of piers founded in the river for the main spans, thus increasing the pier footprint for the southbound bridge. The size of the southbound piers may increase to provide extra support for the additional weight of transit. In addition, more piers may be placed in shallow water to support the additional structures for the southbound STHB structure. Where the southbound bridge approaches Hayden Island, transit will separate off onto its own structure before it touches land; therefore additional piers will likely be placed in shallow water on the Oregon side to support the transit structure. See table below.

Number of Piers and Footprint Area in the Columbia River, 96-inch Vertical Pipe Piles

		Baseline Concept			STHB Concept		
Structure Location	Main/Approach Structure	Number of Piers (ea)	Foundation Size (ft)	River Footprint (sq ft)	Number of Piers (ea)	Foundation Size (ft)	River Footprint (sq ft)
Northbound Structure	Main Structure	6	90 x 90	48,600	6	90 x 90	48,600
	Approach Structure	2	30 x 30	3,600	3	30 x 30	5,400
Southbound Structure	Main Structure	6	90 x 90	48,600	6	90 x 90	48,600
	Approach Structure	1	30 x 30	1,800	2	30 x 30	3,600
Transit/ multi-use Structure	Main Structure	5	70 x 70	24,500	--	--	--
	Approach Structure	1	30 x 30	1,800	--	--	--
	Total	**21**		**128,900**	**17**		**106,200**

Total decrease in foundation footprint of STHB Alternative to that of the baseline concept: 18 percent.

Overall, a STHB would decrease the concrete footprint of the replacement crossing when compared to the standard replacement bridge. The primary impact of STHB on aquatic resources would be the additional placement of piers in the shallow water at the south shore.

Temporary effects due to the STHB design option would be similar to those described for the standard replacement river crossing. However, by eliminating the HCT structure, the schedule for construction of the main river crossing and demolition of the existing structures can be reduced by approximately 20 percent (approximately 1 year). The shorter construction time would give endangered and threatened species a greater time to recover from potential impacts caused by driving piles or increased turbidity in the water.

1.3.2 Water Quality

Long-term and short-term impacts of STHB on water quality have not been evaluated by the project team. Many impacts of the STHB design on water quality would be similar to those described for the replacement river crossing in the Water Quality Technical Report. However, the decrease in impervious surface with the STHB design option compared to the standard replacement design would improve stormwater quality and lessen impact to the water quality of the Columbia River.

In addition to a decrease in impervious surface area, transit will not be exposed to rain water with the STHB option, so the pollutants associated with LRT or BRT will not be carried by rainwater to the stormwater system. The STHB will include a draining system for transit to keep moisture out of the tunnel; however, rain water is not expected to reach inside the transit guideway. Thus, overall the STHB design would most likely have less impact on water quality compared to the standard replacement river crossing.

1.4 Transit and Safety

Like any bridge design option, STHB raises an array of potential human safety concerns; however, STHB is unique in that transit will be operating in an encased tunnel for 2600 feet. The users of transit would mostly be impacted by possible hazards; although some safety concerns present a possible threat to all users of the bridge. Below is a discussion of the safety impacts and proposed safety mitigation measures.

1.4.1 Ventilation and Air Quality

STHB could have long-term effects on air quality or lack of ventilation within the enclosed tunnel. In order to ensure safe operation for either transit mode under consideration, certain mechanical and electrical systems necessary to support the fire and safety requirements set out by National Fire Protection Association (NFPA) standards.

LRT has electric powered vehicles and as such, a ventilation system would be necessary to control the movement of smoke and heat in the case of a vehicle fire emergency. Likewise, the BRT, which is assumed to use diesel powered buses, requires a ventilation system that will maintain safe emission levels within the tunnels as well as being capable of controlling the movement of smoke and heat in the case of a vehicle fire.

For both LRT and BRT, a longitudinal ventilation system is proposed. The system would consist of a series of jet fans located within each cell. In the case of a vehicle fire emergency, the ventilation system must be designed to prevent the back-layering of smoke within the southbound structure.

1.4.2 Fire Protection System

A potential impact could occur if a fire started in the tunnel. The STHB design option will require that a water system be installed within the guideway for either transit mode. The proposed system would have a dry standpipe system connected to a water source on both sides of the river, with hose valves located every 150 feet along the walls of the tunnel. System activation would be manually controlled with provisions for operation located both locally (at both water source points) and from a central control location.

1.4.3 Lighting

Lighting in the bridge with transit will be designed to meet the statutory requirements for normal and emergency lighting in tunnels for transit. For both LRT and BRT, luminaries are to be wall-mounted on the walkway sides of the tunnel, which will allow the luminaries to be as low as possible.

1.4.4 Emergency Egress

The STHB option will require a means of egress for passengers in case of an emergency. For both LRT and BRT, the proposed egress system would incorporate a walkway in each cell extending the full length of the tunnel. Emergency walkways would be located adjacent to the center web and provide unobstructed cross-passageways leading from one tunnel to the other.

1.4.5 Threat

A long-term effect of STHB would be the on-going threat of a person or persons trying to gain access to the tunnel with the intention of causing harm to others or to the structure. Inherent features of the proposed STHB girder bridge, such as the location and occupancy of the structure, affect the project threat and risk profile. High explosive detonations are of concern with all build alternatives. The progressive failure of the proposed STHB bridge design may be a great concern, even if the box structures are not completely damaged during the blast.

Possible mitigation methods to protecting the tunnel against blast induced damages or from post-blast progressive failure damages include: increasing reinforcement of the bridge, thickening the walls, placing steel plates with energy-absorbing blast mats inside the bridge, pre-stressing and post-tensioning, joint strengthening and polyurethane spraying to prevent shear failure. Many of these mitigation measures will be applied to any of the build alternatives for other reasons.

1.5 Traffic

1.5.1 Bike and Pedestrian Facility

A path for bicyclists and pedestrians would travel along the eastern edge of the northbound bridge. A multi-use path will follow the vertical roadway profile underneath the southbound bridge. There are two different design options:

- **Cantilevered Multi-Use Path:** The multi-use path would be supported by a cantilever frame which would be anchored on the lower eastern edge of the northbound bridge. The path would be at deck level.
- **Vertically Supported Multi-Use Path:** The multi-use path would be suspended from the overhang of the eastern edge of the top deck of the northbound bridge. The path would be below deck level.

Both concepts provide a 16-foot wide path for bicyclist and pedestrians. To alleviate the “tunnel” feel for the path users, a 15 foot vertical clearance would provided. Both paths would provide a pedestrian handrail on the exterior section.

The suspended multi-use path provides benefits to bicyclist and pedestrians. First, a multi-use pathway suspended under an edge of a bridge would provide a shorter connection between Portland and Vancouver as the pathway’s elevation would be lower than the roadway deck. Second, as compared to the standard replacement crossing, the STHB design would give bicyclist and pedestrians a view of Mt. Hood to the east, slightly obstructed by beams, whereas that view would be greatly obstructed with the standard design. Another long-term benefit to bicyclists and pedestrians is safety. The multi-use path would be separate from vehicles, which greatly reduces the possibility of an accident, while still providing an “open air” feel to users.

Similar to the multi-use path for the supplemental crossing, ramps to the east of I-5 would connect the pathway to Columbia Way in Vancouver and Tomahawk Island Drive on Hayden Island. Also similar to the supplemental crossing, an above-grade multi-use pathway would be provided alongside the high capacity transit guideway between Tomahawk Island Drive and Marine Drive, west of I-5 and crossing over North Portland Harbor. Pedestrians and bicyclists using both pathways would need to travel along Tomahawk Island Drive, under I-5, and through at-grade intersections.

Thus, at both the north and south ends of the bridge, I-5 roadway ramps may interfere with the multi-use path approaches. Although traffic impacts have not been fully evaluated, users of the path would most likely have difficulty proceeding through Hayden Island. This would have a long-term effect on multi-path users as compared to the standard replacement crossing design, which will be continuous through Hayden Island. To mitigate this impact, one option is to design the path on the westbound side of the southbound bridge. With this design option, connections would be improved, but there would be no view of Mt. Hood.

Another potential long-term effect on path users is safety. The pedestrians and bicyclists on the path would not be visible or accessible by highway users. Although the path will be lighted, this may create an unsafe environment. Possible mitigation measures include: 1) installing cameras on the path which would be incorporated in the safety system for transit, and 2) creating a Safety Plan with local governments so that safety officials have a presence and prepared response on the path.

1.5.2 Vehicle Traffic

Long-term and short-term effects of the STHB design option on vehicle traffic have not been analyzed. Vehicle traffic is expected to be similar to traffic projections for the alternatives with the standard replacement crossing. Compared to the standard replacement crossing, STHB will touch down in slightly different locations which could impact intersections at the on and off ramps. The project team has not analyzed how STHB would impact vehicle demand and transit ridership in the project area.

1.6 Visual and Aesthetics

The STHB design option would cause different visual impacts and provide different visual benefits than the standard replacement river crossing. The replacement river crossing would build northbound and southbound bridges that look almost identical, with the exception of the entrance and exit ramps, in addition to the third bridge for transit. STHB only requires two bridges, which will reduce the prominence of the river crossing from all views. However, visual quality of the river crossing will be reduced for STHB due to the different sizes of the northbound and southbound bridges. In addition, transit riders will be visually impacted by traveling in a tunnel environment across the river.

The positive long-term visual benefit of the STHB design option is the overall reduction of concrete structure in and over the Columbia River. Compared to the standard replacement design, the STHB option will take up less physical space and cause less shading, providing a more positive visualization of the river for people at river-level from all viewpoints.

With a STHB, the two dissimilar bridge structures could appear busy or aesthetically incoherent, causing a long-term visual impact. To carry transit, the southbound bridge would be longer in depth than the northbound bridge. The southbound bridge would block more of the horizon and long-distance views, and the southbound bride would cause more shading than the northbound bridge. Water or shoreline-level views looking north from the south would be affected more by STHB than by the standard replacement crossing because of the increased size of the southbound bridge.

When transit separates from the primary structure at the transition piers with the STHB design option, transit would travel on a separate structure when traveling from the primary structure. The additional structure for transit could be a negative visual impact on both sides of the bridge. The transit structure may also block more water-level river views from Vancouver, Washington or from Hayden Island. However, this visual impairment will be less, or at a minimum, different than the standard replacement crossing with three bridges.

In addition, users of the transit will not be able to have a view of the river or of Mt. Hood while traveling inside the concrete box girder bridge. Compared to the replacement crossing, the tunnel effect of STHB could be a disincentive for sight-seers to take transit from Portland to Vancouver, or vice-versa.