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Technical Memorandum

To:

From:

Date: July 25, 2007

Subject: ODOT Contract No. 16902 – I-5 Trade Corridor Study Phase II
Technical Memorandum, Option Package 2

OPTION PACKAGE 2: EXPRESS BUS WITHOUT CORRIDOR-WIDE CAPACITY INCREASE

Road Network Description

Option Package 2 involves the operation of directional peak period express bus transit service between Clark County and the Expo Center/PIR Interstate Max transit center. This option does not include a corridor-wide capacity increase but does involve an increase in Columbia River crossing capacity along a new four-lane joint use arterial and HOV/express bus bridge.

Key features of this option package include the following:

- Converts the inside existing/planned third northbound travel lane from Mill Plain Blvd. to 134th Street for afternoon peak period HOV use
- Establishes a new four-lane joint use arterial and HOV/express bus bridge across the Columbia River -- serving Hayden Island and matching existing/planned HOV lanes in Oregon and Washington
- Results in a northbound HOV system from Going Street to 134th Street and a southbound HOV system from 134th Street to approximately Lombard Street
- Includes direct express bus ramps to/from Expo/PIR transit center
- Results in removal of the existing I-5/Hayden Island interchange and provides a new connection with Hayden Island via the new bridge
- Includes HOV specific facility treatments
- Provides truck access between Marine Drive and the new arterial/HOV facility

Option Package 2 will be designed, modeled, and evaluated as described herein. There are currently no identified variations being tested.

Corridor Schematic

An overall corridor schematic shown in **Figure 2-1** depicts the functional operation of I-5 under the Option Package 2 express bus system. Text call-out boxes direct attention to specific projects or operational features within the corridor.

Express Bus Facility Descriptions

The 1999 Clark County HOV Study presented a recommended year 2017 regional HOV system. From that recommended system, it was assumed for this study that only those facility improvements that directly support express bus service, rather than general use of HOV lanes by autos, would be incorporated into Option Package 2. Where practicable, all HOV types will be allowed to use the express bus facilities. Only the following facilities meet this criteria and will be modeled and included in conceptual designs:

- Single-lane ramp meter bypasses at the southbound I-5 on-ramps from 99th Street and Main Street interchanges
- Direct-connect HOV drop ramps for express buses only and a southbound I-5 ramp meter bypass lane for HOVs as part of new I-5/134th/139th interchange reconfiguration

Park-and-Ride Facilities

The C-TRAN Express Bus network includes new park-and-ride capacity at existing lots and at new park-and-ride lots. It also includes express bus service from those lots to the Expo/PIR Interstate MAX station in the I-5 corridor. The park-and-ride lot locations and capacities are listed below:

TABLE 2-1
EXISTING/PLANNED EXPRESS BUS PARK-AND-RIDE FACILITIES

P&R Facility	Existing Capacity	Option Package 2 Capacity
Battle Ground Park-and-ride	35 spaces	300 spaces
BPA Park & Ride	250 spaces	400 spaces
Salmon Creek Park-and-ride	479 spaces	600 spaces
Washougal Park-and-ride	40 spaces	600 spaces
Evergreen Park-and-ride	290 spaces	300 spaces
Fishers Landing Park-and-ride	550 spaces	900 spaces
Ridgefield Junction Park-and-ride	35 spaces	600 spaces
Planned 99th St. P&R (2 yrs out)	N/A	600 spaces
Fairgrounds	N/A	800 spaces
219th	N/A	600 spaces
Central County	N/A	600 spaces

TOTAL	1,679 spaces	6,300 spaces

Sources: C-Tran and Tri-Met

Although planned park-and-ride capacity will be used as an input into the travel demand modeling, park-and-ride lot capacity will not be constrained to input levels by the model. Through an equilibration procedure, park-and-ride capacity will be adjusted to accommodate and reflect transit ridership demand. This equilibration process allows transit demand under express bus and the LRT options to be compared fairly.

River Crossing Options

Option Package 2 includes a new four-lane joint use arterial and HOV/express bus bridge. This bridge would supplement the existing I-5 Columbia River structures (six lanes), resulting in 10 lanes of river crossing capacity. Key features of the new bridge depicted in **Figure 2-3** include the following:

- New interchange providing arterial and freeway access to/from I-5, downtown Vancouver, and Hayden Island
- Supports removal of existing I-5/Hayden Island interchange
- Serves as HOV/express bus bypass of the existing I-5 Bridge bottleneck
- Provides direct-connection express bus ramps to/from Expo/PIR transit center and I-5
- Provides Marine Drive link for use by freight trucks during off-peak periods
- Links existing/planned corridor HOV system in Oregon and Washington

A detailed functional schematic of this concept with number of lanes and ramp connections is shown **in Figure 2-4**.

Corridor Interchange Revisions

Option Package 2 includes modifications to the existing interchange system between SR 14 and SR 500 to address weaving, merging, and diverging issues. These modifications are common to all new bridge concepts presented under Option Packages 2, 3, 6, and 7. The conceptual interchange modifications along I-5 in Washington are functionally depicted in **Figure 2-5.**

Interchange modifications to address weaving, merging, and diverging issues in Oregon are not assumed to be integrated into the corridor unless the corridor is widened for a fourth lane in each direction as described under Option Packages 6 and 7.

It should be noted that the ultimate interchange configurations may change from those shown as conceptual layout and design move forward. However, these functional descriptions provide guidance to the designers to address interchange spacing and operation issues during the evaluation.

Option Description

ROADWAY

Mill Plain to SR500

Between Mill Plain Blvd. and SR500 in Vancouver, the proposed design reconfigures the existing interchanges to eliminate the number of weaving sections on the freeway. The freeway remains a six through lane section with additional lanes added as auxiliary lanes between interchanges where the space between ramps is inadequate to provide for a merge and a diverge from the highway. The interchange improvements are accomplished primarily by braiding the on/off ramps. Construction of the braided ramps will require replacement of the overpasses for 29th St. and 33rd St., and widening of the Mill Plain and McLaughlin overcrossings.

Interchanges were modified based upon the schematic design developed at a workshop held with DOT and consultant team members on June 29, 2001. The design concept included braiding most of the ramps to and from the existing interchanges. Ramps to be braided include:

Northbound

- Fourth Plain on-ramp with SR500 off-ramp: The new diverge point for the SR500 off-ramp would begin on the north side of the Fourth Plain overpass. The Fourth Plain on-ramp would pass over the SR500 off-ramp, merging with the highway near the 29th Street overpass. The Fourth Plain on-ramp would also have an split to allow traffic to decide between accessing I-5 Northbound or SR500 Eastbound. Braiding of these ramps will require reconstruction of the 29th St. and 33rd St. overpasses.

Southbound

- SR500 on-ramp with Fourth Plain off-ramp: The diverge point for the Fourth Plain off-ramp would be moved to the area between the 39th St. off-ramp and the SR500 overpass. The new ramp would align to the west side of the SR500 on-ramp, cross under the 39th St. on-ramp, and parallel the highway to connect to the existing interchange area. The design currently includes a connection between SR500 and Fourth Plain Blvd via a short weaving area. This weave takes place within the same zone that includes the SR500 to mainline weave and may negate the advantages of braiding the ramps. As a result, further study of the ramp configuration is recommended during the subsequent alternatives analysis to determine the need for this connection and, if warranted, whether the correct design approach is to braid the ramps at this location.
- Fourth Plain on-ramp with Mill Plain off-ramp: The diverge point for the Mill Plain off-ramp would be moved to approximately the same location as the existing Fourth Plain off-ramp diverge. The Mill Plain ramp would rise and crossover both the Fourth Plain on-ramp, which is left mostly unchanged from the existing configuration, and Fourth

Plain Blvd. Much of this ramp will be on structure because of the need to clear Fourth Plain.

- Mill Plain on-ramp with SR14 off-ramp: To mitigate an existing short weave distance between the Mill Plain on-ramp and the SR14 off-ramp, the SR14 off-ramp diverge point would be move to the north edge of the Mill Plain underpass, braid over the Mill Plain on-ramp and make a connection to SR14 via the ramp included in the design for each of the river crossing options. The Mill Plain on-ramp would offer the option, via a mid-ramp split, to go to either I-5 southbound or SR14 eastbound.

This design segment also includes a connector between SR500 westbound and the 39th St. northbound on-ramp providing a direct connection between SR500 and northbound I-5.

During the I-5 HOV study, performed by Parsons Brinckerhoff, the observation was made that in Vancouver I-5 functions as both a regional and local connector. To improve performance of I-5, these two traffic types could be separated via a barrier creating, what is in affect, a bypass system through Vancouver for the regional traffic. This option would require additional widening of the freeway to accommodate all the lanes, but would eliminate the need to extensively braid the interchanges. Separation of the freeway would occur north of SR500 and south of SR14, although the river crossing options that include a bypass bridge could connect into the regional route. Lane configurations would likely include 2 lanes in each direction on the bypass (1 HOV and 1 General Purpose) and 2 lanes on the "local" system plus any necessary auxiliary lanes between interchanges. It is recommended that this option be revisited in future studies along with the braided ramp option shown.

ROADWAY

Four-Lane Bridge

The proposed four-lane bridge will provide one High Occupancy Vehicle (HOV) and one General Purpose (GP) lane for each direction. It has 12' shoulder on both sides and 20' center median for a total width of 92 feet. It is located on the west side of the existing I-5 corridor starting from Victory Boulevard and terminating just south of Evergreen Bridge.

The bridge mainline carrying the HOV lanes begins on the north side of Victory Boulevard with its center matching the existing I-5 centerline. It crosses over Interstate-5 (I-5), Highway 99 and Expo Road. The existing I-5 northbound on-ramp at Victory Blvd. will be widened into two lanes to accommodate the proposed northbound GP lane that will cross over I-5 and then merge with the mainline bridge at Expo Center. An exit ramp will be provided for the southbound GP lane that will split into two lanes, one lane goes to Expo road and the other lane merges into the existing I-5. As shown on the plan, the existing I-5 will be widened to accommodate the additional 2 HOV lanes, 2 GP lanes and the existing 6 lanes.

A bus access ramp is proposed at Expo Center Station to serve City of Vancouver southbound and northbound bus service routes. In addition, a ramp is also provided southbound to City of Portland. The existing private road where the bus access is being proposed will be improved and converted into a public road to improve traffic circulation.

The existing I-5 connections at Hayden Island will be eliminated to relieve congestion on this area. Conversely, a split diamond interchange will be built to access Hayden Island through the new four-lane bridge. Tomahawk Island Drive will be extended thru and under I-5 with signalized intersections at both ramps. The entrance and exit ramps at Hayden Island Drive intersections will also be signalized to allow and control all directional traffic movements.

The four-lane bridge will cross the Columbia River with an elevation meeting the existing navigational clearance of the Interstate Bridge. It will go over the existing railroad and SR 14 interchange and touch down south of Evergreen Bridge. A northbound exit ramp is provided for the SR 14 eastbound and Sixth Avenue westbound connections. Furthermore, a southbound on-connection from Washington Street is proposed and a southbound off-connection with an over-crossing is designed to serve Sixth Avenue. All existing SR-14 and I-5 interchange connections will remain.

The affected area of I-5 where the proposed bridge ends will be widened on both sides to accommodate the additional lanes as a result of this improvement. The said widening will not impact the existing hospital on the historic reserve area, however, its road adjacent to the highway will be affected.

These proposed four-lane bridge terminates just south of Evergreen with its new lanes designed to conform to the proposed development of the Mill Plain interchange.

STRUCTURE - 4-LANE BRIDGE WITH HOV

Main River Crossing

The 4 lane with HOV Bridge alternative over the Columbia River is conceptualized as a concrete segmental type with a bascule moveable span over the navigation channel. The Span layout could be comprised of (south bank to north bank) 260’-540’-270’-540’-540’-280’(Bascule Draw Span)-320’. Currently the existing dual bridges provide a horizontal clearance of 263 feet between the lift spans piers over the main navigation channel. The lift span provides a 39-foot vertical clearance above the Columbia River Datum (also refereed to as zero gage or low water) when closed, and a maximum of 178 feet when fully raised. An increase vertical clearance of 58 feet is provided at the alternate barge channel beneath the bridge’s fixed 531-foot truss span. South of the 531-foot span, a vertical clearance of 72 feet is provided between prier 6 and 7 and piers 7 and 8; these spans are outside of the maintained channel limits. The assumed profile of the 6-lane bridge has the bridge deck elevation over the navigation channel at 145 feet in the closed position. This is compared to the existing twin I-5 bridges which has a deck elevation of 45’feet(+-) in the closed position. The 4 lane with HOV bridge will function with the exiting I-5 Bridges in operation. The new bridge is conceptualized to have a bascule moveable span, that when open provided unlimited vertical clearance. The deck elevation of 145 feet was assumed based on the vertical restriction associated with Person Airpark. The airpark airspace restriction is approximately at 175 feet; with the deck at 145 feet this should allow lights, signs and trucks to pass without infringing into the airspace.

Major Considerations

- *Superstructure Type* **-** The superstructure section could be a multi-cell trapezoidal concrete box girder built by the balanced cantilever method. The cross section varies in depth from maximum depths over the interior piers to 10' at midspan. A suggested depth to span ration would be 1/20 at the pier, and 1/50 at midspan (but no less than 10 feet). The parabolic soffit resulting from the variable structure depth coupled with the sloping webs of the box girder provides a dramatic aesthetic appearance, similar to the Glenn Jackson (I-205) Columbia River Crossing.

- *Column Type* **-** The river pier columns could consist of two 6' by 20' shafts spaced longitudinally 24' on center. The purpose of these twin wall shafts is to provide longitudinal stability during balanced cantilever erection, and then to provide longitudinal flexibility for the large time dependent displacements experienced by this type of bridge in the final service condition. The piers for the moveable span would with be solid 20' X 120' rectangles, housing the bascule lift span drive motors, and if a vertical lift span is utilized, the bridge would most likely be two bridges with 4 towers to lift the large deck section.

- *Foundations* **-** The two end transition piers are on land at the riverbanks, and the remaining interior piers are all in the river. For the river piers, a footing size of approximately 36' by 36' (non-moveable piers) is required. Deep foundation elements may be either driven piles or drilled shafts. Larger diameter drilled shafts may be preferable to limit the construction impacts of noise and vibration normally associated with driven piles.

- *Construction Procedures* **-** The river piers may be constructed by conventional methods using cofferdams. This features braced sheet piling walls, driven piles, underwater tremie concrete pours, and extensive pumping of the water inside the cofferdam to allow construction of the remainder of the pier footing and columns in the dry. This foundation type features footings that are founded below the river bottom. Because contractors assume a high risk with this type of foundation construction, costs are generally high for the cofferdams.

  The river piers may also be constructed as water level foundations. This foundation makes use of a precast concrete lost footing form. The form has a bottom and four sides approximately 15' high. The bottom has holes for piling or in this case, large diameter drilled shafts. The drilled shafts are installed with permanent casings from the water level down below the bottom of the river. The precast footing form is lifted and placed over the top of the shaft casings and supported by hangers from the casings. Underwater tremie concrete is placed in the bottom of the form to allow pumping out the water to construct the remainder of the footing in the dry. However, in this configuration, the bottom of footing is at a much higher elevation, requiring a smaller tremie pour due to the reduced hydrostatic head. This type of foundation is generally less costly, because the contractor risk is lowered.

Superstructure construction could be by the balanced cantilever method. The concrete superstructure may be either cast-in-place or precast, however for the 500’ span range (anticipated for this crossing), cast-in-place has been more widely used and is the recommended construction type. Segments are cast in pairs using form travelers, and typically two segments are cast per one week cycle. Segment lengths may vary between 10’ and 15’, with the shorter lengths occurring near the piers where the sections are heavier.

- *Construction Duration* - Substructure construction could be expected to take about 3 months per main river pier. Construction of the land-based piers could overlap with the construction of the river piers. Therefore substructure construction would be dependant on the actual type of bridge selected and the spans over Columbia River. Superstructure construction is dependent on the number of form travelers utilized (overhead erection equipment). With an average segment length of 12’, one would calculate the numbers of segment pairs comprise each cantilever (½ span). Assuming a one-week cycle per segment pair, superstructure construction could be approximated with only one pair of travelers. Total construction time with mobilization and demobilization could be readily calculated once a conceptual span arrangement is determined. This schedule could be accelerated with the use of additional travelers.

Typical Sections

Deviations from Standards

ROW Impacts

Costs

Figure 1 – Option Schematic

Memorandum