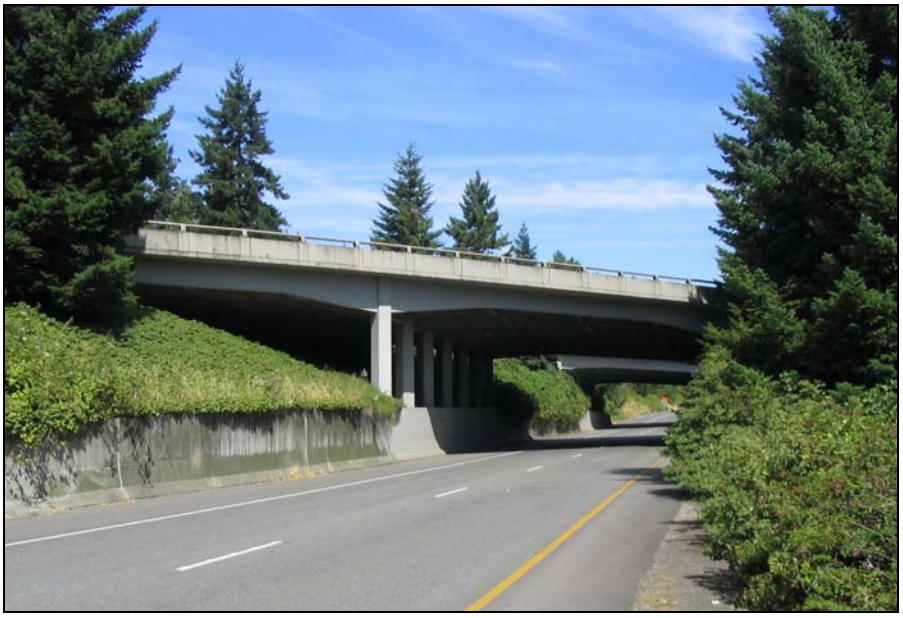
BRIDGE ENGINEERING BASELINE REPORT

Br. No. 07794A
Hwy 1 NB over Hwy 51 SB
Highway 001 NB, MP 282.25
Clackamas County, ODOT Region 2

OREGON'S BRIDGE ASSESSMENT PROGRAM



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1 EXECUTIVE SUMMARY

The Oregon Department of Transportation (ODOT) completed a statewide study into the economic conditions and safety conditions of its bridges. The information has been summarized in the Economic and Bridge Options Report (EBOR), January 2003. The EBOR recommends the repair or replacement of over 360 state bridges and 125 local bridges in the next ten years.

This report contains the engineering baseline information for the Hwy 1 NB over Hwy 51 SB Bridge located approximately one mile south of Wilsonville in Clackamas County, ODOT Region 2. The engineering baseline evaluation concludes that the existing bridge, (Br. No. 07794A, Hwy 1 NB over Hwy 51 SB) should be replaced. The primary issues driving this conclusion are:

1. There is stage 3 cracking throughout the structure.
2. The ratio of repair costs to replacement costs is approximately 0.51, which makes it an unlikely candidate for long-term repair to carry permitted loads.

It is feasible to replace the existing 194-foot-long, three-span bridge with a 115-foot-long, single-span bridge that meets current Oregon Department of Transportation standards.

During the reconstruction project, it is feasible that northbound traffic be detoured onto a temporary bridge in the median and construct a new bridge on the current alignment. A detour alignment in the median is preferred because the adjacent southbound structure crossing southbound Hwy. 51 (Bridge No. 07794B) is also recommended for replacement. It is most cost effective to use the same detour structure in the median for reconstruction of that bridge as well. Due to the cost savings that would be recognized by these two bridges utilizing the same temporary detour bridge, it appears advantageous to develop them as a package. The package could also include the northbound off-ramp in this Hubbard Interchange (Bridge No. 09870: Hwy 1 Conn #1 Over Hwy 51 NB). This report will examine the individual characteristics of the Hwy 1 NB over Hwy 51 SB Bridge (No. 07794A), but will only include 50 percent of the detour structure costs and assumes that it will be constructed as part of a package of three bridges within the Hubbard Interchange.

The project limits for the feasible option extend from M.P. 281.93 to M.P. 282.53, based on the length required for the detour alignment.

ODOT initially recommended that Bridge No. 07794A be replaced at an estimated cost of $3,818,000. This engineering baseline report concludes the existing bridge (Br. No. 07794A) be replaced at an estimated cost of $4,545,000.

Table 1 below provides a snapshot view of issues that could be associated with the project and summarizes the possible degree of complexity and total estimated project cost. Further information is provided in the report and appendices.

Table 1. Feasible Option at a glance

Issue	Degree of complexity			Comment	
	Low	Medium	High		
Environmental	X			Minor change in footprint and no major environmental issues	
Right-of-Way	X			No additional right-of-way required	
Utilities	X			No known utility conflicts. Median luminaire requires temp. relocation for median detour.	
Geotechnical	X			No geotechnical formations evident during site visit.	
Hydraulics/hydrologic	X			Existing drainage system in Hwy 51 below bridge. No stream crossings.	
Alignment	X			No change in permanent alignment.	
Earthwork	X			Standard embankment and grading for detour	
Traffic control		X		Large volume of traffic.	
Detour		X		Detour bridge and median detour shared with Br. No. 07794B	
Bridge construction	X			Short single span construction with span length less than 140'.	
Estimated project cost = PE, ROW, construcion with E&C	**$4,545,000**			Estimated number of construction seasons	**1½**

2 PURPOSE AND NEED

The Oregon Department of Transportation (ODOT) has completed a statewide study into the economic conditions and safety conditions of its bridges. The information has been summarized in the Economic and Bridge Options Report (EBOR), January 2003. In order to refine cost information and position for obtaining permits prior to initiation of formal design, ODOT requires that baseline information be assembled for each bridge identified for replacement or repair. The baseline information will be presented in two separate reports: an Engineering Baseline Report and an Environmental Baseline Report. The Environmental Baseline Report is not part of this report, rather a separate document prepared by others. The intent of these reports is to provide a basis to advance projects in a timely manner through development and construction using the Design/Build or Design/Bid/Build contracting options.

This report contains the engineering baseline information for the Hwy 1 NB over Hwy 51 SB Bridge located approximately one mile south of Wilsonville in Clackamas County, ODOT Region 2.

3 BRIDGE EVALUATION AND RECOMMENDATION

ODOT's Bridge Engineering Section gathered data to evaluate the severity of shear cracking for bridges built between the late 1940s through the early 1960s. Some of this information was general (numbers of bridges, age, location, material type, load rating, and condition summaries) but necessary in order to determine the severity of the overall problem. ODOT identified that the basic shear problem can be traced to bridge design specifications used during the late 1940s through the early 1960s. The assumed allowable shear capacity of the structural elements was over estimated and the design live load (trucks) was 20 percent lower than current design standards.

ODOT performed the initial screening of the bridges that likely require replacement or repair. This baseline effort is intended to confirm the ODOT recommendation for repair or replace.

The evaluation used to make the baseline recommendation given in Table 2 included review of ODOT's data, assumptions, criteria and key results. The evaluation also addressed the cracking stage of the bridge and its load rating, modification of structural elements considering feasible long-term repairs, structural deficiencies, and the cost of repair exceeding 50 percent of replacement cost. The primary reasons for replacement are summarized in Table 2. The methodology for this evaluation is provided in Appendix E, Bridge Evaluation Summary.

Table 2. ODOT recommendations for repair or replacement

Initial Recommendation by ODOT			
X	Replace bridge		Repair bridge
Bridge Engineering Baseline Recommendation			
X	Replace bridge		
• Crack Stage 3 throughout • Ratio of Repair to Replacement is 0.51 (> 0.50) indiacting that repair is not a cost effective option.			

4 EXISTING BRIDGE SITE CONDITIONS

4.1 GENERAL SITE CONDITIONS

Existing conditions have been identified and are summarized in Table 3. Information was obtained from ODOT files and from the site visit made as part of this engineering baseline effort.

Table 3. Existing site conditions

Bridge Identification											
Bridge No.	**07794A**			Bridge name	**Hwy 1 NB over Hwy 51 SB**				Mile Point	**282.25N**	
Highway Identification											
State Hwy. No.	**001**			Hwy. Name	**Pacific Highway I-5**						
County	**Clackamas**			Region	**2**						
NHS	**X**	Yes		No	Expressway	**X**	Yes		No		
Roadway Features											
Road character	**Rural**			Functional class	**1 (Rural Principle Arterial)**			Terrain	**Rolling**		
Lane and shoulder widths	**3 – 12' Lanes** **Shld.- 6'lt, 12'rt**			Pavement condition	**Good**			Pavement type	**Concrete w/ asphalt shoulders**		
Intersections or interchange within project limits	**Bridge is within the Hubbard Interchange**										
Horizontal alignment	**SCS – 3° C.R., 2-500' SPI**				Vertical alignment	**+3.25 %**					
Clear zone obstructions	**None**										
Drainage problems	**None apparent during site visit**										
Traffic Features											
ADT current / year	**112,000 - 2002**			ADT / year projected	**145,000 - 2020**			Accident rate	**1.0**		
Posted speed	**65 mph**			Design speed	**70 mph**			SPIS number / year	**Not in Top 10%**		
Lane Configuration	**Three lanes northbound**										
Lane restrictions for staging	**Keep three lanes open northbound**										
Bridge Features											
Bridge length	**194'**			Span configuration	**3 @ 60,74,60**			Bridge type	**RCDG**		
Bridge roadway width	**54'**			Freeboard (100-year)	**NA**			Year built	**Built in 1954 and widened in 1971**		
Out-to-out deck width	**57' 6"**			Sufficiency rating	**70.80**			Load rating	**No**		
AC surfacing		Yes	**X**	No	Depth of AC surfacing	**NA**					
Historic structure		Yes	**X**	No							
History of bridge	**Widened as part of Hubbard Interchange in 1971**										
Crossed Features (at bridge)											
Roads	**Southbound State Highway 51**										
Utilities	**None found during site visit**										

4.2 SPECIAL SITE CONDITIONS

The following section addresses special site conditions within the project area.

4.2.1 Safety issues or deficiencies

Items that do not meet current safety standards have been listed in Table 4 below.

Table 4. Safety issues or deficiencies

	Description
X	Traffic hazards – Shoulder width on left side is substandard (6')
NA	Traffic control devices – No deficeincies in traffic control devices appearant
NA	Roadside hazards – Traffic appears to be properly protected from hazzards
X	Other safety issues or deficiences – Site distance is impared crossing the bridge for the left lane on the inside of the curve to the left. Evidence of the problem is indicated by numberous tire skid marks across the bridge. It appears the problem is due to the grade drop, the F-Rail and some vegetation blocking the view of traffic that gets stopped ahead. This could be improved by removing vegetation, widening the left shoulder to the standard width and possibly by using two-tube rail instead of concrete F-Rail.

4.2.2 Right-of-way

Table 5 summarizes special issues relative to right-of-way at this location. No additional right-of-way is needed for the feasible option.

Table 5. Right-of-way

	Description
X	Businesses – Langdon Farms Golf Course boarders east side of right-of-way
X	Farmland – Rural farmland southwest of right-of-way
X	Other transportation systems – ODOT Rest Area at SW corner of interchange right-of-way
X	Residential – Rural private propertry boarders west side of right-of-way

4.2.3 Utilities

ODOT Utility Report unavailable during the preparation of this report.

No utilities were seen during the site visit. The existing block-outs in the bridge are unused.

Existing ODOT features on-site include illumination, a traffic counter off the south end of the bridge, and possible irrigation.

4.2.4 Roadside obstacles

The following roadside obstacles have been identified for the site (Table 6), based on a basic clear zone distance up to 30-feet generated from an operating speed of 65 mph, a tangent alignment, and a side slope of 6:1 or flatter. Areas with a steeper slope, curved alignment and a wider clear zone up to 40-feet were also included in the report.

Table 6. Roadside obstacles

	Description
X	Tree – All trees protected by guardrail
X	Curb – The drainage curb off the southwest corner of the bridge is guardrail protected
NA	Fences – No fence within the clearzone
NA	Ditch – Ditch in median flat
X	Sign – Wood sign post meets breakway standards with drilled holes
X	Luminaire – Protected by concrete bridge rail in median
NA	Cable Barrier – Replace in current location.
X	Steep slope – Slopes around the bridge properly protected by barrier and guardrail

4.2.5 Roadway surfacing

The existing roadway surfacing is summarized in Table 7.

The existing mainline highway concrete pavement approaching the bridge is in good condition and only showing minor signs of rutting. The concrete pavement across the end panel and out to the terminal expansion joint has severe transverse cracks and should be replaced as part of the bridge replacement project. Since the feasible option is to shorten the existing bridge by 79-feet, it is possible to relocate a new terminal expansion joint 40-feet towards the bridge.

Table 7. Type and condition of roadway surfacing

TYPE OF ROADWAY SURFACING			
X	Concrete Bridge Deck and Concrete Highway Surfacing	**X**	Asphalt Shoulders
ROADWAY SURFACING CONDITIONS/DEFICIENCIES			
X	Cracking – Severe transverse cracking across end panels out to terminal exp. joints		
NA	Settlement – No signs of differencial settling		

4.2.6 Retaining structures / slope protection

Table 8 summarizes existing retaining walls and slope protection associated with this site.

Table 8. Retaining structures / slope protection

	Type	Location
X	Cast in place	6'-7' tall wall along each side of SB Hwy 51 beneath bridge

4.2.7 Environmental, historical and archaeological issues

No major environmental issues were apparent during the site visit around the bridge within the existing right-of-way. It appeared that the entire interchange was graded during the 1971 widening project. Wetland vegetation or hydrotropic soils were not apparent on site. The vegetation around the bridge appeared to be non-native plants that were part of a landscaping plan done during the interchange project in the early 1970's.

The State of Oregon has declared the Himalayan Blackberry, which is growing profusely around the bridge, a menace to the public welfare per ORS 570.505. The replacement of the existing bridge will not have a major change to the footprint of the highway on the landscape.

See the Environmental Baseline Report for additional information.

4.2.8 Interchanges / intersections / accesses

Br. No. 07794A is located within the limits of the Wilsonville-Hubbard Interchange. The interchange was constructed in 1971 as a directional diamond. ODOT has examined the interchange as part of the 2000 I-5 State of the Interstate Report and identified geometric deficiencies for the ramps, but did not identify major problems with the mainline bridge locations.

The northbound off-ramp is located only 423-feet to the north of the existing bridge. Any change in the permanent alignment of this bridge would impact the geometry of the interchange. The feasible option is to replace the bridge in its existing location.

4.2.9 Local issues and planning issues

No planning issues were revealed during the scoping process that influenced the selection of the feasible option.

4.2.10 Geologic and geotechnical issues

Table 9 summarizes pertinent geologic/geotechnical and foundation issues at the site.

Table 9. Geologic / geotechnical and foundation issues

Observed geologic issues							
General terrain							
	Flat	X	Rolling		Mountainous		
Subsurface							
X	Alluvium		Colluvium		Weathered rock		Bedrock
Surface water							
No surface water observed							
Landslides							
Topography not condusive for landslides							
Seismicity zone (1, 2, or 3)	Zone 2 (A ≅ 0.17 < 0.19)						
Other issues							
None							
Observed geotechnical issues							
Abutments							
X	Fill		Cut		Both		
Piers / bents							
X	Fill		Cut		Both		
Existing abutment foundation type							
	Spread	**X**	Pile				
Existing piers / bents							
	Spread	**X**	Pile (Multiple columns on issolated, pile supported footings)				
Other issues							
None							

Geotechnical borings were completed for the interchange project in the early 1970's and a copy of the boring log information is included with the existing bridge drawings (see Appendix M). A geotechnical baseline report is not necessary prior to bidding the project.

4.2.11 Hydraulic and hydrologic issues

The structure does not cross a stream channel and has no apparent hydraulic issues.

5 SOLUTION OPTIONS EVALUATED

Solution options were evaluated using data received during the data collection phase plus data collected during the site visit. The solution options evaluated are in accordance with current ODOT highway design standards and policies. The ODOT Highway Design Manual is used to determine roadway width including widths for travel lanes, shoulders, medians, barriers, bicycle lanes, and lane transition configurations.

The following alignment options were investigated but were not selected for development as the feasible option, and are described below.

Four Stage Construction:

One alternative considered was to construct the new bridge in four separate stages and not build any type of detour bridge. This staging sequence produces unacceptable results for constructing a new bridge. Traffic lane widths are reduced to 11-feet in two stages and traffic flow is split around the work area with substandard lane widths. The disadvantages for this alternative are that the substandard lane widths and separating traffic around a work area could be unsafe for traffic and the contractor, and would lower the quality of workmanship on the new bridge. Due to the inefficiencies of multiple stages, costs would increase and could be comparable to building a separate detour bridge.

Widen Existing Bridge with Partial Detour Bridge:

Another alternative considered was to remove the median side barrier and add to the existing bridge with a temporary detour structure. The eastern portion of the bridge would then be removed and replaced then traffic diverted to this new portion. The remaining existing bridge and temporary detour structure would then be removed and the remainder of the new bridge completed. There are some advantages to this option. First, utilizing a similar staging approach on the southbound structure that also requires replacement (Bridge No. 07794B) would enable a contractor to work on both structures at the same time. This alternative would also eliminate the need to split traffic around a work area thus providing a safer project for the contractor and public. A disadvantage of this option is that two separate detour bridges would be required for the two bridges that need to be replaced thus adding cost to the project.

Separate Detour Bridge on the East Side:

Constructing a separate detour bridge on the east side of the existing bridge has several disadvantages. First, there is insufficient room between the required location of the detour bridge and the overpass structure north of the project site, to move northbound traffic back to the existing alignment. Second, due to topography and the amount of fill needed, the cost of this alternative is greater than other options. A detour alignment on the east side of the highway could also conflict with the northbound rest area on-ramp to the south, Langdon Golf Course to the east, and northbound off-ramp to the north.

Median Detour Bridge:

The most feasible option, described in further detail below, is to construct a separate detour bridge in the median. This detour bridge would be available for use while replacing both the northbound bridge discussed in this report as well as the southbound bridge (Br. No. 07794B).

5.1 FEASIBLE ALIGNMENT OPTION

5.1.1 Alignment and cross section

After reviewing the existing information and performing a site visit, the feasible alignment option is to construct a separate detour bridge in the median at a location where it can also be used for detour traffic during the reconstruction of the southbound bridge (Br. No. 07794B). Splitting the cost for the detour bridge between the northbound and southbound bridges, makes this option cost efficient when compared to other options. This option allows for an alignment that meets all current ODOT design requirements and allows for the existing bridge to be widened to the right (east). Indirect cost saving advantages of this feasible alternative are that the new bridge can be built in one stage resulting in a higher quality construction product, makes the access to the work area safer for the contractor, and provides an alignment that is safer for traffic.

Table 10. Feasible Alignment and cross section

Horizontal alignment					
X	Reconstruct on existing alignment				
Design exceptions recommended - None					
Vertical alignment					
X	Reconstruct at existing grade				
Design exceptions recommended - None					
Cross section					
Number of travel lanes	**3**	Lane width	**12'**	Median width	**Varies**
Shoulder width left	**10'+2'E**	Shoulder width right	**10'+2'E**		
Sidewalk width left	**NA**	Sidewalk width right	**NA**	Total width	**60'**

5.1.2 Earthwork

Earthwork for the feasible alignment is summarized in Table 11.

Earthwork for this project is needed to construct the median detour. It appears feasible to place the detour bridge midway in elevation between the northbound and southbound bridges at an optimum grade suitable for each detour direction. The difficulty of the work is due to the limited space in the median and the related traffic control. It is likely that the contractor would minimize the shoulder width on the right, push traffic to the right, and create a minimum width left shoulder by placing temporary concrete barrier to isolate the median area. Detour embankment, supported by geo-fabric walls on the east side, would then be placed in the median.

Table 11. Earthwork

	Complexity of earthwork	Activity	Volume estimate
X	Embankment in place	Construct embankment in median for detour	900 cu. yd.
X	General excavation – low	Some excavation needed for median mound south of the bridge. Can be placed on site.	NA

5.1.3 Wearing surface

The following surfacing is feasible for this project as shown in Table 12.

It is expected that the existing pavement will be damaged during the construction and removal of the detour. It is estimated that a 8,300 square yard asphalt overlay will be needed.

Table 12. Wearing surface

	Description	
X	Overlay Surfacing – ACP	Asphalt overlay to repair pavement after detour is removed

5.1.4 Water quality

Water quality base cost is typically determined by the total area impacted by the project limits. The quantity used is the total impervious surface area covered by the roadway wearing surface and new structure. However, this project only slightly widens the existing structure in place and there is an existing drainage system on Southbound Hwy. 51 below the bridge. It is likely that the permitting agencies will require some water quality features to be installed, but not a complete new system. The area of the deck (7875 sq. yd.) generates $31,500 in the cost estimate to cover the water quality costs. This amount seems reasonable for minor improvements to the existing system for features such as sediment catching manholes or small swales if space is available.

Table 13 depicts the feasible water quality option recommended.

Table 13. Water quality

	Description		Area
X	Water quality – manholes	This water quality option is used when limited surface area is available as is the case on this project. Manholes or other mechanical devices are used to retain and filter water runoff.	7875 yd2

5.1.5 Retaining walls

The feasible option includes the removal of the existing slope paving and end spans, and the construction of a single span bridge. Proprietary mechanically stabilized earth (MSE) wingwalls and abutment walls could retain bridge approaches. A geotechnical investigation may be necessary to determine if the bridge superstructure can be supported on spread footings in the MSE walls or if the footings will need to be supported on piles driven through the MSE fill. Costs of the wingwalls and abutment walls will be included in the bridge costs for the project.

The existing retaining walls on both sides of southbound Hwy 51 crossing below the bridge will be maintained during construction and remain in use following the project. A summary of the retaining walls required for the feasible alignment is shown in Table 14.

Table 14. Retaining walls

	Type	Description
X	Retaining wall – fill section	Proprietary (MSE) wingwalls and abutment walls at both end bents. Heights vary with maximum heights of 25' for abutment walls and 33' for tapered wingwalls.

5.1.6 Permanent traffic control and guidance devices

Modifications to permanent traffic control or guidance devices anticipated at this site are summarized in Table 15. No major changes occur with the feasible option to replace the bridge in its existing location.

Table 15. Permanent traffic control and guidance devices

	Type	Description
X	Concrete barrier – standard (ft)	Remove and replace – no additional length
X	Guardrail (ft)	Replace 200'
X	Bridge end treatment (ea)	Two new guardrail transitions to F Rail and new terminal
X	Illumination (ea)	Remove and replace one high-mast luminair
X	Ramp meter (ea)	Existing traffic counter – Need to install new loops

5.1.7 Right-of-way development and control

Based on preliminary environmental investigations and the site visit, no mitigation measures are anticipated at this location. Refer to the Environmental Baseline Report to confirm this assumption prior to developing the project. Minor work will include fine grading of the site after the detour is removed and then the application of seed, fertilizer, and mulch.

Table 16. Right-of-way development and control

	Type	Description
X	Landscaping	Standard seed and mulch

5.1.8 Right-of-way acquisition

Right-of-way requirements and access management needs were investigated to determine cost and to predict project development time.

Due to the size of existing area in the Wilsonville-Hubbard Interchange, no additional right-of-way is needed.

5.1.9 Utilities to be relocated

No utilities have been identified as requiring relocation or protection for the feasible alignment.

ODOT does have electrical features and irrigation on site that will need to be replaced as part of the project. There is a high-mast luminaire in the median on the north side that may require temporary relocation for the detour alignment and replacement after the detour is removed. The traffic counter loops in the northbound roadway must be replaced following the bridge replacement.

5.1.10 Other

No other issues were apparent during the site visit.

5.2 STAGING AND TEMPORARY TRAFFIC CONTROL

Generally, construction could occur in two stages as described in Table 17. The recommended method of traffic control is listed in Table 18.

Table 17. Feasible staged construction

Stage	Description of construction stages
I	1. Shift traffic to the right side of existing roadway 2. Construct grade for detour 3. Construct detour bridge (if not in place from construction of Br. No. 07794B) 4. Pave and stripe detour 5. Shift traffic to detour 6. Demolish existing bridge 7. Construct new Bridge 07794B
II	1. Shift traffic to new bridge 2. Remove detour pavement and fill 3. Use detour bridge as part of southbound bridge project or remove detour bridge 4. Overlay highway as needed 5. Move traffic to final location

Table 18. Feasible temporary traffic control options

Detour when constructing new bridge on existing alignment	
NA	Widen existing structure right or left to gain width – Not feasible
NA	Route around site – use existing alternate route – No feasible detour route available
X	Route around site – build detour bridge in median
NA	Signaled or flagged – Not practicle for I-5 volume of traffic.

5.3 DETOUR BRIDGE

A detour bridge will likely be required to shift traffic away from the existing alignment so that the existing horizontal alignment can be maintained. The Detour Bridge in the median at this site appears necessary for the following reasons:

- Necessary for constructing new bridge on the existing alignment
- Provides higher level of safety for the construction contractor and traveling public
- Topography in median is conducive for a detour
- Preferred method to keep three lanes of traffic open during construction of new bridge
- When combined with the reconstruction of the southbound bridge, a median detour bridge becomes a cost-effective way to detour traffic during construction of both projects.

The Detour Bridge is generally described as follows:

- The detour bridge will be required for construction stages 1 and 2.
- The detour bridge will carry three lanes of traffic and will provide 8-foot shoulders (bridge will be built wide to accommodate Br. No. 07794B which has three lanes of traffic and an acceleration lane).
- The Detour Bridge will span southbound Hwy 51.

The cost for the detour bridge has been defined using two categories: standard and special design. The detour bridge construction for this site is considered a special design and construction system due to the long span needed to cross Hwy 51 southbound. The detour bridge cost factors are described in Table 19.

Table 19. Detour Bridge

Cost factor	***Description***
Special	The special design detour bridge is likely to have spans longer than 20 feet in length and will consist of floor beams or girder that are precast members, steel girders, or truss systems.

6 STRUCTURE TYPE

In this section, major factors that affect the overall bridge cost for replacement at the site are discussed for use in developing the construction cost estimates.

6.1 BRIDGE STRUCTURE CONFIGURATION

The existing structure is 194-foot-long reinforced concrete deck girder bridge. The 57.5-foot out-to-out width provides for three lanes of traffic and two shoulders. The superstructure is supported on multiple column interior bents on individual pile supported footings. End bents are pile supported, spill-through type with concrete slope paving on the fill slopes beneath the bridge. See Appendix M for as-built plans. A feasible structure configuration is shown in Table 20. The features to be crossed by the bridge are shown in Table 21.

The feasible replacement structure is a single-span bridge with a total length of 115-feet. The total out-to-out width of the feasible replacement structure is 63-feet. The lane configuration to be located on the structure is three 12-foot lanes and two 12-foot shoulders.

Table 20. Feasible bridge span lengths and configuration

	Predominant span lengths (ft)	***Span bridge configuration***
X	Spans ≤ 140 feet ◄——►	Single 115-foot span
X	Total structure width	63' out-to-out

The feasible span configuration given in Table 20 has been selected to:

- Span the crossing provided in Table 21.
- Achieve minimum structural depth to meet vertical clearances.
- Achieve a structurally efficient span layout.
- Avoid grade changes on I-5.

Table 21. Features to cross

	Crossing	***Names of feature***
X	Street / highway	State Highway 51 Southbound

Bridge configurations considered for the most feasible roadway alignment are given in table 22.

Table 22 Feasible bridge configurations

Total Bridge Length/ Span Length Configuration (ft)	Description of Structural System	Discussion of Structural System
115/ 115	Simple span using CIP vertical abutments and wingwalls or MSE wall abutments and wingwall	Provides for the shortest main span length over southbound Hwy. 51. Slightly increases the amount of roadway embankment when compared with other single-span option but existing I-5 profile can remain unchanged. This option is less expensive when compared to the three span option developed.
120 / 120	Simple span using CIP vertical abutments and wingwalls or MSE wall abutments and wingwalls	This configuration was considered to cross the existing southbound Hwy 51 with a short span but long enough to lessen the skew angle. CIP vertical abutments or MSE wall abutments allow for a reasonable overall bridge length however, structure depth required for this span length requires raising the I-5 grade approx. 14-inches.
200 / 50 / 100 / 50	Three span system using multiple column interior bents and spill-through end-bents on stub abutments.	Reduces the amount of roadway embankment, and reduces the area of abutment walls and wingwalls but total length of bridge becomes 200-feet. This option allows the I-5 grade to remain unchanged, but is more expensive compared to the feasible option developed.

6.2 ABUTMENT TYPES

The feasible option proposes the use of proprietary (MSE) abutment and wingwalls to contain the approach roadway fill. Slope paving behind the existing retaining walls each side of Hwy 51 will be replaced up to the abutment wall. The cost of the abutment is captured by the area of the MSE wall with a height from 2-feet below the super structure to 5-feet below the fill slope, and a width equal to the out-to-out width of the proposed bridge. The wingwall cost is captured by the tapered area of MSE walls from the roadway grade to 5-feet below the fill slope. A feasible abutment type and approximate height of the abutment is given in Table 23.

Table 23. Feasible abutment types

	Abutment types	***Height (ft)***
X	MSE wall abutment	19' (max) – Bent 1: 25' (max) – Bent 2

6.3 FOUNDATION TYPE

Foundations at the existing site consist of driven timber pile deep foundations. Based upon review of existing as-built plans, the substructure cost factor selected for the site is given in Table 24.

Table 24.Feasible substructure

Substructure cost factors	Description
None	Standard spill-through end bents and multiple column interior bents on pile caps.

Foundation cost at the site will likely be influenced by:

- Ability to drive piles within the existing fill embankment and in vicinity of existing timber piles that may be difficult to remove.

6.4 SEISMIC CONSIDERATIONS

At this site, the peak horizontal rock acceleration (in g's), having a return period of 500 years with a mean annual frequency of exceedance of 0.002, is approximately 0.17 g based on ODOT's Office Practice Seismic Map.

6.5 BRIDGE REHABILITION ITEMS

- No bridge rehabilitation items are anticipated at this site.

6.6 BRIDGE REMOVAL

The bridge removal for this site is considered special due to the need to protect Hwy 51 traffic below from falling debris. The Bridge Removal Cost factors are described in Table 25. If traffic volumes on Hwy 51 are analyzed and it is determined that it is reasonable to have periodic closures of Hwy 51 southbound, then the project could realize a cost savings of approximately $100,000.

Table 25. Bridge removal

Cost factor	Description
Bridges over railroad or over live load traffic	This type of bridge removal would be considered for bridges located over railroads and roadways that must remain open to trafic and must be protected from debris from the proposed bridge removal or construction.

6.7 WORK BRIDGE

A work bridge is not anticipated at this site.

6.8 AESTHETICS FEATURES

For the purpose of this study, aesthetic enhancement factors have been included to account for aesthetic features. The criteria for selection of aesthetic enhancement ranges from low to high as describe in Table 26.

Table 26. Aesthetic enhancement factor

Aesthetic enhancement factor		
X	Standard	Propose to use standard bridge construction elements with general finish.
NA	Low	Propose to use small amount of formliners to enhance overall look of columns, abutments, railing, beams, or wingwalls.
NA	Medium	Propose special treatment of the pier and bent caps, haunched beams, or use of ornamental features instead of formliners.
NA	High	Proposed structure should be considered signature bridge.

7 PROJECT DELIVERY SCHEDULE

The following table summarizes the major factors that may affect project development time and construction seasons. This schedule is based on design/bid/build contracting method. If design/build contracting method is used the duration would change. One and a half construction seasons are anticipated to construct the Hubbard Interchange package of bridges.

Table 27. Feasible project delivery schedule

Item	***Item duration (months)***	***From Notice to Proceed, Project duration (months)***
Environmental compliance and permitting	10	2 – 12
Right-of-way acquisition	0	NA
Design	12	0 – 12
Utility relocation	0	NA
PS&E to first Notice	4	12-16
Construction	18	16-34

8 COST ESTIMATE

Based upon the site and other cost factors discussed in this report, the total estimated project cost for this site is $4,545,000 including right-of-way, preliminary engineering, construction and E&C. The reader is referred to the Project Cost Summary in Appendix D for a breakdown of project cost.

9 REFERENCES

Oregon Department of Transportation (ODOT). 2002. *Oregon's Bridge Strategy*, ODOT Bridge Strategy Task Force. June 20.

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