Broadway Bridge Feasibility Study Cost Estimate

PREPARED FOR: City of West Sacramento, in cooperation with the City of Sacramento

PREPARED BY: CH2M and Hardesty &Hanover

Introduction

This technical memorandum developed a range of potential project costs for the Broadway Bridge project. Alignment, movable span types, fixed span types, and bridge typical section were the project components evaluated to determine a combination that would produce both the low end and the high end of this range. Actual project cost will most likely fall somewhere within this range. The costs of all alternatives were evaluated from a comparative standpoint, but only two detailed cost estimates were developed: A low-end cost estimate and a high-end cost estimate.

The high end cost estimate utilized the southern-most alignment (Alignment D), a 98-foot wide typical section, a bascule movable span, and steel plate girders for the fixed span. A summary of the high end cost estimate is attached to this technical memorandum.

The low end cost estimate utilized the most direct alignment (Alignment C1), a 64-foot wide typical section, a bobtail swing movable span, and pre-cast wide flange girders for the fixed spans. A summary of the low end cost estimate is attached to this technical memorandum.

Escalation was applied at a rate of 3% annually for a period of 10-years. This is based on the mid-point of construction being in the year 2025. Right of way impacts were evaluated to determine approximate number of parcels impacted and approximate square footage of anticipated right of way take. Actual right of way costs were excluded from the estimates.

Alignments

Five alignments were evaluated from a comparative cost perspective. Below is a brief summary of the cost implications associated with each alternative.

Alignment A

This alignment would most likely cost more than Alignment B and C1/C2 due to the increase in Right of Way take north of Broadway on the East side of the River and the additional earthwork and anticipated retaining walls associated with the grade differences at the intersection of 5th Street and Broadway. Additionally, a new 4-legged intersection would need to be constructed at 5th Street and Broadway.5th Street. The other alignments do not require this additional infrastructure. This alignment represents a decrease in cost when compared to Alignment D because the geometry still allows for the minimum 170-foot wide movable span, similar to Alignments B and C1/C2.

Alignment B

This alignment is similar to Alignment A, and would most likely cost more than Alignment C1/C2 due to the increase in Right of Way take north of Broadway on the East side of the River and the additional earthwork and anticipated retaining walls associated with the grade differences at the intersection of 5th Street and Broadway. Additionally, a new 4-legged intersection would need to be constructed at 5th Street and Broadway and the portion of roadway between Jefferson Blvd and 5th Street would need to

be re-aligned. The other alignments do not require this additional infrastructure. This alignment represents a decrease in cost when compared to Alignment D because the geometry still allows for the minimum 170-foot wide movable span, similar to Alignments A and C1/C2.

Alignment C1

This alignment would most likely result in the lowest cost when compared to the others. The right of way take would be similar or less than the other options. Similar to alignments C2 and D, a new tee intersection would be required at 5th Street. Additionally, when compared to Alignment C2, it will not require a relocation of the Kinder Morgan Gas line going under the River. Alignment C2 would require a relocation. This alignment allows for the minimum 170-foot wide movable span, similar to A, B, and C2. This alignment was selected for the low-end cost estimate.

Alignment C2

This alignment is very similar to Alignment C1, but it would require a full relocation of the Kinder Morgan gas line going under the River. This would be an added cost to the project. This alignment allows for the minimum 170-foot wide movable span, similar to A, B and C1. Anticipated right of way take for this alignment would be similar to or less than the other options.

Alignment D

This alignment would result in the highest cost when compared to the others. This is primarily attributed to the unfavorable geometry over the River and the alignments location relative to the existing bend in the river immediately south of the proposed bridge. This geometry will require a minimum of a 200-foot wide movable span, as opposed to the 170-foot wide navigation channel associated with the other alignments. Additionally this alignment would result in similar or more Right of Way take on both sides of the river. This would also require additional infrastructure, such as retaining walls near the Marina on the east side of the river. For these factors, this alignment was selected for the high-end cost estimate.

Fixed-Span Types

Two Fixed Span Types were evaluated from a cost perspective. Below is a brief summary of the cost implications associated with each alternative.

Steel Plate Girders

Steel plate girders are expected to be more expensive than pre-cast wide flange girders. However, if steel girders are used, the material type of the approach spans will match the material used for the movable spans. In addition, steel plate girders can span the 200-feet required for a two span eastern approach that minimizes the amount of in river construction. This is beneficial from an environmental perspective and a hydraulic perspective. A steel superstructure is also lighter than an equivalent pre-cast girder superstructure, resulting in lower seismic demands and correspondingly lower foundation costs.

Planning level estimates and review of historical unit costs indicated an approximate cost of $375 per square foot is appropriate for this structure type.

Precast Wide Flange Girders

Precast wide flange girders offer a design solution that involves similar construction methods to the steel plate girder option. Precast girders are readily available and slightly more cost effective than the steel plate girder option. The long term maintenance costs associated with precast girders are less than a steel superstructure, as costly repainting is not required for concrete girders.

Planning level estimates and review of historical unit costs indicated an approximate cost of $290 per square foot is appropriate for this structure type.

Three Movable Span Types were evaluated from a cost perspective. Below is a brief summary of the cost implications associated with each alternative.

Vertical Lift

A Vertical Lift is the most economical of the three movable span options studied. For the span substructure, the main towers can feature concrete construction in order to provide cost savings over traditional steel framed towers. Both precast and cast-in-place concrete options are available and offer flexibility to the Contractor with tower assembly. For the span superstructure, multi steel box girders can be incorporated as an economical solution, offering basic and repetitive details for fabrication, while maintaining ease for shipping and erection. Most importantly, the use of multi-steel box girders provides an opportunity to keep the unit cost of steel lower when compared to the other movable span superstructures and more likely to be in line with the unit cost for the approach span steel. For the mechanical operating system, the vertical lift span can feature two modified tower rope drives.

Planning level estimates and review of historical unit costs indicated an approximate cost of $4230 per square foot is appropriate for this movable span type.

Bobtail Swing

A Bobtail Swing is a third movable span option for two of the narrower proposed typical section and alignment alternatives. The substructure for a Bobtail Swing option includes a central pivot pier which houses the main drive machinery. Superstructure details feature a steel orthotropic box section. Complexities for steel detailing of the bobtail swing are more significant than those of the vertical lift option resulting in a premium on unit cost of steel for this movable span type.

Planning level estimates and review of historical unit costs indicated an approximate cost of $3336 per square foot is appropriate for this movable span type. Note, however, overall movable bridge length is longer when compared to the vertical lift option, resulting in a higher overall cost.

Double Leaf Bascule

The double leaf bascule sections are more complex and costly when compared to the vertical lift sections due several factors. One of the most significant cost drivers of the double leaf bascule option is the substructure which requires larger concrete pier foundations for each leaf.

A steel thru-truss section with an overhead counterweight is another alternative for the bascule span superstructure. Given the required complexities of the superstructure details for the double leaf bascule, higher structural steel unit costs are expected in comparison to those costs on the vertical lift option.

For the balance of the double leaf bascule span, more substantial counterweight balance material is required versus the vertical lift span option. This is to satisfy the required span weight ratios for balance design and efficient mechanical operation. It is also important to note that the widest proposed typical cross section (98 feet) has a substantial effect on the cost of the double leaf bascule, as it likely warrants implementation of a four leaf superstructure, in lieu of a twin leaf structure for the narrower options. This increases both the complexity and the quantity of components, particularly with the mechanical lift system as 4 sets of drive machinery are required.

Planning level estimates and review of historical unit costs indicated an approximate cost of $3956 per square foot is appropriate for this movable span type. Note, however, overall movable bridge length (i.e. movable span plus deck over counterweight) is longer when compared to the vertical lift option, resulting in a higher overall cost.

Typical Section

Three Typical Sections were evaluated from a cost perspective. Due to minor revisions in the typical sections being made in the later stages of the Study, the sections widths below differ from those described in the Executive Summary and Alignments/Connections memo. The preferred typical section(s) and ramifications to movable bridge types will be addressed in future project phases. Below is a brief summary of the cost implications associated with each option.

Two Lanes (64 feet wide)

This is the narrowest of the three typical sections evaluated and presents the lowest cost alternative. When compared to the other two Typical Sections, this option will result in the least amount of infrastructure, reducing volume of materials and overall bridge footprint. This typical was selected for the low-end cost estimate.

Adaptable Two to Four Lanes (84 feet wide)

A selection of this typical section would result in a cost increase over the 2-lane (64-feet) section, but would be less than the 4-lane (98-feet). A cost estimate using this section was not developed, as it would land within the range established by the 64-foot wide and the 98-foot wide sections.

Four Lanes (98 feet wide)

This is the widest of the three typical sections evaluated and presents the highest cost alternative. When compared to the other two Typical Sections, this option will result in the most amount of infrastructure, increasing volume of materials and overall bridge footprint. This typical was selected for the high-end cost estimate.

Conclusion

The lowest movable cost option for the 98 foot width is the vertical lift, and the bobtail swing is the lowest cost option for the 64 foot width. Using the low-end selections and the high-end selections the total project costs could be as low as $181 million or as high as $310 million. There numerous different combinations of alignments, bridge types, and typical sections, that will all influence the project cost. Actual project cost will depend on what components are chosen to move forward with into final design and subsequently construction.

Project Planning Cost Estimate - Low End
November 3, 2015
Broadway Bridge

PROJECT COMPONENTS SELECTED FOR LOW-END COST ESTIMATE

NUMBER OF LANES: **2**

TYPICAL SECTION WIDTH: **64-FEET**

ALIGNMENT: **C1**

FIXED SPAN BRIDGE TYPE: **PRE-CAST GIRDERS**

MOVABLE SPAN BRIDGE TYPE: **BOBTAIL SWING**

		Current Cost
ROADWAY ITEMS	**$**	**24,700,000**
BRIDGE ITEMS	**$**	**83,742,820**
SUBTOTAL CONSTRUCTION COST**	**$**	**108,442,820**
RIGHT OF WAY AND UTILITIES	**$**	**-**
TOTAL CAPITAL OUTLAY COST	**$**	**108,443,000**
PA&ED (3%)	**$**	**3,253,285**
PS&E (8%)	**$**	**8,675,426**
RIGHT OF WAY AND UTILITY SUPPORT	**$**	**-**
CONSTRUCTION SUPPORT (12%)	**$**	**13,013,138**
TOTAL CAPITAL OUTLAY SUPPORT COST	**$**	**24,941,849**
TOTAL PROJECT COST (2015)	**$**	**134,000,000**
ESCALATION (3% ANNUALLY FOR 10-YEARS)	**$**	**47,000,000**
TOTAL PROJECT COST (2025)*	**$**	**181,000,000**

*Costs exclude right of way, and utility coordination/relocation

**Includes 10% time related overhead, 10% mobilization, 25% contingency on bridge items and 30% contingency on roadway items.

Project Planning Cost Estimate - High End
November 3, 2015
Broadway Bridge

PROJECT COMPONENTS SELECTED FOR HIGH-END COST ESTIMATE

NUMBER OF LANES: **4**

TYPICAL SECTION WIDTH: **98-FEET**

ALIGNMENT: **D**

FIXED SPAN BRIDGE TYPE: **STEEL PLATE GIRDERS**

MOVABLE SPAN BRIDGE TYPE: **QUAD-LEAF BASCULE**

		Current Cost
ROADWAY ITEMS	**$**	**33,500,000**
BRIDGE ITEMS	**$**	**153,151,386**
SUBTOTAL CONSTRUCTION COST**	**$**	**186,651,386**
RIGHT OF WAY AND UTILITIES	**$**	**-**
TOTAL CAPITAL OUTLAY COST	**$**	**186,652,000**
PA&ED (3%)	**$**	**5,599,542**
PS&E (8%)	**$**	**14,932,111**
RIGHT OF WAY AND UTILITIES SUPPORT	**$**	**-**
CONSTRUCTION SUPPORT (12%)	**$**	**22,398,166**
TOTAL CAPITAL OUTLAY SUPPORT COST	**$**	**42,929,819**
TOTAL PROJECT COST (2015)	**$**	**230,000,000**
ESCALATION (3% ANNUALLY FOR 10-YEARS)	**$**	**80,000,000**
TOTAL PROJECT COST (2025)*	**$**	**310,000,000**

*Costs exclude right of way, and utility coordination/relocation

**Includes 10% time related overhead, 10% mobilization, 25% contingency on bridge items and 30% contingency on roadway items.