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 Cost Estimate Technical Memorandum provides a range of potential project costs for the Broadway Bridge project. Alignment, movable-span types, fixed-span types, and bridge widths were the project components evaluated to produce 18 cost scenarios for each bridge alignment. **Table 1** summarizes these cost scenarios. Due to the similarity in costs, Alignments C1 and C 2 were consolidated and shown as one alignment. The estimates include 10 percent time-related overhead, 10 percent mobilization, 25 percent contingency on bridge items, and 30 percent contingency on roadway items. Costs assume a construction year of 2025 and an annual escalation factor of 3 percent. Construction support costs of 10 percent are included as well. Current (2015) cost totals are shown, as well as future costs based on escalation applied at a rate of 3 percent 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; however, right-of-way and utility impacts may vary significantly among the alignments, due to the types of properties impacted and status of land development/redevelopment activities at the time of right-of-way acquisition.

Costs range from approximately $180 million at the low end and $350 million at the high end. The ranges are segregated further in Table 1 by alignment, bridge width, and movable- and fixed-bridge types. **Figure 1** illustrates the range of project costs by alternative. The respective ranges encompass the three movable-bridge types currently under consideration.

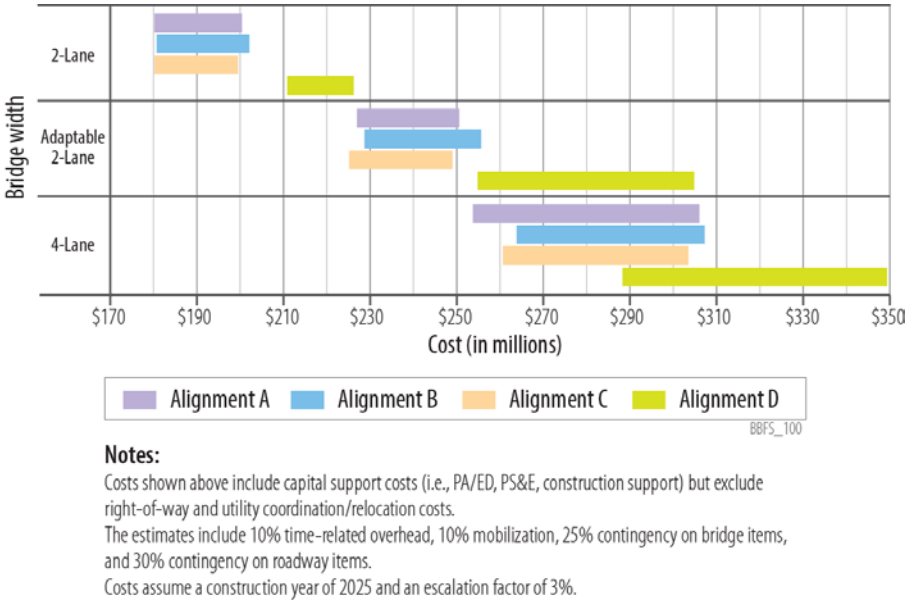

Figure 1. Project Cost Ranges (By Alignment and Crossing Width)

As shown, the high end cost estimate used the southern-most alignment (Alignment D), four-lane bridge typical section, bascule movable span, and steel plate girders for the fixed span. The low end cost estimate used the northern-most alignment (Alignment A), two-lane bridge typical section, bobtail swing movable span, and precast wide flange girders for the fixed spans.

As shown in Table 1 and Figure 1 for all three bridge width options, Alignments A, B, and C have relatively similar costs for each movable-bridge type. Under all scenarios, Alignment D is the highest-cost alternative due to the longer alignment and the wider bridge opening required for river navigation.

Alignments

Below is a brief summary of the cost implications associated with each alternative. The roadway cost estimates presented in Table 1 were developed by preparing a cost per lineal foot and applying to the lengths of the varying alignments. It is probable that actual cost per linear foot would vary based on alignment, even if the same section is used as items such as right-of-way cost and major utilities could vary significantly based on alignment chosen. This variability is not captured with these estimates.

Alignment A

This alignment would most likely cost more than Alignments 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 four-legged intersection would need to be constructed at 5th Street and Broadway. 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 four-legged intersection would need to be constructed at 5th Street and Broadway and the portion of roadway between Jefferson Boulevard and 5th Street would need to be realigned. 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 T-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 Alignments A, B, and C2.

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 Alignments A, B and C1. Anticipated right-of-way take for this alignment would be similar to or less than the other options.

Table 1. Construction Cost Matrix

Broadway Bridge Feasibility Study - Construction Cost Matrix - Alignment A Estimates														
Crossing Configuration				Construction Cost				Support Cost						
Crossing Alignment	Crossing Width	Approach Span Type	Movable Span Type	Roadway	Approach Spans	Moveble Span	Subtotal	PA&ED (3%)	PS&E (8%)	Construction Support (12%)	Subtotal	TOTAL PROJECT COST (2015)	ESCALATION (3% ANNUALLY FOR 10-YEARS)	TOTAL PROJECT COST (2025)
A	2 Lane	Steel	Vertical Lift	$25,600,000	$13,440,000	$ 77,112,000	$116,200,000	$3,486,000	$9,296,000	$13,944,000	$26,800,000	$142,926,000	$49,155,000	$192,100,000
			Bobtail Swing	$25,600,000	$13,440,000	$ 73,947,000	$113,000,000	$3,390,000	$9,040,000	$13,560,000	$26,000,000	$138,990,000	$47,801,000	$186,800,000
			Bascule	$25,600,000	$13,440,000	$ 82,654,000	$121,700,000	$3,651,000	$9,736,000	$14,604,000	$28,000,000	$149,691,000	$51,482,000	$201,200,000
		Precast	Vertical Lift	$25,600,000	$10,393,600	$ 77,112,000	$113,200,000	$3,396,000	$9,056,000	$13,584,000	$26,100,000	$139,236,000	$47,886,000	$187,200,000
			Bobtail Swing	$25,600,000	$10,393,600	$ 73,947,000	$110,000,000	$3,300,000	$8,800,000	$13,200,000	$25,300,000	$135,300,000	$46,532,000	$181,900,000
			Bascule	$25,600,000	$10,393,600	$ 82,654,000	$118,700,000	$3,561,000	$9,496,000	$14,244,000	$27,400,000	$146,001,000	$50,213,000	$196,300,000
	Adaptable 2 Lane	Steel	Vertical Lift	$28,500,000	$15,960,000	$ 96,310,000	$140,800,000	$4,224,000	$11,264,000	$16,896,000	$32,400,000	$173,184,000	$59,561,000	$232,800,000
			Bobtail Swing	$28,500,000	$15,960,000	$ 101,266,000	$145,800,000	$4,374,000	$11,664,000	$17,496,000	$33,600,000	$179,334,000	$61,676,000	$241,100,000
			Bascule	$28,500,000	$15,960,000	$ 107,659,000	$152,200,000	$4,566,000	$12,176,000	$18,264,000	$35,100,000	$187,206,000	$64,384,000	$251,600,000
		Precast	Vertical Lift	$28,500,000	$12,342,400	$ 96,310,000	$137,200,000	$4,116,000	$10,976,000	$16,464,000	$31,600,000	$168,756,000	$58,038,000	$226,800,000
			Bobtail Swing	$28,500,000	$12,342,400	$ 101,266,000	$142,200,000	$4,266,000	$11,376,000	$17,064,000	$32,800,000	$174,906,000	$60,154,000	$235,100,000
			Bascule	$28,500,000	$12,342,400	$ 107,659,000	$148,600,000	$4,458,000	$11,888,000	$17,832,000	$34,200,000	$182,778,000	$62,861,000	$245,700,000
	4 Lane	Steel	Vertical Lift	$31,500,000	$20,580,000	$ 105,745,000	$157,900,000	$4,737,000	$12,632,000	$18,948,000	$36,400,000	$194,217,000	$66,795,000	$261,100,000
			Bobtail Swing	$31,500,000	$20,580,000	$ 125,981,000	$178,100,000	$5,343,000	$14,248,000	$21,372,000	$41,000,000	$219,063,000	$75,340,000	$294,500,000
			Bascule	$31,500,000	$20,580,000	$ 133,178,000	$185,300,000	$5,559,000	$14,824,000	$22,236,000	$42,700,000	$227,919,000	$78,386,000	$306,400,000
		Precast	Vertical Lift	$31,500,000	$15,915,200	$ 105,745,000	$153,200,000	$4,596,000	$12,256,000	$18,384,000	$35,300,000	$188,436,000	$64,807,000	$253,300,000
			Bobtail Swing	$31,500,000	$15,915,200	$ 125,981,000	$173,400,000	$5,202,000	$13,872,000	$20,808,000	$39,900,000	$213,282,000	$73,352,000	$286,700,000
			Bascule	$31,500,000	$15,915,200	$ 133,178,000	$180,600,000	$5,418,000	$14,448,000	$21,672,000	$41,600,000	$222,138,000	$76,397,000	$298,600,000
Broadway Bridge Feasibility Study - Construction Cost Matrix - Alignment B Estimates														
Crossing Configuration				Construction Cost				Support Cost						
Crossing Alignment	Crossing Width	Approach Span Type	Movable Span Type	Roadway	Approach Spans	Moveble Span	Subtotal	PA&ED (3%)	PS&E (8%)	Construction Support (12%)	Subtotal	TOTAL PROJECT COST (2015)	ESCALATION (3% ANNUALLY FOR 10-YEARS)	TOTAL PROJECT COST (2025)
B	2 Lane	Steel	Vertical Lift	$26,500,000	$13,200,000	$ 77,112,000	$116,900,000	$3,507,000	$9,352,000	$14,028,000	$26,900,000	$143,787,000	$49,451,000	$193,300,000
			Bobtail Swing	$26,500,000	$13,200,000	$ 73,947,000	$113,700,000	$3,411,000	$9,096,000	$13,644,000	$26,200,000	$139,851,000	$48,098,000	$188,000,000
			Bascule	$26,500,000	$13,200,000	$ 82,654,000	$122,400,000	$3,672,000	$9,792,000	$14,688,000	$28,200,000	$150,552,000	$51,778,000	$202,400,000
		Precast	Vertical Lift	$26,500,000	$10,208,000	$ 77,112,000	$113,900,000	$3,417,000	$9,112,000	$13,668,000	$26,200,000	$140,097,000	$48,182,000	$188,300,000
			Bobtail Swing	$26,500,000	$10,208,000	$ 73,947,000	$110,700,000	$3,321,000	$8,856,000	$13,284,000	$25,500,000	$136,161,000	$46,828,000	$183,000,000
			Bascule	$26,500,000	$10,208,000	$ 82,654,000	$119,400,000	$3,582,000	$9,552,000	$14,328,000	$27,500,000	$146,862,000	$50,509,000	$197,400,000
	Adaptable 2 Lane	Steel	Vertical Lift	$29,500,000	$15,675,000	$ 96,310,000	$141,500,000	$4,245,000	$11,320,000	$16,980,000	$32,600,000	$174,045,000	$59,857,000	$234,000,000
			Bobtail Swing	$29,500,000	$15,675,000	$ 101,266,000	$146,500,000	$4,395,000	$11,720,000	$17,580,000	$33,700,000	$180,195,000	$61,973,000	$242,200,000
			Bascule	$29,500,000	$15,675,000	$ 107,659,000	$152,900,000	$4,587,000	$12,232,000	$18,348,000	$35,200,000	$188,067,000	$64,680,000	$252,800,000
		Precast	Vertical Lift	$29,500,000	$12,122,000	$ 96,310,000	$138,000,000	$4,140,000	$11,040,000	$16,560,000	$31,800,000	$169,740,000	$58,377,000	$228,200,000
			Bobtail Swing	$29,500,000	$12,122,000	$ 101,266,000	$142,900,000	$4,287,000	$11,432,000	$17,148,000	$32,900,000	$175,767,000	$60,450,000	$236,300,000
			Bascule	$29,500,000	$12,122,000	$ 107,659,000	$149,300,000	$4,479,000	$11,944,000	$17,916,000	$34,400,000	$183,639,000	$63,157,000	$246,800,000
	4 Lane	Steel	Vertical Lift	$32,500,000	$20,212,500	$ 105,745,000	$158,500,000	$4,755,000	$12,680,000	$19,020,000	$36,500,000	$194,955,000	$67,049,000	$262,100,000
			Bobtail Swing	$32,500,000	$20,212,500	$ 125,981,000	$178,700,000	$5,361,000	$14,296,000	$21,444,000	$41,200,000	$219,801,000	$75,594,000	$295,400,000
			Bascule	$32,500,000	$20,212,500	$ 133,178,000	$185,900,000	$5,577,000	$14,872,000	$22,308,000	$42,800,000	$228,657,000	$78,639,000	$307,300,000
		Precast	Vertical Lift	$32,500,000	$15,631,000	$ 105,745,000	$153,900,000	$4,617,000	$12,312,000	$18,468,000	$35,400,000	$189,297,000	$65,103,000	$254,400,000
			Bobtail Swing	$32,500,000	$15,631,000	$ 125,981,000	$174,200,000	$5,226,000	$13,936,000	$20,904,000	$40,100,000	$214,266,000	$73,690,000	$288,000,000
			Bascule	$32,500,000	$15,631,000	$ 133,178,000	$181,400,000	$5,442,000	$14,512,000	$21,768,000	$41,800,000	$223,122,000	$76,736,000	$299,900,000

Table 1. Construction Cost Matrix

Broadway Bridge Feasibility Study - Construction Cost Matrix - Alignment C Estimates															
Crossing Configuration				Construction Cost				Support Cost							
Crossing Alignment	Crossing Width	Approach Span Type	Movable Span Type	Roadway	Approach Spans	Moveble Span	Subtotal	PA&ED (3%)	PS&E (8%)	Construction Support (12%)	Subtotal	TOTAL PROJECT COST (2015)	ESCALATION (3% ANNUALLY FOR 10-YEARS)	TOTAL PROJECT COST (2025)
C	2 Lane	Steel	Vertical Lift	$24,700,000	$13,200,000	$ 77,112,000	$115,100,000	$3,453,000	$9,208,000	$13,812,000	$26,500,000	$141,573,000	$48,690,000	$190,300,000
			Bobtail Swing	$24,700,000	$13,200,000	$ 73,947,000	$111,900,000	$3,357,000	$8,952,000	$13,428,000	$25,800,000	$137,637,000	$47,336,000	$185,000,000
			Bascule	$24,700,000	$13,200,000	$ 82,654,000	$120,600,000	$3,618,000	$9,648,000	$14,472,000	$27,800,000	$148,338,000	$51,016,000	$199,400,000
		Precast	Vertical Lift	$24,700,000	$10,208,000	$ 77,112,000	$112,100,000	$3,363,000	$8,968,000	$13,452,000	$25,800,000	$137,883,000	$47,421,000	$185,400,000
			Bobtail Swing	$24,700,000	$10,208,000	$ 73,947,000	$108,900,000	$3,267,000	$8,712,000	$13,068,000	$25,100,000	$133,947,000	$46,067,000	$180,100,000
			Bascule	$24,700,000	$10,208,000	$ 82,654,000	$117,600,000	$3,528,000	$9,408,000	$14,112,000	$27,100,000	$144,648,000	$49,747,000	$194,400,000
	Adaptable 2 Lane	Steel	Vertical Lift	$27,600,000	$15,675,000	$ 96,310,000	$139,600,000	$4,188,000	$11,168,000	$16,752,000	$32,200,000	$171,708,000	$59,054,000	$230,800,000
			Bobtail Swing	$27,600,000	$15,675,000	$ 101,266,000	$144,600,000	$4,338,000	$11,568,000	$17,352,000	$33,300,000	$177,858,000	$61,169,000	$239,100,000
			Bascule	$27,600,000	$15,675,000	$ 107,659,000	$151,000,000	$4,530,000	$12,080,000	$18,120,000	$34,800,000	$185,730,000	$63,876,000	$249,700,000
		Precast	Vertical Lift	$27,600,000	$12,122,000	$ 96,310,000	$136,100,000	$4,083,000	$10,888,000	$16,332,000	$31,400,000	$167,403,000	$57,573,000	$225,000,000
			Bobtail Swing	$27,600,000	$12,122,000	$ 101,266,000	$141,000,000	$4,230,000	$11,280,000	$16,920,000	$32,500,000	$173,430,000	$59,646,000	$233,100,000
			Bascule	$27,600,000	$12,122,000	$ 107,659,000	$147,400,000	$4,422,000	$11,792,000	$17,688,000	$34,000,000	$181,302,000	$62,353,000	$243,700,000
	4 Lane	Steel	Vertical Lift	$30,400,000	$20,212,500	$ 105,745,000	$156,400,000	$4,692,000	$12,512,000	$18,768,000	$36,000,000	$192,372,000	$66,160,000	$258,600,000
			Bobtail Swing	$30,400,000	$20,212,500	$ 125,981,000	$176,600,000	$5,298,000	$14,128,000	$21,192,000	$40,700,000	$217,218,000	$74,705,000	$292,000,000
			Bascule	$30,400,000	$20,212,500	$ 133,178,000	$183,800,000	$5,514,000	$14,704,000	$22,056,000	$42,300,000	$226,074,000	$77,751,000	$303,900,000
		Precast	Vertical Lift	$30,400,000	$15,631,000	$ 105,745,000	$151,800,000	$4,554,000	$12,144,000	$18,216,000	$35,000,000	$186,714,000	$64,215,000	$251,000,000
			Bobtail Swing	$30,400,000	$15,631,000	$ 125,981,000	$172,100,000	$5,163,000	$13,768,000	$20,652,000	$39,600,000	$211,683,000	$72,802,000	$284,500,000
			Bascule	$30,400,000	$15,631,000	$ 133,178,000	$179,300,000	$5,379,000	$14,344,000	$21,516,000	$41,300,000	$220,539,000	$75,847,000	$296,400,000
Broadway Bridge Feasibility Study - Construction Cost Matrix - Alignment D Estimates															
Crossing Configuration				Construction Cost				Support Cost							
Crossing Alignment	Crossing Width	Approach Span Type	Movable Span Type	Roadway	Approach Spans	Moveble Span	Subtotal	PA&ED (3%)	PS&E (8%)	Construction Support (12%)	Subtotal	TOTAL PROJECT COST (2015)	ESCALATION (3% ANNUALLY FOR 10-YEARS)	TOTAL PROJECT COST (2025)
D	2 Lane	Steel	Vertical Lift	$27,300,000	$13,800,000	$ 89,740,000	$130,900,000	$3,927,000	$10,472,000	$15,708,000	$30,200,000	$161,007,000	$55,373,000	$216,400,000
			Bobtail Swing	$27,300,000	$13,800,000	$ 95,887,000	$137,000,000	$4,110,000	$10,960,000	$16,440,000	$31,600,000	$168,510,000	$57,954,000	$226,500,000
			Bascule	$27,300,000	$13,800,000	$ 95,058,000	$136,200,000	$4,086,000	$10,896,000	$16,344,000	$31,400,000	$167,526,000	$57,615,000	$225,200,000
		Precast	Vertical Lift	$27,300,000	$10,672,000	$ 89,740,000	$127,800,000	$3,834,000	$10,224,000	$15,336,000	$29,400,000	$157,194,000	$54,062,000	$211,300,000
			Bobtail Swing	$27,300,000	$10,672,000	$ 95,887,000	$133,900,000	$4,017,000	$10,712,000	$16,068,000	$30,800,000	$164,697,000	$56,642,000	$221,400,000
			Bascule	$27,300,000	$10,672,000	$ 95,058,000	$133,100,000	$3,993,000	$10,648,000	$15,972,000	$30,700,000	$163,713,000	$56,304,000	$220,100,000
	Adaptable 2 Lane	Steel	Vertical Lift	$30,400,000	$16,387,500	$ 110,572,000	$157,400,000	$4,722,000	$12,592,000	$18,888,000	$36,300,000	$193,602,000	$66,583,000	$260,200,000
			Bobtail Swing	$30,400,000	$16,387,500	$ 137,114,000	$184,000,000	$5,520,000	$14,720,000	$22,080,000	$42,400,000	$226,320,000	$77,836,000	$304,200,000
			Bascule	$30,400,000	$16,387,500	$ 123,055,000	$169,900,000	$5,097,000	$13,592,000	$20,388,000	$39,100,000	$208,977,000	$71,871,000	$280,900,000
		Precast	Vertical Lift	$30,400,000	$12,673,000	$ 110,572,000	$153,700,000	$4,611,000	$12,296,000	$18,444,000	$35,400,000	$189,051,000	$65,018,000	$254,100,000
			Bobtail Swing	$30,400,000	$12,673,000	$ 137,114,000	$180,200,000	$5,406,000	$14,416,000	$21,624,000	$41,500,000	$221,646,000	$76,228,000	$297,900,000
			Bascule	$30,400,000	$12,673,000	$ 123,055,000	$166,200,000	$4,986,000	$13,296,000	$19,944,000	$38,300,000	$204,426,000	$70,306,000	$274,800,000
	4 Lane	Steel	Vertical Lift	$33,500,000	$21,131,250	$ 124,405,000	$179,100,000	$5,373,000	$14,328,000	$21,492,000	$41,200,000	$220,293,000	$75,763,000	$296,100,000
			Bobtail Swing	$33,500,000	$21,131,250	$ 151,177,000	$205,900,000	$6,177,000	$16,472,000	$24,708,000	$47,400,000	$253,257,000	$87,100,000	$340,400,000
			Bascule	$33,500,000	$21,131,250	$ 156,732,000	$211,400,000	$6,342,000	$16,912,000	$25,368,000	$48,700,000	$260,022,000	$89,426,000	$349,500,000
		Precast	Vertical Lift	$33,500,000	$16,341,500	$ 124,405,000	$174,300,000	$5,229,000	$13,944,000	$20,916,000	$40,100,000	$214,389,000	$73,732,000	$288,200,000
			Bobtail Swing	$33,500,000	$16,341,500	$ 151,177,000	$201,100,000	$6,033,000	$16,088,000	$24,132,000	$46,300,000	$247,353,000	$85,069,000	$332,500,000
			Bascule	$33,500,000	$16,341,500	$ 156,732,000	$206,600,000	$6,198,000	$16,528,000	$24,792,000	$47,600,000	$254,118,000	$88,000,000	$342,200,000

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 alignment's 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.

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 precast 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 both an environmental and hydraulic perspective. A steel superstructure is also lighter than an equivalent precast 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.

Movable Spans

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, multisteel 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 multisteel 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 $4,230 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 $3,336 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 through-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 (four-lane width) 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 four sets of drive machinery are required.

Planning-level estimates and review of historical unit costs indicated an approximate cost of $3,956 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.

Conclusion

The lowest movable cost option for the four-lane width is the vertical lift, and the bobtail swing is the lowest cost option for the two-lane width. Using the low-end and high-end selections, the total project costs could be as low as approximately $180 million or as high as $350 million. There are numerous different combinations of alignments, bridge types, and typical sections that will influence the project cost. Actual project cost will depend on what components are chosen to move forward with the project into final design and subsequent construction.