OKLAHOMA Transportation

CROSSROADS OF AMERICA:
BRIDGES ON I-40 OVER I-44 AND PORTLAND

APPENDIX B: BCA REPORT

BRIDGE INVESTMENT PROGRAM - BRIDGE GRANT APPLICATION

September 9, 2022

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Introduction

The Benefit-Cost Analysis (BCA) has been conducted for the *Crossroads of America: Bridges on I-40 over I-44 and Portland* (the Project) Bridge Investment Program (BIP) Bridge grant application. The BCA follows the USDOT's Benefit-Cost Analysis Guidance for Discretionary Grant Programs (2022, Revised), The following general parameters and assumptions were used in the BCA:

- A real discount rate of seven percent is applied to all costs and benefits except for carbon emissions reductions, which are discounted at three percent.
- A residual value is assumed at the close of the 25 years of operation, based on a full 50-year useful life of the build project, which includes four new bridges.
- The Project construction is assumed to commence in October 2024 and end in December 2026, with operation commencing in 2027 and extending to 2051.
- All costs and benefits are in 2020 dollars.
- The year 2020 was used as the base year for discounting; that is, 2020 is considered year zero for discounting.

Costs

Capital Cost

As shown in **Table 1**, previously incurred costs totaled $4.7 million, while future costs are estimated to total $83.5 million in 2022 dollars. Future costs are estimated based on 2022 bid prices. All costs are adjusted in the BCA to 2020 dollars; future costs have been de-escalated from 2022 dollars to 2020 dollars based on the 2020-2022 GDP Price Deflator from the US Bureau of Economic Analysis.

Table 1: Capital Costs (2022 $s)

Activity	Non-Federal Sources State Funds		Federal Funds		BIP Bridge Funds	Total Project Cost
	Incurred	Future	Incurred	Future		
Environmental & Engineering	$1,033,519	$0	$2,801,563	$0	$0	$3,835,082
Right-of-Way & Utilities	$183,975	$0	$735,896	$0	$0	$919,871
Construction	$0	$36,000,000	$0	$0	$36,000,000	$72,000,000
Construction Management	$0	$2,160,000	$0	$0	$2,160,000	$4,320,000
Contingency & Other	$0	$3,600,000	$0	$0	$3,600,000	$7,200,000
TOTALS	**$1,217,494**	**$41,760,000**	**$3,537,459**	**$0**	**$41,760,000**	**$88,274,953**

Activity	FY2023	FY2024	FY2025	FY2026	FY2027	Total
Pre-Construction	$0	$0	$0	$0	$0	$0
Right-of-Way	$0	$0	$0	$0	$0	$0
Construction	$0	$5,000,000	$36,000,000	$35,000,000	$7,520,000	$83,520,000
TOTALS	$0	$5,000,000	$36,000,000	$35,000,000	$7,520,000	$83,520,000

Source: ODOT

Operations and Maintenance Costs

Routine maintenance costs for the No-Build and Build scenarios are expected to be minor and offsetting. However, significant additional major maintenance and rehabilitation costs would be incurred under the No-Build scenario between 2024 and 2051. These are avoided costs and are included in the analysis as benefits.

Benefits

Six categories of benefits are captured in the BCA: life cycle cost savings, travel time savings, crash reduction benefits, fuel benefits, emission benefits, and freight logistics (supply chain) benefits. Economic benefits such as enhanced productivity (over and above those embodied in travel time savings) are not included. However, the overall improvements in regional accessibility may generate such agglomeration benefits.

Crash Reductions

Since the Project includes adding capacity (lanes), a significant share of the benefits anticipated will be due to reduced vehicular collisions. To estimate these likely impacts, a detailed data list of collisions that occurred throughout the Project area between the years 2012 and 2021 were collected by severity levels. Levels of severity were measured on a scale of one to five, including fatal crashes, injury crashes of three degrees of severity, and property damage-only crashes. For this Project, we are specifically focusing on a subset of crashes, judged to be most attributable to design or capacity constraints, namely rear end, roll over, sideswipes, and fixed objects. The total number of collisions is different from the collisions totals reported in the Supplemental Project Narrative as the BCA includes collision counts related to the design or capacity constraints. The collision types and counts are summarized in **Table 2**.

Table 2: Collisions by the Type

Type	Count
Property Damage Only	2,092
Injury (three degrees of severity)	715
Fatal	6
TOTAL	2,813

Source: ODOT

Based on these data and combined with Annual Average Daily Traffic (AADT) measured across the Project, crash rates were calculated (crashes per million AADT) and applied to ODOT's estimates of future project wide VMT. A baseline of total anticipated crashes without the proposed bridges was then calculated for the entire Project horizon of 25 years.

Next, the FHWA's Crash Modification Factor (CMF) database was researched to obtain the most applicable Crash Reduction Factor (CRF). This search yielded a most relevant CMF of 75 percent (and thus a CRF of 25 percent). The selected CMF/CRF is obtained from research involving the additional capacity of travel lanes. The relevant CMF was then applied to the future stream of

No-Build crashes (by category of severity) to obtain estimates of reduced annual crashes over the study period.

The Project will generate significant savings in the human costs of crashes. Over the 25 years, it is estimated that five lives will be saved, and another 560 injury crashes will also be avoided. The crash benefits are conservative as additional secondary crashes that occur outside of the Project area were not considered in benefits that can be attributed to this bottleneck of the Interstate. The BCA Excel spreadsheet crash reduction calculations are provided in **Appendix C**.

Life Cycle Cost Savings

As shown in **Table 3**, the No-Build vs. Build rehabilitation and maintenance costs to the year 2050 total $18,000,000 and $1,000,000, respectively. The No-Build scenario requires significant bridge rehabilitation and maintenance spending compared to replacing and rehabilitating the eight bridges.

Table 3: Major Rehabilitation and Maintenance Costs (2022 $s)

No-Build				Build	
Year	Rehab	Damage Repair	Total	Rehab	Total
2024	$0	$100,000	$100,000		
2025	$0	$0	$0		
2026	3,000,000	$0	$3,000,000		
2028	$0	$0	$0	$0	$0
2030	$0	$0	$0	$0	$0
2032	$0	$0	$0	$0	$0
2034	$0	$0	$0	$0	$0
2036	$0	$0	$0	$0	$0
2038	$0	$0	$0	$0	$0
2040	15,000,000	$0	$15,000,000	$0	$0
2042	$0	$0	$0	$0	$0
2044	$0	$0	$0	$0	$0
2046	$0	$0	$0	$0	$0
2048	$0	$0	$0	$0	$0
2050	$0	$100,000	$100,000	$1,000,000	$1,000,000
Total		**$18,200,000**		**$1,000,000**	

Source: ODOT

Travel Delay Savings

Travel delay savings are based on VISSIM traffic simulation runs conducted specifically for this grant application, by ODOT. The analysis discloses significant travel time benefits for autos and trucks. For this analysis, the VISSIM model runs were performed on the AM and PM peak hour, and additional savings were estimated for the adjacent two shoulder hours based on trip times observed in those shoulder periods relative to the peak hour. It was determined that on average, shoulder hours would experience about 63 percent of the delay observed during the peak of the peak hour. Hours saved were increased in future years based on projected AADT growth through the Project area.

Table 4 summarizes the total Vehicle Hours Traveled (VHT) savings in auto and truck hours over the 25 years of operation considered in the BCA. **Table 5** summarizes the total Person Hours Traveled (PHT) savings in auto passenger hours and truck hours over the 25 years of operation considered in the BCA.

Table 4: Cumulative VHT Savings Over 25 Years

Cumulative VHT Savings Over 25 Years	
Auto Vehicle Hours	3,140,025
Truck Hours	556,992

Source: ODOT

Table 5: Cumulative PHT Savings Over 25 Years

Cumulative PHT/Driver Operator Savings Over 25 Years	
Auto Passenger Hours	5,243,843
Truck Hours	556,992

Source: ODOT

Air Emissions Reductions

The VHT savings were used to estimate emissions reductions based on vehicle emissions rates per delay hour calibrated by the Indian Nations Council of Governments (INCOG) based on MOVES3 model runs. Emissions forecasts also assume significant growth in the electric vehicle (EV) share between 2022 and 2051. A consensus of reviewed EV market forecasts led to an assumption that the EV share would grow from the current level of about 2 percent to 40 percent by 2051. Because of the assumed growth in the EV share consistent in the No-Build and Build scenarios, and because the project results in no change in VMT, thus the emissions savings are relatively small over time.

Fuel Savings

Like emissions, fuel savings are based on assumed EV market penetration over time, as well as data relating to the differences in average miles per gallon (MPG) for gasoline-powered vehicles at different speeds. The No-Build speed would be approximately 10 miles per hour (MPH) slower than under the Build. Average trip lengths through the Project area are assumed to be about one mile, allowing an estimate of VMT through the Project area under different speeds

and associated MPG assumptions. As with air emissions, fuel savings are relatively small because of EV penetration and no net change in VMT. Moreover, average prices of motor fuels in Oklahoma in 2020 were lower than the national average, and prices net out motor fuel excise taxes.

Shipper/Logistics Cost Savings

The I-40/I-44 **i**nterchange is a major crossroad for local, regional, and long-distance trucking. The travel delay derived from the VISSIM runs was used to estimate the supply chain benefits of reducing truck delay. The hourly value of truck delay is based on prior NCHRP research relating to the economic impacts of freight delay (NCHRP Report 732, Methodologies to Estimate the Economic Impact of Disruptions to the Goods Movement System, 2012). Values in that report were updated to 2020 dollars.

Results

Based on the assumptions, methodology, and other information presented above, the Project yields a Benefit-Cost Ratio of 1.59 and a Net Present Value of $30.7 million (**Table 6**). The preponderance of benefits are from travel time savings, crash reductions, with smaller but still significant shares due to supply chain benefits, and Life Cycle savings.

Table 6: BCA Results

BCA Results	
Discounted Costs	**Present Value**
Build Capital Costs	$56,847,111
Residual Value of 25 Years	-$4,701,088
Net Capital Costs	**$52,146,023**
Discounted Benefits	
Maintenance and Rehab (Life Cycle) Cost Savings	$5,833,371
Value of Travel Time Savings	
Auto	$27,971,973
Truck	$5,341,371
VOC (Fuel) Saving	$397,523
Value of Crash Reductions	$37,251,619
Value of Emissions Reductions	
CO2	$1,164,424
Other Emissions	$79,723
Freight Supply Chain (Logistics) Savings	$4,771,319
Total Discounted Benefits	**$82,811,324**
Summary	
Benefit-Cost Ratio	1.59
Net Present Value	$30,665,301
Share of Benefits by Type	
Life Cycle Cost Savings	7%
Value of Travel Time Savings	40.2%
VOC (Fuel) Savings	0.5%
Value of Crash Reductions	45.0%
Value of Emissions Reductions	1.5%
Freight Supply Chain (Logistics) Savings	5.8%

Source: EBP