OKLAHOMA
Transportation

I-40 and SH-100 Bridge Replacement Bundle at Webbers Falls

Benefit-Cost Analysis Technical Memorandum

Bridge Investment Program—
Large Bridge Project Grants
Opportunity # 693JJ323NF00019
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Table of Contents

Table of Figures

List of Tables

1 Introduction

This technical memorandum describes the results of the benefit-cost analysis (BCA) that was conducted for the I-40 and SH-100 Bridge Replacement Bundle at Webbers Falls (the Project) conducted for Oklahoma Department of Transportation's (ODOT) application for funding under the Fiscal Year (FY) 2026 Bridge Investment Program (BIP). ODOT is requesting funding to replace the Interstate 40 (I-40) bridge and State Highway 100 (SH-100) bridge over the Arkansas River. The bridges span from Muskogee County (western terminus) and Sequoyah County (eastern terminus) in eastern Oklahoma. Both bridges are considered fracture critical and do not meet ODOT's current geometric design standards. The bridges support Oklahoma's local and regional economy, serving as a crucial connector for freight and passenger vehicles. The realization of the Project will deliver an array of benefits to ODOT as well as to freight operators and passenger vehicles that traverse I-40 and SH-100 for business, personal travel, and other recreational purposes. Figure 1 shows the Project location map.

Figure 1: Project Location

1.1 Project Understanding

The Project seeks to replace both the I-40 and SH-100 bridges over the Arkansas River. The I-40 and SH-100 bridges are fracture-critical, meaning they are more susceptible to collapsing than other types of bridges because they do not have redundant structural elements to compensate for load bearing in areas where multiple cracks exist.

Both bridges are reaching the end of their design lives. I-40 was constructed in 1967 and completed in 1968 while SH-100 was constructed in 1969. Both bridges serve as important east-west connectors over the Arkansas River in southeastern Oklahoma, accommodating an average annual daily traffic (AADT) count of 19,800 vehicles on I-40 bridge and 3,700 vehicles on SH-100 in 2024 in 2024.[1] Over the past 10 years, both bridges have seen a steady increase in traffic, with I-40 AADT increasing by 1.3-percent annually and SH-100 growing at 1.1-percent annually. Truck traffic makes up 36-percent of I-40 traffic, and 15-percent of SH-100 traffic.

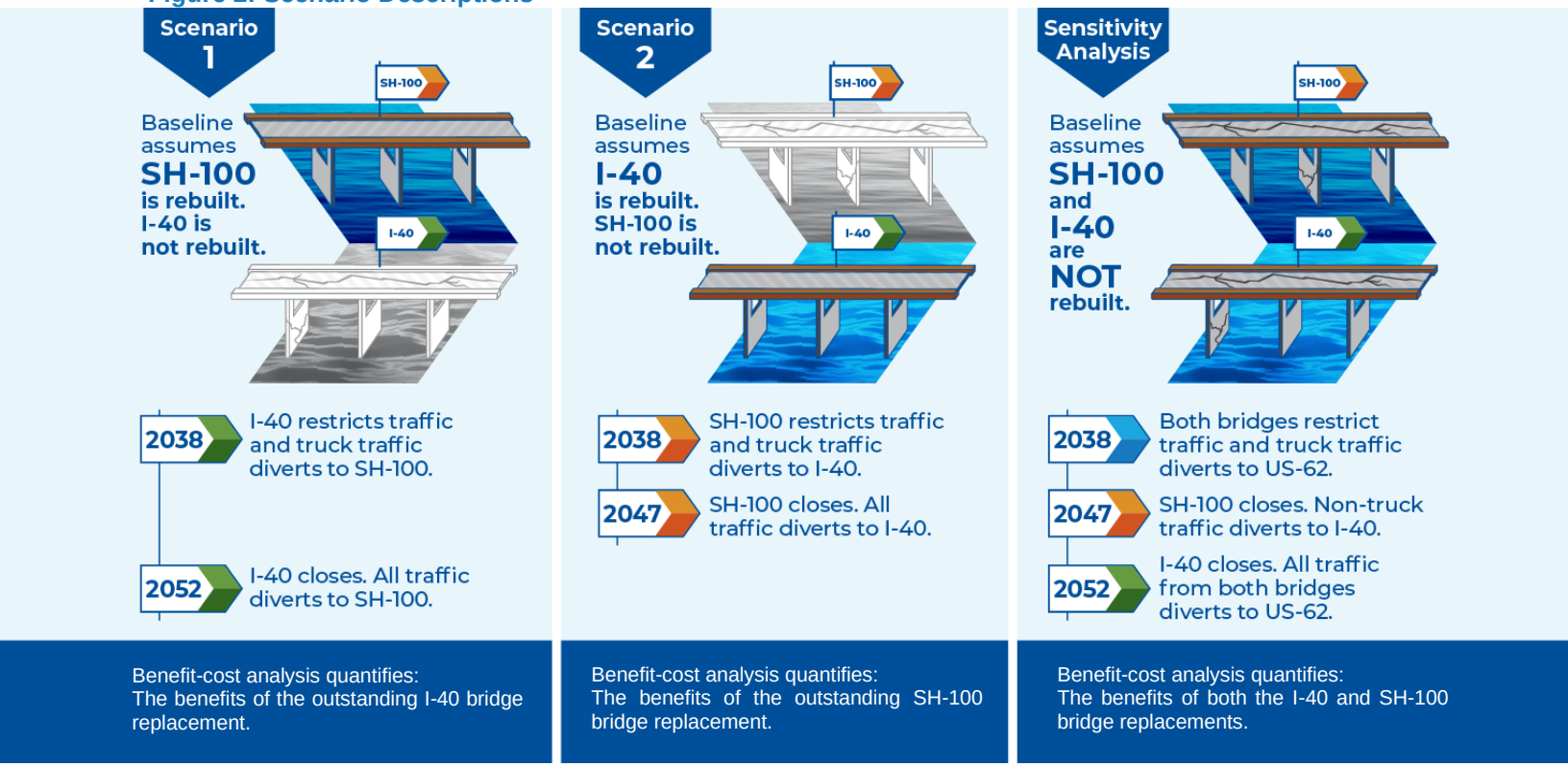
Since both bridges are only four miles apart, I-40 and SH-100 serve as critical relief routes for one another. The realization of the Project will therefore continue to provide reliable connectivity over the Arkansas River for Muskogee and Sequoyah counties, delivering benefits to ODOT and passengers that traverse the I-40 and SH-100 bridges for business, personal travel, and other recreational purposes.

1.1.1 Project Baseline Condition

To assess the economic benefits of the Project, the baseline condition, where the Project does not exist must be defined and compared to the build condition, where the Project is implemented. The baseline and build conditions are defined in the subsequent sections. Economic benefits are derived by comparing the conditions under the build condition to the baseline. The analysis quantifies the benefits for the following three scenarios, described in Figure 2**Error! Reference source not found.**, and further detailed in the following sections. Because the Project includes the replacement of two bridges, the benefits of each of them are calculated independently in Scenarios 1 and 2, respectively. Recognizing that both the I-40 and SH-100 bridges are both in need of repair, the Sensitivity quantifies the benefits of the bundled Project.

[1] Average Annual Daily Traffic Counts 2014-2024, Oklahoma Department of Transportation.

Figure 2: Scenario Descriptions



1.1.1.1 Scenario 1 Baseline Condition (I-40 benefits)

At present, I-40 has a bridge condition rating of 6 (satisfactory) for the deck, superstructure, and the substructure. The baseline or no build condition assumes the Project will not be constructed, and the I-40 bridge will continue operating with increasing likelihood of becoming structurally deficient. Due to the presence of NSTM main span girders, lapsed fatigue life, and historical precedence, the I-40 bridge over the Arkansas River has a high likelihood of becoming structurally deficient. Fatigue cycles are driven by the amount of heavy truck traffic that uses the structure daily. Given that this structure is a major stream crossing on I-40, the fatigue cycles it receives are staggering. Absent the Project, the condition of the bridge will continue to move into a 'serious, critical, or imminent failure' inspection rating. Per FHWA's National Bridge Inspection Standards, a condition rating of 3 necessitates more interventions such as frequent monitoring and significant load restrictions.[1]

Absent the Project, ODOT anticipates that bridge conditions will warrant the need to post load limits that restrict truck access by 2038, at which time, freight truck traffic will have to detour four miles north to connect with SH-100. Due to continued deterioration, I-40 would reach a condition rating of 2 by 2052, requiring ODOT close the bridge to all traffic. All I-40 traffic would detour north to SH-100, adding approximately four miles and eight minutes of travel time for diverted trucks and passenger vehicles. Figure 3 displays the detour route following the closure of the I-40 bridge. This scenario assumes ODOT has previously invested in the replacement of SH-100, allowing the bridge to safely accommodate all traffic diversions from I-40.

Figure 3: Detour Route Following Closure of I-40

1.1.1.2 Scenario 2 Baseline Condition (SH-100 benefits)

SH-100 has a condition rating of 6 (satisfactory) for the deck, 5 for the superstructure, and 6 for the sub-structure. Per the National Bridge Inventory (NBI) database, traffic will grow 2.4-percent annually up to 2040. Due to the urgency of addressing defects as a fracture-critical bridge, SH-100 is currently on ODOT's annual inspection schedule as it approaches the end of its intended useful life. The existing bridge is considered narrow, with 11-foot driving lanes and 3-foot-wide outside shoulders. The bridge is also at risk of becoming structurally deficient. By replacing the bridge, the Project will avoid any costs associated with the deteriorating structural conditions of the existing bridge and add substandard functional aspects for improved safety. The Project will replace the bridge with a wider section, featuring 12-foot driving lanes as well as 8-foot-wide outside shoulders going in each direction. The Project will also reduce the existing bridge's 15 spans in half and implement the use of a 42-inch-tall railing to further increase safety. Absent the Project, ODOT will post load limits on SH-100 that restrict truck access by 2038, requiring trucks to detour 4 miles and 8 minutes south to I-40. In 2047, ODOT will close all vehicles from SH-100, diverting all traffic to I-40. This scenario assumes ODOT has previously invested in the replacement of I-40, allowing the bridge to safely accommodate all traffic diversions from SH-100.

1.1.1.3 Sensitivity Analysis Baseline Condition (I-40 and SH-100 benefits)

Recognizing that absent investment, both the I-40 and SH-100 bridges are expected to close by 2052 and 2047, respectively. The sensitivity analysis highlights the extent of travel impacts associated with the closures of both I-40 and SH-100. The sensitivity analysis considers a baseline in which both I-40 and SH-100 will reach a bridge condition rating of 3 by 2038, requiring all trucks to detour from both bridges. As I-40 and SH-100 serve as relief routes for each other and are no longer a viable option, truck traffic will divert 50 miles north adding up to one hour of travel time to connect to Highway 351, US-62, and Highway 10 to connect back to SH-100 or I-40. In 2047, SH-100 will close to all traffic, detouring passenger vehicles to I-40, up until 2052 when I-40 will shut down to all traffic. As a result, passenger vehicles will also detour 50 miles north, adding up to one hour of travel time for passengers using this route.

Figure 4 displays the detour route for traffic when both I-40 and SH-100 are closed to truck traffic and all traffic.

Figure 4: Detour Route Following Closure of I-40 and SH-100

1.1.2 Project Build Condition

ODOT will replace the existing I-40 bridge to include raising the current 33-inch railing to 42-inches (the minimum standard above deck) and widening the shoulder to accommodate a 4-foot wide inside shoulder, two 12-foot-wide driving lanes, and a 10-foot-wide outside shoulder lane on each side of the median barrier located at the centerline of the bridge. The new bridge will be constructed to ODOT's design standards, resulting in a service life of over 75 years, resulting in a more sustainable and resilient transportation network.

The proposed improvements for SH-100 consist of replacing the existing bridge with a 40-foot wide clear roadway bridge on the existing alignment. The roadway will consist of two 12 feet wide driving lanes and 8-foot wide outside shoulders. Modern 42-inch tall railing will be incorporated to increase safety.

Table 1 displays the Project matrix that summarizes the baseline problem to be addressed, the change in baseline from the Project, and the Project benefits for each respective scenario. The benefits are reflective of the BCA Tool's summary of benefits categories and are organized in accordance with the criteria listed in the Notice of Funding Opportunity (NOFO).

Table 1: Project Matrix

<table>
<tr><th>Baseline Problem to be Addressed</th><th>Change in Baseline</th><th>Benefits Category</th><th>Description</th><th>Affected Population</th></tr>
<tr><td rowspan="11">Scenario 1: By 2038, the I-40 bridge will decline to an overall condition rating of 3, which per FHWA’s National Bridge Inspection Standards requires significant interventions such as frequent monitoring and substantial load restrictions. ODOT will restrict truck traffic on I-40 beginning in 2038, requiring trucks to detour four miles north to SH-100. By 2052, ODOT will close the bridge to all I-40 traffic, requiring all passenger vehicles to detour to SH-100. This scenario assumes I-40 will be reconstructed and can accommodate the additional detour traffic from SH-100.

Scenario 2: By 2038, SH-100 will fall to an overall condition rating of 3, which will result in load restrictions and truck detours under FHWA standards. ODOT will post load limits, requiring all truck traffic to detour four miles south to I-40. By 2047, SH-100 will close to all vehicles, requiring all passenger vehicles to detour to I-40. This scenario assumes SH-100 will be reconstructed and can accommodate the additional detour traffic from I-40.

Sensitivity Analysis: In this scenario, SH-100 and I-40 will post load limits to trucks, requiring trucks to detour in 2038. Since both bridges are unable to accommodate truck traffic, trucks will have to detour 48 miles north to US 62. In 2047 SH-100 will close to all traffic, requiring passenger vehicles to detour to I-40 up until I-40’s closure in 2052. All passenger vehicles will require detouring 48 miles north to US 62 adding up to 55 minutes of travel time.</td><td rowspan="11">ODOT will replace the existing I-40 bridge to include raising the current 33-inch railing to 42-inches (the minimum standard above deck) and widening the shoulder to accommodate a 4-foot wide inside shoulder, two 12-foot-wide driving lanes, and a 10-foot-wide outside shoulder lane on each side of the median barrier located at the centerline of the bridge. The new bridge will be constructed to ODOT’s design standards, resulting in a service life of over 75 years, resulting in a more sustainable and resilient transportation network.

The proposed improvements for SH-100 consists of replacing the existing bridge with 40 ft. wide clear roadway bridge on the existing alignment. The roadway will consist of two 12 ft. wide driving lanes and 8 ft. wide outside shoulders. Modern 42” tall railing will be incorporated to increase safety.</td><td colspan="3">State of Good Repair</td></tr>
<tr><td>Maintenance</td><td>Difference in O&M costs between baseline and build</td><td rowspan="2">ODOT, taxpayers</td></tr>
<tr><td>Residual Value</td><td>Useful service life of that asset remaining after the conclusion of the period of analysis</td></tr>
<tr><td colspan="3">Safety and Mobility</td></tr>
<tr><td>Safety</td><td>• Reduction in vehicle crashes from VMT avoided
• Increase in vehicle accidents from construction activities on I-40 (scenario 1 and scenario 3 only)</td><td>Roadway users</td></tr>
<tr><td colspan="3">Economic Competitiveness and Opportunity</td></tr>
<tr><td>Travel Time</td><td>Time savings from detours avoided and vehicle delays on I-40 due to construction (scenario 1 and scenario 3 only)</td><td rowspan="2">Roadway users</td></tr>
<tr><td>Vehicle Operating Cost (VOC)</td><td>Savings in VOC from VMT avoided</td></tr>
<tr><td colspan="3">Sustainability, Resilience, and the Environment</td></tr>
<tr><td>CO2 Emissions</td><td>CO2 savings from VMT avoided</td><td rowspan="3">Roadway users, Muskogee and Sequoyah counties</td></tr>
<tr><td>Non-CO2 Emissions</td><td>SOX, PM2.5, and NOX savings from VMT avoided</td></tr>
<tr><td>Other Environmental</td><td>Congestion and noise reduction from VMT avoided</td></tr>
<tr><td>Total Benefits</td><td></td><td></td></tr>
</table>

2 Benefits Analysis Framework and Assumptions

The BCA is conducted in accordance with the United States Department of Transportation (USDOT) Federal Highway Administration (FHWA) BIP BCA Tool (BCA Tool).[2] The analysis summarizes findings using the standard factors and values provided in the BCA Tool except in cases where more Project-specific values or prices are available. In all such cases, modifications are noted, and references are provided for data sources. The BCA Tool, last updated in December 2023, uses values obtained from the USDOT BCA Guidance for Discretionary Grant Programs, dated January 2024.

The analysis applies a construction period between Quarter (Q) 4 2027 to Q2 2030 for I-40 and a construction period between Q2 2030 to Q4 2032 for SH-100. All scenarios are evaluated within a 30-year analysis period of between Q3 2030 to Q3 2060 for I-40 and the full year of 2033 to 2062 for SH-100.

Per the BCA Tool, all values are in 2022 dollars, which avoids forecasting future inflation and escalating future values for benefits and costs accordingly. In instances where assumptions or cost estimates were expressed in dollar values for other years, the analysis applies the Chained Price Index information from the White House Office of Management and Budget's Gross Domestic Product and Deflators (GDP deflator) to bring these values to 2022-dollar figures.[3] The use of constant dollar values requires the use of a real discount rate for discounting to the present value. The analysis summarizes all costs and benefits in 2022 dollars using a 3.1 percent discount rate, consistent with the BCA tool. The detailed analysis for the components of the Project is included in the 'ODOT_BIP_BCA_Tool' workbook.

The BCA converts potential gains (benefits) and losses (costs) with the Project into monetary units and compares them. The following common benefit-cost evaluation measures are included in this BCA:

- Net Present Value (NPV): NPV compares the net benefits (benefits minus costs) after being discounted to present values using the real discount rate assumption. The NPV provides a perspective on the overall dollar magnitude of cash flows over time in today's dollar terms.
- Benefit Cost Ratio (BCR): The evaluation also estimates the benefit-cost ratio; the present value of incremental benefits is divided by the present value of incremental costs to yield the benefit-cost ratio. The BCR expresses the relation of discounted benefits to discounted costs as a measure of the extent to which a project's benefits either exceed or fall short of the costs.

2.1 Sensitivity Analysis

The analysis conducts the sensitivity analysis in the BCA Tool in four sections;

- Benefits from truck detours avoided when both I-40 and SH-100 post load limits in 2038, requiring trucks to detour 48 miles north to US 62;
- Benefits from passenger vehicle detours avoided when SH-100 closes in 2047, requiring vehicles to detour four miles south to I-40;
- Benefits associated with the detours avoided from the closure of I-40 in 2052, requiring all passenger vehicles to detour 48 miles north to US 62; and

[2] Bridge Investment Program Benefit-Cost Analysis Tool. Accessed https://www.fhwa.dot.gov/bridge/bip/bca/.
[3] White House Office of Management and Budget. Historical Tables, Table 10.1 – Gross Domestic Product and Deflators Used in the Historical Tables 1940-2027. Accessed from https://www.whitehouse.gov/omb/budget/historical-tables/

- The costs of construction and O&M of SH-100 and I-40.

3 Benefits Methods

Most project benefits are derived from changes in vehicle miles traveled (VMT) and vehicle hours traveled (VHT). The analysis uses ODOT's Annual Average Daily Traffic (AADT) County Site Locations dataset to develop traffic forecasts. The analysis uses the compound annual growth rate (CAGR) for I-40 and SH-100 traffic counts between 2014 and 2024, the latest data available for all years, to extrapolate traffic for the analysis period. The analysis uses a CAGR of 1.3 percent on I-40 and 1.1 percent on SH-100 over the analysis period. Since ODOT's traffic counts are representative of total traffic, the analysis uses ODOT's National Bridge Inspection Reports truck traffic factors for I-40 of 36-percent and SH-100 of 15-percent to breakdown traffic by vehicle type.

The analysis applies the traffic counts from Table 2 to the BCA Tool to estimate the benefits associated with VMT and VHT avoided for all scenarios. The analysis inputs daily traffic counts and uses the BCA Tool's default annualization factor of 365 days to annualize traffic. The analysis factors half of traffic on I-40 for the first and last year of the analysis period to account for the half-year benefits associated with the opening of the I-40 bridge in Q3 2030.

Table 2: AADT on I-40 and SH-100 over analysis period

	I-40		SH-100	
Calendar Year	Passenger Vehicles	Trucks	Passenger Vehicles	Trucks
2030	6,900*	3,900*	-	-
2031	13,900	7,800	-	-
2032	14,100	7,900	-	-
2033	14,300	8,000	3,300	600
2034	14,500	8,100	3,400	600
2035	14,700	8,200	3,400	600
2036	14,900	8,400	3,500	600
2037	15,100	8,500	3,500	600
2038	15,300	8,600	3,500	600
2039	15,500	8,700	3,600	600
2040	15,700	8,800	3,600	600
2041	15,900	8,900	3,600	600
2042	16,100	9,000	3,700	600
2043	16,300	9,200	3,700	700
2044	16,500	9,300	3,800	700
2045	16,700	9,400	3,800	700
2046	17,000	9,500	3,800	700
2047	17,200	9,700	3,900	700
2048	17,400	9,800	3,900	700
2049	17,600	9,900	4,000	700
2050	17,900	10,100	4,000	700
2051	18,100	10,200	4,000	700
2052	18,400	10,300	4,100	700
2053	18,600	10,500	4,100	700

	I-40		SH-100	
Calendar Year	Passenger Vehicles	Trucks	Passenger Vehicles	Trucks
2054	18,900	10,600	4,200	700
2055	19,100	10,700	4,200	700
2056	19,400	10,900	4,300	800
2057	19,600	11,000	4,300	800
2058	19,900	11,200	4,400	800
2059	20,100	11,300	4,400	800
2060	10,200*	5,700*	4,400	800
2061	-	-	4,500	800
2062	-	-	4,500	800
2063	-	-	4,600	800

Note: Rounded to the nearest hundred

*Represents traffic for half a year due to Project opening in Q3 2030

Under Scenario 1 and Scenario 3, construction of the I-40 bridge will result in the closure of two out of four lanes to accommodate repair work. Table 3 summarizes the AADT over the I-40 bridge during the construction period (Q4 2027 to Q2 2030) that will be impacted by the four-mile construction zone.

Table 3: AADT on I-40 Bridge During Construction

Year	AADT on I-40 Bridge Construction Zone	
	Passenger Vehicles	Trucks
2027 (Q4)	3,300	1,900
2028	13,400	7,500
2029	13,500	7,600
2030 (Q1-Q2)	6,900	3,900
Total	**37,100**	**20,900**

Note: Rounded to the nearest hundred

4 Benefits Analysis

The benefits are organized in accordance with the criteria listed in the Notice of Funding Opportunity (NOFO) and BIP BCA tool, which include:

- State of Good Repair
- Safety and Mobility
- Economic Competitiveness and Opportunity
- Sustainability, Resiliency, and the Environment
- Quality of Life

4.1 State of Good Repair

The benefits derived under State of Good Repair include:

- Maintenance
- Residual Value

4.1.1 Maintenance

The implementation of the Project will result in significant operations and maintenance (O&M) cost savings for ODOT while also bringing I-40 and SH-100 from a critical condition to a state of good repair. Absent the Project, ODOT will have to continuously allocate funds towards maintenance and repairs until the closure of I-40 in 2052 and SH-100 in 2047. These O&M costs include:

- Annual O&M costs
- Biannual special inspection costs
- Biannual NBI and NSTM inspection costs
- Under water inspection costs (every five years)
- Rehabilitation

Under the build condition, implementation of the Project will require recurring O&M throughout the analysis period for both I-40 and SH-100, which includes special inspections and NBI and NSTM inspections every two years, as well as under water inspections every five years.

The BCA Tool takes the difference between the no build cost and build annual cost to calculate total O&M costs avoided over the 30-year analysis period, which amounts to $19.6 million (2022$) for Scenario 1, $7.8 million (2022$) for Scenario 2, and $27.4 million (2022$) for the sensitivity analysis, all discounted at 3.1 percent over the 30-year analysis period.

4.1.2 Residual Value

The residual value of a capital investment is the useful service life of that asset which is remaining after the conclusion of the period of analysis. The BCA Tool calculates residual value by determining the percent of useful life remaining beyond the analysis period and multiplying that value by the associated construction cost. The analysis assumes a useful life of 75 years based on design industry standards for similar bridges. The total residual value over the 30-year analysis period for amount to $17.6 million (2022$) for Scenario 1, $6.6 million (2022$) for Scenario 2, and $23.6 million (2022$) for the sensitivity analysis, all discounted at 3.1 percent over the 30-year analysis period.

4.2 Safety and Mobility

Safety benefits for each scenario are derived due to VMT avoided for trucks and passenger vehicles. The benefits derived under Safety and Mobility include:

- Safety from reduced roadway fatalities and crashes

This section also presents disbenefits associated with increased roadway fatalities and crashes for passenger vehicles and trucks resulting from the lack of a center median during the construction period for the I-40 bridge. The analysis applies these disbenefits to Scenario 1 and Scenario 3.

4.2.1 Safety

The Project will result in VMT avoided for each scenario, resulting in reduced personal vehicle accidents and fatalities. The analysis uses the BIP Tool to monetize the value of accidents avoided by calculating the accident rate per mile multiplied by the monetized value per crash type and VMT avoided. The analysis sources accident rates from ODOT's 2021 Crash Data

for Sequoyah County (the latest data available) from Table 4 and divides by 100 million to derive accident rate per mile.

Table 4: Sequoyah County Crash Rate per 100 million VMT

Crash Type	Crash Rate per 100 million VMT
Fatal Crashes	1.6
Injury Crashes	25.9
Property Damage Only (PDO) Crashes	81.9

The analysis captures the additional safety benefits associated with the shoulder widening on both I-40 and SH-100. The analysis applies a crash modification factor (CMF) to estimate the reduction in vehicle accidents associated with wider shoulders. According to the FHWA CMF Clearinghouse, a CMF is a multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure at a specific site; CMFs are generally used to calculate the reduction in the expected number of crashes after implementing a countermeasure on a road or intersection. The analysis applies a CMF of 0.95 from the CMF Clearing House to the BCA Tool to calculate the total accidents reduced over the analysis period.

Scenario 1 and the sensitivity analysis 3 will also result in safety disbenefits during construction activities for I-40 that are scheduled to occur between Q4 2027 to Q2 2030. During construction, the existing I-40 bridge will operate in partial capacity, with one lane of traffic operating in each direction. As such, there will not be a center median separating bi-directional traffic through the duration of the four-mile construction zone.

Center medians provide significant safety benefits by reducing the risk of head on collisions and accidents. The analysis utilizes a CMF of 0.29 for center medians from the CMF Clearing House. During construction, the Project will temporarily remove the center median counter measure, resulting in a 29 percent likelihood increase in crashes due to the construction of the I-40 bridge. The analysis applies the CMF of 29 percent to the BCA Tool to calculate the increase in accidents from the temporary removal of the center median.

The BCA Tool summarizes safety benefits as the net value between the reduction in vehicle accidents associated with VMT avoided and the increase in accidents associated with construction activities (for Scenario 1 and the sensitivity analysis). The total value of safety benefits amounts to $71.0 million (2022$) for Scenario 1, $30.1 million (2022$) for Scenario 2, and $1,145.3 million (2022$) for the sensitivity analysis, all discounted at 3.1 percent over the 30-year analysis period.

4.3 Economic Competitiveness and Opportunity

The benefits derived under Economic Competitiveness and Opportunity for each scenario include:

- Travel time
- Vehicle operating cost (VOC)

In addition, the Project will result in travel time disbenefits during construction activities.

4.3.1 Travel Time

The Project will reduce travel time from detours avoided for each scenario. The analysis uses the BCA Tool's default calculation to estimate additional detour time per vehicle by dividing the

detour length to the detour average speed in miles per hour (mph). Table 5 summarizes the average detour length, speed, and associated additional detour time per vehicle. The BCA Tool calculates travel time savings by multiplying the additional detour time to the annual traffic per scenario for trucks and passenger vehicles over the 30-year analysis period.

Table 5: Average detour travel time per vehicle

Scenario	Vehicle Type	Time Period	Detour Length (miles)	Detour Speed (mph)	Additional detour time (minutes)
1. I-40 is rebuilt (SH-100 is not rebuilt)	Trucks	2038	4	55	8
	Passenger vehicles	2047	4	55	8
2. SH-100 is rebuilt (I-40 is not rebuilt)	Trucks	2038	8	66	9
	Passenger vehicles	2052	8	66	9
3. Sensitivity Analysis	Trucks	2038	48	66	52
	SH-100 passenger vehicles	2047	8	66	9
	Passenger vehicles	2052	48	66	52

The BCA Tool further calculates travel time disbenefits resulting from the additional travel time passenger vehicles and trucks will incur during the construction of the new I-40 bridge. Construction of the Project is set to begin in Q4 2027 and end in Q2 2030. During this period, the I-40 bridge will close one lane in both directions, increasing travel time for passenger vehicles and trucks crossing the bridge. The lane reductions will be accompanied by a construction work zone of 4 miles, reducing free flow speed by 78 percent.[4] The analysis calculates the vehicle delay minutes by taking the difference between the free flow speed of 55 mph and the construction zone speed of 43 mph to construction length of 4 miles for the I-40 bridge. This speed limit reduction will lead to an additional travel time for both passenger vehicles and trucks over the I-40 bridge.

The BCA Tool summarizes travel time benefits as the net value between the reduction in travel time associated with detours avoided and the increase in travel time associated with construction activities. The BCA Tool applies the default value of time of $33.50 (2022$) for trucks and $19.60 (2022$) for passenger vehicles to monetize travel time savings. The total travel time savings amounts to $146.8 million (2022$) for Scenario 1, $17.9 million (2022$) for Scenario 2, and $2,408.3 million (2022$) for the sensitivity analysis, all discounted at 3.1 percent over the 30-year analysis period.

4.3.2 Vehicle Operating Costs Avoided

When a driver uses their vehicle, there are vehicle operating costs (VOC) associated with that wear and tear. Per the BCA Guidance, vehicle operating costs include gasoline, maintenance, tires, and depreciation. The Project will result in VMT avoided for each scenario, resulting in VOC avoided. The BCA Tool calculates VOC by applying the annual VMT avoided for Scenario 1, Scenario 2, and Scenario 3 to the default value of VOC of $0.52 (2022$) per mile for passenger vehicles and $1.32 (2022$) per mile for trucks to monetize vehicle operating costs

[4] Understanding the Impacts of Work Zone Activities on Traffic Flow Characteristics, 2018. Accessed https://publications.iowa.gov/27272/1/Final%20Report_work_zone_activity_traffic_flow_impacts_w_cvr.pdf.

avoided. The total VOC avoided amounts to $235.2 million (2022$) for Scenario 1, $67.6 million (2022$) for Scenario 2, and $3,516.5 million (2022$) for the sensitivity analysis, all discounted at 3.1 percent over the 30-year analysis period.

4.4 Sustainability, Resiliency, and the Environment

Sustainability, Resilience, and the Environment outcomes capture the benefits of decreased in emissions associated with vehicle miles from personal vehicles and trucks avoided under the no-build scenario. The benefits derived under Sustainability, Resiliency, and the Environment include:

- Non-CO2 Emissions
- CO2 Emissions
- Other Environmental

4.4.1 Non-CO2 Emissions Avoided

The Project will result in the reduction of volatile organic compounds (VOC), nitrous oxide (NOx), particulate matter (PM2.5), sulfur oxides (SOX) associated with each scenario's reduction in VMT. The BCA Tool calculates non-CO2 emissions avoided by multiplying the VMT avoided for each scenario to the BCA Tool's default emissions rates per mile. The BCA Tool sources emissions rates from the EPA's MOtor Vehicle Emission Simulator (MOVES) to estimate non-CO2 emissions outputs per mile over the 30-year analysis period for passenger vehicles and trucks. The total non-CO2 emissions avoided amounts to $6.6 million (2022$) for Scenario 1, $1.3 million (2022$) for Scenario 2, and $130.3 million (2022$) for the sensitivity analysis, all discounted at 3.1 percent over the 30-year analysis period.

4.4.2 CO2 Emissions Avoided

The Project will result in the reduction of carbon dioxide (CO2) associated with each scenario's reduction in VMT. The BCA Tool calculates non-CO2 emissions avoided by multiplying the VMT avoided for each scenario to the BCA Tool's default emissions rates per mile from MOVES to estimate CO2 emissions outputs per mile over the 30-year analysis period for passenger vehicles and trucks. The total CO2 avoided amounts to $68.1 million (2022$) for Scenario 1, $18.7 million (2022$) for Scenario 2, and $1,094.0 million (2022$) for the sensitivity analysis, all discounted at 2.0 percent over the 30-year analysis period.

4.4.3 Other Environmental

The Project will result in VMT avoided for each scenario, resulting in the reduction of congestion and noise. The BCA Tool estimates the benefits from congestion and noise by multiplying VMT avoided for each scenario to the rural congestion cost of $0.08 (2022$) per mile for trucks and $0.03 per mile for personal vehicles to monetize the marginal social costs of congestion avoided and noise costs of $0.004 (2022$) per mile for trucks and $0.0002 (2022$) per mile. The total other environmental costs avoided amount to $0.6 million (2022$) for Scenario 1, $0.1 million (2022$) for Scenario 2, and $7.8 million (2022$) for the sensitivity analysis, all discounted at 3.1 percent over the 30-year analysis period.

5 Cost Analysis

The Project has two cost components: the capital costs for the I-40 and SH-100 bridge and ongoing O&M costs of both bridges. The Project capital costs include design and construction

of roadway and bridge components, as well as costs associated with mobilization and traffic control. The analysis applies capital costs in the BCA Tool in 2022 dollars with an annual escalation factor of 3 percent. Table 6 summarizes the costs associated with each scenario in the baseline and build condition. Since the BCA Tool is limited to applying costs for the build scenario and not under the baseline condition, the analysis only applies the net cost to the BCA Tool.

Table 6: Costs in Baseline and Build Condition

Scenario	Baseline Capital Cost	Build Capital Cost	Capital Cost in BCA Tool
1	Construction of SH-100	Construction of SH-100 Construction of I-40	Construction of I-40
2	Construction of I-40	Construction of I-40 Construction of SH-100	Construction of SH-100
Sensitivity Analysis	No costs as scenario assumes no construction of SH-100 or I-40.	Construction of I-40 Construction of SH-100	Construction of I-40 Construction of SH-100

Table 7 and Table 8 details the capital costs for I-40 details and SH-100 in 2022 dollars.

Table 7: Capital Costs for I-40

Year	Costs (without escalation) (2022$)	Discounted Costs (2022$, discounted at 3.1%)
2025	$2,227,000	$2,032,000
2026	$2,162,000	$1,913,000
2027	$9,233,000	$7,926,000
2028	$33,817,000	$28,157,000
2029	$32,832,000	$26,515,000
2030	$15,938,000	$12,484,000
Total	**$96,209,000**	**$79,027,000**

Note: Rounded to the nearest thousand

Table 8: Capital Costs for SH-100

Year	Costs (without escalation) (2022$)	Discounted Costs (2022$, discounted at 3.1%)
2024	$1,945,000	$1,830,000
2025	$611,000	$558,000
2026	$593,000	$525,000
2027	$576,000	$495,000
2028	$559,000	$466,000
2029	$271,000	$219,000
2030	$9,178,000	$7,189,000
2031	$11,881,000	$9,027,000
2032	$11,535,000	$8,500,000
Total	**$37,149,000**	**$28,809,000**

Note: Rounded to the nearest thousand

6 Benefits Cost Analysis Results

Table 9 summarizes the Project's costs and benefits in 2022 dollars, discounted at 3.1-percent (with the exception of CO2 emissions, discounted at 2-percent), the benefit-cost ratio (BCR), and net present value (NPV).

Table 9: Project Summary of Benefits and Costs, in Millions (2022$, discounted at 3.1%*)

Benefits Category	Scenario 1	Scenario 2	Sensitivity Analysis
Analysis Years	Q3 2030- Q2 2060	2033-2062	2033-2062
Safety	$71.0	$30.1	$1,145.3
Travel Time	$146.8	$17.9	$2,408.3
VOC	$235.2	$67.6	$3,516.5
CO2 Emissions*	$68.1	$18.7	$1,094.0
Non-CO2 Emissions	$6.6	$1.3	$130.3
Other Environmental	$0.6	$0.1	$7.8
Maintenance	$19.6	$7.8	$27.4
Residual Value	$17.6	$6.6	$23.6
Total Benefits	**$565.5**	**$150.2**	**$8,353.2**
Total Discounted Costs	**$79.0**	**$28.8**	**$107.8**
Benefit-Cost Ratio (BCR)	**7.2**	**5.2**	**77.5**
Net Present Value (NPV)	**$486.5**	**$121.4**	**$8,353.2**

**CO2 emissions discounted at 2-percent*

Source: BIP BCA Tool, Results. The analysis does not evaluate Resilience, Health and Amenity, and Other Benefits categories.

In response to the latest BCA Guidance, updated May 2025, the analysis additionally reports the findings of the benefits and costs analysis discount at 7-percent in Table 10. All other monetized values in the BCA Tool remain as defaults, in 2022 dollars.

Table 10: Project Summary of Benefits and Costs, in Millions (2022$, discounted at 7.0%*)

Benefits Category	Scenario 1	Scenario 2	Sensitivity Analysis
Analysis Years	Q3 2030- Q2 2060	2033-2062	2033-2062
Safety	$24.3	$9.8	$381.6
Travel Time	$49.7	-$8.8	$777.7
VOC	$87.4	$23.0	$1,246.5
CO2 Emissions*	$68.1	$18.7	$1,094.0
Non-CO2 Emissions	$2.7	$0.5	$51.3
Other Environmental	$0.2	$0.0	$2.9
Maintenance	$12.5	$4.8	$17.3
Residual Value	$4.3	$1.5	$5.3
Total Benefits	**$249.3**	**$49.6**	**$3,576.7**
Total Discounted Costs	**$62.3**	**$21.3**	**$83.6**

Benefits Category	Scenario 1	Scenario 2	Sensitivity Analysis
Analysis Years	Q3 2030- Q2 2060	2033-2062	2033-2062
Benefit-Cost Ratio (BCR)	**4.0**	**2.3**	**42.8**
Net Present Value (NPV)	**$187.0**	**$28.3**	**$3,576.7**

**CO2 emissions discounted at 2-percent*