SH-100 over the Arkansas River
Bridge Replacement Project

Benefit Cost Analysis Technical Memo

Submitted by Oklahoma Department of Transportation

FY 2026 Bridge Investment Program
Bridge Project Grants
Opportunity # 693JJ324NF00006
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OKLAHOMA Transportation

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I. Executive Summary

The Benefit-Cost Analysis **(BCA)** for the SH-100 over Arkansas River Bridge Replacement Project application compares the costs and benefits of the proposed Project. The analysis utilized the Bridge Investment Program Benefit-Cost Analysis Tool v.1.1.2 (BCA Tool) and associated User Manual released by USDOT in January 2026. To the extent possible, expected benefits were monetized. A qualitative discussion is presented for benefits that are more difficult to quantify.

The Oklahoma Department of Transportation (ODOT) is requesting funding to replace State Highway 100 (SH-100) bridge over the Arkansas River. The bridge spans Muskogee County (western terminus) and Sequoyah County (eastern terminus) in eastern Oklahoma. The bridge is considered fracture critical and does not meet ODOT's current geometric design standards. The bridge supports 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 SH-100 for business, personal travel, and other recreational purposes.

The SH-100 bridge over the Arkansas River is in fair condition and is in danger of falling into poor condition in the next three years. The bridge is narrow, with lane and shoulder widths less than ODOT's current design standards. The bridge can no longer accommodate the needs of the regional transportation network. Specific improvements planned as part of the project include:

- Replacement of the SH-100 over Arkansas River bridge that is fracture critical and is deteriorating at a rapid rate;
- Providing lane and shoulder widths to meet today's design standards, as well as new safety guardrails.

Table 1 below summarizes the changes expected from the project, and the associated quantified benefits. The period of analysis used in the estimation of benefits and costs is 35 years, including five years of project development and construction and 30 years of operations. The project will construct a new bridge with a 75-year design life and so a longer analysis period was selected. Total project development and construction costs are estimated at $40.99 million. Costs were entered into the BCA Tool in Year of Expenditure dollars and automatically de-escalated to 2024 and discounted for a total discounted capital cost of $29.04 million.

All relevant data and calculations used to derive the benefits and costs of the project are shown in the BCA Tool that accompanies this grant application. Based on the analysis presented in the rest of this document, the Project is expected to generate $37.96 million in discounted benefits and $29.04 million in discounted capital costs (**Table 1**).

Therefore, the Project is expected to generate a Net Present Value of $8.92 million and a Benefit/Cost Ratio (BCR) of 1.31 as shown below in **Table 2.**

Table 1: Summary of Monetized Benefits

Baseline Status and Problems to be Addressed	Change to Baseline	Types of Impacts & Benefits	Population Affected by Impacts	Benefit Value (2024 $ millions)
The bridge is in fair condition and is in danger of falling into poor condition in the next 3 years. The deck and substructure have deteriorated noticeably in the last year. The bridge also has deficient lane and shoulder widths. With no improvement the bridges would require load posting and eventual closure, requiring long detours. These detours increase travel time and collision risk.	ODOT proposes to construct a new bridge with standard lane and shoulder widths. Improving the condition of the bridge would avoid future load postings and closures, avoiding costly detours.	***Impact*** – Improved lane and shoulder widths ***Benefit*** - Improved vehicle safety	Vehicle Owners and Truck Operators	$ 6.52
		Impact - Reduced vehicular delays and avoided detours due to structure condition ***Benefit*** - Reduction in travel times	Vehicle Owners, and Truck Operators	$ 8.54
		Impact - Reduced vehicular delays and avoided detours due to structure condition ***Benefit*** - Reduced vehicle operating costs (fuel reduction)	Vehicle Owners and Truck Operators	$ 14.08
		Impact - Reduced time spent idling during delays ***Benefit*** - Emissions reduction	Vehicle Owners, Truck Operators, and Residents of adjacent communities	$ 0.42
		Impact – Avoided impacts to communities on the detour route ***Benefit*** – Other environmental	Residents of adjacent communities	$ 0.04
		Impact – New structure with less frequent maintenance requirements ***Benefit*** – Maintenance cost savings.	ODOT and traveling public	$ 6.18
		Impact - New bridge ***Benefit*** – Extended residual life of bridge	ODOT	$ 2.18
Total Benefit				**$ 37.96**

Table 2: Summary of BCA Outcomes, Millions of 2024 Dollars

Category	Benefit	Percent of Total Benefits
Safety	$ 6,518,193	**17%**
Travel Time	$ 8,538,074	**22%**
VOC	$ 14,084,069	**37%**
Resilience	$ -	**0%**
Health and Amenity	$ -	**0%**
Emissions	$ 418,989	**1%**
Other Environmental	$ 37,776	**<1%**
Maintenance	$ 6,181,237	**16%**
Other Benefits	$	**0%**
Residual Value	$ 2,183,389	**6%**
Total Benefits	$ 37,962,178	**100%**
Total Discounted Costs	$ 29,041,938	**N/A**
BCR	1.31	**N/A**
Net Present Value (NPV)	$ 8,920,240	**N/A**

In addition to the monetized benefits, the project is expected to generate benefits that are more difficult to quantify. More detail is presented in the **Merit Criteria** section of the application narrative.

II. Introduction and Methodology

This document provides detailed technical information on the benefit-cost analysis (BCA) conducted in support of the grant application for the Project. The BCA includes the monetized benefits and costs measured using the USDOT BCA Tool, as well as the quantitative and qualitative merits of the project. A BCA provides estimates of the benefits that are expected to accrue from a project over a specified period and compares them to the anticipated costs of the project. Costs include both the resources required to develop the project and the costs of maintaining the new or improved asset over time. Estimated benefits are based on the projected impacts of the project on both users and non-users of the facility, valued in monetary terms. While a BCA is just one of many tools that can be used in making decisions about infrastructure investments, it provides a useful benchmark from which to evaluate and compare potential transportation investments. This memo documents the assumptions used to produce

the analysis, a description of the baseline, the sources of data used to project the outcome of the project, and the values of key input parameters. The methodology and calculations are derived from the USDOT Benefit-Cost Analysis Tool v.1.1.2 (BCA Tool) and associated User Manual released by USDOT in January 2026.

III. Project Overview

The proposed SH-100 over Arkansas River Replacement Project will replace the existing bridge on SH-100 over the Arkansas River in Muskogee and Sequoyah Counties in Oklahoma. The existing bridge is in fair condition, has deficient clearances, and does not meet the transportation needs of the region. The purpose of the Project is to eliminate this bridge at risk of falling into poor condition and restore a safe crossing that is up to today's design standards and meets the transportation needs of the current and future regional network. The bridge supports Oklahoma's local and regional economy, serving as a crucial connector for freight and passenger vehicles. The net detour length is 7.8 miles, and any possible future load posting or closure would pose a hardship for the local economy and the regional residents' connections to daily activities such as school, work, medical facilities, and grocery stores.

The Project will provide a new structure designed with a 75-year service life. The new bridge will have 12-foot lanes, 8-foot shoulders, and a 42-inch safety rail to meet ODOT's design criteria. The Project will improve safety, improve the efficiency and reliability of the movement of people and freight, and provide safe and secure transportation options for the communities of Webbers Falls and Gore that rely on the bridge to access critical destinations. More detail about the Project's state of good repair, safety, economic, resiliency, and quality of life outcomes are presented in the application narrative.

Specific improvements planned as part of the Project include:

- Construction of a new two-lane steel girder bridge on existing alignment with a 75-year service life.
- Providing two 12' driving lanes and two 8' shoulders to meet today's design standards, as well as 42" F-shaped parapet on both sides for increased safety.

Base Case and Alternative

The Base Case for the Project is defined as the "No Build" scenario. This scenario reflects no capital improvements within the project limits but would require certain maintenance and rehabilitation costs over the analysis period. According to NBIAS data, the SH-100 bridge is forecasted to require 100% load posting in 2035 and closure in 2049. The I-40 bridge over the Arkansas River would serve as the closest detour route. However, the I-40 bridge is also forecasted to require load posting and closure during

the analysis period. Closing both bridges would require a detour of closer to 40 miles and would add benefit to the Project; however, for simplicity and as a conservative approach, this was not accounted for in the BCA analysis.

The Alternative Case is defined as the Build scenario as described in the Project Description section above.

Types of Impacts

The proposed Project is expected to have the following impacts:

- Reduction in expected number of crashes due to wider bridges with standard shoulders and guardrail,
- Reduction in travel times and vehicle operating costs due to avoidance of detours that would be required if the bridge is not improved,
- Reduction in noise and emissions due to avoided detours, and
- Decreased maintenance costs and increased useful life of the bridge.

Project Cost and Schedule – Alternative Case

Total project capital development and construction costs are estimated at $40.99 million in today's dollars. The BCA Tool adjusted these costs to 2024 dollars and discounted them by 7%. The adjusted project development and construction cost amounts to $29.04 million in discounted dollars. Project construction is anticipated to start in 2027 and take two years with completion by the end of 2028. For simplicity, 2029 is assumed as the Project opening year and first year of Project-related benefits.

The Project will require maintenance during the 30-year operating period that is estimated at $12.0 million (in $2022). This assumes inspections every two years and minor repairs, with a major rehabilitation towards the end of the period.

Project Cost – Base Case

The Base Case (No Build) assumes no capital development or construction. However, the Base Case would require additional maintenance until 2049, when the bridge is anticipated to be closed. Maintenance costs of the No Build include annual inspections and rehabilitation required every four years until 2049 when the bridge is forecasted to be closed. The total major maintenance rehabilitation costs required are estimated at $17.2 million (in $2022). While the Alternative Case has maintenance costs associated with the project lifecycle planning, it is less than what would be incurred under the Base Case when discounted over time. Thus, the Alternative case creates a net savings in maintenance costs of approximately $6.18 million (in $2024, discounted).

Alignment with Selection Criteria

The main benefit categories associated with the Project are mapped into the merit criteria set forth by U.S. DOT in **Table 3**.

Table 3: Benefit Categories of the Project

Criteria	Benefit(s)	Description	Monetized	Qualitative
State of Good Repair	Reduced O&M Cost	Bridge replacement will reduce O&M	Yes	Yes
	Residual Value	Useful life of bridge will be extended	Yes	Yes
	Detour avoidance	Bridge replacement will avoid costly detours when the bridge is load posted and eventually closed	Yes	Yes
Safety and Mobility	Increased vehicle safety	Widened bridge and addition of shoulders and guardrail are expected to reduce collisions. Also, savings from avoidance of detours and associated crashes.	Yes	Yes
	Added pedestrian and bicycle comfort and safety	Wider lanes shoulders will provide a separated space for pedestrian and bicyclists	No	Yes
Economic Competitiveness and Opportunity	Travel time savings	Travel time reliability will increase the efficiency and movement of the goods and people surrounding the project.	Yes	Yes
	Contribution to local economic development and growth	Economic impact of construction project.	No	Yes
Resiliency and the Environment	Air quality	Detour avoidance will improve air quality.	Yes	Yes
	Other environmental benefits	Detour avoidance will reduce noise and other impacts along the detour route.	Yes	Yes
Quality of Life	Improved access to daily destinations	Provide a safe and reliable connection between communities using the bridge to access critical services.	No	Yes
	Non-vehicular transportation and affordability	Wider lanes and shoulders will provide a separated space for pedestrian and bicyclists	No	Yes
Innovation	Project Delivery	3D models increase accuracy	No	Yes
	Construction methods	Accelerated Bridge Construction could save time and cost.	No	Yes

General Assumptions

The BCA measures benefits against costs throughout a period of analysis beginning at the start of construction and including 30 years of operations. The methodology makes several important assumptions and seeks to avoid overestimation of benefits and underestimation of costs. These assumptions are documented in the USDOT BCA Tool. Specifically:

- Input prices, costs, and benefits are expressed in 2024 dollars.
- The period of analysis begins in 2029 and ends in 2058. The project includes two years of construction in 2027 - 2028 prior to the 30-year analysis period.
- A constant 7 percent real discount rate is assumed throughout the period of analysis.
- Opening year demand and benefits are inputs to the BCA and are assumed to be fully realized after construction is finished and project starts operations in 2029 (no ramp-up).

Traffic Volumes

The BCA Tool provides traffic volumes based on a history of traffic count data collected by ODOT. The Tool includes a forecasted annual average daily traffic (AADT) volume for the opening year and last year of the analysis period, based on historical growth rates observed on either side of the bridge from 2021-2024. Based on the average growth rate, projected volumes were derived for the years 2027-2058. These values were entered into Table 3 in the BCA Tool. Traffic count data, count site data, and projected traffic volumes are included in the BCA model at SH-100 FY26 BIP.

IV. Benefits

This section describes the measurement approach used for each quantifiable benefit or impact category identified in **Table 1** and provides an overview of the methodologies and assumptions. A summary of all benefits is presented in **Table 2.**

Safety Benefits

Data from the ODOT SAFE-T collision database was reviewed between the years 2012-2025[1]. There were two total collisions associated with the bridge documented during this time period, one that involved property damage only and one injury crash. Safety benefits of the new bridge include reduction in expected number of crashes through wider lanes, wider shoulders, and new guardrail. Crash Modification Factors (CMF) were investigated and identified for these improvements. CMF 11 for widening the paved shoulder was identified and applied. CMF was selected due to its applicability to

[1] ODOT Traffic Engineering Division, report created 6/17/2026. Note data for 2021-2025 may be incomplete (per ODOT).

rural highways and it was the most highly rated and conservative of the available factors. Because additional safety benefits are anticipated due to the wider lanes and improved guardrail and these are not captured in CMF 11, a sensitivity analysis is included with a different CMF.

Monetization of crashes is calculated by the BCA Tool according to values provided in the BCA Guidance document. The Project will also realize safety benefits from avoided detouring. However, these benefits are offset by the disbenefits of detouring all traffic during construction. In total, safety benefits of the Project are estimated at $6.52 million.

By 2059, the project is anticipated to impact 78,819 person-miles traveled (PMT) assuming the average daily traffic volumes shown in the BCA Tool, 1.52 persons/vehicle (per BCA guidance), and a bridge length of 0.365 miles.

Travel Time Savings

The Project will provide travel time and mobility-related benefits due to the avoidance of detours. Posting and closure dates for the bridge were derived from the NBI data in the BCA Tool. Similar to the safety disbenefits described above, travel time savings are reduced by longer travel times during construction when the bridge will be closed. It is assumed the bridge would take 640 calendar days to construct, 275 days in 2027 and 365 days in 2028. Total travel time savings for the Project is $8.54 million.

Reduced Vehicle Operating Costs

Vehicle operating costs are captured in the benefits of detour avoidance along with disbenefits during construction. Estimated vehicle operating cost savings of the Project are $14.08 million.

Emissions Reduction

Emissions reduction benefits are captured in the detour avoidance benefits along with disbenefits during construction. Emissions reduction benefits for the Project are estimated at $418,989.

Other Environmental

The BCA Tool calculates noise reduction benefits as a result of detour avoidance and disbenefits due to the construction detour. The benefit is calculated at $37,776.

Maintenance Savings

As described above, the total major maintenance and rehabilitation costs required under the Base Case are estimated at about $17.2 million over the 30-year analysis period, compared to the Alternative Case at approximately $12 million ($2024). While the Alternative Case has maintenance costs associated with the new bridge, it is less than what would be incurred under the Base Case when discounted over time. Thus, the

Alternative case creates a net savings in maintenance costs of approximately $6.18 million in discounted costs.

Residual Value

Under the No Build scenario, the existing bridge would not have any remaining useful life in 2059. The new bridge is assumed to have a service life of 75 years and represents 100% of the project cost. The residual value translates to a benefit of $2.18 million in discounted savings.

V. Summary

Overall, the Project is expected to generate $37.96 million in discounted benefits with a total discounted cost of $29.04 million. Therefore, the project has a Net Present Value of $8.92 million and a Benefit/Cost Ratio (BCR) of 1.31.

VI. BCA Sensitivity Analysis

The BCA outcomes presented in the previous sections rely on many assumptions and long-term projections, both of which are subject to considerable uncertainty. The primary purpose of the sensitivity analysis is to help identify the “critical variables”—the variables and model parameters whose variations have the greatest impact on the BCA outcomes.

The sensitivity analysis can also be used to:

- Evaluate the impact of changes in individual critical variables—how much the final results would vary with reasonable departures from the “preferred” or most likely value for the variable, and
- Assess the robustness of the BCA and evaluate whether the conclusions reached under the “preferred” set of input values are significantly altered by reasonable departures from those values.

The sensitivity analysis was conducted with respect to capital costs and safety benefits. A sensitivity analysis was carried out assuming capital costs increased 20%. A second sensitivity analysis was conducted to adjust the crash modification factor used in the safety analysis. The current analysis includes a crash modification factor of 0.95 (CMF 11) for widening the shoulder from 3 to 5 feet. This is a conservative CMF given the shoulder will widen from 3 to 8 feet. A sensitivity analysis using a different CMF [5402: upgrade narrow unpaved shoulder (<5 ft) to wide paved shoulder (>5 ft)[2]] is included

[2] CMF Clearinghouse

(CMF=0.71). The outcomes of the analysis are summarized in **Table 5**. The table provides the percentage changes in project NPV associated with the new parameters.

Table 5: BCA Sensitivity Analysis

Parameters	Change in Parameter Value	NPV (millions of discounted $)	% Change in NPV	New B/C Ratio
Project Analysis		**$8.92**		**1.31**
Capital Cost	20% Increase	$3.89	-56.2 %	1.11
CMF	Use CMF 5402 instead of 11	$8.98	+.67 %	1.31

The table demonstrates that increasing the capital cost by 20% reduces the NPV by over half but still remains a positive BC Ratio of 1.11. Using CMF 5402 instead of CMF 11 has no substantive impact on NPV or the BC Ratio.