



# Strengthening Connections: Rehabilitating I-44 Bridges for Regional Resilience

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Oklahoma Department of Transportation

Bridge Investment Program FY 2024

BCA Memorandum



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## Executive Summary

The **Strengthening Connections: Rehabilitating I-44 Bridges for Regional Resilience** Project is working to rehabilitate the northbound and southbound bridges along I-44 over the Union Pacific Railroad (UPRR) in Oklahoma City, Oklahoma.

The \$35.8 million (2023\$) total capital project cost of the Project yields:

- Benefit-cost ratio (BCR) of 8.56
- Positive net user benefit of about \$235.8 million (NPV) over 30 years

Over the life of the Project, these investments will produce (in NPV):

Benefits	Total
Safety	\$38,560,601
Travel Time	\$117,534,125
Vehicle Operating Cost	\$80,114,785
Emissions (CO2)	\$19,453,983
Emissions (non-CO2)	\$969,808
Other Environmental	\$621,736
Maintenance	\$5,706,155
Residual Value	\$4,062,835
<b>Total Benefits</b>	<b>\$267,024,028</b>
<b>Total Discounted Costs</b>	<b>\$31,190,862</b>
<b>Net Present Value (NPV)</b>	<b>\$235,833,166</b>

Over the life of each Improvement investment, these two structures will produce (in NPV):

Benefits	Southbound Bridge (18770)	Northbound Bridge (18769)	Total
Safety	\$19,462,335	\$19,098,266	\$38,560,601
Travel Time	\$58,767,062	\$58,767,062	\$117,534,125
Vehicle Operating Cost	\$40,057,392	\$40,057,392	\$80,114,785
Emissions (CO2)	\$9,726,992	\$9,726,992	\$19,453,983
Emissions (non-CO2)	\$484,904	\$484,904	\$969,808
Other Environmental	\$310,868	\$310,868	\$621,736
Maintenance	\$2,853,078	\$2,853,078	\$5,706,155
Residual Value	\$1,834,320	\$2,228,515	\$4,062,835
<b>Total Benefits</b>	<b>\$133,496,951</b>	<b>\$133,527,077</b>	<b>\$267,024,028</b>
<b>Total Discounted Costs</b>	<b>\$14,097,583</b>	<b>\$17,093,278</b>	<b>\$31,190,862</b>
<b>Net Present Value (NPV)</b>	<b>\$119,399,367</b>	<b>\$116,433,799</b>	<b>\$235,833,166</b>

## BCA Methodology

For the 2024 BIP application BCA model, the FHWA released a new tool (updated January of 2024) using the National Bridge Inventory (NBI) in coordination with the National Bridge Investment Analysis System (NBIAS) and Motor Vehicle Emission Simulator to pull in anticipated values for calculating the benefit-cost ratio of BIP projects/Projects. This tool was used for the BCA analysis, which is based on this Project eliminating the possibility of lane and bridge closures and thus avoiding the costs associated with detours. The model utilizes NBI, NBIAS, and EPA MOVES data, various region or corridor specific statistics, and global parameters provided by the United States Department of Transportation (USDOT) specifically for the purposes of completing BCAs in support of federal grant applications.

Using Project-specific inputs, the BCA model calculates life-cycle costs, life-cycle benefits, annual benefits, the NPV of quantifiable costs and benefits, and the resulting B/C ratio, utilizing a methodology that aligns with the most recent USDOT guidance.

The BCA was prepared using total quantifiable Project costs and benefits that are adjusted for inflation and then discounted to reflect the time value of money. In summary, the BCA was created by:

1. Identifying the Project's benefits and costs in terms of proposed improvements versus a no-build scenario;
2. Deriving current and forecasted use levels for the baseline and the "build case";
3. Denominating all benefits and costs in constant 2022 dollars;
4. Assuming inflation based on the Implicit Price Deflators for Gross Domestic Product;
5. Discounting dollar amounts by 3.1 percent to reflect the time value of money and discounting emissions at a 2 percent rate for all carbon pollutants and 3.1 percent for all non-carbon pollutants; and
6. Setting an appropriate analysis period of 20 or 30 years for the Project's development, construction, and subsequent operational service. (Conservatively assumed 30 years at the start of the first full year of benefits.)

## Project Overview

The **Strengthening Connections: Rehabilitating I-44 Bridges for Regional Resilience Project** (Project) consists of two bridges, one northbound and one southbound along I-44 in Oklahoma City, Oklahoma. The project, NBI number, and description of structures are shown below:

- I-44 Northbound Bridge – 18769
- I-44 Southbound Bridge – 18770

The Project will rehabilitate the existing north- and southbound bridges to modern standards and ensure the bridges are compatible with the future needs of the I-40 and I-44 interchange just to the south.

The project location can be seen below (Figure 1).

**Figure 1: Project Location**



Source: ODOT

## **I-44 Northbound Bridge (18769) and Southbound Bridge (18770)**

The I-44 north- and southbound bridges will be rehabilitated to modern standards including accommodating roadway widths, which will eventually be compatible with future interstate improvements including five southbound lanes and six northbound lanes, plus shoulders. The rehabilitation consists of replacing the existing abutments and superstructure while utilizing as much of the existing substructure as possible. The existing piers will be widened to accommodate the increased superstructure width and a crash wall will be added to Pier 1 per railroad requirements.

## Project Cost

The Project’s **total capital cost will be \$35.8 million** in 2023 dollars, or \$31.2 million in 2022 discounted dollars per federal guidance. This estimate includes total delivery costs (construction, design, environmental analysis, and other Project management costs). Annual Project costs and timelines are shown in **Table 1**, which includes its Net Present Value (NPV) based on a discount rate of 3.1 percent.

**Table 1: Project Costs**

Bridge	NBI Structure #	Construct Start (Year)	Construct End (Year)	Total Project Cost (2023\$)	Total Project Cost NPV (2022\$)
I-44 NB	18769	2027	2029	\$19,724,342	\$17,093,278
I-44 SB	18770	2027	2029	\$16,122,826	\$14,097,583
<b>Total</b>				<b>\$35,847,168</b>	<b>\$31,190,862</b>

Note: Costs Rounded to Nearest Dollar

The residual values are shown in **Table 2** below. At the end of the analysis period, shown as 30 years, the corridor will have a **discounted residual value of \$4.1 million** as calculated using the FHWA-recommended residual value calculation for the time before the improvement components will need to be replaced.

**Table 2: Project Residual Value**

Bridge	Residual Value NPV (2022\$)
I-44 NB	\$2,228,515
I-44 SB	\$1,834,320
<b>Total</b>	<b>\$4,062,835</b>

The project will also experience a decrease in Operation and Maintenance (O&M) costs in the build scenario. ODOT’s current spending trends indicate that \$7-8 thousand per year will continue to be spent for the annual requirements to keep the bridge maintained. It is expected that a \$2.7 million dollar repair, for each bridge, will have to take place in 2032 for necessary repairs. In the build scenario, ODOT indicated that after the bridges are built, a silane bridge deck waterproofing will need to be applied after one year of being open (\$40 thousand). The anticipated O&M will drop significantly down to \$1 thousand annually, for both bridge structures. These O&M costs can be seen in the BCA Workbook included in this grant application.

## Project Benefits

The following benefits are quantified for this analysis:

- Safety cost savings from avoided crashes on the additional distance travelled on detour routes and safety improvements on primary route.
- Emissions savings from avoided additional distance travelled on detour routes.
- Travel time savings from avoided longer travel time on detour routes.
- Vehicle operating costs savings from avoided additional distance travelled on detour routes.
- Other Environmental benefits due to avoided load posting or closures.

The benefits calculated were considered conservatively calculated from a detour route perspective. ODOT specified that the signed detour during closure would take place along I-235, adding roughly 10 miles (12 minutes) to the average trip. The BCA assumes that not all traffic would utilize the full detour and respectively, not experience the full mileage and time additions to their travel. **Table 3** shows the breakdown of expected detour experience. This can be seen in the BCA Workbook.

**Table 3: Experienced Detours to Traffic**

Expected Detour Experience	Percent Breakdown of Daily Traffic
Full Detour	15%
1/2 Detour	30%
1/4 Detour	40%
Avoid Detour (Local Traffic)	15%

The Project will provide substantial benefits by improving safety, decreasing travel time, reducing emissions, and reducing operating costs. These benefits are quantified in the following subsections. Benefits were calculated using traffic and safety data provided by the City and other sources cited in the BCA Workbook included with the grant application.

### Safety Benefit

The Project produces **safety savings of \$38.6 million (NPV)** by increasing the shoulder width on the two bridge structures and by avoiding the potential collisions that would occur on the detour routes in relations to statewide crash rates and congestion.

Collision data was provided by ODOT according to the (JP) project number. Over the 5-year analysis period (2017-2021) there were 24 collisions along the Northbound bridge, and 59 collisions along the southbound bridge. These



collisions are expected to be reduced due to the increase in shoulder width from 10ft to 12ft. This improvement is linked to the CMF Clearinghouse ID: [5509](#), with a value of 77.4% (or a 22.6% reduction in collisions).

## Travel Time Benefit

The Project reduces potential detour total travel time, resulting in a benefit of **\$118 million (NPV)** to travelers. Only vehicle impacts were calculated for each bridge. Travel Time calculations were calculated for both structures, starting in 2052 when NBI data suggested the bridges to fully close due to failure. The benefits stem from the extensive detour routes that traffic would have to utilize if no rehab or improvements occurred.

**\$118M**

TRAVEL TIME COST (NPV)

## Avoided Operating Costs

By providing more direct routes for travelers, the Project is projected to reduce vehicle operating costs by **\$80.1 million dollars** over the analysis period (30 years). Only vehicle operating costs were quantified in the benefit calculations. Avoided Operating Costs were calculated for both structures, starting in 2052 when NBI data suggested the bridges to fully close due to failure. The benefits stem from the extensive detour routes that traffic would have to utilize if no rehab or improvements occurred.

**\$80.1M**

VEHICLE OPERATING COSTS  
(NPV)

## Emissions Benefit

The Project produces a total **reduced damage of pollutant emissions of \$20.4 million (NPV)**. Majority of the avoided emissions came from strictly CO<sub>2</sub> emissions, which summed to \$19.5 million dollars. All other non-carbon emissions (SO<sub>x</sub>, PM<sub>2.5</sub>, and NO<sub>x</sub>) summed to an avoided benefit of \$970 thousand dollars.

**\$20.4M**

EMISSIONS SAVINGS (NPV)

## Other Environmental Benefit

In addition to the emissions savings resulting from the avoided detours, other environmental benefits were calculated. The Project benefits from avoided noise level increases due to added traffic on derour routes, occurring in 2052 from NBI’s closure forecasting. The analysis estimates **\$622 thousand (NPV)** in total noise related environmental benefits.



## Benefits Summary

The Project has a **Benefit-Cost Ratio (BCR) of 8.56**. This ratio was derived by dividing total discounted benefits by total discounted costs over a 30-year period. **Table 4** shows the breakdown of BCR per structure, below. The results shown in **Table 5** and throughout this memo were derived based on the [2023 BCA Guidance - December Update](#) and USDOT’s 2024 updated guidance on the [BIP BCA Tool](#).



**Table 4: Project Improvements Benefits Summary**

Benefits	Southbound Bridge	Northbound Bridge	Total
Safety	\$19,462,335	\$19,098,266	\$38,560,601
Travel Time	\$58,767,062	\$58,767,062	\$117,534,125
Vehicle Operating Cost	\$40,057,392	\$40,057,392	\$80,114,785
Emissions (CO2)	\$9,726,992	\$9,726,992	\$19,453,983
Emissions (non-CO2)	\$484,904	\$484,904	\$969,808
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Maintenance	\$2,853,078	\$2,853,078	\$5,706,155
Residual Value	\$1,834,320	\$2,228,515	\$4,062,835
<b>Total Benefits</b>	<b>\$133,496,951</b>	<b>\$133,527,077</b>	<b>\$267,024,028</b>
<b>Total Discounted Costs</b>	<b>\$14,097,583</b>	<b>\$17,093,278</b>	<b>\$31,190,862</b>
<b>Net Present Value (NPV)</b>	<b>\$119,399,367</b>	<b>\$116,433,799</b>	<b>\$235,833,166</b>

**Table 5: Project Benefits Summary**

<b>Total Benefits</b>	<b>Total</b>	<b>Total (\$M)</b>
<i>Safety</i>	\$38,560,601	\$38.6
<i>Travel Time</i>	\$117,534,125	\$117.5
<i>Vehicle Operating Cost</i>	\$80,114,785	\$80.1
<i>Emissions (CO2)</i>	\$19,453,983	\$19.5
<i>Emissions (non-CO2)</i>	\$969,808	\$0.9
<i>Other Environmental</i>	\$621,736	\$0.6
<i>Maintenance</i>	\$5,706,155	\$5.7
<i>Residual Value</i>	\$4,062,835	\$4.1
<b>Total Benefits</b>	<b>\$267,024,028</b>	<b>\$267.0</b>
<b>Total Costs</b>	<b>\$31,190,862</b>	<b>\$31.2</b>
<b>BCR</b>	<b>8.56</b>	<b>8.56</b>
<b>Net Present Value</b>	<b>\$235,833,166</b>	<b>\$235.8</b>

## Unquantifiable Benefits

The Project has been conservatively evaluated using the methodology and assumptions described above. The cost effectiveness of the Project may be greater than indicated by the quantitative calculations because certain benefits that were not included in the BCA analysis.

The final surface of the bridge will undergo a diamond grind to ensure a smooth, flush connection between the pre-fabricated bridge units. Longitudinal deck grooving will serve to reduce tire noise from traffic crossing the bridge. In addition, these bridges were originally built during the era where lead paint was commonly used on bridges. Due to aging, lead paint has been slowly chipping off these bridges and into the surrounding areas below. Due to the toxicity of lead paint, these project improvements will remove the ability for lead paint to find its way into the environment.

As the NBI forecasts, these bridges are anticipated to close due to failure in 2052. If nothing is done and the bridges fail and fall, there would be a large negative impact to the traffic on Black Gold Drive and the Union Pacific railroad lines below the bridges. Black Gold Drive is one of the main access roads to the Oklahoma City Fair Grounds and the surrounding industrial area. Similar benefits as stated above could be assumed to occur to the local traffic utilizing the arterial. Economic impact to freight would take a heavy hit if Union Pacific was required to reroute all deliveries through other rail networks. The delay would affect rail specific travel times, operating costs, environmental impacts, and more.

The Project is one of many upgrades currently planned for I-44 and the interchanges both north and south of the project area. This project will be just one step in this larger project. Benefits were only calculated for this project's specified scope, but it can be assumed that more benefits would hit this area due to the other projects happening along the I-44 corridor. In addition, many

of the lights along the interstate are aging and no longer work. Repairing, replacing, and upgrading the ITS system is included in the project costs to ensure the ITS is running efficiently.