

FIX I-44

FY2022 MPDG Grant Application



APPENDIX B BENEFIT-COST ANALYSIS



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I. EXECUTIVE SUMMARY

The Freight, Innovation and Safety for the Ozarks, or FIX I-44 Capital Improvement Project (“the Project”) will improve capacity, create a more reliable interstate system, enhance safety, and improve multi-modal pedestrian and cycling connectivity. The proposed improvements are expected to significantly decrease delay times for I-44 commuters, regional and national freight movement, and emergency/incident response. The project will also reduce delays and improve operations at the MO 13/I-44 Interchange by implementing a new interchange configuration, including a SB-EB Flyover, Norton Road Underpass, roundabout intersections, and other associated local road safety and connectivity enhancements. This Benefit-Cost Analysis (BCA) was prepared by the Missouri Department of Transportation (MoDOT); Ozarks Transportation Organization (OTO); and Crawford, Murphy & Tilly (CMT).

Project Summary Matrix & Baseline Comparison

Current Status/Baseline and Problem to be Addressed	Change to Baseline or Alternatives	Types of Impacts
Mainline I-44 Travel delays and Traffic congestion bottlenecks	Widen I-44 from 4 to 6 lanes	Increase in Travel Time Savings
Significant Traffic Congestion at the MO 13/I-44 Interchange	Implement new Interchange configuration, including SB-to-EB Flyover to relieve traffic congestion at Interchange	Increase in Travel Time Savings & Enhanced Safety and Crash Reduction
Significant number and frequency of vehicular crashes on I-44	Increase Capacity & Add Concrete Median barrier to reduce median crossover crashes	Reduced congestion and Increased safety and reduction of crashes
Emissions attributed to idling/slow moving vehicles as a result of traffic congestion backups on I-44 & MO 13	Widen I-44 from 4 to 6 lanes to reduce incident bottlenecks and reduce idle time. Implement new interchange configuration to relieve congestion and reduce idle time	Reduced Vehicular Emissions Output
Increasing Maintenance and Rehabilitation Costs due to aging pavement and bridge infrastructure	Rebuild existing pavement and Replace 6 existing I-44 bridges over local streets. Implement new interchange configuration, and reduce 1 signalized intersection	Reduce annual operations/ maintenance costs & Improved State of Good Repair Condition
Traffic Congestion results in commercial freight truck delays	Widen I-44 from 4 to 6 lanes	Improved Corridor Reliability for Regional & National Freight Movement
I-44 Vehicular Volume Increases result in noise pollution to surrounding residential areas	Construct Noise Walls (as identified in Noise Study Report)	Reduced Noise Pollution
Limited Pedestrian/Cyclist connectivity across I-44	Construct Pedestrian/Multi-Use Trail Underpass under I-44 and Improve Pedestrian Facilities at I-44 Crossover bridges	Improved Pedestrian Facilities & Access

BCA Result Summary

Table 1. BCA Summary below summarizes the Project’s costs and quantifiable benefits in present value terms. As shown in the table, the benefits yield a BCA ratio of **1.74** when discounting at 7% (excluding reduced CO₂ emissions, which are discounted at a 3%), showing that future benefits outweigh the Project costs and will result in a positive Return-on-Investment (ROI).

Additional benefits to the Project cannot be readily quantified but are qualitatively addressed in the analysis. These include improved emergency responder response times, economic development and land-use planning, and overall impact on local resident and employer quality of life in Springfield, Missouri. These items are further discussed in **Section IV**.

Benefit-Cost Analysis Summary		
Benefits	7% Discount Rate (in million \$)	Undiscounted (in million \$)
Travel Time Savings	\$ 65,742,141	\$ 270,865,904
Safety	\$ 38,061,503	\$ 129,777,370
Emissions Reduction (Non-CO ₂ @ 7% Discount + CO ₂ & 3% Discount)	\$ 3,096,600	\$ 12,367,729
Operations & Maintenance	\$ 5,332,917	\$ 44,827,519
State of Good Repair	\$ 440,468	\$ (9,359,825)
Other Benefits - Freight Reliability	\$ 14,273,075	\$ 53,246,407
Other Benefits - Noise Reduction	\$ 3,319,506	\$ 11,150,888
Other Benefits - Pedestrian & Cycling Facilities	\$ 54,309	\$ 187,084
Total Benefits	\$130,320,519	\$513,063,075
Total Project Costs (Undiscounted)	\$109,423,597	
Total Project Costs (7% Discounted)	\$74,975,071	
BCA Ratio (By Discount Rate)	1.74	4.69
Project BCA Ratio (Non CO₂ @ 7% Discount + CO₂ @ 3% Discount)	1.74	

Table 1. BCA Summary

II. Introduction

The following Benefit-Cost Analysis (BCA) was conducted as part of the application package for the United States Department of Transportation’s (USDOT) *Multimodal Projects Discretionary Grant Program* (MPDG) discretionary funding program for the FIX I-44 Capital Improvement Project to increase mainline capacity, improve safety, replace aging pavement, and enhance active transportation options.

This document outlines the assumptions and methodologies associated with quantifying the net economic benefits of the improvements and has been produced in accordance with the Benefit-Cost Analysis Guidance for Discretionary Grant Programs as of March 2022 (“BCA Guidance Document”). This document also relied upon several primary data sources including the Missouri Department of Transportation (MoDOT), Ozarks Transportation Organization (OTO), TRB Highway Capacity Manual, AASHTO Highway Safety Manual, as well as studies and analysis by Crawford, Murphy & Tilly (CMT) and other publicly available local, regional, and national plans, studies, and data.

Impacts of Transportation Infrastructure Improvements

The proposed MoDOT FIX I-44: Freight, Innovation & Safety for the Ozarks Improvements (“the project”) seeks to fix capacity issues, improve safety, and enhance connectivity along the 4.5-mile I-44 corridor through Springfield, MO. The project spans the length between MO 13/Kansas Expressway (Mile Marker 77) and US 65 (Mile Marker 82). The project is in partnership with MoDOT, the OTO, Greene County, and the City of Springfield.

The project represents a critical freight transportation corridor for the region and nation. The proposed project will enhance this corridor to improve capacity by widening from 4 to 6 lanes and improve safety by adding a concrete median barrier and reducing overall crashes.

Additionally, the project will enhance connectivity by reducing travel time and providing improved multi-modal and pedestrian access to bridge the existing barrier I-44 creates for a walkable and connected community for residents.

Quantifiable Benefits

The implementation of the Project will generate the following benefits that are quantified in the following BCA:

1. Reduction in state highway and interstate highway congestion which will result in travel time savings (TRAVEL TIME)
2. Reduction of potential conflicts through the improved MO 13 interchange will result in safety cost savings (SAFETY)
3. Reduction in annual vehicle emissions due to reduced congestion and fuel consumption (EMISSIONS)
4. Reduction of annual operations and maintenance costs, which will result in direct annual cost savings (OPERATIONS & MAINTENANCE)
5. Reduction in infrastructure preservation and service life extension expenditures as a result of replacing existing infrastructure (STATE OF GOOD REPAIR)
6. Reduction in Incident Management Delays attributed to weather, work zones, or vehicular crashes (RELIABILITY)
7. Reduction in Noise Pollution as a result of constructing Noise/Sound Walls along corridor with nearby residential structures (NOISE)
8. Improved access, connectivity, and condition of multi-use pedestrian and cyclist facilities (PEDESTRIAN & CYCLING FACILITIES)

Qualitative Benefits

There are also numerous benefits to the Project that are non-quantifiable given the lack of available data or which involve broader impacts to the regional and state economies. However, these benefits should also be considered, which further enhance the net positive impacts of the project on the local, regional, and national economies.

Reliable Freight Network

I-44 through Missouri, and specifically, this project area, serves as a critical segment in the movement of local, regional, and national freight. Creating a reliable transportation network in regard to the broader movement of freight is critical to maintain the nation’s supply chain via the interstate highway system.

While the BCA analysis quantifies a significant freight reliability component for this project, it is not possible to quantify every freight benefit that passes through the project corridor due to the varying volume, type, and frequency of freight that is transported along the I-44 corridor. Additionally, Springfield is the convergence point of the top 2 highway freight corridors in Missouri – I-44 (#1) and US 60 (#2) – further highlighting the critical need to develop a reliable transportation system to maintain economic efficiency across the nation.

For example, one such industry that's lifeline depends on I-44 is the Stainless-Steel industry; with over thirty (30) industrial and manufacturing companies, Springfield, MO was ranked as the No. 1 top producer of stainless-steel manufacturing in 2018¹ – further highlighting the critical need for reliability improvements along this section of I-44.

Innovative Technology Deployment

The proposed project seeks to deploy new technology along the project corridor, from US 160 to US 65. Technology upgrades include the replacement of existing and failing hardware and software that will result in improved regional traffic monitoring, enhanced incident response, and real-time data allowing for system oversight to provide an improved experience for transportation system end users.

Improved Greenways Connectivity

The project will implement a Pedestrian Underpass to create a grade-separated crossing beneath I-44 for pedestrians and cyclists and build approximately 1,200 feet of new multi-use trail. The proposed improvements are part of the future Pea Creek Ridge Trail & Regional Greenway system.

While the BCA quantifies certain benefits in the near future, the implementation of this phase of the project is expected to leverage and accelerate implementation of future trail phases – resulting in significantly more benefits that are unable to be quantified as part of this project. The future trail will connect northern Springfield to the current Fulbright Trail System and other recreational amenities.

Quality of Life

The overarching goals of the project are to reduce vehicular travel delays and improve safety along I-44 and MO 13, the project also prioritizes several initiatives to improve Quality of Life for local residents and the transportation system users. Improved Quality of Life will be realized through several benefits of the project, and while non-quantifiable, are still valuable priorities of the project:

- Added Multi-Use Pedestrian & Cyclist Connectivity
- Enhanced visual Aesthetics of New Bridge Structures & Pavement
- Potential Implementation of Arrival/Welcome District
- Soft-scape plantings, water quality improvements, and beautification

The City of Springfield has worked diligently to implement many Quality-of-Life Initiatives in numerous local projects, including placemaking, water quality, aesthetics, and soft-scape improvements. As a project partner, the City of Springfield plans to seek avenues to implement

¹ <https://www.missouripartnership.com/site-selection-springfield-became-stainless-steel-capital-u-s/>

many of these same benefits on this project as part of a potential ‘arrival/welcome district’ on I-44 and MO 13.

Reduction in Work Zone Congestion & Improved Worker Safety

The proposed project will fully reconstruct the I-44 corridor from MO 13 to US Route 65, and as a result reduce the future need for critical infrastructure maintenance and rehabilitation activities. While the benefits of improved infrastructure pavement and structures are realized in the *State of Good Repair* section, there are additional benefits that cannot be easily monetized. Each time a work zone is implemented, greater safety concerns are present for drivers and workers, as a result of potentially reduced signing, decreased lane widths, and increased congestion. Additionally, reducing the need for maintenance or work zone activities along this corridor will effectively reduce worker risk as a result of minimized exposure.

Baseline and Alternatives

No Build Scenario (Baseline): Currently, the existing I-44 corridor is a 4-lane divided highway, with a grass median and guard cable between the Eastbound and Westbound lanes. Where clear zone is not achievable, guardrail is present on the outside edge, mainly in locations where rock outcrops are present. Interchange ramps have acceleration/deceleration lanes, with lengths varying dependent on interchange location. I-44 services significant traffic volumes on the local, regional, and national levels with an approximate Average Daily Traffic (ADT) of 64,600 (31,900 WB & 32,700 EB).

The existing MO 13/I-44 Interchange is a Diverging Diamond Configuration (DDI) and services over 21,000 vehicles daily (2021). While this interchange was the first DDI configuration in the nation, it is no longer providing adequate capacity due to the more recent local development, regional transportation demand to Kansas City, and increase in I-44 traffic. Currently, southbound MO 13 can see delays up to 20 minutes at peak hours, highlighting the critical need for improvements to improve traffic flows.

Build Scenario (Proposed): The proposed project will improve capacity along the 4.75-mile corridor from MO 13 to US 65, including widening from 4-6 lanes, and replace aging I-44 mainline bridges. In combination with I-44 mainline capacity, the project will reconstruct the MO 13 interchange, which includes a SB-EB Flyover, grade-separated local roadway, and ramp intersection geometric reconfigurations to mitigate the congested interchange to improve capacity and improve both local and regional flow. Additionally, the project will implement a pedestrian underpass to mitigate the communal divide I-44 creates for multi-modal access and connectivity and construct noise walls to mitigate noise pollution to nearby residential areas.

The project includes the following components:

- Roadway Improvements; including pavement, center median, lighting, enclosed drainage system, sidewalk. Roadway improvements will result in approximately 9.5 new lane miles (new pavement) on I-44, including 2 new mainline lanes in the inside median, and reconstruction of existing pavement
- Three (3) new mainline I-44 bridges (National, Grant, Broadway)
- One (1) flyover bridge at MO 13 (SB-EB Traffic)

- One (1) new MO 13 bridge (Over I-44)
- One (1) grade-separated local roadway with pedestrian path (Norton Rd)
- Two (2) local roadway roundabout intersections (Norton Rd)
- One (1) pedestrian underpass near Doling Park.
- Approximately 9,750 ft of new sidewalk/trail

The project seeks to improve and extend infrastructure life (State of Good Repair) by replacing existing aging pavement that requires significant time and monetary investment to maintain, totaling over 18-miles of existing pavement replacement. Additionally, the 3 existing mainline I-44 bridges and MO 13 bridge over I-44, of which all have sub-standard clearance and weight restrictions) will be replaced, resulting in a reduced preservation and maintenance monetary investment in the Build Scenario.

Analysis Period

The BCA considers the benefits over a 30-year period during and after construction for roadway widening, rebuild, and connectivity enhancements starting in 2026 (Year 2 construction). The benefit tables in this BCA establish baseline conditions in 2022, or Year 0, with the analysis period also beginning in 2022 as design and conceptual analysis begins. The monetized values in this analysis are discounted to constant 2020 dollars.

Partial benefits are assumed to be realized throughout construction. It is assumed that 33% of full benefits will be realized starting in Year 2 of construction (2026) and achieving full project benefits beginning in 2028, after construction is complete.

Scope of the Analysis

The following BCA only focuses on benefits and costs from the proposed implementation of the approximately **\$109.424 million** Project and impacts to users of the I-44 and MO 13 Corridor. It can be assumed that after complete implementation of the project, considerable additional benefits would be incurred from improved efficiencies in local and regional travel in addition to that quantified in this analysis, as previously highlighted in **Qualitative Benefits**.

III. Assumptions and Inputs

The BCA developed for this project utilizes the revised Benefit-Cost Analysis Guidance for Discretionary Grant Programs as of **March 2022**. Additional assumptions, sources, and local/regional inputs were necessary to fully understand and realize the project impacts and realized benefits. The BCA excel file contains a table of all assumptions and fixed inputs utilized in this analysis. These are summarized further in the relevant sections below, including: Project Program & Capital Costs, Project Maintenance Costs, Project Schedule, Traffic Data & Projections, Safety Data & CMF's, Emissions Rates, Project Components, and External Highway Factors.

IV. Benefits

1. Travel Time Savings

The largest calculated benefit of this Project is realized through travel times savings and the decrease in overall transportation delays. Given the current configuration and inadequate roadway capacity, there is considerable congestion and traffic delays along I-44 through Springfield, which is expected to worsen as traffic volumes grow in the future. The corridor is currently a 4-lane divided highway and services approximately 64,600 vehicles daily, with significant peak hour movements that often result in traffic backups and bottlenecks. Additionally, frequent vehicular and weather events occur along the corridor, creating significant congestion and results in traffic rerouting. The I-44 Project corridor has an existing Level of Service (LOS) of E for both Eastbound and Westbound traffic and currently operates at 99% capacity on weekday average traffic. **If no improvements are made, I-44 is projected be over capacity by 2025.**

Interchange Reconfiguration and associated local improvements on MO 13 will result in considerable travel time savings. The area has seen significant growth and high volume increases in regional traffic, resulting in the current interchange configuration not being adequate to handle the traffic volumes. As a result, Southbound MO 13 sees consistent delays up to 20 minutes during the PM peak hours. Within the project area, MO 13 transitions from a 4-lane divided highway to a 5-lane undivided urban expressway and services over 21,000 vehicles daily. If no improvements are made, the MO 13 interchange is projected to be LOS F and over capacity by 2030.

In the Build Scenario, the widened roadway will increase capacity that will result in free-flow traffic during all Peak Hour events. The proposed improvements are expected to greatly improve the I-44 and MO 13 project corridor, with a combined LOS C in Year 2052.

The resulting capacity improvements will result in travel time savings for drivers and passengers in both passenger cars and trucks. The total delay is anticipated to be reduced by over 200,000 hours at the completion of construction (Year 2027) and over 12.6M annual hours in Year 2052, with a projected travel time savings benefit of approximately **\$65.7M** at a 7% discount rate, as summarized below in **Table 2. Travel Time Savings**.

Methodology

The existing and proposed roadway capacity and travel time savings utilized the Highway Capacity Manual (HCM) Methodology for analysis. Existing traffic volumes and turning movement counts were generated from MoDOT-provided traffic counts in 2021 and adjusted for year 2022 based on corridor traffic projections provided by MoDOT. Traffic Projections for the MO 13 and I-44 corridors were based on a recent 2022 Traffic Demand Model of the region, and the 2022 MoDOT State Freight & Rail Plan.

The Project traffic model of the MO 13 interchange was developed using Synchro Software, while the I-44 mainline model utilized Highway Capacity Software (HCS), which allows for custom inputs and assumptions to tune the analysis to account for various corridor features and produces travel delay output. Travel Delay was calculated for the beginning year of construction (2025) and 27 years out (Design Year 2052). The difference in delay from the No Build and

Build Scenarios was averaged over the 30-year analysis and an annualized increase in travel delay as derived and increasing annually over the proposed 2025 benefits.

Due to limited available data on Personal vs. Business Travel, the Travel Time Cost Savings utilized the HCM Synchro Analysis and the *Value of Time* for “All Purpose” travel and “Commercial Truck Driver” provided in the BCA Guidance Document to develop the cost savings for the project life, as summarized in the *Assumptions and Inputs* Table.

Value of Reduced Travel Time					
Year	Calendar Year	Total Average Annual Passenger Car Travel Delay Savings (Hours)	Total Average Annual Truck Travel Delay Savings (Hours)	Undiscounted Cost Savings	Discounted Cost Savings (7% Discount)
0	2022	-	-	\$ -	\$ -
1	2023	-	-	\$ -	\$ -
2	2024	-	-	\$ -	\$ -
3	2025 (Construction)			\$ -	\$ -
4	2026 (Construction)	44891.7	15772.7	\$ 1,303,799.21	\$ 868,776.46
5	2027 (Construction)	103312.1	36298.8	\$ 3,000,518.66	\$ 1,868,572.22
6	2028	123605.3	43428.9	\$ 3,589,899.03	\$ 2,089,353.92
7	2029	143898.5	50558.9	\$ 4,179,279.40	\$ 2,273,251.08
8	2030	164191.7	57689.0	\$ 4,768,659.76	\$ 2,424,144.82
9	2031	184484.9	64819.0	\$ 5,358,040.13	\$ 2,545,566.27
10	2032	204778.1	71949.1	\$ 5,947,420.50	\$ 2,640,725.83
11	2033	225071.3	79079.1	\$ 6,536,800.87	\$ 2,712,539.96
12	2034	245364.5	86209.2	\$ 7,126,181.24	\$ 2,763,655.95
13	2035	265657.7	93339.2	\$ 7,715,561.61	\$ 2,796,474.59
14	2036	285950.9	100469.2	\$ 8,304,941.98	\$ 2,813,171.18
15	2037	306244.1	107599.3	\$ 8,894,322.34	\$ 2,815,714.67
16	2038	326537.3	114729.3	\$ 9,483,702.71	\$ 2,805,885.43
17	2039	346830.5	121859.4	\$ 10,073,083.08	\$ 2,785,291.41
18	2040	367123.7	128989.4	\$ 10,662,463.45	\$ 2,755,383.17
19	2041	387416.9	136119.5	\$ 11,251,843.82	\$ 2,717,467.53
20	2042	407710.1	143249.5	\$ 11,841,224.19	\$ 2,672,720.19
21	2043	428003.3	150379.5	\$ 12,430,604.56	\$ 2,622,197.29
22	2044	448296.5	157509.6	\$ 13,019,984.93	\$ 2,566,846.02
23	2045	468589.7	164639.6	\$ 13,609,365.29	\$ 2,507,514.36
24	2046	488882.9	171769.7	\$ 14,198,745.66	\$ 2,444,960.01
25	2047	509176.1	178899.7	\$ 14,788,126.03	\$ 2,379,858.55
26	2048	529469.3	186029.8	\$ 15,377,506.40	\$ 2,312,810.98
27	2049	549762.5	193159.8	\$ 15,966,886.77	\$ 2,244,350.56
28	2050	570055.7	200289.8	\$ 16,556,267.14	\$ 2,174,949.08
29	2051	590348.9	207419.9	\$ 17,145,647.51	\$ 2,105,022.70
30	2052	610642.1	214549.9	\$ 17,735,027.88	\$ 2,034,937.10
Total Savings (7% Discount)					\$ 65,742,141.35

Table 2. Travel Time Savings

2. Safety

In the Build Scenario, the widened roadway and added capacity will inherently improve safety benefits – the fewer bottlenecks result in more free flow traffic, and as a result, improved corridor safety. These capacity improvements made to eliminate these queues will also provide a reduction in back of queue crashes from the currently congested condition on I-44.

Additionally, through the implementation of the flyover at MO 13, the existing signalized intersection will be replaced with a Right In, Right Out intersection and a realignment of Norton Road, resulting in a new underpass under MO 13, and conversion of a stop-controlled intersection to a roundabout – all improvements that result in enhanced safety benefits.

The project is anticipated to result in a reduction of 370 crashes over the analysis period, and an overall project safety benefit of **\$38.1M** at a 7% discount rate, as detailed below in **Table 3**.

Value of Reduced Crashes.

Value of Reduced Crashes							Discounted Cost Savings (7% Discount)
		Fatal (K)	Incapacitating Injury (A)	Minor Injury/Possible	Property Damage Only/No Injury	Undiscounted Cost Savings	
0	2022	-	-	-	-	\$ -	\$ -
1	2023	-	-	-	-	\$ -	\$ -
2	2024	-	-	-	-	\$ -	\$ -
3	2025 (Construction)	-	-	-	-	\$ -	\$ -
4	2026 (Construction)	0.096	0.354	2.100	1.750	\$ 1,478,328.33	\$ 985,072.59
5	2027 (Construction)	0.192	0.708	4.200	3.500	\$ 2,956,656.67	\$ 1,841,257.18
6	2028	0.288	1.063	6.300	5.250	\$ 4,434,985.00	\$ 2,581,201.65
7	2029	0.288	1.063	6.300	5.250	\$ 4,434,985.00	\$ 2,412,337.99
8	2030	0.275	1.031	6.260	5.250	\$ 4,263,343.40	\$ 2,167,267.60
9	2031	0.288	1.063	6.300	5.250	\$ 4,434,985.00	\$ 2,107,029.43
10	2032	0.288	1.063	6.300	5.250	\$ 4,434,985.00	\$ 1,969,186.38
11	2033	0.288	1.063	6.300	5.250	\$ 4,434,985.00	\$ 1,840,361.10
12	2034	0.288	1.063	6.300	5.250	\$ 4,434,985.00	\$ 1,719,963.65
13	2035	0.388	1.063	6.100	5.250	\$ 5,579,545.00	\$ 2,022,283.88
14	2036	0.388	1.063	6.100	5.250	\$ 5,579,545.00	\$ 1,889,984.93
15	2037	0.388	1.063	6.100	5.250	\$ 5,579,545.00	\$ 1,766,341.06
16	2038	0.388	1.063	6.100	5.250	\$ 5,579,545.00	\$ 1,650,786.03
17	2039	0.388	1.063	6.800	5.250	\$ 5,633,585.00	\$ 1,557,733.20
18	2040	0.288	1.063	6.200	5.250	\$ 4,427,265.00	\$ 1,144,089.41
19	2041	0.288	1.063	6.200	5.250	\$ 4,427,265.00	\$ 1,069,242.44
20	2042	0.288	1.063	6.200	5.250	\$ 4,427,265.00	\$ 999,292.00
21	2043	0.288	1.063	6.200	(8.850)	\$ 4,362,405.00	\$ 920,235.74
22	2044	0.288	1.063	6.300	5.250	\$ 4,434,985.00	\$ 874,342.30
23	2045	0.388	1.063	6.200	5.250	\$ 5,587,265.00	\$ 1,029,448.98
24	2046	0.388	1.063	6.200	5.250	\$ 5,587,265.00	\$ 962,101.85
25	2047	0.388	1.063	6.200	5.250	\$ 5,587,265.00	\$ 899,160.61
26	2048	0.388	1.063	6.200	5.250	\$ 5,587,265.00	\$ 840,337.02
27	2049	0.388	1.063	6.200	5.250	\$ 5,587,265.00	\$ 785,361.70
28	2050	0.369	1.030	6.125	5.250	\$ 5,342,766.60	\$ 701,863.85
29	2051	0.388	1.063	6.100	5.250	\$ 5,579,545.00	\$ 685,017.52
30	2052	0.388	1.063	6.100	5.250	\$ 5,579,545.00	\$ 640,203.29
Total Savings (7% Discount)							\$ 38,061,503.34

Table 3. Value of Reduced Crashes

Methodology

To quantify the benefits of improved reliability, the projected *Missouri Freight Corridor* volumes were utilized from the 2022 Freight Plan² and 2022 Freight Executive Summary³, in addition to MoDOT's incident management delay report for the Project corridor. Average existing delays per incident were derived, and the projected average annual incident delay was calculated using an assumed 60% reduction in delay due to the added lane/capacity.

² [MoDOT 2022 State Freight & Rail Plan](#)

³ [MoDOT 2022 State Freight & Rail Plan Executive Summary](#)

A 60% reduction was derived as a conservation measure of the HCM Lane Closure Severity Index (LCSI), which results in a 62% decrease in impact for lane closures from 2:1 (LCSI=2.00) vs. 3:2 (LCSI=0.75).

Methodology

The existing and proposed safety analysis was developed based on the AASHTO Highway Safety Manual (HSM) methodology and fine-tuned using MoDOT calibration factors based on facility type for the corridor. The most recent 3-year crash history was utilized in the analysis, including calendar years 2018 - 2021. The existing crash prediction was developed by fine tuning the model to existing parameters: 4 Lane Divided Highway, Median Width, Guard Cable, Clearzone & Guardrail, etc. The proposed improvement safety model built upon this existing analysis, and utilized modification factors that account for the improvements: Widening from 4 to 6 Lanes, Installation of Permanent Concrete Barrier, Added Flyover & Ramp, etc.

The following Crash Modification Factors (CMF) were utilized in the HSM analysis:

- CMF ID 206 – Conversion of Stop Controlled to Single Lane Roundabout (0.28)
- CMF ID 9821 – Install Right In Right Out at Stop Controlled Intersection (0.55)
- Widen from 4 to 6 Lanes – Crash Modification automatically computed with HSM ISATe Analysis Spreadsheet

HSM Freeway Analysis Methodology did not accurately account for the elimination of queues and the resulting rear end and passing/sideswipe crashes currently occurring at the westbound I-44 offramp to MO 13. To quantify the crash savings, these two crash types (rear-end & sideswipe) were investigated further with a review of the law enforcement crash report, with only those reports that identified the cause being attributed to traffic congestion/queues being used in the Queue Crash Reduction Analysis. The average queuing crashes per year (by crash severity) was derived, and the proposed queuing crashes per year was calculated assuming an 75% reduction in these crash types as a result of reduced congestion due to of added lanes (capacity). It should be noted that the project will likely not eliminate all rear-end and sideswipe crashes, thus a conservative 75% reduction factor was used for the Build Scenario.

3. Emissions Reduction

In the Build Scenario, the project is anticipated to reduce vehicular Emissions through reduced vehicle delay times as a result of added capacity, consolidation of at-grade intersections, and the MO 13 interchange reconfiguration. Reduced emissions are anticipated as a result of the project improvements, resulting in an emissions reduction benefit of approximately **\$3.1M** at a 7% discount rate for Non-CO₂ emissions and 3% for CO₂ emissions, as summarized below in **Table**

4.Value of Reduced Emissions.

- NO_x Emissions – 172.7 Metric Tons
- PM_{2.5} Emissions – 5.4 Metric Tons
- CO₂ Emissions – 64,200 Metric Tons

Methodology

The project's benefits of reduced delays and reduced travel times are expected to also result in a reduction of vehicle emissions. While the project will not reduce over Vehicle Miles Traveled (VMT), the project will reduce vehicle idle times, and as a result reduce emissions output. Reduced vehicle idling will occur through the MO 13 Interchange Improvements and reduction in Incident Delays on I-44:

- The elimination of the MO 13/Norton Rd signalized intersection, and improved MO 13/I-44 signalized ramp intersections will reduce intersection control delay (idle time)⁴.
- The I-44 capacity expansion of additional lanes is expected reduce congestion during incident occurrences, and result in reduced vehicle idle time. See **Freight Reliability** for additional details on this reduction in congestion.

Vehicular emissions output (tons) was derived from the above idle delays and the US EPA Emissions rates for Idling Passenger Vehicles and Heavy-Duty Trucks⁵ rates for Non-CO₂ emissions. CO₂ Emissions output (tons) was derived from the above idle delays, Argonne National Laboratory Fuel Consumption rates⁶, and the US EPA Greenhouse Gas Emissions from a Typical Passenger Vehicle⁷ rates. Emission tonnage was converted from short tons to metric tons, then to monetized values using the "Damage Costs for Emissions" rates provided in the BCA Guidance. Non-CO₂ emissions (NO_x, PM_{2.5}) were discounted a 7% discount rate while CO₂ emissions were discounted at a 3% discount rate.

Value of Reduced Emissions															
Year	Calendar Year	Total Average Annual Passenger Vehicle Intersection Control Delay Savings (hrs)	Total Average Annual Truck Intersection Control Delay Savings (hrs)	Reduction in Annual Corridor Incident Delays for Passenger Vehicles (Hours) ²	Reduction in Annual Corridor Incident Delays for Trucks (Hours) ²	Passenger Vehicles			Heavy-Duty Trucks			Un-Discounted Emissions Savings (excluding CO ₂)	Undiscounted CO ₂ Emissions Savings	Discounted Cost Savings (Non CO ₂ @ 7% Discount + CO ₂ @ 3% Discount)	
						NO _x	PM _{2.5}	CO ₂	NO _x	PM _{2.5}	CO ₂				
0	2022	-	-	-	-	\$ -	N/A	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
1	2023	-	-	-	-	\$ -	N/A	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2	2024	-	-	-	-	\$ -	N/A	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
3	2025 (Construction)	-	-	-	-	\$ -	N/A	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
4	2026 (Construction)	15,737	44,790	0.74	0.26	\$ 862.49	N/A	\$ 2,889.35	\$ 23,578.16	\$ 37,242.90	\$ 25,791.77	\$ 61,683.55	\$ 28,681.12	\$ 64,428.76	
5	2027 (Construction)	29,235	83,207	1.12	0.39	\$ 1,630.84	N/A	\$ 5,468.76	\$ 44,583.24	\$ 70,281.77	\$ 48,817.31	\$ 116,495.85	\$ 54,286.07	\$ 121,765.15	
6	2028	32,594	92,768	1.12	0.39	\$ 1,850.12	N/A	\$ 6,210.01	\$ 50,577.92	\$ 79,607.27	\$ 55,434.35	\$ 132,035.30	\$ 61,644.36	\$ 112,723.33	
7	2029	35,953	102,328	1.12	0.39	\$ 2,075.97	N/A	\$ 6,974.54	\$ 56,752.33	\$ 89,211.32	\$ 62,259.13	\$ 148,039.63	\$ 69,233.67	\$ 118,182.28	
8	2030	39,312	111,889	1.12	0.39	\$ 2,321.22	N/A	\$ 7,762.33	\$ 63,457.09	\$ 99,099.79	\$ 69,291.67	\$ 164,878.10	\$ 77,054.00	\$ 122,986.01	
9	2031	42,671	121,450	1.12	0.39	\$ 2,519.56	N/A	\$ 8,573.40	\$ 68,879.30	\$ 107,567.57	\$ 76,531.94	\$ 178,966.43	\$ 85,105.34	\$ 125,458.60	
10	2032	46,031	131,010	1.12	0.39	\$ 2,717.90	N/A	\$ 9,567.20	\$ 74,301.51	\$ 116,035.34	\$ 85,403.35	\$ 193,054.75	\$ 94,970.55	\$ 127,886.68	
11	2033	49,390	140,571	1.12	0.39	\$ 2,916.23	N/A	\$ 10,436.44	\$ 79,723.73	\$ 124,503.12	\$ 93,163.00	\$ 207,143.08	\$ 103,599.44	\$ 128,947.10	
12	2034	52,749	150,131	1.12	0.39	\$ 3,114.57	N/A	\$ 11,328.96	\$ 85,145.94	\$ 132,970.89	\$ 101,130.38	\$ 221,231.40	\$ 112,459.35	\$ 129,411.03	
13	2035	56,108	159,692	1.12	0.39	\$ 3,312.91	N/A	\$ 12,244.76	\$ 90,568.16	\$ 141,438.66	\$ 109,305.52	\$ 235,319.73	\$ 121,550.27	\$ 129,346.11	
14	2036	59,467	169,253	1.12	0.39	\$ 3,511.24	N/A	\$ 13,183.82	\$ 95,990.37	\$ 149,906.44	\$ 117,688.40	\$ 249,408.05	\$ 130,872.22	\$ 128,814.08	
15	2037	62,826	178,813	1.12	0.39	\$ 3,709.58	N/A	\$ 14,146.16	\$ 101,412.58	\$ 158,374.21	\$ 126,279.02	\$ 263,496.37	\$ 140,425.18	\$ 127,871.22	
16	2038	66,185	188,374	1.12	0.39	\$ 3,907.91	N/A	\$ 15,131.76	\$ 106,834.80	\$ 166,841.99	\$ 135,077.40	\$ 277,584.70	\$ 150,209.16	\$ 126,568.77	
17	2039	69,545	197,935	1.12	0.39	\$ 4,106.25	N/A	\$ 16,140.64	\$ 112,257.01	\$ 175,309.76	\$ 144,083.51	\$ 291,673.02	\$ 160,224.16	\$ 124,953.34	
18	2040	72,904	207,495	1.12	0.39	\$ 4,304.59	N/A	\$ 17,125.34	\$ 117,679.22	\$ 183,777.53	\$ 155,551.75	\$ 305,761.35	\$ 172,977.09	\$ 123,715.11	
19	2041	76,263	217,056	1.12	0.39	\$ 4,502.92	N/A	\$ 18,092.40	\$ 123,101.44	\$ 192,245.31	\$ 165,077.23	\$ 319,849.67	\$ 183,569.63	\$ 121,582.35	
20	2042	79,622	226,616	1.12	0.39	\$ 4,701.26	N/A	\$ 19,582.73	\$ 128,523.65	\$ 200,713.08	\$ 174,810.46	\$ 333,938.00	\$ 194,393.19	\$ 119,251.30	
21	2043	82,981	236,177	1.12	0.39	\$ 4,899.60	N/A	\$ 20,696.33	\$ 133,945.87	\$ 209,180.86	\$ 184,751.44	\$ 348,026.32	\$ 205,447.77	\$ 116,753.63	
22	2044	86,340	245,738	1.12	0.39	\$ 5,097.93	N/A	\$ 21,833.21	\$ 139,368.08	\$ 217,648.63	\$ 194,900.16	\$ 362,114.64	\$ 216,733.37	\$ 114,117.93	
23	2045	89,699	255,298	1.12	0.39	\$ 5,296.27	N/A	\$ 22,993.36	\$ 144,790.29	\$ 226,116.41	\$ 205,256.62	\$ 376,202.97	\$ 228,249.98	\$ 111,369.96	
24	2046	93,058	264,859	1.12	0.39	\$ 5,494.61	N/A	\$ 24,176.78	\$ 150,212.51	\$ 234,584.18	\$ 215,820.84	\$ 390,291.29	\$ 239,997.61	\$ 108,532.91	
25	2047	96,418	274,419	1.12	0.39	\$ 5,692.94	N/A	\$ 25,717.46	\$ 155,634.72	\$ 243,051.95	\$ 229,574.28	\$ 404,379.62	\$ 255,291.74	\$ 106,161.15	
26	2048	99,777	283,980	1.12	0.39	\$ 5,891.28	N/A	\$ 26,959.06	\$ 161,056.93	\$ 251,519.73	\$ 240,657.86	\$ 418,467.94	\$ 267,616.92	\$ 103,188.68	
27	2049	103,136	293,541	1.12	0.39	\$ 6,089.62	N/A	\$ 28,223.93	\$ 166,479.15	\$ 259,987.50	\$ 251,949.18	\$ 432,556.27	\$ 280,173.12	\$ 100,183.25	
28	2050	106,495	303,101	1.12	0.39	\$ 6,287.95	N/A	\$ 29,512.08	\$ 171,901.36	\$ 268,455.28	\$ 263,448.25	\$ 446,644.59	\$ 292,960.33	\$ 97,159.77	
29	2051	109,854	312,662	1.12	0.39	\$ 6,486.29	N/A	\$ 30,823.49	\$ 177,323.58	\$ 276,923.05	\$ 275,155.07	\$ 460,732.91	\$ 305,978.56	\$ 94,131.47	
30	2052	113,213	322,222	1.12	0.39	\$ 6,684.63	N/A	\$ 32,158.18	\$ 182,745.79	\$ 285,390.82	\$ 287,069.63	\$ 474,821.24	\$ 319,227.81	\$ 91,110.08	
Total Savings (Non CO ₂ @ 7% Discount + CO ₂ @ 3% Discount)													\$ 3,096,600.04		

Table 4. Value of Reduced Emissions

⁴ Vehicle Idle Time is a metric used to quantify the time a vehicle is delayed due to an intersection (ie. Yield Sign, Stop Sign, Signal, etc)

⁵ [Idling Vehicle Emissions for Passenger Cars, Light-Duty Trucks, and Heavy-Duty Trucks. US EPA. October 2008](#)

⁶ [Idling Reduction Savings Calculator. Argonne National Laboratory. April 2022](#)

⁷ [Greenhouse Gas Emissions from a Typical Passenger Vehicle. US EPA. March 2018.](#)

4. Operations & Maintenance

In the Build Scenario, the project is anticipated to reduce overall Operations & Maintenance Costs over the useful life of the project improvements, including the following maintenance and operations activities:

- Elimination of Guard cable maintenance costs (replaced with Permanent Barrier)
- Reduced Mowing & Landscaping as a result of the added lanes in median
- Reduced Signing Maintenance (new signing installed)
- Reduced Pothole and Full-Depth Pavement Repairs as a result of pavement reconstruction
- Elimination of Signal operations & maintenance due to the Grade-Separation of the Norton Rd Grade-Separation

The project, however, is anticipated to result in added maintenance cost for the added I-44 lanes and new SB-EB Flyover and have been included in the analysis as disbenefits. These activities include:

- Added Lighting Operations/Maintenance due to added lighting at MO 13 interchange
- Sweeping/Debris Removal along the I-44 Median Barrier
- Added Striping as a result of added lane miles
- Increased Snow Removal as a result of added lane miles
- Increased Bridge Structure Flushing Maintenance as a result in increasing bridge deck surface area
- The project is expected to result in an overall increase in a reduction of Operations and Maintenance costs of approximately **\$5.4M** at a 7% discount rate, as summarized in **Table 5.Value of Reduced Operations & Maintenance.**

Value of Reduced Operations & Maintenance															Undiscounted Cost Savings	Discounted Cost Savings (7% Discount)
Year	Calendar Year	Mowing & Landscaping	Guardcable	Lighting	Sweeping/Debris Removal	Striping	Signing	Snow Removal	Pothole Repairs	Full Depth Pavement Repairs	Signals	Bridge Structure Flushing	Residual Service Life			
0	2022	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
1	2023	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2	2024	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
3	2025 (Construction)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
4	2026 (Construction)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
5	2027 (Construction)	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
6	2028	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 5,000.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 43,923.20	\$ 25,563.70	
7	2029	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 5,000.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 43,923.20	\$ 23,891.31	
8	2030	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 5,000.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 43,923.20	\$ 22,328.33	
9	2031	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 5,000.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 43,923.20	\$ 20,867.60	
10	2032	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 5,000.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 43,923.20	\$ 19,502.43	
11	2033	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 5,000.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 43,923.20	\$ 18,226.57	
12	2034	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 5,000.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 43,923.20	\$ 17,034.17	
13	2035	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 5,000.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 43,923.20	\$ 15,919.79	
14	2036	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 5,000.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 43,923.20	\$ 14,878.31	
15	2037	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 2,500.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 41,423.20	\$ 13,113.52	
16	2038	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 2,500.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 41,423.20	\$ 12,255.63	
17	2039	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 2,500.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 41,423.20	\$ 11,453.86	
18	2040	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 2,500.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 41,423.20	\$ 10,704.54	
19	2041	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 2,500.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 41,423.20	\$ 10,004.24	
20	2042	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 2,500.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 41,423.20	\$ 9,349.76	
21	2043	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 2,500.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 41,423.20	\$ 8,738.09	
22	2044	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 2,500.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 41,423.20	\$ 8,166.44	
23	2045	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 2,500.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 41,423.20	\$ 7,632.19	
24	2046	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 2,500.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 41,423.20	\$ 7,132.89	
25	2047	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 2,500.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 41,423.20	\$ 6,666.25	
26	2048	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 2,500.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 41,423.20	\$ 6,230.14	
27	2049	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 2,500.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 41,423.20	\$ 5,822.56	
28	2050	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 2,500.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 41,423.20	\$ 5,441.65	
29	2051	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 2,500.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 41,423.20	\$ 5,085.65	
30	2052	\$ 3,232.47	\$ 5,667	\$ (500.00)	\$ (1,806.52)	\$ (4,712.00)	\$ 2,042.50	\$ (10,000.00)	\$ 2,500.00	\$ 35,000.00	\$ 10,000.00	\$ (4,830.40)	\$ -	\$ 43,769,438.80	\$ 43,810,862.00	\$ 5,026,907.71
Total Savings (7% Discount)															\$	\$ 5,332,917.34

Table 5.Value of Reduced Operations & Maintenance

Methodology

Operations and Maintenance reduction and added disbenefits were derived from the annualized costs provided by MoDOT along the existing I-44 and MoDOT's asset Management Program. Project benefits and disbenefits were calculated in the analysis based on frequency of activities, as provided by MoDOT, and as detailed in the BCA spreadsheet. The difference between the Build and No-Build Scenario benefits are automatically computed within the excel formula; the table above summarizes the overall project benefits & disbenefits (See BCA excel file). No Operations & Maintenance benefits are anticipated to occur until Year 2028, after construction is complete.

Residual Service Life benefits are quantified under the Operations & Maintenance section. See **Residual Service Life** for details on how these benefits were derived.

5. State of Good Repair

As a result of aging and failing pavements and structures, the project proposes a complete replacement of infrastructure throughout the project corridor. The Build Scenario is anticipated to result in significant savings for the project corridor, including the State of Good Repair Costs of Bridge Sealing/Preservation and Pavement Maintenance/Rehabilitation.

As a result of the project, the analysis projects State of Good Repair benefits of **\$0.5M** at a 7% discount rate, as summarized in **Table 6. Value of State of Good Repair**.

Value of State of Good Repair					
		Bridge Deck Preservation	Pavement Maintenance & Rehabilitation	Undiscounted Cost Savings	Discounted Cost Savings (7% Discount)
0	2022	\$ -	\$ -	\$ -	\$ -
1	2023	\$ -	\$ -	\$ -	\$ -
2	2024	\$ -	\$ 2,203,734.00	\$ 2,203,734.00	\$ 1,681,218.12
3	2025 (Construction)	\$ 1,534,500.00	\$ -	\$ 1,534,500.00	\$ 1,094,077.29
4	2026 (Construction)	\$ -	\$ -	\$ -	\$ -
5	2027 (Construction)	\$ -	\$ -	\$ -	\$ -
6	2028	\$ -	\$ -	\$ -	\$ -
7	2029	\$ -	\$ -	\$ -	\$ -
8	2030	\$ 1,534,500.00	\$ -	\$ 1,534,500.00	\$ 780,061.99
9	2031	\$ -	\$ -	\$ -	\$ -
10	2032	\$ (4,454,080.00)	\$ 2,203,734.00	\$ (2,250,346.00)	\$ (999,180.54)
11	2033	\$ -	\$ -	\$ -	\$ -
12	2034	\$ -	\$ -	\$ -	\$ -
13	2035	\$ 1,534,500.00	\$ -	\$ 1,534,500.00	\$ 556,173.42
14	2036	\$ -	\$ -	\$ -	\$ -
15	2037	\$ (4,454,080.00)	\$ (902,880.00)	\$ (5,356,960.00)	\$ (1,695,876.35)
16	2038	\$ -	\$ -	\$ -	\$ -
17	2039	\$ -	\$ -	\$ -	\$ -
18	2040	\$ 1,534,500.00	\$ 2,203,734.00	\$ 3,738,234.00	\$ 966,030.70
19	2041	\$ -	\$ -	\$ -	\$ -
20	2042	\$ (4,454,080.00)	\$ -	\$ (4,454,080.00)	\$ (1,005,344.49)
21	2043	\$ -	\$ -	\$ -	\$ -
22	2044	\$ -	\$ -	\$ -	\$ -
23	2045	\$ 1,534,500.00	\$ -	\$ 1,534,500.00	\$ 282,730.36
24	2046	\$ -	\$ -	\$ -	\$ -
25	2047	\$ (4,454,080.00)	\$ (902,880.00)	\$ (5,356,960.00)	\$ (862,097.54)
26	2048	\$ -	\$ 2,203,734.00	\$ 2,203,734.00	\$ 331,446.47
27	2049	\$ -	\$ -	\$ -	\$ -
28	2050	\$ 1,534,500.00	\$ -	\$ 1,534,500.00	\$ 201,582.84
29	2051	\$ -	\$ -	\$ -	\$ -
30	2052	\$ (4,454,080.00)	\$ (3,305,601.00)	\$ (7,759,681.00)	\$ (890,354.55)
Total Savings (7% Discount)					\$ 440,467.72

Table 6. Value of State of Good Repair

Methodology

Bridge Preservation costs and frequency were provided by MoDOT. Due to construction of new structures, the 2025 bridge sealing can be omitted, while additional preservation activities are considered a disbenefit occurring on 5-year cycles to maintain and extend service life.

Pavement Maintenance and Rehabilitation benefits will be realized throughout the project life. The planned 2024 mainline resurfacing will be omitted as a result of the planned pavement reconstruction beginning in 2025. Additionally, the analysis assumes concrete pavement will be installed to limit future traffic disruptions, delays, and limit worker safety exposure for future asphalt pavement maintenance/overlays occurring on MoDOT's 8-year asset management cycle. A concrete surface diamond grind will be required in Years 10 and 20, with surface improvements/asphalt overlay anticipated in Year 30 to extend the useful pavement life and State of Good Repair.

6. Freight Reliability

Adding capacity and additional lanes creates numerous additional benefits that improves the overall corridor resiliency and reliability of the transportation network. The 2022 MoDOT State Freight Plan identifies I-44 as the top freight mover in Missouri, and projects I-44 to continue to move freight at an ever-increasing rate, increasing total tonnage by 2.5 Billion and value by \$10.3 Billion by Year 2045. Incidents that occur along this corridor result in significant delays and interrupt the local, regional, and national movement of freight. The Project will construct an additional lane in each direction, allowing for most incidents to result in only 33.3% of the directional lane closure, compared to 50.0% existing directional lane closure.

The resulting freight reliability benefits are expected to result in approximately **\$14.3M** at 7% discount rate, as summarized in **Table 7. Value of Improved Freight Reliability.**

Methodology

To quantify the benefits of improved reliability, the projected *Missouri Freight Corridor* volumes were utilized from the 2022 Freight Plan⁸ and 2022 Freight Executive Summary⁹, in addition to MoDOT's incident management delay report for the Project corridor. Average existing delays per incident were derived, and the projected average annual incident delay was calculated using an assumed 60% reduction in delay due to the added lane/capacity.

A 60% reduction was derived as a conservative measure of the HCM Lane Closure Severity Index (LCSI), which results in a 62% decrease in impact for lane closures from 2:1 (LCSI=2.00) vs. 3:2 (LCSI=0.75).

⁸ [MoDOT 2022 State Freight & Rail Plan](#)

⁹ [MoDOT 2022 State Freight & Rail Plan Executive Summary](#)

Value of Reduced Incident Delays & Freight Reliability						
		I-44 Average Annual Truck Freight (Tons Per Hour)	I-44 Average Annual Truck Freight Value (\$ Per Hour)	Reduction in Annual Corridor Incident Delays (Hours) ³	Undiscounted Cost Savings	Discounted Cost Savings (7% Discount)
0	2022	190,682	\$ 596,567	-	\$ -	\$ -
1	2023	201,251	\$ 640,115	-	\$ -	\$ -
2	2024	211,821	\$ 683,663	-	\$ -	\$ -
3	2025 (Construction)	222,391	\$ 727,211		\$ -	\$ -
4	2026 (Construction)	232,961	\$ 770,759	0.50	\$ 387,420.47	\$ 258,154.62
5	2027 (Construction)	243,531	\$ 814,307	1.01	\$ 818,619.67	\$ 509,795.19
6	2028	254,101	\$ 857,856	1.51	\$ 1,293,597.59	\$ 752,885.58
7	2029	264,671	\$ 901,404	1.51	\$ 1,359,265.68	\$ 739,350.47
8	2030	275,241	\$ 944,952	1.51	\$ 1,424,933.77	\$ 724,364.07
9	2031	285,811	\$ 988,500	1.51	\$ 1,490,601.86	\$ 708,174.20
10	2032	296,381	\$ 1,032,048	1.51	\$ 1,556,269.95	\$ 691,002.47
11	2033	306,951	\$ 1,075,596	1.51	\$ 1,621,938.03	\$ 673,046.62
12	2034	317,521	\$ 1,119,144	1.51	\$ 1,687,606.12	\$ 654,482.75
13	2035	328,091	\$ 1,162,692	1.51	\$ 1,753,274.21	\$ 635,467.26
14	2036	338,661	\$ 1,206,240	1.51	\$ 1,818,942.30	\$ 616,138.69
15	2037	349,231	\$ 1,249,789	1.51	\$ 1,884,610.39	\$ 596,619.39
16	2038	359,800	\$ 1,293,337	1.51	\$ 1,950,278.48	\$ 577,017.03
17	2039	370,370	\$ 1,336,885	1.51	\$ 2,015,946.57	\$ 557,426.02
18	2040	380,940	\$ 1,380,433	1.51	\$ 2,081,614.66	\$ 537,928.78
19	2041	391,510	\$ 1,423,981	1.51	\$ 2,147,282.74	\$ 518,596.88
20	2042	402,080	\$ 1,467,529	1.51	\$ 2,212,950.83	\$ 499,492.14
21	2043	412,650	\$ 1,511,077	1.51	\$ 2,278,618.92	\$ 480,667.56
22	2044	423,220	\$ 1,554,625	1.51	\$ 2,344,287.01	\$ 462,168.26
23	2045	433,790	\$ 1,598,174	1.51	\$ 2,409,955.10	\$ 444,032.24
24	2046	444,360	\$ 1,641,722	1.51	\$ 2,475,623.19	\$ 426,291.16
25	2047	454,930	\$ 1,685,270	1.51	\$ 2,541,291.28	\$ 408,970.94
26	2048	465,500	\$ 1,728,818	1.51	\$ 2,606,959.36	\$ 392,092.46
27	2049	476,070	\$ 1,772,366	1.51	\$ 2,672,627.45	\$ 375,672.04
28	2050	486,640	\$ 1,815,914	1.51	\$ 2,738,295.54	\$ 359,721.99
29	2051	497,210	\$ 1,859,462	1.51	\$ 2,803,963.63	\$ 344,251.05
30	2052	507,779	\$ 1,903,010	1.51	\$ 2,869,631.72	\$ 329,264.78
Total Savings (7% Discount)						\$ 14,273,074.63

Table 7. Value of Improved Freight Reliability

7. Noise

The Project proposes mitigating highway sound pollution to the nearby community through the implementation of Noise Walls along the corridor. MoDOT recently conducted a Noise Study on I-44 and identifies areas where potential noise walls are recommended, most specifically near residential areas. The report recommends that the I-44 corridor from MO 13 to Route H (Glenstone Ave) implement noise walls on both the north and south sides, effectively reducing noise transfer to the nearby areas.

The project is anticipated to result in noise reduction benefits in approximately **\$3.3M** at a 7% discount rate, as summarized below in **Table 8. Value of Reduced Noise**.

Methodology

Noise benefits were developed using the MoDOT Noise Study Report and the I-44 Traffic Volumes to develop Vehicle Miles Traveled (VMT). Length of noise benefits (2.5 miles) were

only considered at the locations where walls are proposed and feasible along I-44 per the MoDOT Noise Study Report.

The BCA Guidance provides recommendation for quantifying noise and congestion reduction. To quantify the benefits of this project, these monetized values were applied to the annual VMT for the locations where noise walls will be implemented.

Value of Reduced Noise					
Year	Calendar Year	Total Average Annual Passenger Car VMT	Total Average Annual Truck VMT	Undiscounted Cost Savings	Discounted Cost Savings (7% Discount)
0	2022	-	-	\$ -	\$ -
1	2023	-	-	\$ -	\$ -
2	2024	-	-	\$ -	\$ -
3	2025 (Construction)	-	-	\$ -	\$ -
4	2026 (Construction)	14293650.3	4110737.0	\$ 185,851.17	\$ 123,840.48
5	2027 (Construction)	23591717.8	8288981.9	\$ 365,862.91	\$ 227,841.03
6	2028	23879924.5	8390243.7	\$ 370,332.45	\$ 215,536.86
7	2029	24168131.2	8491505.5	\$ 374,801.99	\$ 203,867.45
8	2030	24456337.9	8592767.4	\$ 379,271.53	\$ 192,802.41
9	2031	24744544.6	8694029.2	\$ 383,741.07	\$ 182,312.62
10	2032	25032751.3	8795291.0	\$ 388,210.61	\$ 172,370.15
11	2033	25320958.0	8896552.8	\$ 392,680.15	\$ 162,948.30
12	2034	25609164.7	8997814.6	\$ 397,149.69	\$ 154,021.50
13	2035	25897371.4	9099076.4	\$ 401,619.24	\$ 145,565.29
14	2036	26185578.1	9200338.3	\$ 406,088.78	\$ 137,556.32
15	2037	26473784.8	9301600.1	\$ 410,558.32	\$ 129,972.25
16	2038	26761991.5	9402861.9	\$ 415,027.86	\$ 122,791.77
17	2039	27050198.2	9504123.7	\$ 419,497.40	\$ 115,994.53
18	2040	27338404.9	9605385.5	\$ 423,966.94	\$ 109,561.11
19	2041	27626611.6	9706647.3	\$ 428,436.48	\$ 103,473.02
20	2042	27914818.3	9807909.1	\$ 432,906.02	\$ 97,712.59
21	2043	28203025.0	9909171.0	\$ 437,375.56	\$ 92,263.01
22	2044	28491231.7	10010432.8	\$ 441,845.10	\$ 87,108.27
23	2045	28779438.4	10111694.6	\$ 446,314.64	\$ 82,233.11
24	2046	29067645.1	10212956.4	\$ 450,784.18	\$ 77,623.00
25	2047	29355851.8	10314218.2	\$ 455,253.72	\$ 73,264.15
26	2048	29644058.5	10415480.0	\$ 459,723.26	\$ 69,143.40
27	2049	29932265.3	10516741.8	\$ 464,192.81	\$ 65,248.25
28	2050	30220472.0	10618003.7	\$ 468,662.35	\$ 61,566.82
29	2051	30508678.7	10719265.5	\$ 473,131.89	\$ 58,087.82
30	2052	30796885.4	10820527.3	\$ 477,601.43	\$ 54,800.53
Total Savings (7% Discount)					\$ 3,319,506.04

Table 8. Value of Reduced Noise

8. Pedestrian & Cycling Facilities

The project will implement numerous modal improvements, including for pedestrians and cyclists. The resulting benefits will provide upgraded & safer facilities, improved connectivity for transit, and added health benefits.

The BCA Guidance provides recommendation for quantifying improved pedestrian and cycling facilities. Benefits were quantified for the following project improvements, based on an assumed, conservative ADT at each location and a 1.00% annual increase:

- 6' Sidewalk Replacement at National Ave Under I-44 (Added 1' width each side)
- 6' Sidewalk Replacement at Grant Ave Under I-44 (Added 1' width each side)
- 6' Sidewalk Replacement at Broadway Ave Under I-44 (Added 1' width each side)
- New Pea Creek Ridge Trail & I-44 Underpass (New 10' wide multi-use trail)
- New 6' Sidewalk along the Norton Road Realignment & MO 13 Underpass

The Project is anticipated to result in approximately **\$54,000** in Pedestrian & Cycling Facility benefits at a 7% discount rate, as summarized below in **Table 8. Value of Improved Pedestrian Facilities.**

While Health & Mortality Benefits were not quantified in this analysis, it is expected that additional benefits would arise as a result of added pedestrian and cyclist trips on the new Pedestrian Underpass Section of the Future Pea Creek Ridge Trail. Until the full trail is connected, user benefits may be limited, however the improvements implemented in this project are anticipated to result in significant Health and Mortality Reduction Benefits in the future.

Value Pedestrian & Cycling Facility Improvements									
		Pedestrian Facility Improvements at National Ave	Pedestrian Facility Improvements at Grant Ave	Pedestrian Facility Improvements at Broadway Ave	Pedestrian Facility Improvements at Norton Road (Rte 13 Interchange Improvements)	Cycling Facility Improvements at Peak Creek Ridge Trail & I- 44 Underpass	Undiscounted Cost Savings	Discounted Cost Savings (7% Discount)	
0	2022	-	-	-	-	-	\$ -	\$ -	
1	2023	-	-	-	-	-	\$ -	\$ -	
2	2024	-	-	-	-	-	\$ -	\$ -	
3	2025 (Construction)	-	-	-	-	-	\$ -	\$ -	
4	2026 (Construction)	-	-	-	-	-	\$ -	\$ -	
5	2027 (Construction)	-	-	-	-	-	\$ -	\$ -	
6	2028	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 4,355.39	
7	2029	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 4,070.45	
8	2030	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 3,804.16	
9	2031	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 3,555.29	
10	2032	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 3,322.70	
11	2033	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 3,105.33	
12	2034	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 2,902.18	
13	2035	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 2,712.32	
14	2036	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 2,534.87	
15	2037	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 2,369.04	
16	2038	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 2,214.06	
17	2039	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 2,069.21	
18	2040	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 1,933.84	
19	2041	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 1,807.33	
20	2042	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 1,689.09	
21	2043	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 1,578.59	
22	2044	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 1,475.32	
23	2045	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 1,378.80	
24	2046	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 1,288.60	
25	2047	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 1,204.30	
26	2048	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 1,125.51	
27	2049	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 1,051.88	
28	2050	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 983.07	
29	2051	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 918.76	
30	2052	\$ 257.2	\$ 871.0	\$ 522.6	\$ 2,125.7	\$ 3,706.9	\$ 7,483.36	\$ 858.65	
Total Savings (7% Discount)								\$54,308.76	

Table 8. Value of Improved Pedestrian Facilities

V. Costs

1. Program and Capital Expenditures

According to MoDOT, OTO, and City of Springfield, the total project cost is **\$109,423,597**. The cost includes full program costs, including Design Engineering, Environmental Review, Right-of-Way, Utility Relocation, Capital Construction, and Construction Administration.

Project costs have been projected to start occurring in 2023, starting with Design Engineering & Environmental Reviews. Project construction is anticipated to take 33 months to complete, with commencement in April 2025 and completion the end of 2027, as detailed below in **Table 9**.

Project Costs & Schedule.

Program Costs & Schedule						
Cost	2022	2023	2024	2025	2026	2027
Design Engineering		\$ 6,983,685	\$ 2,327,895			
Right-of-Way			\$ 5,696,500			
Utilities				\$ 3,144,000		
Construction Administration				\$ 3,321,740	\$ 3,321,740	\$ 3,321,740
Capital Construction				\$ 27,102,099	\$ 27,102,099	\$ 27,102,099
Total Annual Program Cost	\$ -	\$ 6,983,685	\$ 8,024,395	\$ 33,567,839	\$ 30,423,839	\$ 30,423,839

Table 9. Project Costs & Schedule

2. Operations and Maintenance Costs

As part of MoDOT's asset management program, the agency seeks to preserve and maintain the integrity of infrastructure with early and periodic maintenance activities to extend the useful service life of capital improvements. Operation & Maintenance Costs utilized in the BCA were derived from MoDOT's historical maintenance & preservation costs along the regional I-44 project corridor, and from MoDOT's 2021 Asset Management Plan¹⁰.

3. Residual Value & Remaining Service Life

The project is anticipated to have a useful service life of 50 years, extending 20 years past the 30-year analysis period. Therefore, the residual value of project improvements was calculated within the **Operations & Maintenance** section and applied in 2052 (Year 30) of the analysis, accounting for remaining capital improvement infrastructure life. Since residual value is applied to Year 30 of the analysis period, it is discounted to a present value of **\$5.0M** using the 7% Discount Rate.

VI. Assumptions and Limiting Conditions

This economic analysis and projection of impacts is subject to the following limiting conditions and assumptions:

1. Information obtained from Crawford, Murphy & Tilly, Missouri Department of Transportation, City of Springfield, the Ozarks Transportation Organization, the State of Missouri, U.S. Department of Commerce, U.S. DOT, U.S. EPA and various secondary

¹⁰ https://epg.modot.org/files/e/e6/121.5.1.1.1_asset.pdf

sources is assumed to be reliable and accurate. However, this information cannot be guaranteed or construed to represent judgments by the consultant. Such information and the results of its application by the consultant are subject to change without notice.

2. The future course of Missouri and Greene County's regional economy as represented herein, are based on our current understanding of the market and representations made to us. The future courses of Missouri and Greene County's regional economies are difficult to predict, and any forecasts herein are subject to change, although we deem our projections as reasonable given current information available at the date of this analysis.
3. We have analyzed the current economic conditions in Missouri, Greene County, and the City of Springfield and have taken them into consideration in making long-term judgments. However, should the state or national economies suffer a major recession; this could have a material effect on our conclusion.