Benefit-Cost Analysis Supplementary Documentation

FY 2022 Bridge Investment Program (BIP) Bridge Projects Grant Application

The Iowa County Engineers Association and Iowa DOT: *BUILDING BRIDGES TODAY HELPING FEED AMERICA TOMORROW*

September 8, 2022

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Benefit-Cost Analysis Supplementary Documentation

1. Executive Summary

The Benefit-Cost Analysis (BCA) conducted for the Building Bridges Today, Helping Feed America Tomorrow grant application compares the costs associated with the proposed investments to the benefits of the project. To the extent possible, benefits have been monetized. Where not possible to assign a dollar value to a benefit, efforts have been made to quantify it. A qualitative discussion is also provided when a benefit is anticipated to be generated but is not easily monetized or quantified.

The transportation system in Iowa is a critical component of the state's agriculture businesses. These industries thrive because of the transportation infrastructure that helps move their goods from farm to market. The continued success of Iowa's producer economy requires the use of many municipal, county and state bridges which serve small communities, local traffic, and farm implements. This project will improve eight bridges in rural communities throughout Iowa. These individual projects are an important part of the region's transportation system due to the impact they have in the local and regional roadway network. As these bridges, all currently rated in poor condition or load posted, continue to deteriorate beyond safe use, critical agricultural and community routes are diminished. Table ES-1 summarizes the projected benefits expected from the project. Monetized and non-monetized benefits are provided.

Table ES-1: Project Improvements and Associated Benefits, Millions of 2020 Dollars

Benefit Category	Benefit (million$) Discounted at 7%
Travel Time Savings - Existing Vehicles	$49.18
Vehicle Operating Cost Savings - Existing Vehicles	$41.85
Emissions (Non-Carbon and Carbon)	$2.87
Safety Benefits	$43.97
Benefits to New Users	$37.57
Bridge Residual Value	$1.65
Operations & Maintenance Savings	$1.55
TOTAL Benefits	**$178.63**
Unquantified Benefits	
Project Administration and Management savings due to joint contract management and some shared administrative expenses, as well as shared experiences and support.	
Reduced Pavement and Asset Maintenance Costs as older, more repair-prone bridges are replaced with new structures less likely to need unexpected and costly repairs.	
Maintaining Local Agricultural Competitiveness as local farms and related businesses can use heavier and larger machinery, vehicles, and equipment, currently not allowed on several of these bridges.	
Improved Travel Time Reliability due to fewer crashes and added lanes and shoulders.	
Safer And More Reliable Mobility for local underserved Amish population.	

A 29-year period of analysis was used in the estimation of the project's benefits and costs. Construction of the eight bridges begins in either early 2023 or 2024 with the last bridge opening in 2027 and includes 25 years of operation. Benefits are monetized as thoroughly as possible with the data currently available.

The total project capital costs are $49.3 million undiscounted and are expected to be financed by Federal, State, and local funds.

Based on the analysis presented in the rest of this document, the project is expected to generate $178.6 million in discounted benefits and $36.7 million in discounted costs, using a 7 percent real discount rate (except for CO2 emissions, which are discounted at 3%, per USDOT guidance).

Therefore, the project is expected to generate a Net Present Value of $142.0million and a Benefit-Cost Ratio of 4.9, as presented in Table ES-2.

Table ES-2: Overall Results of the Benefit Cost Analysis, Millions of 2020 Dollars

Project Evaluation Metric	7% Discount Rate
Total Discounted Benefits	$178.6
Total Discounted Costs	$36.7
Net Present Value	$142.0
Benefit-Cost Ratio	4.9

In addition to the monetized benefits presented in section 7, the project would generate other benefits that have not been monetized due to lack of guidance/methodology from the U.S. Department of Transportation (USDOT) or a lack of relevant data. These benefits include:

- **Project Administration and Management**: Managing the reconstruction of eight bridges together is expected to have project administration and management efficiencies. Although each county will contract separately, as a team all eight can leverage the others' experiences and share some administrative tasks related to grant management. Additionally, there will be to the projects by having the Iowa DOT, as main project sponsor and having experience with larger grant awards, administer the grant funds to the individual Counties.
- **Pavement Condition and Asset Maintenance**: Due to their age and current condition, the existing bridges have higher risk of an unexpected need for costly repairs before the bridge can be replaced if BIP funds cannot assist in replacing these bridges in the next several years.
- **Local Agricultural Competitiveness**: Agricultural machinery, vehicles, and equipment continue to become bigger and heavier as farms continue to seek ways to improve productivity and remain competitive. Overtime, increasing numbers of local farms and related businesses may need to detour as average equipment size and weights increase, which will hamper some businesses' ability to compete.

- **Travel Time Reliability**: Reducing crashes on these bridges will decrease the variability of travel time across them. Inclusion of these benefits (inventory cost savings and travel time reliability) would increase the overall benefit-cost ratio. Additionally, the project will improve short and long-term employment by increasing access to existing and new jobs. Furthermore, it will create employment in project planning and construction.

Additionally, in many of these counties, there are Amish communities that depend on these bridges to connect with the larger local community. In these circumstances, the bridges are typically on the edge of Amish communities and when horse and buggy traffic is combined with vehicular traffic and narrow bridge designs, safety become a major concern. These communities are limited to how they obtain access to vital services and the rest of the community. Finally, detour routes are not always a suitable, safe alternative because they force horse and buggy onto higher speed and volume roadways.

The BCA also evaluated each bridge separately, shown in Table ES-3. Individual bridge Net Present Value varies from $51.6 million to -$1.3 million. (Table ES-4.)

Table ES-3: Individual Bridge Improvements and Benefits, Millions of 2020 Dollars

County	Travel Time Savings	Vehicle Operating Cost Savings	Emissions (Non-Carbon and Carbon)	Safety Benefits	Benefits to New Users	Bridge Residual Value	O&M Savings	Total Benefits
CEDAR	$13.57	$11.20	$0.76	$8.80	$16.90	$0.40	$0.03	$51.66
WASHINGTON	$0.86	$0.77	-$0.05	$1.50	$2.88	$0.30	$0.22	$6.48
DELAWARE	$4.17	-$0.37	-$0.24	$0.00	$3.39	$0.23	$0.27	$7.45
MONROE	$3.77	$1.91	$0.16	$3.92	$0.43	$0.16	$0.00	$10.35
BUCHANAN	$15.31	$14.19	$1.34	$17.31	$6.32	$0.13	$0.00	$54.60
HAMILTON	$8.97	$9.22	$0.87	$7.41	$2.03	$0.13	$0.02	$28.65
SCOTT	$2.08	$4.49	$0.07	$4.26	$4.41	$0.11	$1.02	$16.44
JONES	$0.43	$0.43	-$0.03	$0.77	$1.21	$0.19	$0.00	$3.00
All Bridges	**$49.18**	**$41.85**	**$2.87**	**$43.97**	**$37.57**	**$1.65**	**$1.55**	**$178.63**

Table ES-4: Individual Bridge Benefit Cost Analysis Results, Millions of 2020 Dollars

Bridge ID	Discounted Total Benefits	Discounted Individual Costs	Net Present Value - Individual	Individual B/C Ratio
CEDAR	$51.7	$8.6	$43.1	6.03
WASHINGTON	$6.5	$6.7	-$0.2	0.97
DELAWARE	$7.5	$5.2	$2.3	1.44
MONROE	$10.3	$3.6	$6.8	2.91
BUCHANAN	$54.6	$3.0	$51.6	18.50
HAMILTON	$28.6	$2.9	$25.8	10.03
SCOTT	$16.4	$2.6	$13.9	6.37
JONES	$3.0	$4.3	-$1.3	0.70
All Bridges	**$178.6**	**$36.7**	**$142.0**	**4.87**

Other important benefits which could not be monetized, by bridge include:

- **The Cutshaw Bridge in Buchanan County – Safer and More Reliable Mobility for local underserved Amish population.** Buchanan county is home to a large Amish community that regularly needs access to the bridge and the community has noted dangerous conditions.

- **The Rochester Cedar Bridge in Cedar County – Environmental Resiliency.** The current bridge is susceptible to damage from the river. In 2008 a flood created dual river channel resulting in scout issues. The new bridge will be designed to withstand higher flood frequency.

- **New Bridge at lake Delhi in Delaware County - Environmental Resiliency and Recovery.** In 2010, a flood caused catastrophic damage to the dam and the roadway on it. While the dam has been restored, a viable roadway connection over the lake has not been. Emergency services and school buses would be among those that would save 1.9 miles.

- **Vail Avenue Bridge in Hamilton County – Improved Network Resiliency.** The Vail Avenue bridge is a designated detour for I-35 and can be used as a detour for Highway 20 during weather closures.

- **Landis Road Bridge in Jones County – Improved Reliability.** In addition to improved reliability from fewer crashes (and the associated delays), the new Landis Road Bridge will have an additional lane. The added lane makes it easier for vehicles to pass slower moving agricultural vehicles when both are crossing the bridge.

- **Bridge Crossings at UPRR/BNSF Railroads Bridge in Monroe County - Environmental Resiliency and Recovery – Improve Connectivity.** The new bridge will increase connectivity of local agricultural businesses and heavy industry which is expected support increased economic activity.

- **The Skunk River Bridge in Washington County – Environmental Resiliency and Reduced Clean-up Costs.** The roadway approaches to the current bridge floods frequently and has been part of FEMA Disaster declarations 7 times since 1993. The new bridge will be raised to a level two feet above the 100-year flood elevation, which will significantly improve infrastructure resiliency by reducing flood damage and clean-up costs.

2. Introduction

This document provides detailed technical information on the economic analyses conducted in support of the grant application for the Iowa County Engineers Association (ICEA) and Iowa DOT (IDOT): Building Bridges Today Helping Feed America Tomorrow project.

Section 3, Methodological Framework, introduces the conceptual framework used in the Benefit-Cost Analysis. Section 4, Project Overview, provides an overview of the project, including a brief description of existing conditions and proposed alternatives; a summary of cost estimates and schedule; and a description of the types of effects that the project is expected to generate. Monetized, quantified, and qualitative effects are highlighted. Section 5, General Assumptions, discusses the general assumptions used in the estimation of project costs and benefits, while estimates of travel demand and traffic growth can be found in Section 6, Demand Projections. Specific data elements and assumptions pertaining to the merit criteria are presented in Section 7, Estimation of Economic Benefits, along with associated benefit estimates. Estimates of the project's Net Present Value (NPV), its Benefit-Cost Ratio (BCR) and other project evaluation metrics are introduced in Section 8, Summary of Findings and BCA Outcomes. Additional data tables are provided within the BCA model including annual estimates of benefits and costs to assist the U.S. Department of Transportation (USDOT) in its review of the application.[1]

3. Methodological Framework

The specific methodology developed for this application was developed using the BCA guidance developed by USDOT. In particular, the methodology involves:

- Establishing existing and future conditions under the build and no-build scenarios;
- Assessing benefits that align with those identified in the BCA guidance;
- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a common unit of measurement;
- Using USDOT guidance for the valuation of travel time savings, safety benefits and reductions in air emissions, while relying on industry best practice for the valuation of other effects;
- Discounting future benefits and costs utilizing the 7 percent real discount rate recommended by USDOT; and
- Conducting a sensitivity analysis to assess the impacts of changes in key estimating assumptions.

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 Iowa's roadway network, valued in monetary terms.[2]

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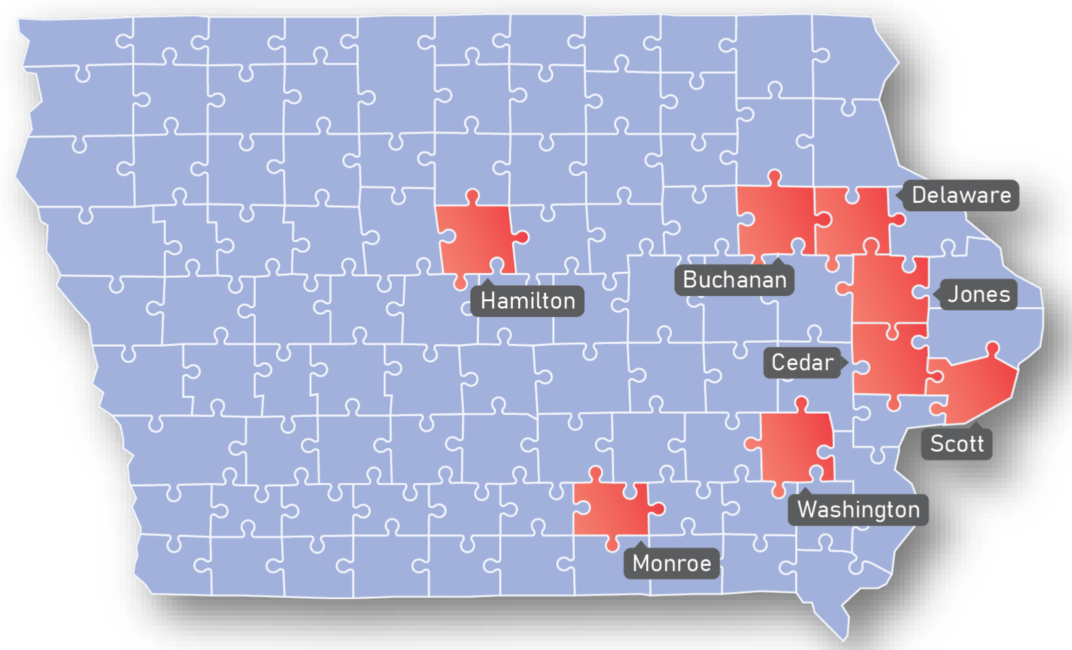
[1] The BCA model is provided separately as part of the application.

[2] USDOT, *Benefit-Cost Analysis Guidance for Discretionary Grant Programs*, March 2022 (revised).

4. Project Overview

Iowa's industries thrive because of the transportation network, which allows goods to be moved efficiently from farm to market. Local bridges serve small, rural, and often underserved communities throughout Iowa. However, the transportation system continues to be challenged by degrading and this degradation is further exacerbated by an inability for local jurisdictions to dedicate community resources for needed investment in local bridges projects.

Iowa has 4,599 structurally deficient bridges, the most of any state in the country, and has the highest number of poor condition bridges in the country. These poor bridges are prioritized for repairs and replacement. However, when resources must be "saved up" for a decade or longer to fund these projects using Swap Highway Bridge Program (HBP), other needs are left unattended, so the cycle of deterioration perpetuates. Much like the cycle of human poverty, it is extremely difficult to "dig out" unless an additional resource is given that gives the county a "step up" out of the hole. The state of Iowa and the counties within are working together in support of a collaborative program to obtain federal funding to support eight significant county bridge projects. The Iowa County Engineers Association (ICEA) and the Iowa Department of Transportation (Iowa DOT) have been working together over the past year to identify and prioritize bridges that will greatly impact Iowa's ability to support local traffic needs, public safety and economic vitality for the region and nation. The selection of these eight bridges was a competitive, data-driven process that identified the most suitable projects for investment.



Over the past half century, the agricultural industry across the State has witnessed a strain on roadways and bridges. Producers are using increasingly larger capacity equipment, hauling heavier loads, and using larger, wider, and heavier transport implements in their operations. This places additional stress on these bridges, often resulting in an inability to use the bridge, forcing added miles and time to use detour routes.

Load restrictions and bridge closures have forced traffic to detour onto alternate routes. Detours affect the ability for students to get to school on time, employees to commute in a timely manner without the burden of added cost and time, and the delivery of goods and services in an economical manner.

4.1 Base Case and Alternatives

To analyze the benefits and costs associated with *Iowa's Building Bridges Today Helping Feed America Tomorrow* project, a single no-build and a single build scenario have been developed. The no-build scenario reflects the continuation of current conditions. Operations and maintenance will continue with no major infrastructure improvements. All eight of these bridges are either in poor or fair condition; one of them already closed for traffic; several are currently posted for load restrictions, and the remainder anticipate restrictions beginning as soon as next year. These load postings inhibit the movement of critical farm vehicles and other large trucks from utilizing the most direct routes to access their destinations, increasing vehicle miles traveled.

Each of these bridges is at or near their expected life and will undergo more stringent load posting or complete closure soon. Detour routes were established for all eight bridges (the Delaware County bridge detour is already in operation). Detour routes were selected based on added travel time.

4.2 Project Cost and Schedule[3]

Project support costs will be incurred between 2023 and 2026. Individual bridge construction begins in either late 2023 or 2024 with the last bridge opening in 2027. The total discounted capital costs of the project are approximately $36.7 million. Capital costs include construction costs and miscellaneous costs such as utilities, permits, incentives, design, and construction engineering.

Following USDOT BCA guidance, the difference between the build and the no build operation and maintenance (O&M) costs and cyclical repaving costs are included as a disbenefit rather than a project cost.[4]

5. General Assumptions

The BCA measures benefits against costs throughout a period of analysis beginning at the start of construction of the first bridge and including 25 years of operations for each bridge.

The monetized benefits and costs are estimated in 2020 dollars with future dollars discounted in compliance with BIP requirements using a 7 percent real rate.

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[3] All cost estimates in this section are in millions of 2020 dollars, discounted to 2020 using a 7 percent real discount rate.

[4] USDOT, *Benefit-Cost Analysis Guidance for Discretionary Grant Programs.* March 2022.

The methodology makes several important assumptions and seeks to avoid overestimation of benefits and underestimation of costs. Specifically:

- Input prices are expressed in 2022 dollars.
- The period of analysis begins in 2023 and ends in 2051. This includes project development and construction years for each bridge across eight Iowa counties, and 25 years of operations (2027-2051);
- A constant 7 percent real discount rate is assumed throughout the period of analysis;
- A useful life of 75 years is utilized for the calculation of residual value for each bridge;
- 40% = The percentage of construction costs for materials that endure;
- An annualization factor of 365 days is applied

6. Demand Projections

As an essential part of a successful benefit-cost analysis, a strong traffic forecast was applied to the Project Team's analysis.

6.1 Methodology and Assumptions

The Project Team's traffic specialists have prepared a separate memo on the data, methodology and forecasting that feeds the benefit-cost analysis model. A table showing the growth projections for average daily traffic is shown below.

The Iowa statewide travel demand model (iTRAM) was used to help determine daily traffic volumes at 7 of the 8 bridges in year 2040. The Jones County bridge is not part of iTRAM, and thus couldn't be modeled. An alternative planning analysis was conducted by HDR and approved by Jeff Von Brown with the Iowa DOT to determine 2040 daily traffic volumes if the Jones County bridge was replaced. Table 1 presents the 2040 daily traffic volumes if the bridges are replaced as well as 2040 daily traffic volumes if the bridges remain in place (assuming no additional load restrictions or closures). It should be noted, however, the benefit-cost analysis will take into account future load restrictions and closures if bridges are not replaced, which are not reflected in Table 1.

Table 1: 2040 Daily Traffic Volumes

County	2010 Count	2040 Adjusted Flow (if bridge is replaced)	2040 Adjusted Flow (if bridge is not replaced)*
Cedar	830	1,740	1,075
Washington	130	190	70
Delaware	700	1,150	690
Monroe	420	420	390
Buchanan	1,450	1,620	1,270
Hamilton	920	920	780
Scott	2,290	2,640	2,260
Jones	80	245	80

***Assumes bridge remains in current state**

Note that the traffic model expects an increase in usage in future years in the Build scenario. Benefits for these consumers are estimated using the rule of half.

7. Estimation of Economic Benefits

7.1 Benefits Measurement, Data and Assumptions

This section describes the measurement approach used for each benefit or impact category and provides an overview of the associated methodology, assumptions, and estimates.

LIST OF BENEFITS ANALYZED

The benefits assessed for the *Building Bridges Today Helping Feed America Tomorrow* project are as follows:

- **Travel Time Savings:** Captures the reduced travel time for automobiles and trucks under the build scenario as a result of roadway improvements. Travel time savings will be realized by passenger vehicles, which will be able to take advantage of the higher speeds compared to those experienced in the no build scenario. Truck drivers will also benefit and save time as well. Across the eight bridges of observation, the percentage of heavy vehicles (trucks) that make up total volume range from 4% (Jones County) to 17% (Buchanan County). Road postings and closures are expected to occur in each county, specified by pre-determined timing that is based on each county's project schedule. As a result of utilizing detour routes number of hours that are traveled among both trucks and passenger vehicles are expected to rise over the period of analysis. Due to an absence of numerous travel routes in certain counties, there may be a change of plans for those who are unable to endure the change.
- **Vehicle Operating Cost Savings:** Captures fuel cost savings and non-fuel cost savings (e.g., tire wear and tear, cost of maintenance, and depreciation) for drivers of personal and commercial vehicles.
- **Accident Cost Savings:** The proposed improvements will achieve reduction in traffic fatalities and serious injuries by providing motorists with safer travel through the build scenario improvements.
- **Emission Cost Savings:** The proposed improvements will reduce emissions by allowing for more consistent free flow speeds. As a result of the proposed improvements, emissions will decrease for pollutants such as carbon monoxide (CO), volatile organic compounds (VOC), nitrogen oxides (NOx), fine particulate matter (PM2.5), sulfur dioxide (SO2), and carbon dioxide (CO2).

METHODOLOGY

The methodology used for estimating each of the benefits listed is presented below:

- **Travel Time Savings:** Calculated based on VMT and VHT data provided by the Iowa County Engineers at each county location. A separate traffic analysis was produced by specialists on the Project Team for personal vehicles and trucks in the period between 2020 and 2045 (No-Build and Build scenarios). Each bridge's data from the Iowa statewide travel demand model (iTRAM) was incorporated into the BCA model, and for added context speed is calculated from the VMT and VHT that were reported. Average vehicle occupancy and percent trucks data were also entered in the model. The model multiplies the number of hours saved by personal vehicle drivers and truck drivers by their corresponding vehicle occupancy rates and values of time. Travel time costs are compared between the No-Build and Build, and the difference is the travel time savings.

- **Vehicle Operating Cost Savings:** Calculated based on VMT and VHT data derived from the client and traffic specialists for the period between 2020 and 2045 (No 'BUILD' and 'BUILD' scenarios) for personal vehicles and trucks. The data was then entered in the BCA model. Speed is calculated from the VMT and VHT. VMT and VHT were also allocated to auto and truck based on the percent of truck traffic. Vehicle operating cost savings were calculated for the induced demand that would spill into the newly generated bridges for each county. Fuel costs are calculated by multiplying VMT by fuel consumption per mile and by fuel price for both the No-Build and Build scenarios. Non-fuel cost is calculated by multiplying VMT by non-fuel per-mile cost (which accounts for maintenance and other vehicle ownership costs) for both cases. These costs are compared between the No-Build and Build, and the difference is the vehicle operating cost savings.
- **Accident Cost Savings:** The installation of eight new bridges and additional travel lanes will improve safety for travelers in each county. As part of the traffic analysis, the Project Team's specialists recorded and forecasted the No-Build and Build scenario safety conditions over the project's full period. Those values were pulled into the BCA Model and were used in order to measure the frequency of crashes at each site, in addition to the severity of each crash (per KABCO recommended scaling). The primary benefits realized through safety were calculated first by avoided fatality and/or injury, followed by the occurrences where damages were limited exclusively to property. Benefits were calculated by taking the timing for each individual bridge's benefit index into account and multiplying by the difference between the reported statistics at the trend observed over the 29-year period of analysis. In order to monetize these findings (e.g., direct savings from averted fatalities/injuries, property damage, full closure, load posting), the values that arrived following an analysis of overall crash calculations were multiplied by the USDOT recommended values, by injury severity. In the case of load postings and closures the crash values were monetized by factoring in the timing in which benefit indexes become active.
- **Emission Cost Savings:** There are five types of emissions measured in the analysis: carbon monoxide (CO), volatile organic compounds (VOC), nitrogen oxide (NO_x), fine particulate matter (PM 2.5), sulfur dioxide (SO_2), and carbon dioxide (CO_2). Emissions per mile travelled for these pollutants were estimated using EPA's Motor Vehicles Emissions Simulator (MOVES) model run for Iowa, for the years spanning 2022 and 2045. The emissions are monetized using values consistent with Passenger Cars and Light Trucks in the USDOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs (2021). Each emission type was converted in units from grams per mile into metric tons. Total emission cost savings were represented in units of $ per metric ton.

- **O&M Cost Savings:** As per USDOT's BCA guidance, net O&M costs are included in the numerator along with other project benefits when calculating a benefit-cost ratio for a project proposed under the discretionary grant programs.

ASSUMPTIONS

The assumptions used in the estimation of economic benefits for the project are summarized in Table 2.

Table 2: Assumptions Used in the Estimation of Economic Benefits

Model Assumptions	Value	Units	Source
General			
Base/Start Year	2022		Project Assumptions
Discount Year	2020		
Length of Analysis	25	years	
First Construction Year	2023		
Last Opening Year	2027		
Analysis End Year	2051		
Annualization factor	365	days per year	
Discount Rate	7%		USDOT BCA Guidance, March 2022
Discount Rate - Carbon Emissions	3%		
Vehicle Related			
Passenger Vehicle Occupancy	1.96	persons per automobile	2017 National Household Travel Survey, FHWA. https://nhts.ornl.gov/ Accessed 9/02/2022
Average Speed	55.00	miles per hour	Assumption - largely used in bridge database detour calculations
Value of Time			
Passenger Vehicles	$16.20	2020$ per hour	US DOT, Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis; http://www.dot.gov/office-policy/transportation-policy/guidance-value-time
Trucks	$29.40	2020$ per hour	US DOT, Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis; http://www.dot.gov/office-policy/transportation-policy/guidance-value-time
Vehicle Operating Costs			
Passenger Vehicles	$0.45	$ per mile	USDOT BCA Guidance, March 2022
Trucks	$0.94	$ per mile	
Emissions / Environmental			
Carbon Dioxide (CO2)	**	$ per metric ton	**varies over time, see emissions values sheet for USDOT BCA Guidance Recommendations
Nitrogen Oxides (NOx)	**	$ per metric ton	**varies over time, see emissions values sheet for USDOT BCA Guidance Recommendations

Fine Particulate Matter (PM2.5)	**	$ per metric ton	**varies over time, see emissions values sheet for USDOT BCA Guidance Recommendations
Sulfur Dioxide (SO2)	**	$ per metric ton	**varies over time, see emissions values sheet for USDOT BCA Guidance Recommendations
Carbon Dioxide (CO)	**	$ per metric ton	**varies over time, see emissions values sheet for USDOT BCA Guidance Recommendations
Volatile Organic Compounds (VOC)	$2,100	$ per metric ton	Source (2021-2050): USDOT BCA Guidance, March 2022
grams per metric ton	1000000	g	
Crash Costs			
O - No Injury	$3,900	$ per event	*USDOT BCA Guidance, March 2022*
C - Possible Injury	$77,200	$ per event	
B - Non-Incapacitating Injury	$151,100	$ per event	
A - Incapacitating Injury	$554,800	$ per event	
K - Killed	$11,600,000	$ per event	
Injured - Severity Unknown	$210,300	$ per event	
Unknown if Injured	$159,800	$ per event	
Property Damage Only	$4,600	$ per vehicle	
Ratio of Vehicle Occupancy in Iowa (1.96) to Vehicle Occupancy in US (1.67)	1.17	ratio	National Household Travel Survey, 2017, FHWA. https://nhts.ornl.gov/ Accessed 9/2/2022
Residual Value			
Bridge Useful Life	75	years	Project Assumptions
Percent of Construction Costs for materials that endure	40%	percent	

AGGREGATION OF BENEFIT ESTIMATES

Table 7 presents the benefit estimates by benefit categories over the project's lifecycle. Both travel time savings and safety benefits represent a large majority of the total benefits ($49 million and $43 million, respectively). Vehicle Operating Cost Savings is the benefit category with the next strongest figure ($41.85 million). The state of good repair following project completion adds a massive benefit ($37 million) to the analysis. New bridges reduce the need to perform the frequent maintenance repairs that would arise over time in the No-Build scenario and delay the commute of personal and business travelers. The O&M cost savings would be $1.55 million. Increased efficiency in the flow of traffic from the resulting project improvements results in societal benefits via the emission cost reductions ($2.9 million).

Table 3: Estimates of Economic Benefits, Millions of 2019 Dollars

Benefit Category	Over the Project Lifecycle Discounted at 7%
Travel Time Savings - Existing Vehicles	$49.18
Vehicle Operating Cost Savings - Existing Vehicles	$41.85
Emissions (Non-Carbon and Carbon)	$2.87
Safety Benefits	$43.97
Benefits to New Users	$37.57
Bridge Residual Value	$1.65
Operations & Maintenance Savings	$1.55
Total Benefits	**$178.63**

*Total may not sum up due to rounding

7.2 Comparison of Benefits and Costs

The project's benefits exceed the costs over the life cycle of this project. Total benefits work out to be monetized and valued at approximately $178 million, while total costs are valued at a $36.67 million. The net present value (NPV) for the *Building Bridges Today Helping Feed America Tomorrow* project is slated to be $142 million.

8. Summary of Findings and BCA Outcomes

Based on the analysis presented in the rest of this document, the project is expected to generate $189.48 million in discounted benefits and $36.67 million in discounted costs, using a 7 percent real discount rate (except for CO2 emissions, which are discounted at 3%, per USDOT guidance).

Therefore, the project is expected to generate a Net Present Value of $141.96 million and a Benefit-Cost Ratio of 4.9, as presented

Table 4: Benefit-Cost Analysis for Building Bridges Today Helping Feed America Tomorrow

Bridges	Discounted Total Benefits (million $)	Discounted Total Costs (million $)	Net Present Value (million $)	Benefit-Cost Ratio
All Bridges	**$178.6**	**$36.7**	**$142.0**	**4.9**

BCAs for the individual bridges find Benefit-Cost Ratios ranging from 0.7 to 18.50.

Table 5: Individual Bridge Benefit Cost Analysis Results, Millions of 2020 Dollars

Bridge ID	Discounted Total Benefits	Discounted Individual Costs	Net Present Value - Individual	Individual B/C Ratio
Cedar	$51.66	$8.57	$43.09	6.03
Washington	$6.48	$6.71	-$0.23	0.97
Delaware	$7.45	$5.17	$2.28	1.44
Monroe	$10.35	$3.55	$6.80	2.91
Buchanan	$54.60	$2.95	$51.65	18.50
Hamilton	$28.65	$2.86	$25.79	10.03
Scott	$16.44	$2.58	$13.86	6.37
Jones	$3.00	$4.28	-$1.28	0.70
All Bridges	**$178.63**	**$36.67**	**$141.96**	**4.87**